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The Contribution of Dissocial Personality Disorder to Cognition, Emotion Processing and Clinical Outcome in Violent Men with Psychosis.

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The Contribution of Dissocial Personality Disorder to Cognition, Emotion Processing and Clinical Outcome in Violent Men with Psychosis.

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Submitted to King's College London for the degree of

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List of Abbreviations

ANCOVA	Analysis Of Covariance
ANOVA	Analysis Of Variance
ASPD	Antisocial Personality Disorder
ASR	Acoustic Startle Response
AUC	Area Under The Curve
BADS	Behavioural Assessment Of Dysexecutive Syndrome
BPD	Borderline Personality Disorder
CANFOR	Camberwell Assessment Of Need – Forensic Version
CANTAB	Cambridge Neuropsychological Test Automated Battery
CBT	Cognitive Behavioural Therapy
CNV	Contingent Negative Variation
COM	Comorbid Group
CONT	Control Group
CPA	Care Programme Approach
CPZ	Chlorpromazine
CRT	Cognitive Remediation Therapy
DSM -IV	Diagnostic and Statistical Manual, 4 th edition
DSM-5	Diagnostic and Statistical Manual, 5 th edition
DPD	Dissocial Personality Disorder
EMDR	Eye Movement Desensitisation And Reprocessing
EMG	Electromyographic
HAWIE	Hamburg-Wechsler-Intelligenztest Für Erwachsene
HCR-20	Historical, Clinical, Risk-Management Scheme
HoNOS	Health Of The Nation Outcome Scales
HVLT-R	Hopkins Verbal Learning Test – Revised
IAPS	International Affective Picture System
ICC	Intraclass Correlation Coefficients
ICD-10	International Classification Of Diseases
IGT	Iowa Gambling Task
JLOT	Judgement Of Line Orientation Test
JORT	Joystick Operated Runway Task
LNS Test	Letter Number Span Test
MATRICES	Measurement And Treatment Research To Improve Cognition In Schizophrenia
MCCB	Matrics Consensus Cognitive Battery
MOAS	Modified Overt Aggression Scale
MRI	Magnetic Resonance Imaging

MWT	Mehrfachwahl Wortschatz Test
NART	National Adult Reading Test
NHS	National Health Service
NVSZ	Non-Violent Schizophrenia
PCL-R	Psychopathy Checklist – Revised
PD	Personality Disorder
PEBL	Psychological Experiment Building Language
PMI	Patient Motivation Inventory
PPI	Prepulse Inhibition
PPQ	Patient Perception Questionnaire
PSY	Psychosis Group
R&R	Reasoning And Rehabilitation
RBANS	Repeatable Battery For The Assessment Of Neuropsychological Status
RT	Reaction Time
SCWT	Stroop Colour/Word Test
SEM	Standard Error Of The Mean
SPSS	Statistical Package for the Social Sciences
SRH Lab	Startle Reflex (Human) Laboratory
TMT	Trail Making Test
ToL	Tower Of London
ToM	Theory Of Mind
VSZ	Violent Schizophrenia
WAIS	Wechsler Adult Intelligence Scale
WCST	Wisconsin Card Sorting Test
WMS	Wechsler Memory Scales
WTAR	Wechsler Test Of Adult Reading

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Abstract

Research to date suggests that violent individuals with psychosis do not constitute a homogenous group, and subtypes of offender exist. One proposed subtype consists of people with comorbid antisocial personality traits, who constitute a significant proportion of individuals in forensic psychiatric services but have attracted little focussed research.

This thesis aimed to characterise this comorbid group by examining the neuropsychological characteristics, emotion processing characteristics and clinical outcomes of male patients recruited from high-secure forensic psychiatric hospital, falling into one of the following diagnostic groups: 1. psychotic disorder (n=15); 2. dissocial personality disorder (DPD; n=17); and 3. comorbid psychosis and DPD (n=26). Clinical groups were compared to each other and to a group of healthy controls (n=30) on measures of neuropsychological functioning, facial affect recognition, sensorimotor gating and appetitive and defensive responding. In addition, the clinical groups were compared on their historical characteristics (offending, psychosocial, psychopathy) and current clinical outcomes, corresponding to clinician rated clinical progress, risk/violence and engagement with the clinical team. The relationship between the characterisation measures and outcomes (progress, risk and engagement) was explored to assess the clinical relevance of such indices.

The results supported a distinct subgroup of those with comorbid psychosis and DPD, who were characterised by a poorer sensorimotor gating profile and poorer fearful facial affect recognition than their non-DPD counterparts, with a tendency towards poorer neurocognition. The comorbid group was more similar to the DPD alone group on experimental and historical measures. The clinical groups did not differ from each other, or healthy controls, on appetitive/defensive responding, and the clinical groups did not differ with respect to outcomes. Measures of memory, executive function and facial affect recognition correlated with indices of outcome, suggesting that such characteristics may be promising treatment targets within forensic mental health services.

Thesis Overview

This thesis makes a unique contribution to the field of forensic mental health by comprehensively characterising a subgroup of mentally disordered offenders who are diagnosed with both a psychotic disorder and a comorbid personality disorder, namely dissocial personality disorder (DPD; the ICD approximate equivalent to DSM antisocial personality disorder). To date, this group has received very little focussed research despite being prevalent within forensic mental health services (Blackburn, Logan, Donnelly, & Renwick, 2003), and both theoretical (e.g. Volavka & Citrome, 2008) and empirical (e.g. Moran & Hodgins, 2004; Tang et al., 2016) literature suggesting that they are a group distinct from offenders with psychosis alone. This has implications in terms of designing and providing appropriate therapeutic interventions and services.

Specifically, a group of patients detained in high-secure forensic services with both diagnoses (comorbid psychosis and DPD) were compared to groups with either diagnosis alone, and a group of healthy control participants. Indices on which groups were compared included ‘static’ or ‘historical’ factors, including demographic, clinical, psychosocial and offence-related variables. Further, an examination of the neuropsychological and emotion processing characteristics are reported, using both experimental behavioural tasks and psychophysiological methodology. These facets are important to quantify as they are incorporated into models of violent behaviour (e.g. Blair, 2005; Blair, Jones, Clark, & Smith, 1997; S. T. Harris, Oakley, & Picchioni, 2014; Hoptman, 2015) and thus likely are relevant to the treatment and rehabilitation of such clinical groups. In light of such an association, an assessment of how the characterisation measures outlined above (static/historical, cognitive, emotion processing) relate to clinical outcome whilst hospitalised amongst the study groups is reported.

The thesis consists of ten chapters and will take the following structure:

1. Violence and Mental Disorder

This chapter will:

- Outline the diagnostic criteria for the diagnoses of interest in this thesis, and summarise their association with violent behaviour.
- Particular attention is paid to the diagnostic similarities/differences between antisocial and dissocial personality disorder, as most of the literature to date has focussed on antisocial personality disorder (ASPD), whereas the focus of this thesis will be dissocial personality disorder (DPD).
- The available literature on the static/historical characteristics of comorbid psychosis and ASPD is summarised.

2. Systematic Review and Meta-Analysis of Cognitive and Emotion Processing Characteristics in Violent Schizophrenia and ASPD

This chapter will:

- Present a systematic review and meta-analysis of the cognitive and emotion processing characteristics of violent individuals with schizophrenia and/or ASPD.
- Describe the potential relationship between these characteristics and violence.

3. Relationship of Demographic and Neuropsychological Variables to Outcome in Forensic Mental Health Services: A Systematic Review

This chapter will:

- Present a systematic review of how factors discussed in chapters one and two (static, neuropsychological and emotion processing characteristics) relate to outcome in forensic mental health services, and consider the utility of such facets in clinical practice.

4. Aims and Objectives

This chapter will:

- Set out the overarching aims of the thesis and the research questions to be addressed in the five data-based (empirical) chapters.

5. Demographic, Clinical, Psychosocial and Offending Characteristics of Comorbid Psychosis and DPD

This chapter will:

- Present the sample under investigation in this thesis, and compare diagnostic groups on a number of static variables, including history of offending, psychopathy, substance abuse history and childhood psychosocial deprivation.

6. Cognitive and Emotion Processing Characteristics of Comorbid Psychosis and DPD

This chapter will:

- Provide data on a comprehensive battery of tests to assess cognition (premorbid intelligence, memory, executive function) and emotion processing (facial affect recognition, experiential fear and anxiety).

7. Sensorimotor Gating Characteristics of Comorbid Psychosis and DPD

This chapter will:

- Compare groups on an established psychophysiological experimental paradigm designed to measure sensorimotor gating specifically prepulse inhibition of the startle response.

8. Affective Modulation of the Startle Response in Comorbid Psychosis and DPD

This chapter will:

- Assess and compare appetitive and defensive responding of the four study groups using startle reflex methodology.

9. Relationship of Diagnostic Group, Cognition and Emotion Processing to Clinical Outcome

This chapter will:

- Assess whether the three clinical groups differed on their clinical outcomes at the time they participated in the study. Outcomes include clinician rated routine outcome measures of clinical progress, measures sensitive to risk/violence, and engagement with the clinical team.
- Explore the relationship between the static and experimental measures (described in chapter's five to seven), and psychometric self-reported measures, with measures of outcome.

10. Discussion

This chapter will:

- Summarise the evidence that has been presented in earlier chapters and suggest the potential clinical implications of the findings.

1 Chapter One: Violence and Mental Disorder

Chapter Aims and Overview

Although the large majority of those with a mental disorder will never be violent (Walsh & Fahy, 2002) and are more likely to become the victim of violence themselves (Walsh et al., 2003), there is convincing evidence (reviewed in this chapter) to suggest that some mental disorders are associated with violent behaviour. Two categories of mental disorder are commonly observed at the interface of mental disorder and violence: psychosis and personality disorders, and particularly antisocial personality disorder (ASPD) or the ICD-10 equivalent, dissocial personality disorder (DPD). This thesis will explore the characteristics and outcomes of violent offenders with these diagnoses, with a specific focus on comorbid psychosis and DPD. This chapter will describe the diagnoses of a) psychosis and b) ASPD/DPD including their description in the two main classification systems (DSM-5 and ICD-10), and outline their association with violent behaviour. The literature surrounding comorbid psychosis and ASPD/DPD is also reviewed.

Psychosis

Diagnostic Criteria

Psychotic disorder, as described by the Diagnostic and Statistical Manual (5th edition; DSM-5) (American Psychiatric Association, 2013), encapsulates a number of diagnoses including schizophrenia, schizoaffective disorder, delusional disorder, schizophreniform disorder, brief psychotic episode, substance/medication-induced psychosis and organic psychosis. Psychotic symptoms can be broadly classified into ‘positive’ and ‘negative’ symptoms (Andreasen & Olsen, 1982). These can be conceptualised as ‘florid’ and ‘deficient’, respectively, i.e. positive symptoms represent the addition of behaviour and/or cognitions which were not there before the onset of illness, whereas negative symptoms are the loss of previously intact functions. Typical positive symptoms include anomalous perceptual experiences such as hallucinations, or strange thoughts such as delusional beliefs, whereas negative symptoms encapsulate diminished emotional expression, avolition (lack of motivation) and anhedonia (lack of experienced pleasure), for example. The core cluster of symptoms described in DSM-5 comprises delusions, hallucinations, disorganised speech, disorganised motor behaviour (including catatonia), and negative symptoms.

The International Classification of Diseases (10th edition; ICD-10) (World Health Organization, 1992) provides a very similar diagnostic framework, with a few key differences including illness duration (6 months in DSM-5; 1 month in ICD-10), and functional impairment being necessary in DSM-5 but not ICD-10 (Kumari, 2015). Whilst the different subtypes of schizophrenia, including paranoid, hebephrenic and catatonic, were removed when the DSM was upgraded from its fourth to fifth edition, these remain in the ICD-10 but are expected to be lost once ICD-11 is published. See Table 1.1 for comparison of diagnostic systems.

In addition to positive and negative symptoms, there is evidence of widespread neurocognitive impairment in people with schizophrenia (Reichenberg, 2010), which has been suggested as a core component of the disorder (Elvevag & Goldberg, 2000). Further to typical cognitive domains (i.e. memory, attention, executive function), there is a wealth of evidence highlighting impairment in measures of social cognition including emotion perception and theory of mind in this population (Savla, Vella, Armstrong, Penn, & Twamley, 2013). In combination, these difficulties cause functional impairment for individuals with schizophrenia across multiple settings (Mueser & McGurk, 2004). Consequently, schizophrenia is considered one of the leading causes of disability worldwide (World Health Organization, 2008).

Link with Violent Behaviour

A number of large, prospective studies report a statistically significant association between violence and psychotic disorders. Tiihonen, Isohanni, Räsänen, Koiranen, and Moring (1997) examined a Finnish birth cohort and found that men with schizophrenia were seven times more likely to have been convicted of a violent crime than those with no mental disorder, which was independent of socioeconomic status, yet strongly related to alcohol abuse. This finding was supported in the US National Epidemiologic Survey on Alcohol and Related Conditions (Elbogen & Johnson, 2009), in which major mental disorder was associated with an increased risk for self-reported violence one year later in only those with comorbid substance abuse or dependence. Fazel, Langström, Hjern, Grann, and Lichtenstein (2009) also found a significantly increased risk of violent conviction in those with psychosis, but identified substance abuse to be a significant mediator. This study uniquely used unaffected siblings as comparison subjects, in addition to general population controls, and found that the risk for both violent crime and substance abuse amongst schizophrenia patients was attenuated to a large extent when comparing to unaffected siblings than when comparing to general population controls. This suggests an additional mediating role of either genetic and/or shared environmental factors for the outcomes of violence and substance abuse. However, Brennan, Mednick, and Hodgins (2000) found a relationship between a history of hospitalisation for schizophrenia (present or absent) and a history for having been arrested for violent behaviour in a large Danish birth cohort, which was independent of demographic factors, substance misuse or comorbid personality disorder.

Table 1.1 - Diagnostic Criteria for Schizophrenia in DSM-5 (American Psychiatric Association, 2013) Compared with ICD-10 (World Health Organization, 1992)

Criterion	DSM-5 Schizophrenia	Criterion	ICD-10 Equivalent Criteria
A.	Characteristic symptoms: Two (or more) of the following, each present for a significant portion of time during a 1-month period (or less if successfully treated): 1. Delusions 2. Hallucinations 3. Disorganized speech 4. Grossly disorganized or catatonic behaviour 5. Negative symptoms (i.e., diminished emotional expression or avolition)	G1.	Either at least one of the syndromes, symptoms and signs listed below under (1), or at least two of the symptoms and signs listed under (2), should be present for most of the time during an episode of psychotic illness lasting for at least one month (or at some time during most of the days). (1) At least one of the following: a) Thought echo, thought insertion or withdrawal, or thought broadcasting. b) Delusions of control, influence or passivity, clearly referred to body or limb movements or specific thoughts, actions, or sensations; delusional perception. c) Hallucinatory voices giving a running commentary on the patient's behaviour, or discussing him between themselves, or other types of hallucinatory voices coming from some part of the body. d) Persistent delusions of other kinds that are culturally inappropriate and completely impossible (e.g. being able to control the weather, or being in communication with aliens from another world). (2) or at least two of the following: e) Persistent hallucinations in any modality, when occurring every day for at least one month, when accompanied by delusions (which may be fleeting or half-formed) without clear affective content, or when accompanied by persistent over-valued ideas. f) Neologisms, breaks or interpolations in the train of thought, resulting in incoherence or irrelevant speech. g) Catatonic behaviour, such as excitement, posturing or waxy flexibility, negativism, mutism and stupor. h) "Negative" symptoms such as marked apathy, paucity of speech, and blunting or incongruity of emotional responses (it must be clear that these are not due to depression or to neuroleptic medication).

Criterion	DSM-5 Schizophrenia	Criterion	ICD-10 Equivalent Criteria
B.	Social/occupational dysfunction: For a significant portion of the time since the onset of the disturbance, one or more major areas of functioning, such as work, interpersonal relations, or self-care, are markedly below the level achieved prior to the onset (or when the onset is in childhood or adolescence, failure to achieve expected level of interpersonal, academic, or occupational achievement).		No ICD-10 equivalent
C.	Duration: Continuous signs of the disturbance persist for at least 6 months. This 6-month period must include at least 1 month of symptoms (or less if successfully treated) that meet Criterion A (i.e., active-phase symptoms) and may include periods of prodromal or residual symptoms. During these prodromal or residual periods, the signs of the disturbance may be manifested by only negative symptoms or by two or more symptoms listed in Criterion A present in an attenuated form (e.g., odd beliefs, unusual perceptual experiences).	G1.	...should be present for most of the time during an episode of psychotic illness lasting for at least one month (or at some time during most of the days).

Criterion	DSM-5 Schizophrenia	Criterion	ICD-10 Equivalent Criteria
D.	Schizoaffective and major mood disorder exclusion: Schizoaffective disorder and depressive or bipolar disorder with psychotic features have been ruled out because either (1) no major depressive or manic episodes have occurred concurrently with the active phase symptoms; or (2) if mood episodes have occurred during active-phase symptoms, their total duration has been brief relative to the duration of the active and residual periods.	G2.	Most commonly used exclusion criteria: If the patient also meets criteria for manic episode (F30) or depressive episode (F32), the criteria listed under G1.1 and G1.2 above must have been met before the disturbance of mood developed.
E.	Substance/general mood condition exclusion: Substance/general medical condition exclusion: The disturbance is not attributed to the direct physiological effects of a substance (e.g., a drug of abuse, a medication) or another medical condition.	G3.	The disorder is not attributable to organic brain disease (in the sense of F0), or to alcohol- or drug-related intoxication, dependence or withdrawal.
F.	Relationship to Global Developmental Delay or Autism Spectrum Disorder: If there is a history of autism spectrum disorder or other communication disorder of childhood onset, the additional diagnosis of schizophrenia is made only if prominent delusions or hallucinations are also present for at least 1 month (or less if successfully treated).		No ICD-10 equivalent

Two meta-analytic investigations also support a link between psychosis and violence (Douglas, Guy, & Hart, 2009; Fazel, Gulati, Linsell, Geddes, & Grann, 2009), albeit with substantial heterogeneity between reported effect sizes, and both analyses identified a significant role for other variables which moderated the strength of the relationship. For example, Fazel, Gulati, et al. (2009) identified that substance misuse accounted for a large proportion of violence in people with psychosis, and that the risk for people with psychosis and comorbid substance abuse and for those with substance abuse alone was not significantly different. Douglas et al. (2009) surmised that although psychosis was a risk factor, on average it represented a similar level of risk as a number of other risk factors for future violence, including history of violence and marital status, identified from other meta-analyses (Bonta, Law, & Hanson, 1998). Thus, in sum the evidence supports a small but independent association between psychosis and violent behaviour; it contributes, alongside a number of risk factors, towards the risk of violence. However it is also prudent to note that in Fazel and colleagues (2009) meta-analysis, the population attributable risk fraction for violence as a result of psychosis consistently fell below 10% (across the six studies where this could be calculated), indicating that only a small proportion of the total violence observed in society is perpetrated by those with psychosis. This has important implications in terms of reducing stigma for those diagnosed with a psychotic disorder (Walsh, Buchanan, & Fahy, 2002).

Aetiological Subtypes of Violent Offender

It has been hypothesised by several authors that individuals with psychosis who display violent behaviour are unlikely to represent a homogeneous group. Hodgins (2008) proposed three subtypes. The first of these subtypes comprises 'early start' offenders, who exhibit antisocial behaviour throughout childhood and adolescence, and subsequently develop schizophrenia while continuing with their offending behaviours. Hodgins (2008) proposes various hypotheses to attempt to explain this pathway, for example shared risk factors for both antisocial behaviour and schizophrenia (childhood abuse, obstetric complications, low socioeconomic status, etc.). The second subtype consists of 'later start' offenders, whose illness onset coincided with the initiation of persistent, aggressive behaviour. Hodgins (2008) postulates that this may be related to sensitivity amongst this group to substance misuse, which infers risk, at both the brain and behaviour levels, for antisocial behaviour. The third subtype described those with chronic schizophrenia who commit acts of homicidal violence (usually of caregivers) later in life (usually aged within the 30's). It is suggested that this may be due to fluctuating levels of negative symptoms, specifically diminished affective experience, which when particularly low may render the individual to a high risk for aggression.

Alternative frameworks have also been proposed, albeit with some overlap. Volavka and Citrome (2008) also suggest three subtypes, namely that violence arises from a) positive symptoms, b)

impulsivity, or c) comorbidity with personality disorder, and particularly with psychopathy (see ‘Personality Disorder’ section below). The case for a relationship between positive symptoms (e.g. command hallucinations, thought disorder, delusional beliefs) and violence has received mixed support. An influential study found no evidence for an association between delusions and violence (Appelbaum, Robbins, & Monahan, 2000), yet reanalysis of the same data when considering the timing of the symptom and subsequent violence identified a relationship with certain delusions, particularly when the delusion induces angry affect in the individual (Ullrich, Keers, & Coid, 2014). Impulsivity, and particularly the “urgency” subtype of impulsivity (impulsivity to act in the presence of strong emotion), has been associated with aggression in schizophrenia (Hoptman, Antonius, Mauro, Parker, & Javitt, 2014). The neural substrates of this type of impulsivity, namely the ventral prefrontal regions and their associated projections to the limbic and executive regions (Hoptman, 2015), indicate an overlap with areas involved in emotional regulation which have been linked to violent behaviour (Davidson, Putnam, & Larson, 2000). The third and final subtype described those with comorbid personality disorder, which in the case of the antisocial personality disorders (ASPD/DPD) reflects life-long patterns of antisocial behaviour (with onset in childhood/adolescence), and thus is somewhat equivalent to Hodgins’ ‘early-start’ offenders. Volavka and Citrome (2008) describe this subtype as typically committing planned aggressive acts, characterised by a lack of remorse and often for personal gain. Similarly, Bo and colleagues (2011) suggest two aetiological subtypes, incorporating violence resulting from positive symptoms, and violence resulting from comorbid personality disorder and/or psychopathic traits.

Personality Disorder

Diagnostic Criteria

Personality disorder (PD) is described in both the DSM-5 and ICD-10 (Table 1.2). Both classification systems set out the definition to encapsulate a set of enduring characteristics which deviate from a culturally accepted range/norm, and affect numerous domains of functioning including cognitive style, interpersonal relationships, affective experience, impulse control and perception. The problems must be manifested across a number of areas (i.e. not just be limited to specific ‘triggers’) and be life-course persistent, i.e. beginning in childhood/early adolescence and pervade through adulthood. The symptoms must be independent of other mental disorders, and cause the individual significant personal distress. Each classification system only has one criterion which does not overlap with the other: ICD-10 requires that the symptoms are not explained by organic brain disease or injury, and the DSM-5 specifies that the symptoms must impact on occupational and/or social functioning. Both systems provide specific subtypes to further classify the nature of personality disorder.

Table 1.2- Diagnostic Criteria For Personality Disorder In DSM-5 (American Psychiatric Association, 2013) Compared with ICD-10 (World Health Organization, 1992)

DSM-5 criteria for general personality disorder	Equivalent ICD-10 criteria for general personality disorder
(a) markedly disharmonious attitudes and behaviour, involving usually several areas of functioning, e.g. affectivity, arousal, impulse control, ways of perceiving and thinking, and style of relating to others;	G1. Evidence that the individual's characteristic and enduring patterns of inner experience and behaviour deviate markedly as a whole from the culturally expected and accepted range (or 'norm'). Such deviation must be manifest in more than one of the following areas: (1) cognition (i.e. ways of perceiving and interpreting things, people and events; forming attitudes and images of self and others); (2) affectivity (range, intensity and appropriateness of emotional arousal and response); (3) control over impulses and need gratification; (4) relating to others and manner of handling interpersonal situations.
(c) the abnormal behaviour pattern is pervasive and clearly maladaptive to a broad range of personal and social situations;	G2. The deviation must manifest itself pervasively as behaviour that is inflexible, maladaptive, or otherwise dysfunctional across a broad range of personal and social situations (i.e. not being limited to one specific 'triggering' stimulus or situation).
(e) the disorder leads to considerable personal distress but this may only become apparent late in its course	G3. There is personal distress, or adverse impact on the social environment, or both, clearly attributable to the behaviour referred to under G2.
(d) the above manifestations always appear during childhood or adolescence and continue into adulthood;	G4. There must be evidence that the deviation is stable and of long duration, having its onset in late childhood or adolescence.
(b) the abnormal behaviour pattern is enduring, of long standing, and not limited to episodes of mental illness;	G5. The deviation cannot be explained as a manifestation or consequence of other adult mental disorders, although episodic or chronic conditions from sections F0 to F7 of this classification may co-exist, or be superimposed on it.
Non-overlapping criterion for DSM-5	Non-overlapping criterion for ICD-10
(f) the disorder is usually, but not invariably, associated with significant problems in occupational and social performance.	G6. Organic brain disease, injury, or dysfunction must be excluded as possible cause of the deviation (if such organic causation is demonstrable, use category F07).

ICD-10 vs. DSM-5 for the Antisocial Personality Disorders

The personality disorders relating to antisocial and/or violent behaviour in the DSM-5 and ICD-10 are antisocial personality disorder (ASPD), and dissocial personality disorder (DPD), respectively. Similarly to the general criteria for personality disorder, there is overlap between these diagnostic frameworks. Similarity between the disorders is thought to have increased in the most recent revision of the DSM, DSM-5; previously, the DSM-IV focussed mainly on the behavioural aspects (e.g. violation of rules, impulsivity) while the ICD-10 was mainly concerned with more emotional/affective deficiencies (e.g. callousness, incapacity to maintain relationships). The DSM-5 now more fully incorporates these aspects into the diagnostic criteria, theoretically increasing diagnostic concordance. Similarly, the DSM-IV criteria required the presence of conduct disorder in childhood, but this criterion is not present in ICD-10, and has been removed from DSM-5. Thus, the diagnoses are now more similar as described in further detail below.

Core self and interpersonal dysfunction: The significant impairments in personality functioning across both self and interpersonal functioning (as required by DSM-5) are also represented in the ICD-10 general criteria for personality disorder, i.e. “deviations in more than one of the following: cognition, affectivity, control over impulses and need for gratification, and handling of interpersonal situations” (see Table 1.2, item G1). The ‘cognition’ criterion specifies “forming attitudes and images of self or others”, which maps onto the DSM-5 description of identity dysfunction in ASPD (for example, ego-centrism). Likewise, the criterion referring to ‘self-direction’ in the DSM-5, including goal setting based on personal gratification, is reflected in ICD 10 ‘control over impulses and need gratification’. Interpersonal dysfunction as required by the DSM-5 is covered in the ICD-10 under ‘handling of interpersonal situations’ and ‘appropriate affectivity’. Thus, although the DSM-5 provides examples specific to ASPD for these essential criteria, the general criteria for PD (which must be fulfilled for a DPD diagnosis) in the ICD-10 appear very similar.

Specific personality traits: For the specific personality traits which must be present, DSM-5 requires characteristics under the broad headings of ‘Antagonism’ (incorporating manipulateness, deceitfulness, callousness including a lack of remorse and hostility) and ‘Disinhibition’ (incorporating irresponsibility, impulsivity and risk taking). Four out of six of the ICD-10 criteria map closely onto these:

- For DSM callousness the following ICD criteria: (1)“callous unconcern for the feelings of others” and (2)“incapacity to experience guilt, or to profit from adverse experience, particularly punishment”;

- For DSM hostility the following ICD criterion: (3) “very low tolerance to frustration and a low threshold for discharge of aggression, including violence”;
- For DSM irresponsibility the following ICD criterion: (4) “gross and persistent attitude of irresponsibility and disregard for social norms, rules, and obligations”.

Thus, the ICD-10 includes criteria which fit into both the Antagonism and Disinhibition domains, although more closely resemble the Antagonism traits consistent with the ICD-10’s focus on the affective traits in comparison to the DSM-IV’s focus on behaviour. The remaining two ICD-10 traits are (5) “incapacity to maintain enduring relationships, though having no difficulty to establish them”, which is reflected in the DSM-5 required impairment in interpersonal functioning, and finally (6) “marked proneness to blame others, or to offer plausible rationalizations for the behaviour bringing the subject into conflict with society”, which could be considered to reflect ego-centricity described in the self-dysfunction required by DSM-5.

The ICD-10 therefore appears to match the DSM-5 criteria closely, albeit with less focus on impulsive and risk taking behaviour in the ICD-10 than the DSM-5. Both classification systems require the individual to be at least 18 years of age, for the traits to be stable across time and to not be better explained by other mental disorder/substance misuse. Criteria for both disorders are listed in Table 1.3 **Error! Reference source not found.** and Table 1.4.

Table 1.3 - DSM-5 Criteria for Antisocial Personality Disorder

Criterion	DSM-5 Antisocial Personality Disorder
A.	Significant impairments in personality functioning manifest by: 1. Impairments in self functioning (a or b): a. Identity: Ego-centrism; self-esteem derived from personal gain, power, or pleasure. b. Self-direction: Goal-setting based on personal gratification; absence of prosocial internal standards associated with failure to conform to lawful or culturally normative ethical behaviour. AND 2. Impairments in interpersonal functioning (a or b): a. Empathy: Lack of concern for feelings, needs, or suffering of others; lack of remorse after hurting or mistreating another. b. Intimacy: Incapacity for mutually intimate relationships, as exploitation is a primary means of relating to others, including by deceit and coercion; use of dominance or intimidation to control others.
B.	<u>Pathological personality traits in the following domains:</u> 1. Antagonism, characterized by: a. Manipulativeness: Frequent use of subterfuge to influence or control others; use of seduction, charm, glibness, or ingratiation to achieve ones ends. b. Deceitfulness: Dishonesty and fraudulence; misrepresentation of self; embellishment or fabrication when relating events. c. Callousness: Lack of concern for feelings or problems of others; lack of guilt or remorse about the negative or harmful effects of ones actions on others; aggression; sadism. d. Hostility: Persistent or frequent angry feelings; anger or irritability in response to minor slights and insults; mean, nasty, or vengeful behaviour. 2. Disinhibition, characterized by: a. Irresponsibility: Disregard for – and failure to honour – financial and other obligations or commitments; lack of respect for – and lack of follow through on – agreements and promises. b. Impulsivity: Acting on the spur of the moment in response to immediate stimuli; acting on a momentary basis without a plan or consideration of outcomes; difficulty establishing and following plans. c. Risk taking: Engagement in dangerous, risky, and potentially self-damaging activities, unnecessarily and without regard for consequences; boredom proneness and thoughtless initiation of activities to counter boredom; lack of concern for ones limitations and denial of the reality of personal danger
C	The impairments in personality functioning and the individuals personality trait expression are relatively stable across time and consistent across situations.
D.	The impairments in personality functioning and the individuals personality trait expression are not better understood as normative for the individuals developmental stage or sociocultural environment.
E.	The impairments in personality functioning and the individuals personality trait expression are not solely due to the direct physiological effects of a substance (e.g., a drug of abuse, medication) or a general medical condition (e.g., severe head trauma).
F.	The individual is at least age 18 years.

Table 1.4 - ICD-10 Criteria for Dissocial Personality Disorder, with Note About Equivalence to DSM-5 Antisocial Personality Disorder

ICD-10 Dissocial Personality Disorder	Notes relating to Equivalence (refer to Error! Reference source not found.)
A. The general criteria of personality disorder (F60) must be met.	These largely reflect DSM-5 Criterion A, items 1 and 2, in addition to DSM-5 Criteria C-F.
B. At least three of the following must be present:	
(1) Callous unconcern for the feelings of others.	Relates to DSM-5 Criterion B, item 1c
(2) Gross and persistent attitude of irresponsibility and disregard for social norms, rules, and obligations.	Relates to DSM-5 Criterion B, item 2a
(3) Incapacity to maintain enduring relationships, though having no difficulty to establish them.	Relates to DSM-5 Criterion A, item 2b
(4) Very low tolerance to frustration and a low threshold for discharge of aggression, including violence.	Relates to DSM-5 Criterion B, items 1c,d
(5) Incapacity to experience guilt, or to profit from adverse experience, particularly punishment.	Relates to DSM-5 Criterion B, item 1c
(6) Marked proneness to blame others, or to offer plausible rationalizations for the behaviour bringing the subject into conflict with society	Relates to DSM-5 Criterion A, item 1a

Link with Violent Behaviour

The majority of studies to date focus on ASPD as opposed to DPD, however given the relative concordance of the two diagnostic systems, inference about DPD can be drawn from the wider ASPD literature. There is a strong association between violent behaviour and ASPD, which is perhaps unsurprising given the diagnostic criteria (DSM-5 specifies both hostility and impulsivity; ICD-10 specifies a low threshold for the discharge of aggression, including violence). There are highly elevated rates of ASPD in prison. A meta-analysis of 62 studies, incorporating over 20,000 prisoners, estimated 47% of men and 21% of women met criteria for ASPD, reflecting a ten-fold increase from general population estimates (Fazel & Danesh, 2002). The rate of ASPD is also high in secure forensic mental health services at around 55% (Coid, 2003). The National Confidential Enquiry for Homicide and Suicide (2014) found that 16% of homicides in England and Wales over a ten year period were committed by those with a personality disorder. Personality disorder has also been associated with violence in the community; the British Household Survey of psychiatric morbidity noted that the amount of violence in the population attributable to ASPD (population attributable risk) was 24% (Coid et al., 2006).

The presence of personality disorder also has predictive validity for anticipating future violence, as evidenced by inclusion of this criterion in the most widely used risk assessment tool for future violence (Doyle et al., 2014), the Historical, Clinical, Risk-Management scheme (HCR-20; Douglas, Hart, Webster, & Belfrage, 2013). Prospective studies have identified personality disorder as a risk factor for reconviction after leaving forensic mental health services (Coid, Hickey, Kahtan, Zhang, & Yang, 2007; Howard, McCarthy, Huband, & Duggan, 2013), and ASPD specifically as being related to institutional violence during detention (Lussier, Verdun-Jones, Deslauriers-Varin, Nicholls, & Brink, 2009).

The specific personality factors linked to violence have been suggested to be four-fold (Nestor, 2002): 1) impulse control, 2) affect regulation, 3) narcissism, and 4) paranoid cognitive personality style. The mechanisms through which these traits may mediate violence include inability to control urges related to violent thoughts or having intense negative emotions such as anger or fear, which may result in impulsive acts of violence. Insults to an individual's self-worth may evoke violence, especially if narcissism is part of the presentation where such insults would be particularly damaging. Finally, paranoid cognitive personality style may be related to increased perception of threat in the environment, for example through hostile attribution biases or suspicious thinking regarding others. The first two facets (impulse control and affect regulation) are core facets of personality disorder as described in the ICD-10 (general criteria G1; see Table 1.2), and narcissism is a core trait of psychopathy which has been conceptually related to ASPD (see below section). Thus these facets give some insight into the mechanisms underlying the risk of violence amongst individuals with DPD/ASPD. It is also notable that paranoid cognitive style

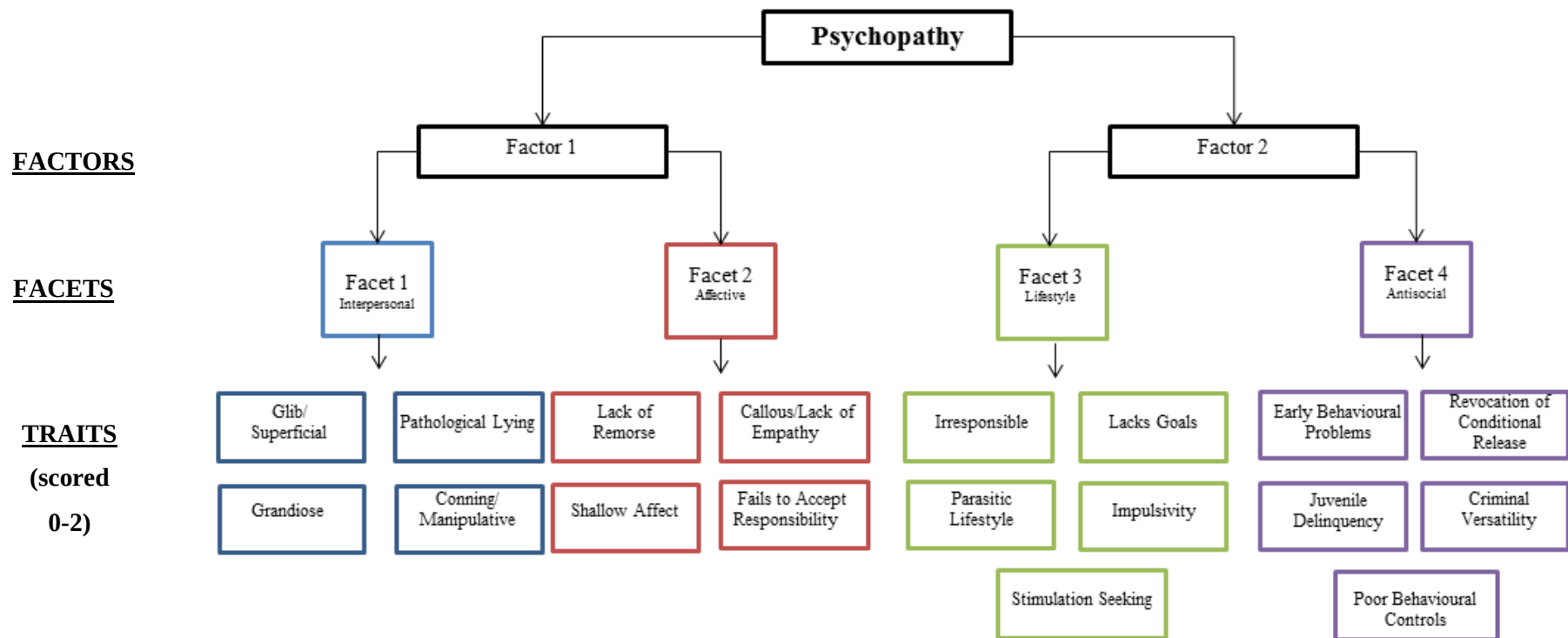
may also present in psychosis, and thus this factor may be particularly relevant to those with both psychosis and a comorbid personality disorder.

Psychopathy

The construct of psychopathy has been conceptually linked with ASPD (Ogloff, 2006). The most widely used model of psychopathy is Hare's two-factor, four facet, model (Figure 1.1) measured by the Psychopathy Checklist – Revised (PCL-R), a twenty item checklist in which items are scored as present (2), partially present (1), or absent (0) (Hare, 2003). Factor one comprises traits relating to an arrogant and deceitful interpersonal style, and diminished affectivity including a callous unconcern for the feelings of others and a lack of empathy and remorse. Factor two relates to an impulsive and erratic lifestyle, characterised by persistent antisocial behaviour and violation of social norms. The factors can be further broken down into facets, broadly corresponding to 'interpersonal style' and 'affect' (Factor 1), and 'lifestyle' and 'antisocial behaviour' (Factor 2). Two items from the PCL-R do not directly map onto any facet, but are included in the total score. These are 'promiscuous sexual behaviour' and 'many short term marital relationships'. In European samples, a clinical cut off of 25 out of 40 is generally accepted for the presence of psychopathy (Cooke, Michie, Hart, & Clark, 2005).

Other factor structures also exist, for example Cooke and Michie (2001) argue that a more appropriate model consists of only the first three facets, as the antisocial behaviour traits (facet four) can be met without the traits being pervasive or persistent and are thus not strictly facets of personality (Cooke, Michie, & Skeem, 2007). However, Hare and Neumann (2005) argue that the fourth facet is critical to the PCL-R's ability to predict external correlates of psychopathy, such as violent behaviour. For example, the four facet model was best able to predict future violence at six month follow up when compared to the three and two factor models, in high-secure psychiatric hospital patients (C. D. Hill, Neumann, & Rogers, 2004).

Figure 1.1- Factor and Facet Structure of Hare's (2003) Psychopathy Construct



Psychopathy and ASPD have some overlapping features, particularly factor two traits, and thus it has been estimated that approximately 32% of those who meet diagnostic criteria for ASPD also reach clinical cut off for psychopathy (score of 25 or greater) in a UK prison sample (Coid & Ullrich, 2010). The large majority (approximately 80%) of those meeting criteria for psychopathy will also meet criteria for ASPD due to high overlap of diagnostic criteria (Hildebrand & de Ruiter, 2004). Some have suggested that those with ASPD and comorbid 'psychopathy' (i.e. reaching clinical cut off on the PCL-R) constitute a distinct subtype. For example, Kosson, Lorenz, and Newman (2006) demonstrated that amongst ASPD offenders, those who met cut off for psychopathy had a history of more severe offending and weaker emotional facilitation on an affect task than those with ASPD alone. They argue that this tentatively supports a distinct subgroup. However, others exploring this phenomenon have failed to show a difference between ASPD plus psychopathy and ASPD alone, in terms of cognitive profiles (De Brito, Viding, Kumari, Blackwood, & Hodgins, 2013; Zeier, Baskin-Sommers, Hiatt Racer, & Newman, 2012), or Axis I comorbidity, demographic factors and treatment-seeking behaviour (Coid & Ullrich, 2010). Coid and Ullrich suggest that psychopathy can thus be conceptualised as a 'severe' variant of ASPD as opposed to a distinct diagnostic group.

Comorbidity of Psychosis and the Antisocial Personality Disorders

In forensic mental health settings, there is a high prevalence of individuals with both psychosis and ASPD. In one high security hospital in the UK, of those with primary mental illness, 45% also met criteria for ASPD (Blackburn et al., 2003). This trend has also emerged from the developmental literature, in that those with an adult schizophreniform disorder were 2.8 times more likely than those without to have been diagnosed with childhood conduct disorder, equating to around 40% of the schizophreniform group (Kim-Cohen et al., 2003). Indeed, in a study of those experiencing their first episode of psychosis, 33.9% of men and 10% of women had an existing record of criminal conviction, with 19.9% and 4.6% (respectively) having a record of violent conviction (Hodgins et al., 2011). This suggests a subgroup of individuals with pervasive and persistent antisocial tendencies before the onset of psychosis, which maps onto the aetiological subtypes of schizophrenia offender proposed above (Bo et al., 2011; Hodgins, 2008; Volavka & Citrome, 2008).

However, despite this compelling evidence, there has been little research focussing on this subgroup, and only three studies have specifically examined the clinical and offence related characteristics of this group. One key investigation examined the correlates of ASPD in schizophrenia, by interviewing 232 men with schizophrenia who were discharged from either forensic or general psychiatric hospital across four sites including Germany, Finland, Sweden and Canada (Moran & Hodgins, 2004). They were characterised on a number of clinical and demographic variables based on interview (including a structured interview to diagnose ASPD), correspondence with relatives and (in some cases) review of their records. In terms of childhood

characteristics, the best variables to distinguish those with ASPD from those without were attention/concentration problems before age 18, substance abuse before 18 and below average performance at elementary school. For adult clinical correlates, the best variables included adult alcohol abuse/dependence, adult drug abuse/dependence and a deficient affective experience. When examining criminal correlates, total number of crimes and having a conviction before first admission to general psychiatry best distinguished the ASPD group from the schizophrenia alone group. The study thus depicts those with comorbid ASPD and schizophrenia as having persistent and prolonged substance abuse, attentional problems, poor educational background and an extensive criminal record.

Another similar study also examined how forensic inpatients with schizophrenia and a history of violent offending, with and without ASPD, differed from one another (Steinert, Voellner, & Faust, 1998). They assessed 25 males: 18 without ASPD and seven with an additional ASPD diagnosis. They observed that the comorbid group were younger at the time of their first psychiatric hospitalisation, younger at their admission to forensic services, were more likely to have previous convictions prior to the index offence, were more likely to have abused drugs in the past, and were less likely to be delusional at the time of their violent offence. In addition, although not reaching statistical significance, there was a pattern for the ASPD group to have poorer educational history; 43% had not finished school compared to 11% of the schizophrenia alone group. Further, 43% of the comorbid group came from a 'broken home' compared to 17% of the schizophrenia alone group, suggesting more early psychosocial deprivation in this group.

One study examined the circumstances surrounding the offence amongst homicidal offenders with schizophrenia with/without ASPD (Joyal, Putkonen, Paavola, & Tiihonen, 2004). They found that the group with an additional ASPD diagnosis, relative to schizophrenia alone, were less likely to have committed their offence as a result of responding to psychotic symptoms, and it was more likely to have been precipitated by a fight or argument. The comorbid group were more likely to have been intoxicated at the time of the offence, and to meet the criteria for alcohol abuse or dependence. Consistently with the other studies, the comorbid group had fewer years of education, more previous convictions and were younger at the age of first conviction. However this study found no difference in the age of onset of psychotic symptoms.

There is some literature to suggest that outcomes for this comorbid group are poor. Meta-analytic evidence indicates that having psychosis comorbid with ASPD approximately doubles the risk for violence compared to those with psychotic disorder alone (Witt, van Dorn, & Fazel, 2013), conferring enhanced risk of conviction and incarceration for these individuals. There is also evidence from a prospective cohort study that the risk of suicide amongst those with both psychosis and any PD is increased compared to psychotic disorder alone (Moran et al., 2003a), although the study was underpowered to detect differences between specific PDs. In a study

examining the prevalence of PD amongst ‘recovered’ and ‘non-recovered’ individuals with schizophrenia (broadly, those who were asymptomatic with typical psychosocial functioning versus those with active symptoms and low psychosocial functioning), there was no significant difference in the prevalence of any PD. However, those in the non-recovered group were significantly more likely to have had conduct or emotional problems in childhood and adolescence, and although a non-significant difference, there were a higher proportion of individuals who reported abusing drugs or alcohol before admission to hospital in the non-recovered group compared to recovered (71.4% vs 28%, respectively). As seen above, these traits are common in people with schizophrenia and comorbid ASPD, and thus are suggestive of poorer outcome for this group.

Analysis of three randomised controlled trials for management of schizophrenia and/or other serious mental illness which observed outcome by PD status was conducted by Tyrer and Simmonds (2003). The results demonstrated that intensive community management was effective at keeping people with comorbid PD and schizophrenia out of hospital, but they had poorer outcomes in depression and social functioning compared to those with no PD. In addition, of all the violent incidents that occurred in the community, the large majority of these were committed by individuals with comorbid cluster B PDs (which includes DSM-IV borderline, antisocial, histrionic and narcissistic PD), suggesting that although reduced hospitalisation time may be beneficial to the individual, it is less clear that this is beneficial to the safety of the public. A meta-analysis of the effect of antipsychotic medication on violence amongst individuals with schizophrenia identified that adherence to medication reduced violence in a subgroup of individuals who had no childhood history of antisocial behaviour, but was not effective at reducing violence amongst those that did (Swanson et al., 2008). This further highlights that treatment options are limited for this comorbid group compared to individuals with psychosis alone.

Chapter Summary

To summarise, it is evident that individuals with comorbid ASPD and schizophrenia constitute a significant proportion of those using forensic mental health services, and likely represent a distinct subgroup of offenders with schizophrenia. The available evidence suggests that they are characterised by pervasive substance abuse, attentional problems, poor educational attainment and a lengthy criminal history which precedes illness onset, and commit crimes which are not driven by symptoms. They also appear to respond less well to treatment than their non-ASPD counterparts, and are at a greater risk of committing violent acts against others or themselves. Greater understanding of this high-risk group should represent a priority for future research, in order to reduce the risk of deleterious outcomes for individuals and the wider public. However, it is evident that there is much still to be understood about this subgroup, including gaining a perspective on the underlying neurobiology of such individuals to ascertain whether, and if so

how exactly, they differ from either group alone. A fuller understanding of specific deficits/strengths would allow the correct direction of therapeutic intervention.

The next chapter will review the neuropsychological and emotion processing characteristics of violent individuals with schizophrenia, ASPD/DPD and comorbidity of these disorders, with a view to obtaining a more specific understanding of the characteristics both within and between groups.

2 Chapter Two: Systematic Review and Meta-Analysis of Cognitive and Emotion Processing Characteristics in Violent Schizophrenia and ASPD

Chapter Aims and Overview

As highlighted in the previous chapter, individuals with psychosis and ASPD are highly prevalent within forensic mental health services and both diagnoses have been linked with violent behaviour. This chapter aims to identify and review previous literature reporting on neuropsychological and emotion processing characteristics of violent individuals. Throughout this thesis the decision has been taken to report statistical trends (i.e. $p < .10$), alongside results at the conventional level of significance ($p < .05$). This was deemed acceptable due to the largely exploratory nature of the studies, the small number of participants, and the relative paucity of previous research on similar samples. In addition, effect sizes are reported throughout the thesis where appropriate, alongside the p-values derived for all analyses. This allows the reader to ascertain the strength and direction of the reported findings, and highlights avenues for future research where trends may be evident although do not meet conventional levels of significance. Individuals with these diagnoses, in order to gain a fuller understanding of these groups. To achieve these aims, neuropsychological studies comparing either group to healthy controls were subjected to meta-analysis in order to quantify the size and direction of difference between groups. Neuropsychological studies which did not compare any of the two clinical groups of interest with a healthy control group, and all the emotion processing studies (due to marked heterogeneity in methods) are reviewed narratively.

Introduction

In order to try to understand violent behaviours, psychosocial, clinical and environmental influences are often considered, such as substance misuse, psychotic symptoms and unemployment (P. E. Mullen, 2006). There are also studies emerging from the experimental psychology literature which draw on cognitive and/or emotion processing traits including inhibitory control theories (Hoptman, 2015; Kumari, Barkataki, et al., 2009), deficits in social-cognitive abilities including facial affect recognition (Malone, Carroll, & Murphy, 2012) and hostile attribution bias (S. T. Harris et al., 2014) to assist in our understanding of violence amongst clinical groups.

Thus, it is important to have an appreciation of both cognition and emotion processing in order to formulate such models which enhance our understanding of the aetiology of violence and thus inform and direct appropriate treatment. For example, Blair's influential Integrated Emotion Systems (IES) model (Blair, 2005) was conceived following evaluation of the literature describing experimental cognitive and/or affective paradigms in individuals with high levels of psychopathic traits. This model describes poor ability to make stimulus-reinforcement associations, particularly in response to aversive cues, and respond to changing contingencies

which he asserts underpins violent and/or antisocial behaviour. For example, failing to associate negative responses from the recipients of violent behaviour with negative feelings, due to a lack of experience of distress on the part of the aggressor, leaves the behaviour ‘unpunished’ and thus more likely to happen again. Additionally, failure to respond to changing contingencies, i.e. expecting a certain outcome based on previous experience, but this not being forthcoming, leads to frustration and thus may mediate reactive aggression.

A systematic review and meta-analysis is presented here which aims to compare and contrast the cognitive (part one) and emotion processing (part two) characteristics of violent individuals with either a schizophrenia spectrum disorder (VSZ) or ASPD¹. A comprehensive overview of such characteristics should help to elucidate common (violence specific) and distinct (diagnosis specific) factors which contribute towards violence in these groups, and allows the generation of hypotheses about how a comorbid group may present. In addition, understanding the nature and degree of such problems can assist in understanding the levels of functional impairments which may be experienced by these diagnostic groups; poor neurocognitive and social cognitive functioning amongst individuals with schizophrenia is known to be associated with lower levels of community and social functioning (Fett et al., 2011), and are likely to be applicable to functioning amongst ASPD groups too.

Thus, the explicit questions being addressed in this review are:

1. What are the neuropsychological characteristics of violent/aggressive/criminal individuals with a diagnosis of schizophrenia spectrum disorder? Are they the same, or different, to violent/aggressive/criminal individuals with a diagnosis of ASPD?
2. What are the emotion processing characteristics of violent/aggressive/criminal individuals with a diagnosis of schizophrenia spectrum disorder? Are they the same, or different, to violent/aggressive/criminal individuals with a diagnosis of ASPD?

Method

This systematic review and meta-analysis was carried out in accordance with ‘Preferred Reporting Items for Systematic Review and Meta-analysis’ (PRISMA) guidelines (Moher et al., 2009). See PRISMA Checklist in Appendix 1.

Information Sources and Search

¹ The large majority of the literature to date has focussed on DSM-IV ASPD. Although slightly different to ICD-10 DPD (see Chapter One) the characteristics of ASPD individuals are considered here in the absence of more specific data on DPD, with some overlap between the characteristics of disorders likely, due to diagnostic criteria overlap.

Embase (1980- June 2016), Ovid MEDLINE(R) (1946-June 2016) and PsycINFO (2002 to June 2016) were searched on 06/06/2016² to identify eligible literature, cross-referencing the following search terms:

1. cognit* OR neuropsych* OR executive function OR affect* OR emotion
2. offender OR criminal OR violent* OR aggress* OR forensic
3. schizophrenia OR psychosis OR antisocial personality disorder.

Results were limited to articles in English, featuring human participants and with abstracts available.

Eligibility Criteria

Studies were assessed against the following inclusion criteria:

1. Participants must be adults and have a diagnosis of a schizophrenia spectrum disorder, antisocial personality disorder/dissocial personality disorder, or both, using a recognised diagnostic system, and must have a history of violent/aggressive/criminal behaviour. The data must be further reported by diagnostic group status and/or violence status.
2. Studies must specify a way to ascertain whether the clinical group is impaired/superior/the same in comparison to each other (i.e. direct comparison between VSZ and ASPD), or compared to another group, i.e. a control group which can be: a) a non-violent sample of clinical cases [e.g. non-violent people with schizophrenia (NVSZ)], or b) non-clinical violent controls (e.g. prisoners), or c) non-clinical, non-violent controls (e.g. hospital staff), or d) a comparison with published norms.
3. Studies must report on: a) at least one standardised neuropsychological measure, and/or b) at least one experimental task of emotion processing including the recognition of emotional expression, theory of mind, or the experience of emotional states.
4. Studies which focus exclusively on psychopathy (without specifically assessing ASPD/DPD) were not included. Studies which additionally assess psychopathy when condition #1 is met were included.
5. Studies must be primary research articles that have been peer-reviewed, i.e. not review articles, theses, books, case studies etc. This was in order to maintain a minimum standard of study quality.

² This was an updated search to ensure that all available literature at the point of thesis submission was included and discussed. However, the first formal search was conducted in January 2015.

Study Selection

Studies were selected based on eligibility criteria detailed above and titles and abstracts were screened to assess for suitability. If insufficient information was provided in the title or abstract, the full text was retrieved before making a decision. After initial screening, the full text of each article was retrieved to assess its suitability for inclusion. This process was conducted independently by two researchers and verified between them.

Data Collection Process

For the comparative meta-analyses, data on cognitive test scores for clinical and control groups were extracted by two researchers independently, recorded in a spreadsheet and reviewed for consistency. Any inconsistencies were discussed until a consensus was reached. For narrative results, data extraction was conducted by one researcher, and a random selection of 20 studies was independently extracted by a second author to verify the extraction. No inconsistencies were identified.

Data Items

The following data items were extracted from each paper: participant information (including sample size, gender, age, and diagnosis of participants), the method by which violence was assessed, whether comorbid axis I/II disorders were assessed and controlled for, details of the cognitive/emotion processing measures used and the main findings from each paper. For papers included in the meta-analyses mean and standard deviation scores of cognitive tests for clinical and healthy control groups were extracted. Attempts to collect data across multiple cognitive domains were made, including intelligence, memory, executive function and attention. However, due to a lack of available data for the attention domain, only the former three domains were included. Where data were not available, authors were contacted.

Summary Measures for Meta-Analysis

For papers reporting on more than one measure purportedly assessing the same domain (e.g., executive function assessed by both the Wisconsin Card Sorting Test [WCST] and the Tower of London [ToL] task), a summary score for that cognitive domain was calculated by taking a mean of the effect sizes of individual scores. Similarly, if a task produced multiple outcome parameters (i.e. categories completed and number of perseverative errors on the WCST), then all outcome parameters were extracted and a mean of the effect size was taken for that test. This approach was deemed appropriate as it conferred the lowest risk of researcher bias in choosing one specific parameter/test, and to incorporate maximal information into the analyses.

When research groups had published data on the same measure(s) with the same sample in different papers, the paper with the largest sample size was chosen. Similarly, for papers where

the clinical groups were further divided (i.e. high, medium, low psychopathy groups in VSZ or ASPD) the group with the largest number of participants was chosen to represent that diagnostic category. For investigations by the same group incorporating the same participants but reporting on different measures (i.e. ToL and WCST in different publications, but in the same sample), these scores were incorporated into a single summary score for the domain. Thus, each sample (as opposed to each paper) had a summary score for each domain (where reported).

Synthesis of Results

For the meta-analysis all effect sizes were calculated as Hedge's g . This is considered to provide a more accurate effect size estimate than Cohen's d , especially when sample sizes are small as it applies a correction for bias by utilising the pooled standard deviation of 'n-1' as opposed to just 'n' (the method used to calculate Cohen's d ; Grissom & Kim, 2005). Effect sizes were calculated so that negative values represent a poorer performance in the clinical group compared to healthy, non-violent controls. A more conservative random effects model was utilised due to the assumption that effect sizes would vary dependent on sampling method and population specific characteristics. Planned analyses included comparing VSZ and ASPD on the cognitive domains of IQ, memory and executive function. Subgroup analyses within diagnostic groups comparing those tasks of executive function assessing impulsivity/inhibitory control with those that did not (see Table 2.1) were performed due to the hypothesised link with violent behaviour and the specific subtype of VSZ characterised by impulsive behaviour (Volavka & Citrome, 2008; see Chapter One for discussion). Publication bias was assessed formally by conducting Egger's and Begg's tests. A measure of consistency (I^2) was also taken for each set of analyses to assess for heterogeneity. Statistical procedures were carried out using Stata 11 (StataCorp, 2009) *metan* package for meta-analyses, and *metabias* for publication bias.

For studies reporting on emotion processing characteristics, or neuropsychological characteristics comparing to a group other than healthy controls, narrative summaries and evaluation are provided.

Results

Study Selection

The initial search identified 51 papers (see Figure 2.1 for selection process). Reference lists were hand-searched to identify any further literature, including those of two previous meta-analyses on related topics (Ogilvie, Stewart, Chan, & Shum, 2011; Schug & Raine, 2009), resulting in 11 additional papers being added. Thus 62 papers were included in total (See Appendix 2 for table of all included studies).

Study Characteristics

Twenty-nine studies provided data on cognitive functioning in a VSZ and/or ASPD, comparing them to healthy controls. Sixteen studies compared cognitive functioning in VSZ relative to NVSZ, and 8 studies directly compared cognition in VSZ and PD groups. Four studies provided data on (putatively) comorbid schizophrenia and ASPD. For emotion processing traits, 13 studies examined emotion in VSZ and 13 in ASPD, with two studies providing information on a comorbid (schizophrenia and ASPD) group.

Only studies providing cognitive functioning data in VSZ/ASPD groups compared to healthy, non-violent controls (in an effort to standardise the comparison group) were included in the meta-analyses. Thus 29 papers (including 4 overlapping samples reported in 11 papers; 22 distinct samples examined) were included in the meta-analyses (see Table 2.1 for included studies and tests).

Figure 2.1 - Flowchart of Literature Selection

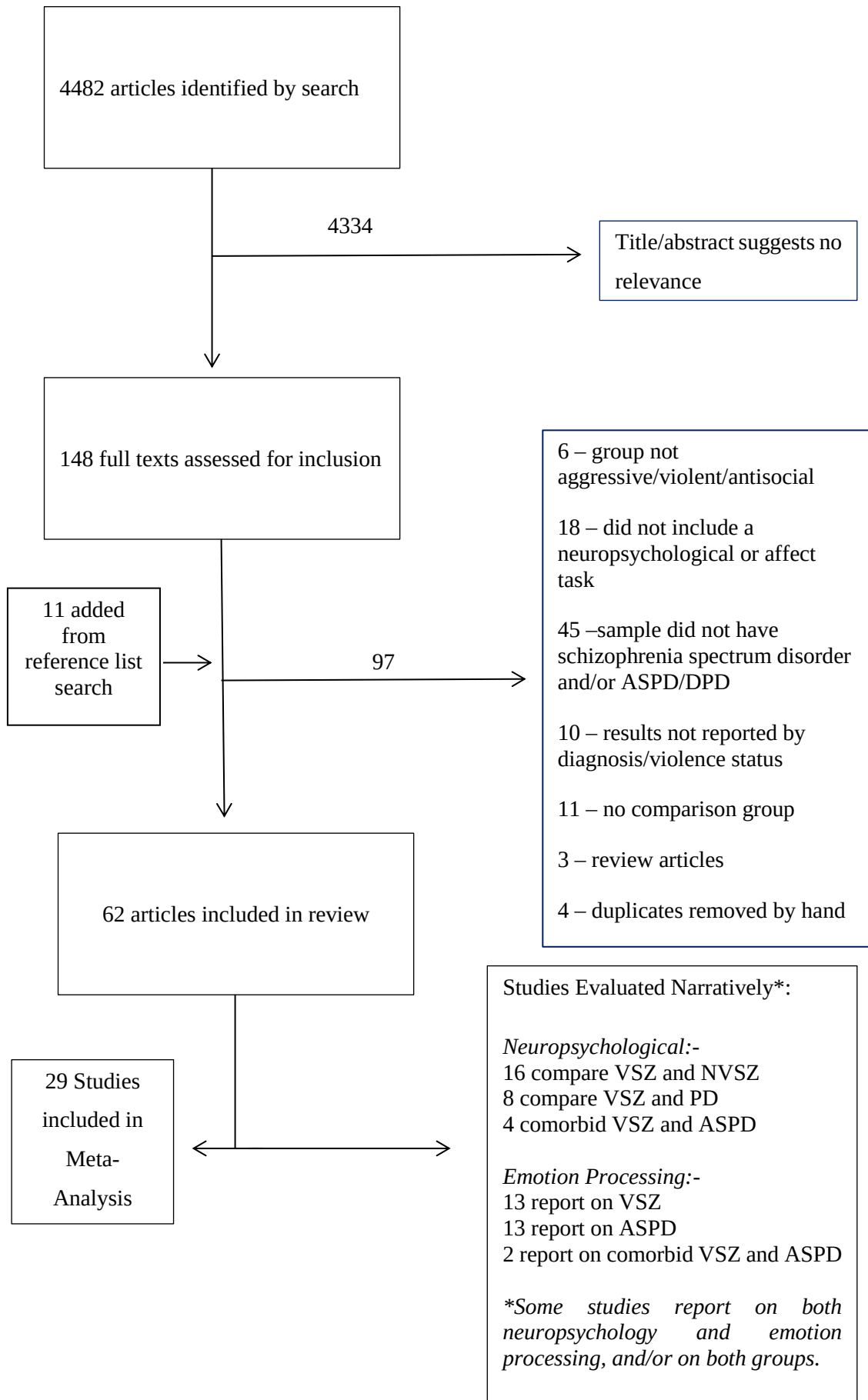


Table 2.1- Measures Included In Meta-Analyses with References, Grouped by Domain

Measures	References
IQ	
HAWIE	Domes, Mense, Vohs, & Habermeyer, 2013; Prehn, et al., 2013
MWT	Majorek, et al., 2009
MWT-B	Schiffer, et al., 2014
NART	Dolan & Fullam, 2006; Enticott, Ogloff, Bradshaw, & Fitzgerald, 2008; Kumari, et al., 2009
Quick Test	Vollm, et al., 2010
WAIS Chinese Version Short	Yang, et al., 2010
WAIS Korean Version Short	Chung, Chung, Jung, Chang, & Hong, 2010
WAIS Performance IQ	Robertson & Taylor, 1985
WAIS-III Full Scale IQ	Barkataki, et al., 2005; De Brito, Viding, Kumari, Blackwood, & Hodgins, 2013 ^a
WAIS-R Similarities	Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010
Executive Function	
Abstraction and Working Memory Task	Silver, Goodman, Knoll, Isakov, & Modai, 2005
BADS Zoo Map Part 1	Majorek, et al., 2009
Cambridge Gambling Task	De Brito, et al., 2013
CANTAB – Attentional set shifting	Dolan, 2012
CANTAB – Stockings of Cambridge	Dolan, 2012
Emotional Stroop – Reaction Time to Neutral ^{\$}	Domes, et al., 2013
Executive Golf Task	Barkataki, et al., 2005
Go/No Go ^{\$}	Barkataki, et al., 2008; De Sanctis, et al., 2013; Dolan & Park, 2002; Vollm, et al., 2010
Negative Priming - response time ^{\$}	Enticott, et al., 2008

Measures	References
Passive Avoidance Learning	De Brito, et al., 2013
Probabilistic Response Reversal Task	De Brito, et al., 2013
Rey-Osterrieth Complex Figure Test - Copy	Chung, et al., 2010
Single Key Impulsivity Paradigm ^{\$}	Swann, Lijffijt, Lane, Steinberg, & Moeller, 2009
Spatial Alteration Task	Chung, et al., 2010
Spatial Stroop ^{\$}	Enticott, et al., 2008
Stroop Colour Word Test ^{\$}	Barkataki, et al., 2005; Chung, et al., 2010; Roszyk, Izdebska, & Peichert, 2013; Schiffer, et al., 2014
Tower of London	Barkataki, et al., 2005; Dolan & Park, 2002; Roszyk, et al., 2013
Trail Making Test Part B	Braun, et al., 1995 ^b
Two choice impulsivity paradigm ^{\$}	Swann, et al., 2009
Verbal Fluency	Braun, et al., 1995; Robertson & Taylor, 1985
WAIS-R Digit Span Backwards	De Brito, et al., 2013; Silver, et al., 2005
Wisconsin Card Sort Test	Barkataki, et al., 2005; Braun, et al., 1995; Chung, et al., 2010; Majorek, et al., 2009; Pera-Guardiola et al., 2016

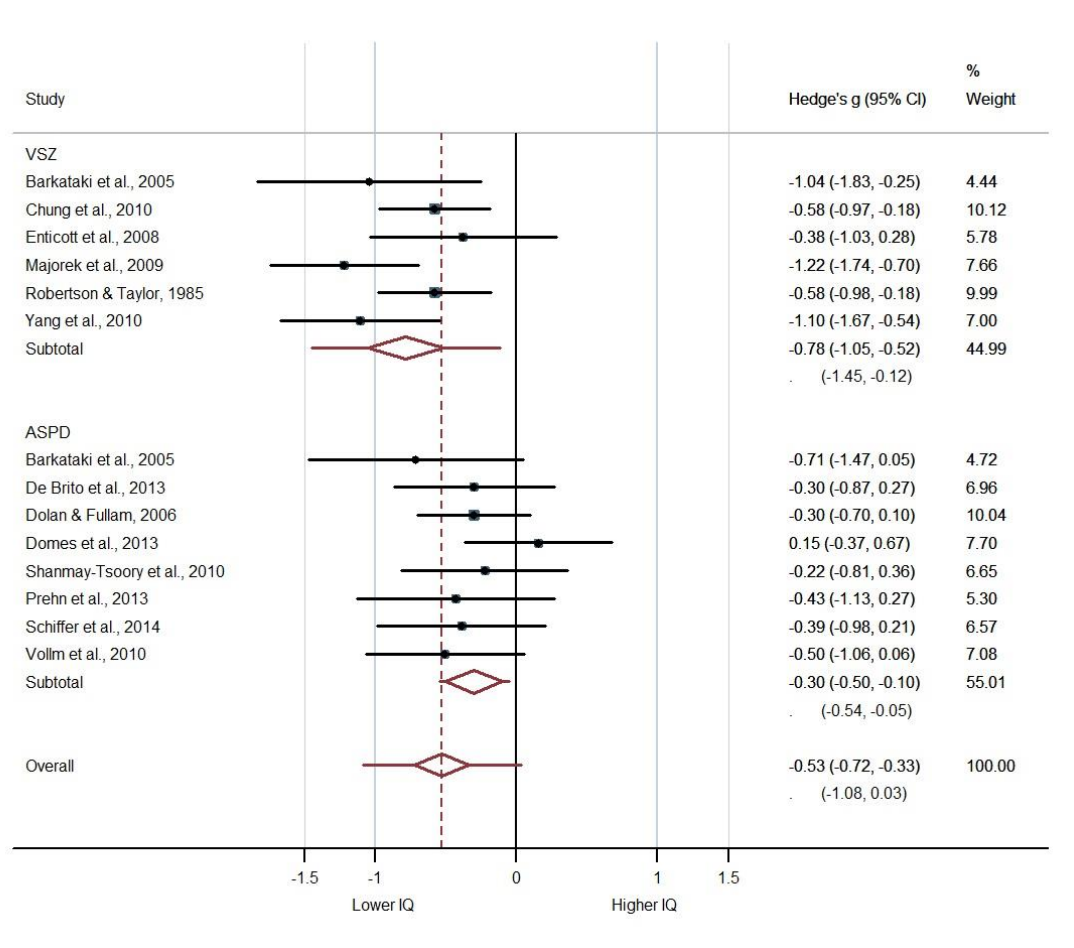
Measures	References
Memory	
CANTAB - Delayed Match to Sample	Dolan & Park, 2002
Dot test modified	Silver, et al., 2005
Memory for objects	Silver, et al., 2005
n-back	Kumari, et al., 2006
Penn Face Memory Task	Silver, et al., 2005
Rey Auditory Verbal Learning Test	Chung, et al., 2010
RBANS delayed & immediate memory	Viljoen, Iverson, Ward, & Brink, 2004
Rey-Osterrieth Complex Figure Test - Recall	Chung, et al., 2010
Visual Retention Task	Robertson & Taylor, 1985
WMS Logical Memory I	Barkataki, et al., 2005
WMS Logical Memory II	Barkataki, et al., 2005
\$ - Measure included in impulsivity subgroup analysis	
a – Overlapping with Gregory et al., (2012); b – Overlapping with LaPierre et al., (1995)	
<i>HAWIE= Hamburg-Wechsler-Intelligenztest für Erwachsene; MWT-B= Mehrfachwahl wortschatz test B; MWT = Mehrfachwahl wortschatz test; NART = National Adult Reading Test; WAIS = Wechsler Adult Intelligence Scale; BADS= Behavioural Assessment of Dysexecutive Syndrome; CANTAB = Cambridge Neuropsychological Test Automated Battery; RBANS = Repeatable Battery for the Assessment of Neuropsychological Status; WMS = Wechsler Memory Scales.</i>	

Part One: Cognitive Profiles of Violent Individuals

Meta-Analysis: VSZ and ASPD vs Healthy, Non-Violent Controls

Meta-analysis of studies assessing IQ showed significantly lower scores in VSZ, compared with healthy, non-violent controls, with a medium-large effect size (Hedge's $g=-0.78$, $df=5$, $p<0.001$, $CI=-1.05 - -0.52$), and in ASPD with a small effect size (Hedge's $g=-0.30$, $df=7$, $p=0.003$, $CI=-0.50 - -0.10$). As confidence intervals do not overlap, it can be inferred that these groups likely also differ significantly from one another, with the VSZ group showing lower IQ than the ASPD group. There was low heterogeneity for both VSZ ($I^2=36.0\%$, $Q=7.81$, $p=0.167$) and ASPD groups ($I^2=0.0\%$, $Q=4.84$, $p=0.679$). See Figure 2.2.

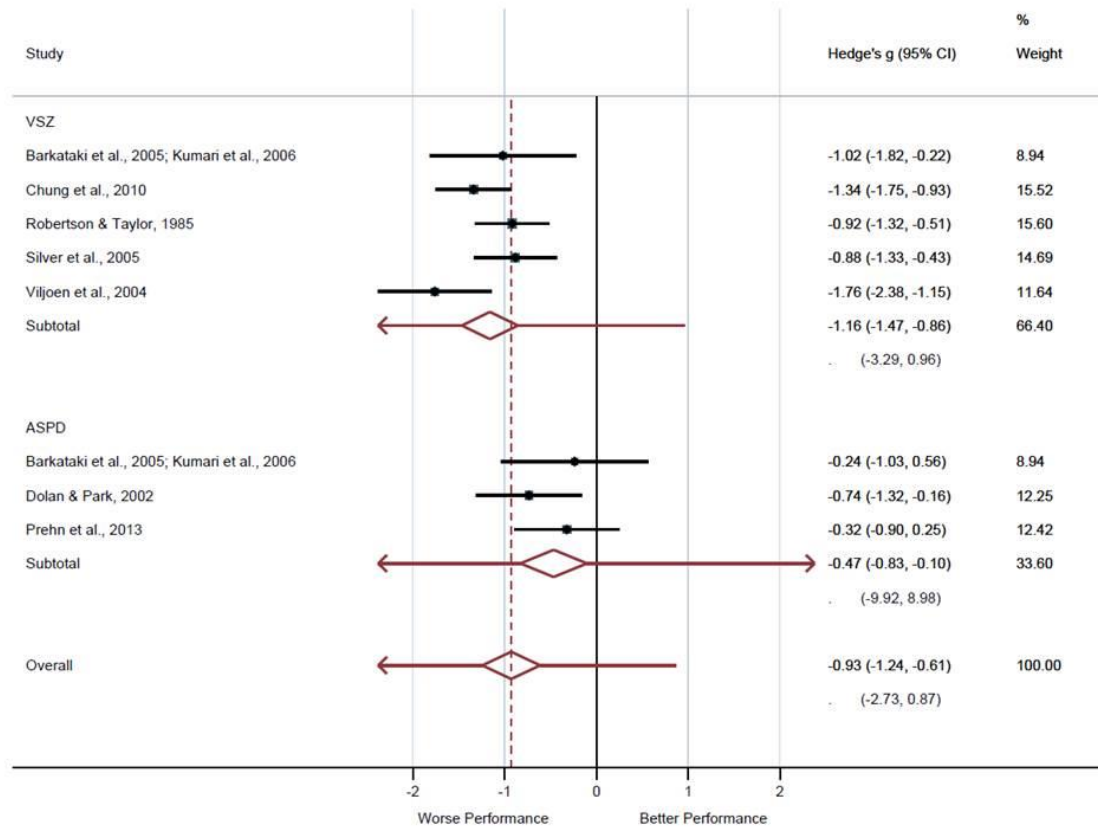
Figure 2.2 - Forest Plot for IQ Effect Sizes in Studies Examining Violent Schizophrenia and ASPD



For memory, there was a significantly poorer performance in VSZ compared with controls, with a large effect size (Hedge's $g=-1.16$, $df=4$, $p<0.001$, $CI=-1.47 - -0.86$). The ASPD group also significantly differed from controls with a medium effect size (Hedge's $g=-0.47$, $df=2$, $p=0.01$, $CI=-0.83 - -0.10$), and as the confidence intervals do not overlap it is likely that the violent groups also differ from each other, with a poorer performance observed in VSZ. There was moderate but

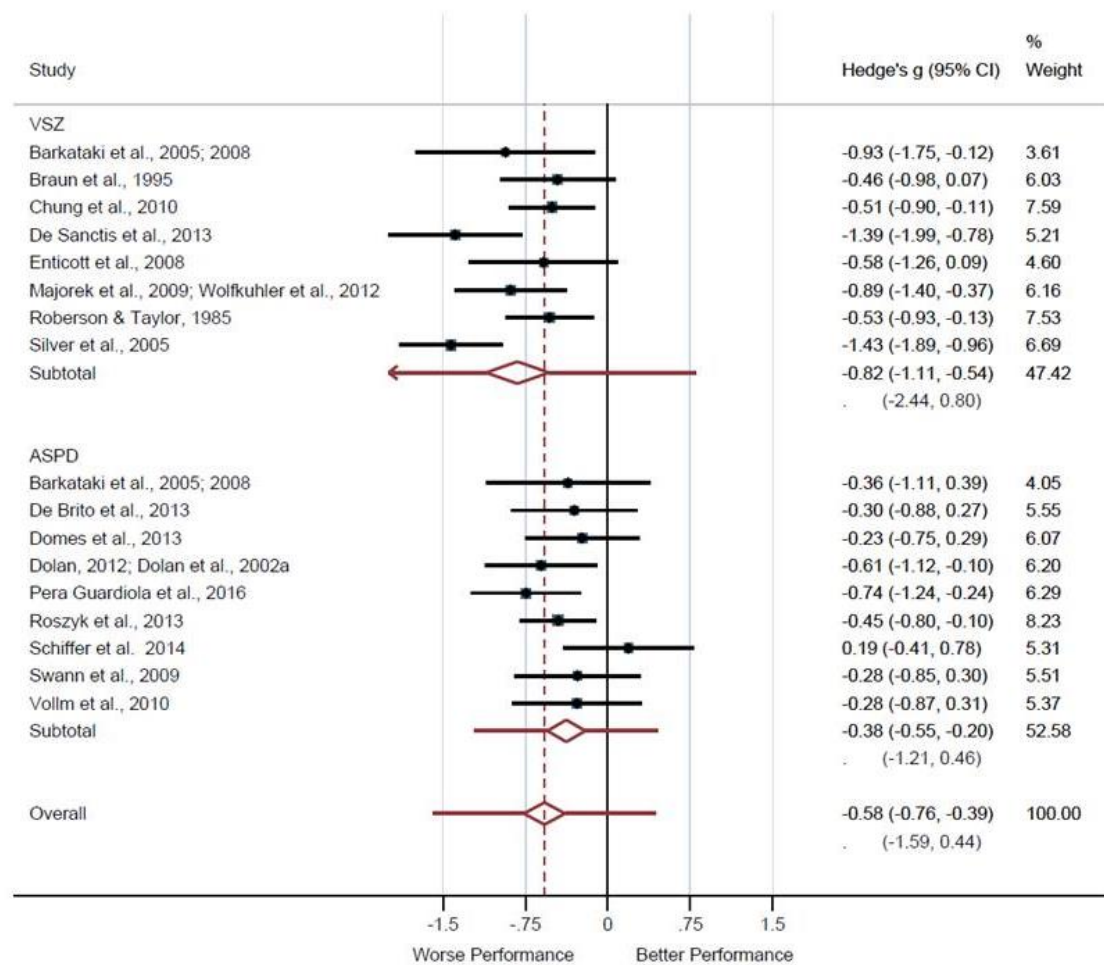
non-significant heterogeneity for the VSZ group ($I^2=45.5\%$, $Q=7.34$ $p=0.119$) and low heterogeneity for the ASPD group ($I^2=0.0\%$, $Q=1.38$ $p=0.50$). See Figure 2.3.

Figure 2.3 - Forest Plot for Memory Effect Sizes in Studies Examining Violent Schizophrenia and ASPD



For executive function, there was significantly poorer performance compared to controls in the VSZ group with a large effect size (Hedge's $g=-0.82$, $df=7$, $p<0.001$, $CI=-1.10$ - -0.54), and in the ASPD group with a small to medium effect size (Hedge's $g=-0.38$, $df=8$, $p=0.006$, $CI=-0.55$ - -0.20). The overlapping confidence intervals suggest that these two groups may not significantly differ from each other, although the degree of overlap is marginal. Significant heterogeneity in the VSZ group must be taken into account ($I^2=58.1\%$, $Q=16.7$, $p=0.019$) with a much more consistent result in the ASPD group ($I^2=0.0\%$, $Q=7.05$, $p=0.531$). See Figure 2.4.

Figure 2.4 - Forest Plot for Executive Function Effect Sizes in Studies Examining Violent Schizophrenia and ASPD



Subgroup analyses within diagnostic groups to compare executive function tasks which assess impulsivity/cognitive control vs. those which do not, were conducted to determine whether this type of task was driving the violent groups vs healthy control difference. Within the VSZ group, effect sizes were medium-to-large for both impulsive and non-impulsive tasks, with overlapping confidence intervals, suggesting that this group perform similarly poorly on both types of task compared to controls (Impulsive: Hedge's $g=-0.64$, $df=3$, $p=0.033$, $CI=-1.22$ - -0.05 ; Non-Impulsive: Hedge's $g=-0.81$, $df=6$, $p<0.001$, $CI=-1.08$ - -0.55). A similar pattern was observed in the ASPD group, although with smaller effect sizes for both impulsive and non-impulsive tasks (Impulsive: Hedge's $g=-0.35$, $df=5$, $p=0.001$, $CI=-0.56$ - -0.12 ; Non-Impulsive: Hedge's $g=-0.45$, $df=5$, $p<0.001$, $CI=-0.65$ - -0.26). There was no significant heterogeneity in the ASPD group (Impulsive: $I^2=0.0\%$, $Q=4.71$, $p=0.452$; Non-Impulsive: $I^2=0.0\%$, $Q=3.92$, $p=0.560$); however, significant heterogeneity remained in the VSZ group for the impulsive/cognitive control tasks (Impulsive: $I^2=74.0\%$ $Q=11.53$, $p=0.009$) although was no longer statistically significant amongst tasks assessing other aspects of executive function, but was present at a trend level (Non-Impulsive: $I^2=46.8\%$, $Q=11.3$, $p=0.080$).

There was no evidence of publication bias as confirmed by using Egger's and Begg's tests. This was the case for all domains including IQ (Egger's $p=0.64$, Begg's $p=0.48$), executive function (Egger's $p=0.99$, Begg's $p=0.71$) and memory (Egger's $p=0.50$, Begg's $p=0.90$).

NARRATIVE SYNTHESIS

VSZ vs. PD

Eight studies directly compared the cognitive profiles of VSZ and PD, see Table 2.2. Although not every study compared with an ASPD group specifically, these studies reported on a VSZ group thus despite not including a clear ASPD group, they were suitable for inclusion based on the stated criteria (i.e. inclusion criteria #1, include violent individuals with schizophrenia, as noted in Methods). However, amongst the PD groups reported here, a large proportion of ASPD participants would be expected given that most of the studies were conducted in high-secure forensic hospitals (Hill, Chesterman, Murphy, Tidmarsh, & Lumsden, 1997; Murphy, 2003, 2011) where ASPD is the most common PD (Blackburn et al., 2003), or in a psychopathy sample (Kiehl, Smith, Hare, & Liddle, 2000) which has been conceptualised as a severe variant of ASPD (Coid & Ullrich, 2010).

Consistent with the meta-analytic investigation, no studies found better performance in the VSZ group for any domain, and all found equivalent or impaired performance compared to a PD group. The IQ findings were equivocal, with some studies finding equal and some lower IQ in the VSZ group compared to PD, yet this is somewhat complicated by overlapping samples. However, it is notable that one study that found no difference overall (Nijman, Cima, & Merckelbach, 2003), did find a relative strength in verbal IQ for the schizophrenia spectrum group, whereas the non-schizophrenia group (largely cluster B PD) had better performance IQ. Results were also equivocal in the executive function domain, mirroring the overlapping confidence intervals observed in the meta-analysis for this type of task. Similarly, the relative weakness of the VSZ group on memory tasks is also reflected in this section, with all studies finding poorer performance in VSZ relative to PD.

Table 2.2 - Cognitive Functioning in Violent Individuals with Schizophrenia (VSZ) Compared To Violent Individuals with Personality Disorder (PD)

Study	% of PD participants with ASPD	IQ	Executive Function	Memory	Visuospatial	Attention
Barkataki et al., 2005 ^{\$}	100%	↓	↓	↓	NR	↓
Barkataki et al., 2008 ^{\$}	100%	↓	=	NR	NR	NR
Hill et al., 1994	NR (no axis I)	NR	NR	NR	=	NR
Kiehl et al., 2000	Psychopathy group	NR	↓ [%]	NR	NR	NR
Kumari et al., 2006 ^{\$}	100%	↓	NR	↓ [%]	NR	NR
Murphy, 2003	NR (axis II)	=	=	↓	=	NR
Murphy, 2011	NR (axis II)	=	=	NR	NR	NR
Nijman et al., 2003	38% ASPD, 70% Cluster B	=	NR	NR	NR	NR

Key: ↑ violent schizophrenia group significantly better than violent PD group; ↓ violent schizophrenia group significantly worse than violent PD group; = violent schizophrenia and violent PD groups equal; NR: domain not reported

^{\$} Overlapping sample
[%] At trend level

Schizophrenia: With (VSZ) vs. Without Violence (NVSZ)

Sixteen studies examined the cognitive profiles of VSZ, relative to NVSZ, individuals. As summarised in Table 2.3, there is clear evidence to suggest that VSZ are at least as impaired as NVSZ individuals across a range of neuropsychological domains; the majority (12 out of 13) of studies examining IQ find equivalent performance between violent and nonviolent groups, as do all five studies examining attention. Seven out of nine studies examining memory find equal performance, with the remaining two observing poorer performance in the violent group. Mirroring the high heterogeneity of effect sizes in the executive function domain observed in the meta-analysis, studies comparing executive function between violent and non-violent schizophrenia groups are mixed in their findings, making a consensus position difficult to reach.

One study not included in Table 2.3, due to the results not being reported by cognitive domain, is an early study in aggressive and non-aggressive men with schizophrenia (Adams, Meloy, & Mortiz, 1990) who were assessed using the Luria-Nebraska Neuropsychological Battery and classified as 'impaired' or 'not impaired'. 'Impaired' status was associated with 'severe' community violence, whereas only one 'moderately' violent individual was 'impaired'. Thus, this study supports greater cognitive deficit in more violent groups, and also highlights that the severity of violence may be a factor to consider when comparing groups, and may be the reason the findings in this area are mixed

Table 2.3 - Cognitive Functioning in Violent Individuals with Schizophrenia (VSZ) Compared to Non-Violent Individuals with Schizophrenia (NVSZ)

Study	IQ	Executive Function	Memory	Visuospatial	Attention
Barkataki et al., 2005	=	↓	=	NR	=
Barkataki et al., 2008	=	=	NR	NR	NR
Chung et al., 2010	=	=	=	=	NR
Fullam & Dolan, 2008 ^{\$}	=	=	=	NR	NR
Hanlon et al., 2012	=	↓	↓	NR	NR
Kashiwagi et al., 2015	NR	↑	=	NR	=
Krakowski et al., 1989 ^{\$}	=	NR	NR	↓	NR
Kumari et al., 2006	=	NR	↓	NR	NR
Lafayette et al., 2003	=	=	NR	NR	=
Majorek et al., 2005	=	↓	NR	NR	NR
Nestor et al., 1995 ^{\$}	↑	=	=	NR	NR
Rasmussen et al., 1995	NR	↑	NR	=	NR
Roy, 1989 ^{\$}	=	NR	NR	NR	NR
Silver et al., 2005	=	=	=	=	=
Viljoen et al., 2004	NR	NR	=	=	=
Yang et al., 2010	=	NR	NR	NR	NR

Key: ↑ violent group significantly better than non-violent group; ↓ violent group significantly worse than non-violent group; = violent and non-violent groups not significantly different; NR: domain not reported; \$: compares high vs. low violence in schizophrenia sample

ASPD vs. Healthy Offenders

Three studies provide data on cognitive abilities in offenders with ASPD compared with offenders without ASPD (Domes, Mense, Vohs, & Habermeyer, 2013; Riser & Kosson, 2013; Yang et al., 2010). Two studies indicate that these groups do not differ in terms of IQ (Domes et al., 2013; Yang et al., 2010). Riser et al. (2013) found cognitive deficits in tasks placing demands on left hemisphere attention, motor or perceptual demands in individuals with ASPD plus psychopathy, but not in individuals with ASPD alone or non-ASPD offenders.

Comorbid VSZ and ASPD

Only three studies (Hill et al., 1997; Moran & Hodgins, 2004; Tang et al., 2016) provide specific data on comorbid VSZ and ASPD groups. Hill et al. (1997) report the visual reproduction task on the Wechsler Memory Scales in a sample of men detained in high secure hospital. When comparing the groups of violent schizophrenia, other Axis I conditions, and Axis II only, there were no significant differences in performance. However, when those with mental illness were stratified into those with and without ASPD, it was shown that those with comorbid ASPD were significantly more likely to make elaborative errors in the recall of images (i.e. elaborate on the designs; add extra information) than those who did not have ASPD. In contrast, those without ASPD were more likely to make reduction errors (i.e. simplifying or removing information from designs). The authors also note in their discussion that those with an additional ASPD diagnosis have a more impulsive, dyscontrolled response style on perceptual mazes, pointing potentially towards a specific visuospatial deficit in this group. Moran and Hodgins (2004) report that violent men with both schizophrenia and ASPD tend to have poorer verbal IQ compared to those with schizophrenia alone (a finding which approached statistical significance), although there were no discernible differences in performance or full scale IQ.

Tang and colleagues (2016) found that, relative to a non-antisocial schizophrenia group, a group of individuals with schizophrenia and comorbid ASPD performed more poorly on the WCST (more perseverative errors). This contrasts another study (Lapierre et al., 1995) which provides less specific data, although trends can be inferred. In a sample of schizophrenia outpatients, 42% of whom also had ASPD, the general trend for the group was that the number of previous violent incidents was *positively* correlated with number of categories completed on the WCST (cognitive flexibility) and total score on the Controlled Oral Word Association Test (information production), both sensitive to executive function. This could tentatively suggest that violent individuals with both ASPD and schizophrenia are cognitively less impaired than those with schizophrenia alone. However, the contrasting results from those specifically examining a comorbid sample (i.e. Tang et al., 2016, Moran & Hodgins, 2004) call this into question.

Part Two: Emotion Recognition, Theory of Mind and Experience of Emotion in Violent Individuals

VSZ vs NVSZ and Healthy Controls

Facial Affect Recognition: Five studies examined the recognition of facial emotion in VSZ (Antonius et al., 2013; Demirbuga et al., 2013; Frommann, Stroth, Brinkmeyer, Wolwer, & Luckhaus, 2013; Silver, Goodman, Knoll, Isakov, & Modai, 2005; Wolfkuhler et al., 2012). Two studies that compared VSZ groups with healthy controls (Silver et al., 2005; Wolfkuhler et al., 2012) support an emotion recognition deficit, as is seen generally in the schizophrenia literature (Trémeau, 2006); the possible exception is fear and disgust recognition, which was similar in VSZ and healthy controls in one of these studies (Wolfkuhler et al., 2012).

The evidence from studies which directly compared VSZ and NVSZ, however, is more mixed. Demirbuga et al. (2013) reported no significant difference in the accuracy of facial emotion identification when comparing VSZ and NVSZ groups. However, Silver et al. (2005) found that their VSZ group was poorer at discriminating between the intensity of emotion shown by two faces. Wolfkuhler et al. (2012) reported that the VSZ group showed better ability to recognise disgust than the NVSZ group. In contrast, Frommann et al. (2013) found worse performance in recognising fearful and neutral faces in a VSZ compared to NVSZ group. Examining the perception of facial dominance, Antonius et al. (2013) showed participants neutral faces which were altered using computer software to show slight emotional expressions, and asked them to rate the perceived dominance. Those with low self-reported aggression rated neutral faces showing micro-expressions of fear as less dominant; however, this effect was not observed in the high aggression group. This suggests that subtle facial cues are not being identified by the high aggression group, which may impede their ability to accurately and appropriately respond in complex social situations. See Table 2.4 for summary of facial affect recognition studies.

Theory of Mind: Five studies (Abu-Akel, 2004; Arborelius, Fors, Svensson, Sygel, & Kristiansson, 2013; Majorek et al., 2009; Murphy, 1998, 2006) examined the attribution of emotional states to others, and specifically theory of mind (ToM) in VSZ, with three studies comparing to different clinical groups. Arborelius et al. (2013) found that VSZ and a violent autism spectrum disorder group were less able to attribute appropriate emotions to an individual they viewed in a video clip, and less able to use contextual information to inform these judgements compared to healthy controls. These results are mirrored in two studies carried out in high secure forensic hospital (Murphy, 1998, 2006) which demonstrate that VSZ individuals have poorer second order ToM (understanding that another may hold a belief different to one's own belief; Murphy, 1998), are less able to interpret emotional information from the eyes and have poorer

performance on ToM tasks (Murphy, 2006) compared to a PD group; however, they did not differ from a violent autism spectrum disorder group.

In contrast, Abu-Akel (2004) showed that VSZ individuals were better at second order ToM tasks and the cognitive component of faux-pas tasks, compared with NVSZ individuals, although they were poorer at recognising faux-pas and empathic inference tasks. In addition, it was shown that ability to infer a cognitive state in others significantly predicted the likelihood of a history of violence, as did poor ability to recognise faux-pas. However, others have noted that this study was confounded by a lack of control for cognitive variables and psychopathology, and so conducted an investigation incorporating these factors (Majorek et al., 2009). Comparing forensic and non-forensic individuals with schizophrenia, they found that ToM ability did not differ significantly, although in the forensic group the impairment was driven by the cognitive and excitement (i.e. tension, hostility, poor impulse control) factors of the Positive and Negative Syndrome Scale (Kay, Fiszbein, & Opler, 1987), whereas in the non-forensic group it was driven by the cognitive and negative component (flattened affect, etc.). This suggests that similar behavioural outcomes may be driven by diverse underlying deficits, requiring different intervention targets in these groups.

Experiential Emotion: Two studies explored the experience of emotion in VSZ. One study asked participants to complete a go/no-go type task, in which they were asked to respond to emotionally valenced images as quickly as possible unless it was a repeat of the previous picture (De Sanctis et al., 2013). Using event-related potentials, the authors demonstrated early sensory processing deficits in individuals with schizophrenia (both violent and non-violent) in response to negatively valenced images compared to healthy controls and this effect was particularly marked in the VSZ group. The authors suggest that their findings may indicate problems with correctly judging the emotional context of a situation due to poor early processing, possibly resulting in inappropriate responses that could include violence. They also suggest that the lack of modulation when comparing neutral and negative images may potentially reflect a tendency to attribute negative emotion to neutral situations.

Another study examined the experience of threat (Kumari, Das, et al., 2009). Participants were told that they were at risk of receiving an electric shock during certain periods of the task, whilst were safe at others. In reality, no shocks were administered. After completing the task, participants were asked to rate on a visual analogue scale from 'safe' to 'fearful' how they had felt during both conditions; although non-significantly different, the results showed that VSZ patients had the highest levels of fear during both conditions compared to NVSZ and controls. In addition, VSZ believed it more likely that the shock was going to be administered in the shock condition than healthy controls at a trend level. The results support an enhanced experience of

anticipatory fear in the VSZ compared to healthy controls and NVSZ, which may mediate violence via inappropriate attribution of threat to non-threatening situations.

ASPD vs. Healthy Controls

Facial Affect Recognition: Five studies examined facial emotion recognition in violent individuals with ASPD (Bagcioglu et al., 2014; Dolan & Fullam, 2004, 2006; Schonenberg & Jusyte, 2014; Schonenberg, Louis, Mayer, & Jusyte, 2013). Bagcioglu et al. (2014) demonstrated that individuals with ASPD alone had impaired detection of disgusted faces and neutral faces compared to healthy controls, despite spending a longer time viewing them. Dolan and Fullam (2004) examined the impact of psychopathy; when dividing ASPD individuals into high and low psychopathy, those with low, but not high, psychopathy were poorer at recognising basic and complex emotions shown on a full face compared to healthy controls. When looking specifically at reading emotion from the eyes, low psychopathy scorers were more impaired at recognising basic emotion than healthy controls. In another study examining this effect (Dolan & Fullam, 2006), individuals with dissocial PD were worse than controls at recognising sad, happy and surprised faces, in some cases even at 100% intensity. High psychopathy scorers were worse at recognising sad faces than low psychopathy scorers at a trend level, and total psychopathy score negatively correlated with the correct identification of sad faces. These studies tend to contradict one another's findings. In the former, the low psychopathy group are relatively impaired, whereas in the latter study impairment is greater in those with high psychopathy scores.

More contradictory evidence has emerged from studies examining morphed or merged faces. Schonenberg and Jusyte (2014) asked ASPD prisoners to choose which emotion a face was showing when the stimulus was created from morphing two emotions together, for example a happy and fearful face. These were combined at different intensities, so for example a face could be showing a 70% fearful and 30% happy expression. ASPD participants were significantly more likely to indicate that the face was angry than controls, even at maximal ambiguity (i.e. 50% angry combined with 50% fearful or happy), suggesting a facial hostile attribution bias. In contrast, an earlier study by the same group (Schonenberg et al. 2013) asked participants to view faces which were animated to change from a neutral expression to an emotional expression at 2% intensity increments, and to press a button as soon as they could recognise the emotion being portrayed. The ASPD group took significantly longer to recognise emergent angry faces than the controls, which calls into question a hostile attribution bias in this group. See Table 2.4.

Theory of Mind: Two studies have investigated ToM in violent ASPD samples. Dolan and Fullam (2004) showed that there were no significant differences between high and low psychopathy ASPD groups or controls, on first order (understanding that another has the capacity to hold a belief), second order (understanding that another may hold a belief different to one's own belief) of faux-pas ToM tasks. However, both ASPD groups performed poorly, relative to controls on

the attribution of a mental state and empathic understanding in the faux-pas scenario. Shamay-Tsoory et al. (2010) demonstrated that individuals with ASPD were impaired at the second order, affective ToM (i.e. using information about one person's mental state to infer a mental state in another).

Experiential Emotion: Seven studies examined the experience/salience of emotion in violent ASPD samples, of which four used lexical tasks. Domes et al. (2013) administered an emotional Stroop task comprised of violent, negative and neutral words. Prisoners with ASPD had a significant attentional bias (i.e. longer reaction times) towards violent and negative words compared to neutral words in a congruent condition, when compared to healthy controls. However, they did not significantly differ from non-ASPD prisoners. In another lexical task, prisoners with ASPD (with/without psychopathy) and non-ASPD prisoners were asked to categorise strings of letters as words or non-words (Kosson et al., 2006). Offenders with ASPD and psychopathy were significantly slower at classifying affective words than neutral words (i.e. less affective facilitation) when compared to offenders with ASPD alone, or offenders with no ASPD (who did not differ from one another). In addition, the degree of affective facilitation in the ASPD plus psychopathy group was significantly negatively correlated with the number of charges for non-violent offences, and the correlation between affective facilitation and criminal versatility in this group approached significance, adding weight to the ecological validity of the findings.

Another study utilised an anger induction interview followed by two implicit association tests: one assessing "self"- "anger" associations and one assessing "aggressor" (i.e. an individual the person had had an argument with)- "swearword" associations (Lobbestael, Arntz, Cima, & Chakhssi, 2009). Following anger induction, ASPD individuals reported similar levels of anger to healthy controls and other PD participants, but demonstrated decreased heart-rate and increased self-anger associations compared to other groups. These observations were independent of psychopathy score. The authors posit that this demonstrates an anger response style characterised by physiological under-arousal yet cognitive over-arousal, perhaps reflecting an ability to engage in controlled, predatory type violence.

Verona, Sprague, and Sadeh (2012) examined the interaction between cognition and emotion in ASPD alone, ASPD plus psychopathy, and offenders with neither disorder. Participants were asked to complete a linguistic go/no-go task using neutral and negative words as stimuli. Although the reaction times and number of errors did not differ between groups, an effect was found from the event related potential data. The ASPD alone group showed enhanced P3 modulation to negative words regardless of whether the word was in the go or no-go condition. This suggests that individuals with ASPD alone fail to ignore emotional material when engaging in inhibitory control, which may give insight into their violent behaviours during episodes of high emotionality.

By comparison, control participants were able to prioritise inhibitory control over emotion processing, and the psychopathic group showed no effect of emotion category. However, the lack of a behavioural effect somewhat weakens this finding. The results regarding psychopathy are consistent with another study examining cognition/emotion interaction (Muller et al., 2008), in which a negative emotion induction paradigm did not affect performance on a cognitive task in those with ASPD who met criteria for psychopathy, but adversely affected performance in healthy controls.

One study examined emotion processing using an affective startle paradigm in ASPD (Loomans, Tulen, & van Marle, 2015), comparing ASPD plus psychopathy, ASPD alone, forensic hospital employees and community controls. This paradigm assesses affective states in response to positive, neutral and negatively valenced images via measurement of the startle response. It was shown that the typical enhanced startle response to aversive images was present in the community controls and ASPD alone group, but not in the ASPD plus psychopathy or forensic hospital employee group, suggesting that these latter groups did not have a typical fearful response to aversive images. The authors suggest that this indicates it is the affective-interpersonal (factor 1) type traits which mediate this poor emotional processing, and it may be that forensic hospital employees have built up a level of resilience to aversive experiences, or have fearless personality traits which predisposes them to a job in which it is necessary to take on risk. The aforementioned study, examining the experience of anticipatory fear, specifically threat of electric shock (Kumari, Das, et al., 2009), showed that violent ASPD patients taking part reported the lowest levels of fear under the threat of shock compared to healthy controls, non-violent men with schizophrenia and violent men with schizophrenia (from whom they differed significantly). They also reported the lowest anticipation of shock. Thus the results from both these studies support an experiential fear deficit, although it is possible that this may be mediated by psychopathy as opposed to ASPD alone.

Comorbid VSZ and ASPD

Facial Affect Recognition: Only one study specifically addressed emotion recognition in a comorbid schizophrenia and ASPD group (Tang et al., 2016). They demonstrated that the comorbid group showed poorer performance, relative to healthy controls, at recognising sad, angry, fearful, surprised and disgusted faces, and were poorer at recognising anger, surprise and disgust compared to individuals with schizophrenia alone. One further study provided data examining the effect of antisocial personality traits on affect recognition in VSZ (Fullam & Dolan, 2006). The results showed that VSZ with high psychopathy scores were impaired in comparison to the low or medium scorers at recognising sad faces, an effect which was mediated mainly by factor two traits (which is more akin to ASPD). Taken together, these studies suggest that antisocial personality traits may further impair facial affect recognition in VSZ.

Theory of Mind and Experiential Emotion: There were no studies identified which examined ToM or the experience of emotion in a comorbid group.

Table 2.4 - Summary of Facial Affect Recognition Studies Using Basic Emotion Recognition Paradigm in VSZ And ASPD

Study	Group	Control Group	Recognition of:							Other Findings
			Happy	Sad	Angry	Fearful	Surprise	Disgust	Neutral	
Demirbuga et al., 2013	VSZ	NVSZ	=	=	=	=	=	=	=	-
Frommann et al., 2013	VSZ	NVSZ	=	=	=	↓	=	=	↓	-
Silver et al., 2005	VSZ	HCS	↓	↓	NR	NR	NR	NR	↓	VSZ poorer at discriminating intensity of happy and sad faces
		NVSZ	↑	↑	NR	NR	NR	NR	↑	
Wolfkühler et al., 2012	VSZ	HCS	↓	↓	↓	=	↓	=	NR	Contempt also examined and found to be poorer in both clinical groups compared to controls, although not to differ between clinical groups.
		NVSZ	=	=	=	=	=	↑	NR	
Bagcioglu et al., 2014	ASPD	HCS	=	=	=	=	=	↓	↓	-
Dolan & Fullam, 2006	ASPD	HCS	↓	↓	=	=	↓	=	NR	Trend for those meeting cut-off for psychopathy to have poorer overall recognition; were significantly poorer at recognising sad.
Fullam & Dolan, 2006	VSZ High Psychopathy	Medium Psychopathy	=	=	=	=	=	=	NR	
		Low Psychopathy	=	↓	=	=	=	=	NR	
Tang et al., 2016	Comorbid	HCS	=	↓	↓	↓	↓	↓	NR	
		VSZ	=	=	↓	=	↓	↓	NR	

Key: ↑; VSZ/ASPD group are significantly better than stated control group, ↓; VSZ/ASPD group are significantly worse than stated control group, =; VSZ/ASPD group and stated control groups are not significantly different, NR; emotion not reported; ASPD – Antisocial Personality Disorder; HCS – Healthy Controls; NVSZ – Non-Violent Schizophrenia; VSZ – Violent Schizophrenia

Discussion

Neuropsychological Profiles

Similarities are evident in the cognitive profiles of violent individuals with schizophrenia (VSZ) and ASPD, although the degree of impairment appears to differ. The results of the meta-analyses indicate that both groups perform poorly across all investigated domains compared to healthy controls, although the effect sizes were consistently larger in the VSZ group, indicating more severe cognitive problems in this group. This is largely consistent with the results of the few studies which directly compare VSZ and PD, which show either equivalent or worse performance in the VSZ group relative to PD.

Poor performance across domains may have a variety of explanations. When considering general intelligence (IQ), a number of the tests included in the meta-analysis were reading based paradigms (see Table 2.1) which are known to be sensitive to the level of educational attainment (Crawford, Stewart, Garthwaite, Parker, & Besson, 1988). Educational attainment is likely to be lower in both clinical groups than healthy comparison groups; conduct disorder in childhood (a necessary precursor for ASPD in DSM-IV) is associated with leaving school before 18 with no qualifications (Fergusson & Horwood, 1998). It has also been demonstrated that individuals with comorbid ASPD and schizophrenia have poorer educational attainment compared to those with schizophrenia alone (Joyal et al., 2004; Moran & Hodgins, 2004; Steinert et al., 1998). Thus, these results may be reflective of common developmental experiences as opposed to being diagnosis-specific, indeed, both studies comparing offenders with and without ASPD found no difference in IQ (Domes et al., 2013; Yang et al., 2010). In addition, the results are complicated by the inclusion of tests purporting to assess both 'current' and 'premorbid' IQ, and future research should assess more specifically whether these constructs differ amongst violent groups.

Both groups showed poorer performance on memory tasks compared to controls. Memory deficits were observed to be specifically present amongst 'antisocial' individuals with schizophrenia, relative to 'non-antisocial' schizophrenia, in a previous meta-analysis comparing these individuals, and were suggested to reflect a temporo-limbic contribution to violent behaviour, as opposed to frontal circuits (Schug & Raine, 2009). This is consistent with the results of the current analysis where both groups have exhibited violent behaviour, and thus problems with memory may represent a transdiagnostic marker associated with violence. The hippocampus (a key structure in memory function) has been implicated in violent and antisocial behaviour (Dolan, 2010; Soderstrom et al., 2002), and is also involved in mediating prepulse inhibition, a measure of sensorimotor gating and automatic inhibition, deficits of which have been linked to violence severity (Kumari, Das, Hodgins, et al., 2005). Thus problems with memory may be reflective of underlying temporo-limbic anomalies which also overlap with violence, and this may be more

relevant to violence amongst VSZ groups than ASPD groups, who appear to have a less pronounced deficit.

Both groups had significant deficits in executive function compared to healthy controls, and the effect size confidence intervals marginally overlapped between the groups, suggesting that they may not differ from each other. This assertion is somewhat supported by a majority of the studies directly comparing PD and VSZ, which found equivalent performance in executive function (see Table 2.2). However, it is reasonable to conclude that the literature as it stands cannot provide a consensus as to whether VSZ and ASPD differ on their executive functioning, although it is clear that both diagnoses confer a risk of poorer performance compared to healthy groups. There also appears to be no difference between the two groups in contribution of impulsivity to the observed executive function deficit, suggesting that both task types are difficult for these groups who have exhibited violent behaviour, and impulsivity may be relevant to violence in both diagnoses (Hoptman, 2015; Schiffer, Pawliczek, Müller, et al., 2014; Volavka & Citrome, 2008).

However, this finding may be complicated by significant heterogeneity observed amongst executive function effect sizes in the VSZ group. This could be hypothesised to be due to the unspecific definition of 'executive function', which is acknowledged in the literature to be an 'umbrella term' encapsulating many cognitive functions such as planning, working memory, inhibition, mental flexibility and initiation/monitoring of actions (Chan, Shum, Touloupoulou, & Chen, 2008). However this argument is weakened as an explanation for the current finding given the lack of significant heterogeneity in the ASPD group. Further, there was a greater diversity of executive function tests included in the meta-analysis from the ASPD group compared to VSZ (15 vs. 13, respectively), which arguably would have produced more, as opposed to less, heterogeneity if the explanation was due to a poor construct definition. Another explanation is that VSZ is often heterogeneous in presentation with diverse aetiology (Bo et al., 2011; Hodgins, 2008; Volavka & Citrome, 2008), and it is likely that these differing subgroups have distinct characteristics and do not constitute a homogenous group. In order to more accurately understand these subgroups, future studies should adequately assess and report on comorbid Axis II pathology and history of substance misuse, as well as consider other environmental factors shown to be associated with violence (Elbogen & Johnson, 2009). This explanation is strengthened when looking at the number of studies which did not control for personality disorders amongst their psychosis groups (only eleven of the studies did so in the current review; four of which were reports of the same sample), whereas almost every study examining ASPD excluded Axis I diagnoses, making this a much more accurately characterised group. Thorough understanding of the neuropsychological features of violence in psychosis is limited due to problems such as this.

What the current evidence base is lacking are data focussing on comorbid presentations of schizophrenia and ASPD. This is a common presentation in clinical practice (approximately 45%

of those with primary mental illness meet criteria for ASPD in high security; Blackburn et al., 2003), and is a risk factor for violence (OR = 2.1; Witt et al., 2013). The current review highlights cognitive problems amongst both diagnostic groups although the deficit appears larger amongst those with psychosis, so it is currently unclear how having both diagnoses would affect cognition. It remains ambiguous as to whether there is a 'double dose' of problems, or whether there are specific characteristics relevant to this group.

The limited data that are available at present suggest that there are specific alterations when compared to either disorder alone, for example more elaboration errors within the design recall subtest of the Wechsler Memory Scales (Hill et al., 1994), and poorer verbal intelligence (Moran & Hodgins, 2004). Further, one study examining a high proportion of individuals with this comorbidity showed that executive function ability was positively correlated with the number of previous violent incidents (Lapierre et al., 1995), perhaps indicating more preserved functioning in a comorbid group, although another study with a more accurately characterised group contrasted this finding and found poorer performance on the WCST in a comorbid sample compared to those with schizophrenia alone (Tang et al., 2016). The notion of a distinct group is supported by fMRI evidence showing homicidal men with diagnoses of schizophrenia, ASPD and substance use disorder have less activity in the inferior and orbital frontal regions whilst completing a Go/No-Go task compared to those with VSZ alone and healthy controls (Joyal et al., 2007). The authors suggest that men with a diagnosis of schizophrenia and additional ASPD are impaired in lower order cognitive functions such as attention and impulsivity, whilst VSZ alone men are impaired in higher order executive functions such as set-shifting. All studies examining a comorbid group point to clear differences hinting at a distinct subtype which requires further investigation.

Emotion Processing Profiles

Facial Affect Recognition

Problems in identifying facial displays of emotion appear common to both groups, at least in comparison to healthy controls. Amongst the VSZ group, there appears to be clear evidence of a deficit across the majority of emotions examined compared to healthy controls (Silver et al., 2005; Wolfkuhler et al., 2012). The picture comparing VSZ to NVSZ is less clear; some studies report superior recognition amongst the violent group of disgust (Wolfkuhler et al., 2012) and happiness, sadness and neutral (Silver et al., 2005), whilst some report poorer recognition of fearful and neutral faces (Frommann et al., 2013), and some report no discernible differences between groups (Demirbuga et al., 2013). However, the VSZ group appeared to be more impaired, relative to NVSZ, on tasks assessing more complex aspects of affect recognition, for example in discerning the intensity of displayed emotion (Silver et al., 2005) or attributing dominance to faces (Antonius

et al., 2013). These skills are likely key to translating emotion into appropriate behavioural actions, and thus may represent an area for potential therapeutic gains.

Amongst studies focussing on ASPD, areas of weakness compared to healthy controls have also been noted, although a consensus on the specificity of these has yet to be reached; one study suggested deficits in disgust and neutral (Bagcioglu et al., 2014), whereas another highlighted happiness, sadness and surprise as problematic (Dolan & Fullam, 2006). A meta-analysis of studies examining facial affect perception in psychopathy identified the recognition of a number of emotions to be impaired amongst those scoring highly on psychopathy, including happiness, sadness, fear and surprise (Dawel, O'Kearney, McKone, & Palermo, 2012), and thus it may be that antisocial traits confer a pervasive deficit across many emotions. The studies reviewed here provide contradictory evidence regarding psychopathy in ASPD; one study found high psychopathy scorers, relative to low scorers, performed relatively poorly on facial affect recognition tasks (Dolan & Fullam, 2006), whereas another found that low scorers were relatively impaired (Dolan & Fullam, 2004).

It may be that increasing levels of psychopathic traits impede emotion processing up to a point, but that very high levels of psychopathy are associated with no deficit. This hypothesis is supported by a study which found that although the affective component of empathy was lower in violent offenders with both high and low psychopathy compared to controls, only high psychopathy scorers gave cognitive empathy responses that did not differ from healthy controls (Pfabigan et al., 2015). Another recent investigation demonstrated that metacognitive ability (including attributing mental state to others) was negatively associated with psychopathy checklist (PCL-R) score in forensic patients with schizophrenia, until a 'break point' score of 24 on the PCL-R, when the relationship reversed and metacognitive score was correlated positively with psychopathy level (Abu-Akel, Heinke, Gillespie, Mitchell, & Bo, 2015). The authors note that the only domain in which this was not the case was the 'mastery' domain, which relates to using information about self or others to plan and implement action. Thus, although the ability to understand and/or recognise emotion may be present, using this information to inform behaviour may be the crucial missing link, and could represent an area for intervention. However, more studies specifically focussing on ASPD/DPD offenders are needed to assess the translational value of such findings, as to date most have focussed on the role of psychopathic traits which may not always be quantified in clinical practice.

Both studies examining the role of antisocial personality traits amongst individuals with schizophrenia (one assessed via psychopathy checklist score, one assessed via a formal ASPD diagnosis) found such traits to contribute to poorer facial affect recognition, relative to non-antisocial/less antisocial schizophrenia groups (Fullam & Dolan, 2006; Tang et al., 2016). As with the neuropsychological findings, this suggests that the comorbid presentation of schizophrenia

and ASPD has distinct characteristics, although comparison of this group with a purely ASPD group is still required before firm conclusions can be drawn. Poorer performance is consistent with a 'double dose' explanation of the deficit, although this should be more thoroughly explored in future research as the available data is limited.

Theory of Mind

There is evidence to indicate that VSZ individuals show ToM deficits compared to those with PD or healthy controls, but do not differ from autism spectrum disorder samples (Arborelius et al., 2013; Murphy, 1998, 2006). Compared to NVSZ, there is evidence to suggest some areas of superiority (2nd order ToM, faux-pas cognitive inference) and other areas of deficit in VSZ (Abu-Akel, 2004), although this has not been robustly demonstrated and it may be that heterogeneous symptomatology profiles are driving these differences (Majorek et al., 2009). ToM deficits also appear evident amongst ASPD groups, although not all investigated areas were impaired (Dolan & Fullam, 2004). One area which appeared to be limited across both groups was the ability to demonstrate empathic inference in faux pas scenarios (Abu-Akel, 2004; Dolan & Fullam, 2004), although having no difficulty in recognising it. This suggests that although there does not seem to be a gross deficit in cognitively understanding a situation, it is the appropriate behavioural/emotional response that is lacking across both groups. However, this is based on a very small number of studies and further research is required in this area.

Experiential Emotion

In terms of the experience of emotion, there has been more focussed research in ASPD compared to VSZ. The few studies in VSZ suggest an enhanced perception of fear and an appraisal of neutral stimuli to be negative. This is consistent with threat control override theories of violence in psychosis (Link, Stueve, & Phelan, 1998), and particularly with the enhanced experience of threat which has shown to be more related to violence than control-override symptoms and also linked to the severity of violent acts (Stompe, Ortwein-Swoboda, & Schanda, 2004).

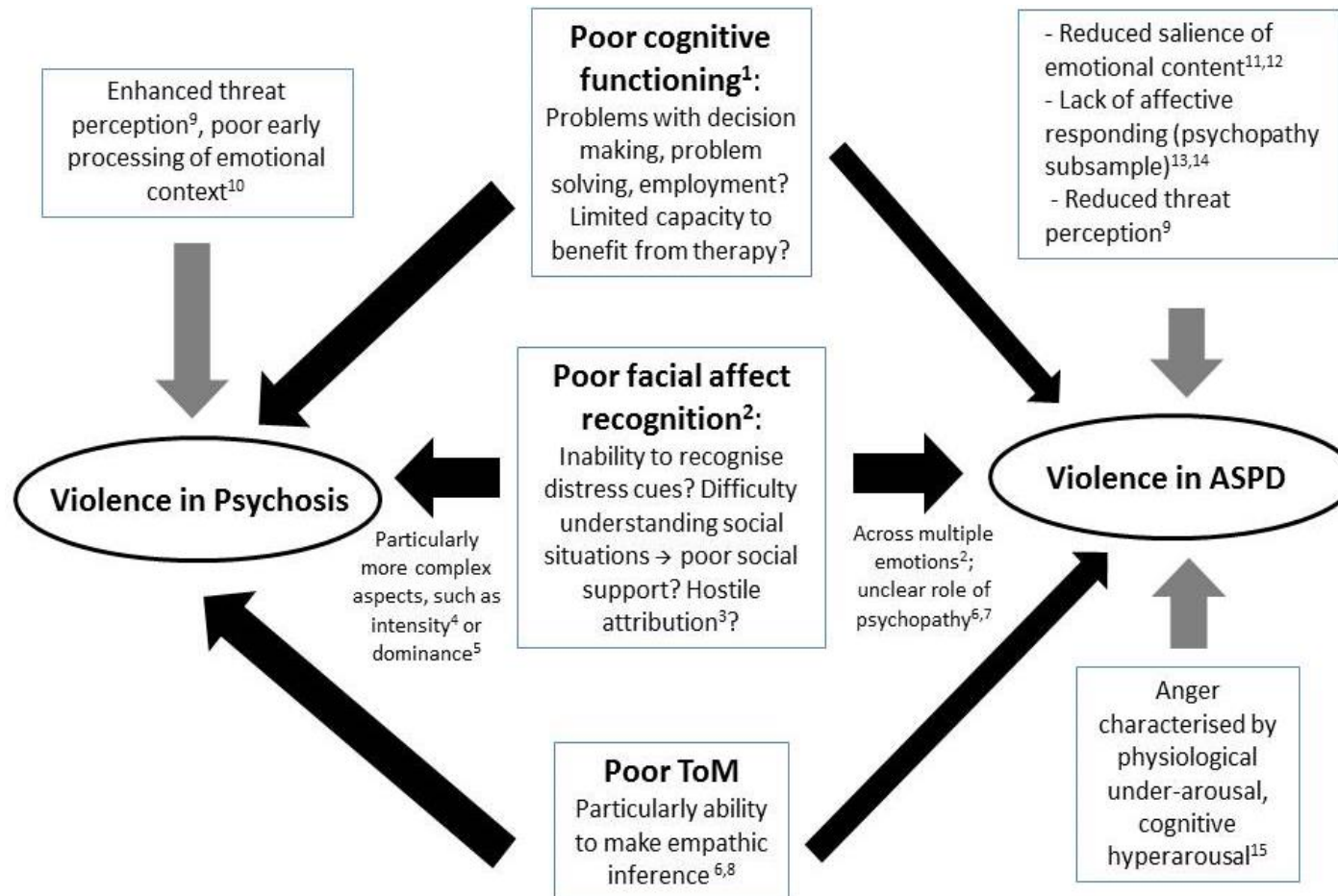
Most of the experiential emotion deficits observed in ASPD appear to be mediated by psychopathy (e.g. Kosson et al., 2006; Muller et al., 2008), and may be specifically mediated via Factor 1 (arrogant/deceitful interpersonal style) (Loomans et al., 2015), which is the factor most divergent from the ASPD DSM-IV diagnostic criteria (see Chapter One). When examining the correlates of ASPD specifically, there is some evidence at a neural level that those with ASPD and low levels of psychopathic traits cannot prioritise cognition over the processing of emotional information (Verona, Sprague & Sadeh, 2012), perhaps indicating why these individuals find it difficult to inhibit violence in emotionally charged situations. In addition, there is evidence that anger in ASPD is characterised by low autonomic arousal with high levels of anger cognitions, perhaps allowing a more controlled, predatory style of aggression (Lobbestael et al., 2009). Low

experience of fear/threat was also observed amongst ASPD participants (Kumari, Das, et al., 2009), however in another paradigm examining a similar construct this observation was confined to the group with comorbid psychopathy (Loomans et al., 2015). Thus, unsurprisingly the evidence for a lack of emotional experience appears stronger amongst those with high psychopathic traits. This highlights the importance of quantifying such traits when formulating risk and causes of violence amongst such individuals, as lack of affective experience may represent a relevant factor, but may not amongst those with ASPD alone. This group may have different characteristics (i.e. cognitive hyperarousal) which require specific consideration, and clarification of ASPD specific traits should be addressed in future research.

Overview

Both diagnoses seem to be characterised by poor cognition. This could enhance the risk of violent behaviour via poorer decision making or problem solving abilities (McMurran, Egan, Richardson, & Ahmadi, 1999), for example difficulty generating prosocial alternatives for emergent problems. Additionally poor cognition could confer a higher risk for related problems such as unemployment (Dickerson et al., 2007) which may foster or perpetuate offending/reoffending (Appleby, Roscoe, & Shaw, 2015; Uggen, 2000). In addition, poor cognitive skills may mean that individuals are less able to participate in, or benefit from, psychological therapy (Granholm et al., 2008; Gupta, Holshausen, Mausbach, Patterson, & Bowie, 2012) which may be offered in order to reduce violent behaviours/manage symptoms. Facial affect recognition is problematic for both groups, perhaps resulting in poor understanding of social situations or the intentions of others. It may also impair the detection of distress cues in others, thereby removing the inhibitory behaviours these typically evoke against violence (Blair et al., 1997). Such explanations are consistent with the experiential emotion literature within the ASPD group which suggests that, especially amongst those with high levels of psychopathic traits, there is a lack of affective experience, diminished salience of emotional content and reduced threat perception. These studies tend to suggest that violence is facilitated amongst this diagnostic group by an ability to commit violent acts without the typically associated emotions which may serve as inhibitors. In contrast, in psychosis, violence may emerge from more of a defensive position (Levi, Nussbaum, & Rich, 2010) for example in response to delusions (Joyal et al., 2004; Steinert et al., 1998) consistent with enhanced threat perception and poor affective judgement/early emotional processing (such as the negative appraisal of neutral situations). These cognitive and emotion processing deficits may combine and contribute additively towards the emergence of violence, or indeed may represent one latent construct as evidence has suggested social and neurocognition may be interrelated (Ventura, Wood, Jimenez, & Helleman, 2013). Future research should identify the relevance and appropriateness of such characteristics as therapeutic targets. See Figure 2.5 for schematic overview of findings.

Figure 2.5 - Overview of Review Findings with Potential Links to Violent Behaviour



1 – Summarised in meta-analysis; 2 – Summarised in Table 4; 3 – Schonenberg & Juyste (2014); 4 – Silver et al., (2005); 5- Antonius et al., (2013) ; 6 – Dolan & Fullam (2004); 7- Dolan & Fullam (2006); 8 – Abu-Akel et al., (2004); 9 – Kumari, Das et al. (2009); 10 – De Sanctis et al., (2013); 11-Domes et al. (2013); 12- Kosson, Lorenz & Newman, (2006); 13- Verona, Sprague & Sadeh, (2013); 14- Muller et al. (2008); 15 - Lobbetael et al., (2009)

Strengths and Limitations

The meta-analyses report summary scores created by averaging a number of outcome variables for the same measure to create a score for that measure (i.e. WCST; ToL), and then averaging across tests to create a domain score for each included study (i.e. executive function score, memory score). Although this inevitably means some level of detail is lost, it was deemed the most appropriate approach to minimise researcher bias in selecting only one outcome parameter, or only one test. In addition, it is unlikely that the different tests reported across studies are measuring the exact same underlying construct, and thus although some similarity can be assumed, it is difficult to pin-point precise cognitive characteristics. The quantitative method, however, gives an indication of the degree and nature of the cognitive deficits and provides a robust overview of the current findings in the literature. A further limitation could arise from the definition of violence across samples; although efforts were made to ensure the sample was characterised by violent behaviours, studies operationalise this differently and sometimes assumptions had to be made i.e. that being a prisoner or detained in forensic psychiatric hospital implied a history of violent behaviour. As far as possible, future research should aim to provide detailed descriptions of the level and nature of violence present in the sample, and avoid broad descriptions such as ‘antisocial’, which could have numerous definitions

Chapter Summary

VSZ and ASPD are both characterised by deficits in IQ, memory and executive function, with larger deficits observed in VSZ. Both disorders are characterised by impaired affect recognition and ToM, and psychopathy appears an important consideration in the experience of emotion. The characteristics of those with both VSZ and ASPD remain largely unknown and should be investigated further, as initial studies suggest a potentially distinct subgroup.

The next chapter will assess the relevance of the characteristics discussed here (neuropsychological and emotion processing) and the characteristics discussed in Chapter One (demographic, offending, clinical) to outcome in forensic mental health services.

3 Chapter Three: Neuropsychological, Emotion Processing and Demographic Predictors of Outcome in Forensic Mental Health Services.

Chapter Aims and Overview

The previous chapter established that violent individuals with psychosis and/or ASPD have difficulties with both neurocognitive and social cognitive functioning. In addition, Chapter One highlighted that individuals with comorbid schizophrenia and ASPD differ from either disorder alone on a number of key static/demographic variables. The aim of this chapter is to assess whether such characteristics are relevant to clinical outcome in forensic mental health services, and thus establish whether further study of such characteristics is clinically relevant and applicable. This chapter presents a modified version of a published systematic review which examined objective predictors of outcome in forensic mental health services, including demographic, neuropsychological and biological predictors (Sedgwick, O., Young, S., Das, M. and Kumari, V. (2016) Objective Predictors of Outcome in Forensic Mental Health Services - A Systematic Review. *CNS Spectrums*. doi: 10.1017/S1092852915000723. See **Error! Reference source not found.** for copy of this manuscript). This chapter will focus only on the results from this review which are relevant to this thesis: firstly the demographic factors associated with outcome in forensic services will be briefly outlined, before focussing on the neuropsychological/neurophysiological predictors which are of particular relevance to the current thesis. In addition, more recently published relevant studies which were not included in the systematic review will be discussed and evaluated.

Introduction

Our understanding of violent behaviour has been informed by models which incorporate neuropsychological and emotion processing traits. For example, it has been proposed that recognising the distress signals (e.g. fear) from an individual inhibits further aggressive behaviour as socialisation during early development results in this experience being aversive (Violence Inhibition Mechanism; Blair et al., 1997). If there are problems in the perception of such emotions, it is proposed that this inhibition is not evoked and violence results. Another example which is suggested as a mechanism by which violence may emerge in mental disorder is impulse control, for example aggression in response to a perceived slight (i.e. in the context of strong emotion such as anger) which has been proposed to be mediated via dysfunction frontotemporal circuitry (Hoptman, 2015).

If such models of violence are to hold ecological validity, relevant neurocognitive and social cognitive measures should be related to treatment efficacy, and thus outcomes amongst mentally disordered offenders. Assessing the relationship between such measures and outcome also highlights whether these are important characteristics on which to conduct further research. Correlates of poor outcome could represent areas of unmet need and thus therapeutic targets.

Development in this area is needed as outcomes in forensic mental health services are varied and often poor. In 2007 around 50% of patients detained under the legal category ‘psychopathic disorder’ in the United Kingdom had a stay in hospital exceeding ten years (Rutherford & Duggan, 2007). Lengthy admissions were also identified in one German study finding that some patients stayed as long as 43 years (T. Ross, Querengasser, Fontao, & Hoffmann, 2012). Further, prospective follow up studies of discharged mentally disordered offenders have shown a relatively high rate of reoffending, with one in eight men being convicted for another grave offence after discharge from medium security services in the UK (Coid, Hickey, Kahtan, Zhang, & Yang, 2007). A recent historical cohort study of over 6000 discharged forensic hospital patients identified high rates of readmission, violent reoffending and mortality (Fazel, Wolf, Fimińska, & Larsson, 2016). This has significant implications in terms of public protection, cost to the taxpayer, and the ethical position of detaining individuals for treatment which may not be efficacious.

This systematic review aimed to identify and evaluate studies which have assessed objective, measurable predictors of outcome in forensic mental health services (i.e. did not rely on self-report or clinical judgement), to gain a perspective on how far these correlates have been used by the scientific and clinical community, and to assess the potential usefulness of such markers in further research and subsequently in clinical practice. The parts which hold relevance to this thesis will be described below; specifically, demographic, neuropsychological/neurophysiological and emotion processing findings will be outlined. Demographic factors have been shown in Chapter One to differ amongst a comorbid group (psychosis and ASPD) compared to violent individuals with psychosis alone, thus the influence of such static characteristics on outcome is of interest. Further, in Chapter Two it was suggested that there are specific neuropsychological/emotion processing characteristics amongst this comorbid group, with some initial studies suggesting a ‘double dose’ of deficit effect (e.g. Tang et al., 2016). Thus how such characteristics relate to outcome whilst hospitalised is also explored.

Method

The general strategy for the systematic review was to assess any study which included a predictor of outcome in forensic mental health services, and then to select those that did not rely on self-report/clinical judgement for review. This was achieved as follows:

OVID-Medline, Embase and PsychInfo (inception-January 2015)³ databases were searched using the following four terms combined with AND:

³ Relevant recent articles (post January 2015) were also included in the chapter of this thesis, although a comprehensive second search was not performed.

1. predict* OR prognos* or marker
2. outcome OR length of stay OR duration of stay OR length of hospitalization OR duration of hospitalization OR reoffen* OR recidiv* OR violen* OR function*
3. mental disorder OR psychiatr* OR mental ill*
4. forensic OR secur* OR incarcerated

A screen of the results for relevance was then conducted on a title/abstract basis. If insufficient information was given in the abstract, the full text was retrieved before making a decision. Studies were assessed for inclusion against the following criteria:

1. All participants were MDOs admitted to inpatient forensic psychiatric services. For the purposes of this review, an MDO is defined as an offender with a diagnosed mental disorder, who is deemed to require treatment in psychiatric services. Individuals residing in prison who have a mental disorder were not included as it is highly likely that individuals who are deemed treatable within prison (as opposed to secure psychiatric hospitals) are qualitatively different. Further, 'specialist' offender groups [adolescents, e.g. Letourneau and Armstrong (2008), learning disability, e.g. Bastert, Schlafke, Pein, Kupke, and Fegert (2012)] were excluded to keep the study samples as homogeneous as possible.
2. Studies which included an objective predictor of outcome (as defined as a factor which does not rely on clinical judgement or self-report, e.g. biological, neuropsychological, demographic factors), with outcome defined as one of the following: length of stay, violent incidents (inpatient or community), reoffending, clinician rated risk/need.
3. Only primary research articles with an abstract were included (e.g. not theses, reviews). The reference lists of relevant reviews were examined to identify any papers not returned by the initial search.
4. Studies were only included if they used a prospective, or pseudo-prospective, design (i.e. looking forward over time) to assess predictive ability. Studies which reported on the ability of static (i.e. demographic) factors to predict outcome were also included; these did not necessarily need to be prospective as static factors by definition are temporally stable.
5. Studies were excluded if they were reviewing the predictive validity of risk assessment tools. This literature is large and robust and has been reviewed elsewhere e.g. (Dolan & Doyle, 2000; G. T. Harris & Rice, 1997; McDermott & Holoyda, 2014). Further, these tools require the assessment of a combination of demographic and clinical factors which may relate to risk collectively, but often individual item predictive validity is not given.

6. Articles referring solely to competency to stand trial were also excluded. This intervention involves treating the underlying disorder and educating the individual about the American legal system so that they are able to stand trial (Zapf & Roesch, 2011) – it is not analogous with the typical treatment MDOs receive (i.e. the focus is to restore competency).

Data Extraction

For each study, predictors associated positively with the outcome variable of interest (e.g. associated with an increased likelihood of violence), predictors with a negative association (e.g. associated with a decreased likelihood of violence) and examined variables with no relationship (e.g. no relationship to violence) were extracted. Studies were examined and any factors identified by the authors as ‘statistically significant’ were extracted. This included significant differences between relevant groups (e.g. between reoffenders and non-reoffenders) and significant positive or negative predictors (e.g. significant correlations, or predictors from a model) of outcome. Variables that were examined by the authors but had no significant effects were included in the ‘no relationship’ category.

Predictor variables were then compiled into a spreadsheet, and studies which reported on the same broad predictors for the outcome of interest were recorded. Categories which were conceptually similar but perhaps not described in the exact same terms (for example ‘severity of offence’ and ‘a violent or homicide offence’) were combined to reduce the number of discrete predictors.

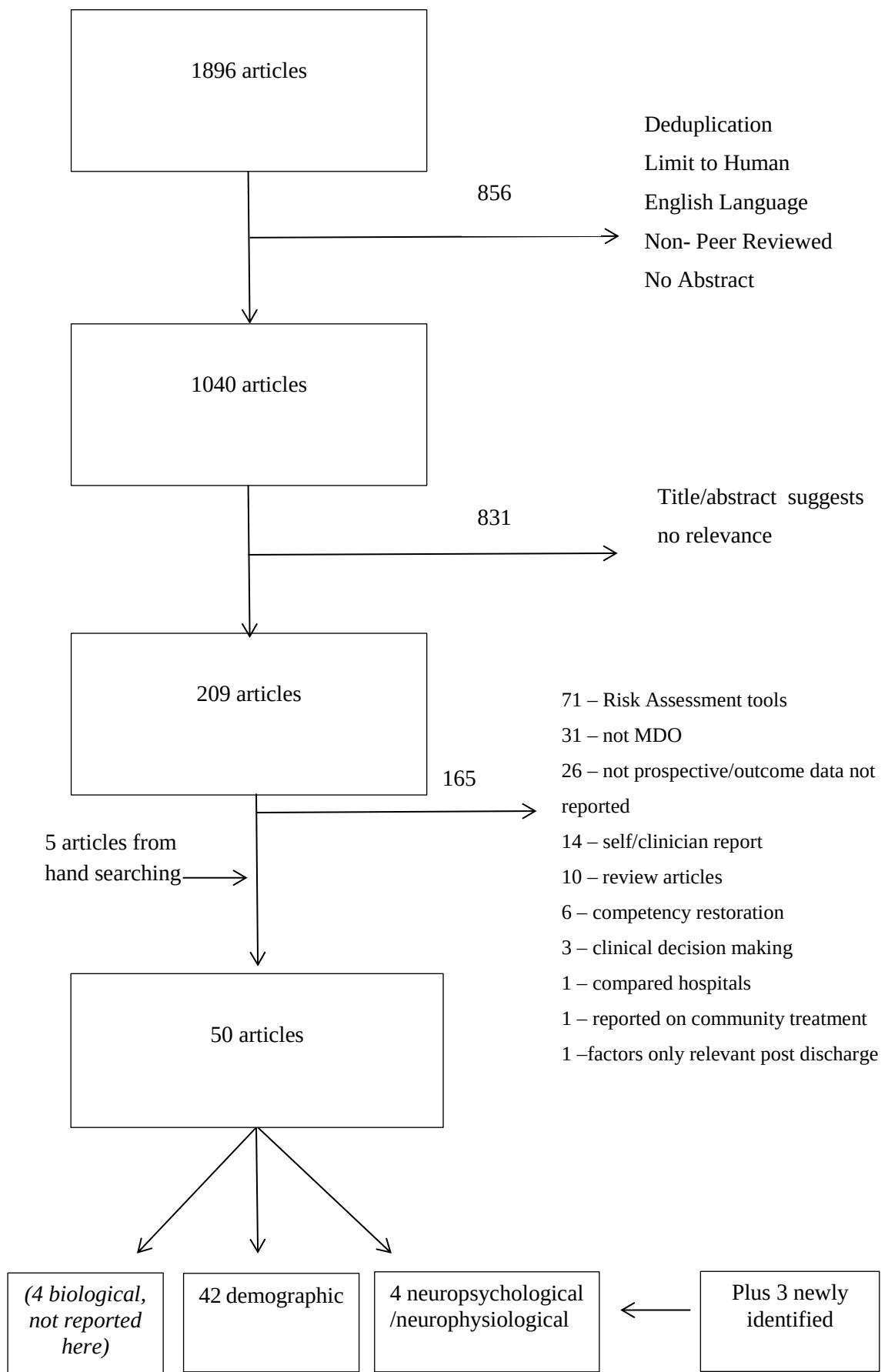
Results

The search returned 1896 results, see Figure 3.1 for flowchart of study selection. 50 articles were retained in the final review which included data on objective predictors of outcome in forensic mental health services. Studies were categorised into three, broad outcome groups, those reporting on predictors of: 1) inpatient violence, 2) length of stay in forensic inpatient services, and 3) community reoffending.

Further, the types of predictor could also be delineated into three categories. These were i) demographic⁴ (42 studies), ii) neuropsychological/ neurophysiological (4 studies) and iii) biological (4 studies) predictors. This chapter will report on only i) demographic and ii) neuropsychological/neurophysiological predictors, as biological predictors are outside the scope of the current thesis. Thus 46 studies from the original 50 will be discussed, plus three additional studies which were published since the publication of the systematic review, or were not identified in the original search (see *Neuropsychological Predictors* section). A table of all included studies can be viewed in Appendix 3.

⁴ The term “demographic” is used here as a broad, all-encompassing term to refer to static, historical factors, including clinical, offence-related, developmental, institutional and sociodemographic factors.

Figure 3.1 - Flowchart of Study Selection



Inpatient Violence

For the outcome of inpatient violence, 38 separate demographic factors across eight studies were identified. Of these, 16 factors were considered in more than one study. Only one factor, previous psychiatric admissions, was found to be associated with inpatient violence in the majority of studies which examined it; two studies found a positive relationship between number of previous psychiatric admissions and inpatient violence, whereas one study found a null effect. One of these studies assessed seclusion episodes as opposed to inpatient violence directly (Thomas et al., 2009); however, all seclusion incidents were related to aggressive behaviour, apart from one episode of self-harm. Another demographic factor, young age, was examined by six studies, of which three found a positive association and three found no association. Similarly, a history of violence was found to be associated with inpatient violence in two studies, and not associated in three studies. Other factors examined by two or more studies and found to be unrelated to inpatient violence are listed in Figure 3.2. Notably, a history of substance use, diagnosis and gender did not emerge as consistent predictors across studies.

Reoffending

Community reoffending, encapsulating re-arrest, readmission, recidivism etc., was the outcome of interest in the majority of the papers (k=25). Again, a large and diverse number of factors (total 66) were considered across studies, with 27 factors only considered in a single study. The most frequently examined predictor was previous offending, examined by 18 studies. 67% of studies examining previous offending found an association with reoffending. Young age at admission or discharge was investigated in 15 studies with 67% finding a positive effect, while the effect of a shorter length of stay was examined in 12 studies and 50% found it was associated with reoffending.

Male gender, race and being single were investigated in 10 studies each, with positive findings indicated in 40%, 20% and 30% of studies, respectively. Other frequently examined factors included previous violence (nine studies, 44% positive finding), young age at time of offence (eight studies, 50% positive finding), employment (eight studies, 34% found that it was negatively associated with reoffending, the remainder finding no association), previous psychiatric admissions (10 studies, 10% found positive effect) and substance use (seven studies, 43% positive finding).

In terms of diagnostic groups, personality disorder (PD) was examined by nine studies, with 78% of studies finding a positive association with reoffending. Six studies examined psychosis and

⁵ For ease of readability in-text citations have been removed from this section as they are numerous, but are fully documented in the published manuscript; please see Appendix 3 for reference to the specific studies.

50% showed that this diagnosis was negatively associated with reoffending, the remaining half showed no association with reoffending. However, four studies found that “diagnosis” as a predictor (encapsulating PD and psychosis) was unrelated to reoffending, somewhat weakening these initially strong findings. This differential pattern of results likely reflects the diagnostic homogeneity of these four studies, in which the vast majority of patients had psychotic disorders and only small numbers were diagnosed with personality disorder (8%, 8%, 13%, and 9%, respectively), whereas studies which had more variance in diagnostic group, and thus more power to detect significant differences, tended to find positive results. For example, in a sample in which the number of participants with PD or psychosis was approximately equivalent (Bailey & Macculloch, 1992), PD emerged as a factor associated with reoffending. See Figure 3.3 for other predictors.

Length of Stay

A total of 44 diverse predictors were examined in relation to length of stay, with 25 of these being examined by more than one study. The factor which most studies examined was severity of offence. Unsurprisingly, nine out of ten studies found that a more ‘severe’ offence was related to a longer length of stay. This is supported by two studies examining the effect of a restriction order on length of stay (administered to patients in the UK who are considered to be particularly high-risk), which both showed a lengthening effect. Three studies found that having a psychotic disorder was associated with a longer length of stay, although one study found the opposite (shorter stay), and one found no significant effect. In addition, three studies found no effect for ‘diagnosis’ on length of stay (which included psychosis). However, it is notable that in two of these studies there was a very small proportion of offenders not diagnosed with a psychotic illness, suggesting limited sensitivity to find an effect. Two out of three studies which examined absconding during hospitalisation found that this was associated with a longer stay.

Previous offences was found to be unrelated to length of stay in all six studies which examined this, providing strong evidence that it is the severity, as opposed to the extent, of offending which is implicated in how long MDOs remain in services. Other examined factors for which no clear association emerged are detailed in Figure 3.4.

Demographic Summary

Thus, in sum, the published literature reports on a large number of individual predictors of outcome. The most convincing evidence for predictors of inpatient violence include a greater number of previous psychiatric admissions, young age and a history of violence. For reoffending, young age again makes a contribution, in addition to the number of previous convictions/offences/arrests. Length of stay appears to be mediated by the severity of the index offence and the number of previous absconding events.

Figure 3.2 - Demographic Predictors Examined by at least 2 Studies and their Association with Inpatient Violence

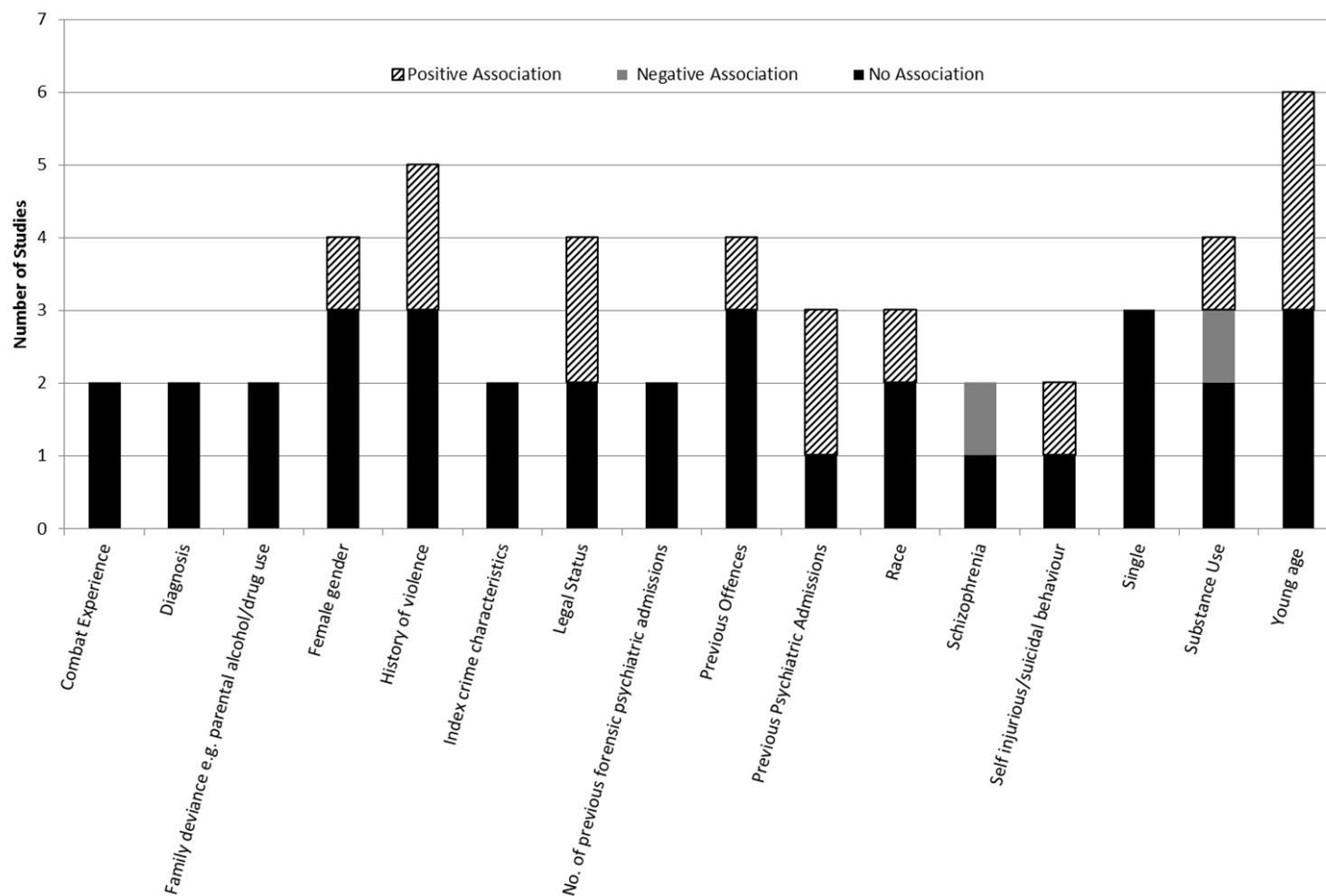


Figure 3.3 - Demographic Predictors Examined by at least 3 Studies and their Association with Reoffending/Rearrest/Readmission

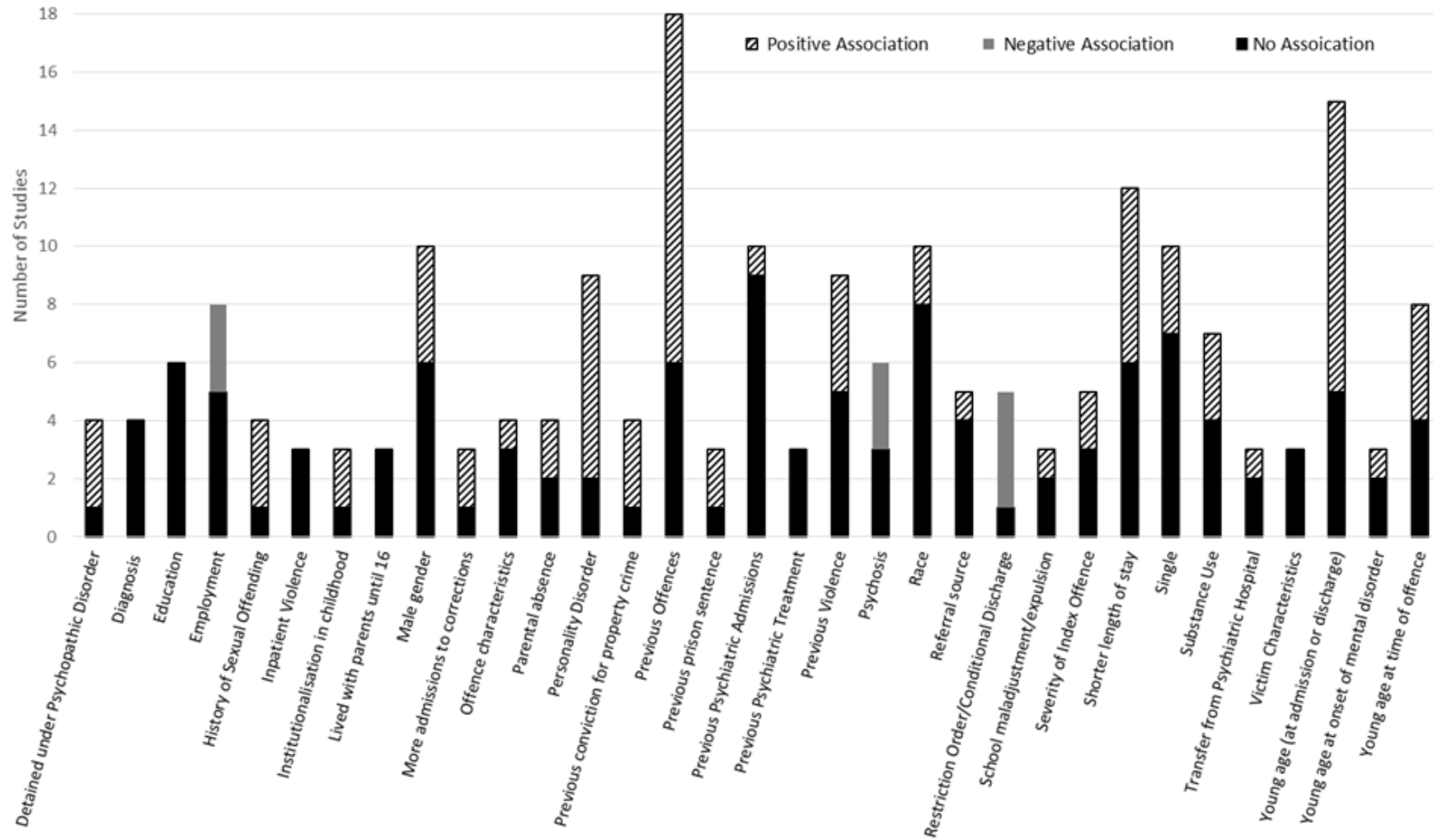
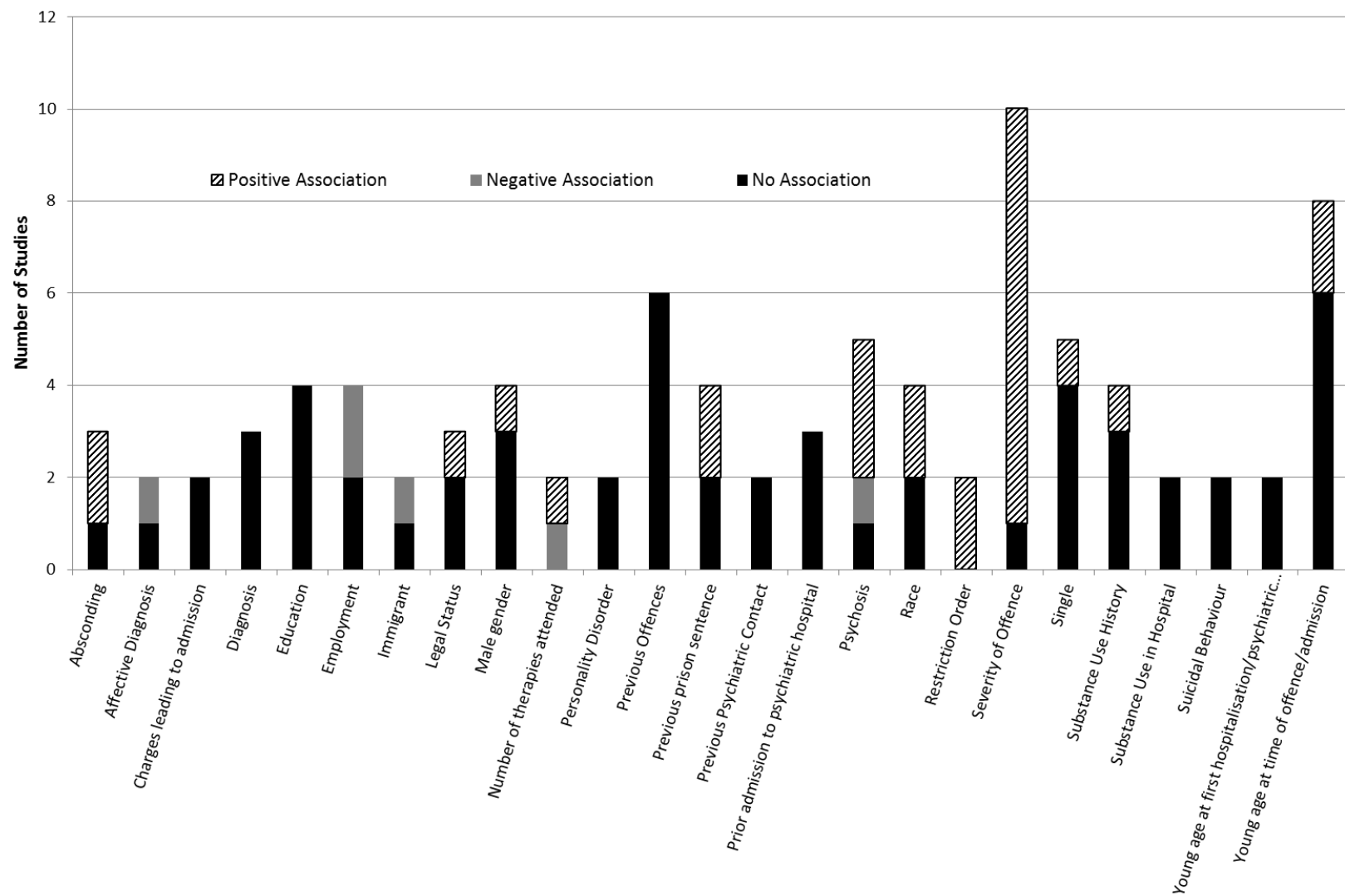


Figure 3.4 - Demographic Predictors Examined by at least 2 Studies and their Association with Length of Stay



Neuropsychological and Neurophysiological Predictors of Outcome

Three studies included in the systematic review (Enticott, Ogloff, Bradshaw, & Daffern, 2007; Foster, Hillbrand, & Silverstein, 1993; Murphy, 2007) provided data relating to neuropsychological predictors of outcome in forensic mental health services; these all reported on the more proximal outcome of inpatient violence, or constructs relevant to this. In addition, three further studies reporting on the relationship of neuropsychological functioning and inpatient violence are described. Two have been published since the publication of this review (Brugman et al., 2016; O'Reilly, Donohoe, Coyle, et al., 2015), and one (Nazmie, Nebi, Zylfije, & Bekim, 2013) was not identified in the initial comprehensive search (as the journal in which the article is published is not indexed in OVID-Medline, Embase or PsychInfo) but was subsequently identified from the reference list of a recently published paper.

One early study (Foster et al., 1993) reported the ability of neuropsychological assessments to predict aggression amongst 23 male forensic inpatients (n=19 diagnosed with a psychotic disorder). Aggressive behaviour was monitored over the year following testing using the Overt Aggression Scale (Yudofsky, Silver, Jackson, Endicott, & Williams, 1986). The results demonstrated that poor visuospatial processing [assessed by the Judgement of Line Orientation Test (JLOT; Benton, Varney, & Hamsher, 1978)], poor cognitive inhibition [scores on the Stroop Colour/Word Test (SCWT; Stroop, 1935)] and the number of misperceptions of an angry voice in an emotional recognition test could reliably predict the frequency of subsequent aggression. Scores from the JLOT and SCWT were also significantly correlated with the severity of aggression.

The Stroop test has shown utility in predicting violence in another study of 65 male, forensic inpatients with a schizophrenia spectrum diagnosis (Nazmie et al., 2013). Patients were assessed at baseline on a number of neuropsychological measures, and followed up for an average of two years over their stay in hospital. After controlling for socioeconomic status, age at first violent incident, previous treatment history and total symptoms, the Stroop word score and verbal IQ score were predictive of violent and aggressive behaviour; poorer performance on these measures corresponded to an increased odds of violence. Thus poor cognitive control as assessed by the Stroop test appears to be a relevant predictor across both these studies.

Another study (Enticott et al., 2007) reported a five week follow-up of ten forensic inpatients. Contrary to expectation, performance on a measure of behavioural inhibition [the Stop Task (Enticott, Ogloff, & Bradshaw, 2006)] was better at a trend level amongst those who were involved in subsequent aggressive incidents compared to those who were not, suggesting that those who were more impulsive were involved in fewer incidents. However, this study was significantly limited by its small sample size and low rate of recorded incidents (12 incidents, conducted by five patients), and thus the results must be interpreted with caution. In addition, no

information regarding diagnosis is given by this study, leaving questions as to the generalizability of the results to other populations.

Murphy (2007) examined clinical outcome, need and risk in high-security hospital, which are all facets sensitive to inpatient violence. Thirty newly admitted men with schizophrenia were assessed on a number of neuropsychological tasks including an assessment of IQ, processing speed and working memory using the Wechsler Adult Intelligence Scales (Wechsler, 1997), in addition to the Trail Making Test (Reitan & Wolfson, 1995) and the SCWT (Stroop, 1935). Further, two social cognitive tasks were conducted, the Revised Eyes Task (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) and a Modified Advanced Theory of Mind Test (e.g. Frith & Corcoran, 1996). Outcome measures included the Health of the Nation Scales – Secure version (HoNOS), the Camberwell Assessment of Need – forensic version (CANFOR) and the ‘Historical Clinical Risk-Management’ risk assessment scheme (HCR-20), assessing clinical, social and functional outcome, need and risk respectively, at three year follow-up. Although a number of non-social cognitive tasks showed utility in predicting some outcomes of interest (e.g. Trail Making part B was significantly correlated with scales from the HoNOS, the total CANFOR score and HCR-20 risk management scale), the overwhelmingly most predictive test was the Revised Eyes Test. After controlling for all other variables, the Revised Eyes Test score could significantly predict total CANFOR score, the risk management score on the HCR-20 and the social scale score of the HoNOS. Thus, patients with schizophrenia who were less able to interpret emotional information from the eyes were likely to have higher ratings of unmet need, poorer social functioning and a higher level of assessed risk.

The findings of Murphy (2007) were largely corroborated by another, more recent study which prospectively examined the relationship between neurocognition, social cognition, symptoms, functioning, assessed risk and violence in forensic inpatients with schizophrenia or schizoaffective disorder (O'Reilly, Donohoe, Coyle, et al., 2015). The study had strong methodological components, including using a standardised neuropsychological battery (the MATRICS consensus cognitive battery) and following up participants for a relatively long period (one year). Out of the 89 patients who participated, ten were involved in at least one violent incident in the subsequent follow up period. When comparing those who were violent during follow up to those who were not, the violent group had significantly lower scores on tests of processing speed, verbal learning, a lower overall neurocognitive composite score and poorer social cognition [assessed via the Managing Emotions subtest of the Meyer Salovey-Caruso Emotional Intelligence Test (Mayer, Salovey, Caruso, & Sitarenios, 2003), comprising of vignettes of various situations for which potential solutions are provided and participants are required to indicate the effectiveness of each solution ranging from very ineffective (1) to very effective (5)].

O'Reilly and colleagues (2015) used receiver operating characteristic (ROC) analysis and area under the curve (AUC) to assess the ability of these variables to predict subsequent violence. ROC analysis attempts to balance sensitivity and specificity; a curve is produced with sensitivity (true positive rate) plotted against specificity (false positive rate). The area under this curve (AUC) can be considered a marker of the overall accuracy of prediction; an area equal to zero represents perfect negative prediction, 0.5 chance prediction, and 1 perfect positive prediction. AUC's equal to 0.7 are considered moderate to large, and areas over 0.75 are considered large (Douglas, Guy, Reeves, & Weir, 2010). The AUC can be conceptualised as the probability that any person who scores above the designated cut-off for the prediction of future violence, will be violent e.g. if AUC=0.80, then there is an 80% chance that an actually violent person will score above the designated threshold. In this study, processing speed, verbal learning and social cognition all had AUC values at a greater than chance level with social cognition showing the largest effect (0.65, 0.72 and 0.81, respectively).

A series of mediation analyses were also conducted to assess the relationship between variables. Neurocognition (composite score) was the only variable whose relationship with violence was consistently completely mediated by other variables. For example, the relationship of neurocognition with violence was completely mediated independently by social cognition (i.e. social problem solving) symptoms, social functioning and the HCR-20 score. Thus, the authors surmise that neurocognition represents a more distal risk factor for violence, which is mediated by more proximal risk factors such as social cognitive abilities, every day functioning and symptoms. They also note that social cognition had the largest between group effect size (violent vs. non-violent; Cohen's $d=1.14$), and had similar AUCs as the HCR-20 for predicting future violence, which is very promising given that the HCR-20 is one of the most widely utilised measure to predict violent behaviour (Khiroya, Weaver, & Maden, 2009). Thus, similarly to Murphy (2007), measures assessing social cognition appear to be superior to neurocognition when predicting future violence.

The contribution of social cognition to inpatient violence has also been replicated in a further study (Brugman et al., 2016), which crucially examined forensic psychiatric inpatients with no current or history of psychosis [whilst Murphy (2007) and O'Reilly et al. (2015) used solely psychosis patients], demonstrating the importance of social cognition within this population across diagnostic groups. Sixty-nine forensic inpatients participated and were followed up one year later, after completing the following cognitive tasks: the emotional Stroop, emotional faces signal detection task, emotion recognition task, implicit association task and an affective Go/No-Go task. Violent incidents were rated for frequency and severity using official hospital records. The results demonstrated that difficulty recognising sad faces at 70% intensity (but not 100% or 40% intensity) was positively associated with the number of violent incidents and the severity of verbal aggression (the latter of which was also predicted by poor ability to recognise happy faces

at 40% intensity). Severity of aggression against property was related to difficulty at recognising angry faces at 40% intensity, and less sensitivity to detecting neutral stimuli amongst negative stimuli was related to the severity of physical aggression. Attentional bias for threatening and aggressive stimuli was also positively associated with the number of violent incidents and severity of verbal aggression. In addition, the factor 2 score of the PCL-R was also a significant predictor for all outcomes, demonstrating the importance of personality traits when considering violence risk, although the cognitive factors added predictive validity alongside this variable.

One neurophysiological study incorporated into the systematic review reported on the outcome of community reoffending. Howard and Lumsden (1996) assessed the relationship between the contingent negative variation (CNV) event related potential during a Go/No-Go task, and reoffending in a sample of 44 admissions to a high-secure forensic hospital. The CNV during this task has been correlated with measures of impulsivity (Howard, Fenton, & Fenwick, 1984) and has been used as evidence of pathological impulsivity in court proceedings (Howard, 2002). Thus, it can be considered an objective measure of behavioural impulsivity. Based on the CNV results obtained, patients were classified as high or low risk, dependent on whether their score was one standard deviation outside or within a control group's score, respectively. At fifteen years post-testing, criminal records were examined to reveal that six of 21 in the high risk group had been convicted of another offence, including manslaughter, burglary and arson. This compares with only one of 23 in the low risk group, convicted of theft. Thus, it appeared that using the CNV during Go/No-Go was sensitive to differentiating those who may reoffend, and appeared to identify those at risk of committing more serious offences. The authors assert that the overall predictive accuracy was 63.6% and the relative improvement over chance was 72%.

Corroborating the results of the neuropsychological/neurophysiological studies, a number of demographic studies examined relevant variables when predicting outcome. For example, one demographic study extracted evidence of "cognitive impairment" (present/absent) from patient files, and found that this was a significant predictor of frequent violent behaviour amongst inpatients (Lussier et al., 2009). Although there is no detailed explanation of the nature or severity of cognitive impairment in these participants, this study supports the assertion that cognitive dysfunction may be related to aggressive behaviours as an inpatient. Six demographic studies examined the effect of IQ on reoffending; five found no relation to reoffending (Quinsey & Maguire, 1986; Quinsey, Rice, & Harris, 1995; Rice & Harris, 1996; Rice, Harris, Lang, & Bell, 1990; Tennent & Way, 1984), while one study found a positive association (i.e. those with lower IQ were more likely to reoffend; Reiss, Grubin, & Meux, 1996). However, again it is notable that these studies did not conduct a formal assessment of IQ and scores were extracted from patient files. This may have limited the findings in terms of standardising the assessment tool used, or introduced variation in terms of when the assessment was conducted (i.e. at admission, during an

acute phase of illness, during court proceedings, etc.), which was not evident from the reviewed papers.

Discussion

This chapter aimed to identify and evaluate studies which have assessed static, neuropsychological or emotion processing predictors of outcome in forensic mental health services.

Static/Historical Factors

In terms of static/historical factors, the predictors of inpatient violence included previous psychiatric admissions (67% positive finding), with mixed findings for young age (50% found an association with inpatient violence). Demographic factors associated with an increased length of stay included the severity of the index offence (90% positive finding) and having a history of absconding (67% positive finding). Initially psychosis appeared to be associated with an increased length of stay, however once studies examining ‘diagnosis’ as a predictor more broadly were considered, this association was weakened, probably due to sample diagnostic homogeneity as a low number patients included in these studies were diagnosed with anything other than psychosis. The findings relating to reoffending suggest previous offending, young age at admission or discharge, and personality disorder are relatively robust predictors of recidivism with the large majority of studies examining each factor indicating a positive association. The majority of studies examining psychosis found that this had no relationship with future offending, perhaps reflecting the relative efficacy of treatments that are available for psychotic disorders in comparison to personality disorder, and particularly pharmacological options (Duggan, 2010).

A number of the factors mentioned above were identified in Chapter One as being more prevalent amongst the comorbid psychosis and ASPD subgroup compared to psychosis alone; for example higher rates of previous offending (Moran & Hodgins, 2004), being younger at their admission to forensic services (Steinert et al., 1998) and at the time of their first conviction (Joyal et al., 2004). This could tentatively suggest that individuals with psychosis and one of the antisocial personality disorders (ASPD/DPD) relative to those with psychosis alone are likely to have poorer outcomes in forensic mental health services, although comparison with those only diagnosed with ASPD/DPD is necessary to establish whether this is solely related to personality pathology.

This review may have been limited in its ability to examine demographic predictors of outcome, as it excluded papers relating to risk assessment tools, which focus on this type of predictor. Structured professional judgement tools such as the Historical Clinical Risk Management scheme (HCR-20; Webster, Douglas, Eaves, & Hart, 1997) include items such as young age, identified by this review to be related to future offending, suggesting that they do hold useful predictive properties. However, many factors identified in this review showed conflicting results, for

example young age was found to be associated, and not associated, with inpatient violence in an equal number of studies, just as a previous prison sentence was found to increase the length of stay in two studies, but found to be unrelated in two further studies. This suggests that demographic factors in isolation are not particularly useful to clinicians in assisting risk decision making, but may perhaps hold more validity when considered in combination (as risk assessment tools advocate).

In addition, demographic factors are static and thus not sensitive to changing risk which may be picked up by indices of neurological or biological function. A further limitation relating to the demographic results is that combining similar, but perhaps slightly different demographic factors (e.g. ‘severity of offence’ and ‘a violent or homicide offence’), may have somewhat distorted the true relationship between a given predictor and outcome. Future research should aim to operationalise predictor variable definitions to aid in the understanding of the unique contributions each predictor makes. This criticism also holds in relation to the definitions of outcome. For example, inpatient violence often has broad and differing conceptualisations in research investigations (S. T. Harris, Oakley, & Picchioni, 2013), and although the majority of papers included in this review included episodes of both verbal and physical aggression in this outcome category, some excluded verbal threats, and some included specific operationalisations such as “throwing food or an object that strikes another person”. Length of stay may also have different implications across countries. For example, in the UK length of stay is linked to clinical responsiveness. Patients admitted under a hospital order are able to move from hospital to conditions of lesser security once they are deemed to have responded to treatment and reduced their level of risk. However, this may not be the case in other countries such as the USA where fixed length sentences may have been imposed. In this review one third of studies examining length of stay were conducted in the USA, with 50% conducted in Europe and 17% in Australasia.

Neuropsychological Predictors

Common themes emerged from the identified neuropsychological and neurophysiological predictors; impulsivity as assessed by the contingent negative variation event related potential was associated with future reoffending upon discharge (Howard & Lumsden, 1996), and SCWT errors (poor cognitive inhibition) were associated with inpatient violence in two studies (Foster et al., 1993; Nazmie et al., 2013). Both of these facets could be considered to reflect poor behavioural controls, and thus this may be an area which merits further research in relation to its utility as a marker of violence or reoffending. One study included in this review (Enticott et al., 2007) did not support this assertion, however as previously discussed it had a small number of participants, with a very short follow-up period and a low rate of inpatient violence was observed, leaving questions as to the power of this study to detect a true effect.

The strategy of using neuropsychological tests to predict outcome is strengthened by other studies not included in this review due to their non-prospective design. For example, it was shown that scores from the Iowa Gambling Task (Bechara, Damasio, Damasio, & Anderson, 1994) could be used effectively to predict whether MDOs had been secluded in the past for either predatory or impulsive violent acts while in secure mental health services (Bass & Nussbaum, 2010). However, one cross-sectional study (Fullam & Dolan, 2008) found no significant association between neuropsychological measures and previous inpatient violence in 82 violent men with schizophrenia [including the National Adult Reading Test (Nelson, 1991), the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999), Stop Task (Rubia et al., 2001) and the CANTAB-2 battery (Fray & Robbins, 1996)]. Although current and predicted IQ tended to correlate negatively with the number of violent incidents across an individual's time in hospital, suggesting that there may be a role for neuropsychological function in the emergence of violent behaviour. This is consistent with the finding that verbal IQ was predictive of violence in one of the reviewed studies (Nazmie et al., 2013).

Poor social cognition emerged from four studies as a significant predictor of inpatient violence (Brugman et al., 2016; Foster et al., 1993; Murphy, 2007; O'Reilly, Donohoe, Coyle, et al., 2015). Predictors included the misperception of angry voices, poor reading of emotion from the revised eyes task, the MSCEIT social cognition task and tests of facial affect recognition. This may be relevant to the Violence Inhibition Mechanism theory (Blair et al., 1997), according to which poor interpretation of negative facial expression removes inhibitory influences which serve to stop violent behaviour through negative reinforcement of the unwanted (aggressive) behaviour. Poor theory of mind may also reduce the capacity for cognitive empathy (Mathersul, McDonald, & Rushby, 2013), or understanding typical social rules (Roncone et al., 2002) which could lead to social conflict and potentially violent behaviour.

With further research, the predictive ability of such measures could prove of great utility to clinicians making risk assessments or prognostic decisions. Current methods of predicting outcome include a multidisciplinary assessment of need (i.e. criminogenic and clinical factors which require intervention) often involving the use of structured professional judgement instruments to assess the level of risk, generally in the context of treatment planning (Glorney et al., 2010; Gudjonsson & Young, 2007). The HCR-20 (Webster et al., 1997) scheme is an example of this, and has shown good predictive validity for future violence (O'Shea, Mitchell, Picchioni, & Dickens, 2013). The psychopathy checklist (PCL-R) has grown in popularity as a quasi-risk-assessment tool due to the demonstrated link between high PCL-R scores and both inpatient violence and community reoffending (Hare, Clark, Grann, & Thornton, 2000; Walters, 2003). However, while these assessment tools supersede unstructured clinical decision making (Hanson & Morton-Bourgon, 2009), they still rely on clinical judgement/decision making to draw conclusions. This is particularly relevant when considering the forensic population, many of

whom are diagnosed with disorders which are characterised by deceptive behaviours (e.g. ASPD, taken from DSM-5; “Deceitfulness: dishonesty and fraudulence; misrepresentation of self; embellishment or fabrication when relating events”). Further, it is plausible that offenders may wish to present as low risk in order to secure early discharge, adding a further complication for clinicians making assessments of need.

It may be that further research allows neurocognition and social cognition, which are objective and measurable, to be considered whilst making clinical decisions. Consideration of these factors alongside methods already employed could enhance the amount of information available, and thus potentially improve decision making or identify areas of outstanding need. This could theoretically lead to improved outcomes for patients, the public and the taxpayer, via more appropriate treatments being offered, fewer premature discharges and more efficient services, respectively.

Chapter Summary

This chapter has demonstrated that indices of neurocognitive and social cognitive function are relevant to outcome (inpatient violence and/or reoffending) in forensic mental health services. This supports the premise that such characteristics are relevant to understanding violent behaviour, and are important candidates for future research and development. Relevant static/historical factors were also considered, with less consistent results emerging. However, predictors of inpatient violence (young age) and reoffending (previous offending, young age at admission or discharge, and personality disorder) all appear to be over represented amongst a comorbid psychosis and ASPD group as reported in Chapter One, suggesting that such individuals may be less responsive to treatment/have outstanding treatment needs.

The next chapter will present the aims and objectives for the experimental chapters of the thesis, by drawing on literature reviewed in this chapter, and in Chapters One and Two.

4 Chapter Four: Aims and Objectives

The reviewed literature points to clear gaps in the current forensic mental health knowledge base which this thesis aims to address.

Very little research to date has focussed on mentally disordered offenders with both diagnoses of a psychotic disorder and one of the antisocial personality disorders (ASPD or DPD). This represents an area in which substantial gains can be made, as this group is common in clinical practice (Blackburn et al., 2003) and often reside within forensic mental health services. Such services are expensive (S. Wilson, James, & Forrester, 2011) and yet have arguably poor outcomes for the patients who use them including lengthy admissions (Rutherford & Duggan, 2007) and high rates of reoffending (Coid, Hickey, Kahtan, Zhang, & Yang, 2007; Fazel et al., 2016), often resulting in readmission (Fazel et al., 2016). In addition, a number of theoretical frameworks of violence amongst individuals with psychosis suggest an ‘antisocial’ subtype (Bo et al., 2011; Hodgins, 2008; Volavka & Citrome, 2008), and thus exploration of this group can assist in confirming and/or developing such models.

Greater understanding of the characteristics and outcomes of this subgroup could therefore point to areas where therapy could be targeted, as well as enhance our theoretical understanding of violent behaviour. This is important in order to develop services which will result in improved outcomes for the patient, the safety of the public and commissioners alike.

The following five chapters will present data collected from a high-security hospital in the United Kingdom to attempt to meet the following overarching aims:

1. To accurately characterise individuals with both psychosis and DPD with respect to their historical characteristics, cognitive functioning and emotion processing.
2. To ascertain how these groups differ in their current clinical outcomes, and whether the characterisation measures are relevant to outcomes.

To achieve this, clinical participants are examined with respect to their diagnostic group (psychosis, DPD, comorbid psychosis and DPD) across a number of characterisation measures, including demographic, clinical, psychosocial and offence-related measures, and experimental tasks designed to measure cognitive function, emotion processing, sensorimotor gating and appetitive/defensive responding. In addition, current clinical outcome of these diagnostic groups is examined, and correlations with the characterisation measures are explored in order to assess if they are related to outcome, and thus ascertain whether such indices may be of future clinical utility with further development.

Research questions are summarised below, and hypotheses are given in the relevant chapters.

Chapter 5 Demographic, Clinical, Psychosocial and Offending Characteristics of Comorbid Psychosis and DPD

Research Question: How do individuals with comorbid psychosis and DPD differ from those with psychosis or DPD with regard to their demographic, clinical, psychosocial and offending characteristics?

Chapter 6 Cognitive and Emotion Processing Characteristics of Comorbid Psychosis and DPD

Research Question 1: How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to cognitive function?

Research Question 2: How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to facial affect recognition?

Research Question 3: How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to experiential fear and anxiety?

Chapter 7 Sensorimotor Gating Characteristics of Comorbid Psychosis and DPD

Research Question 1: How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to sensorimotor gating?

Research Question 2: Is sensorimotor gating influenced by psychopathy, psychosocial deprivation or severity of previous violence?

Chapter 8 Affective Modulation of the Startle Response in Comorbid Psychosis and DPD

Research Question 1: How do individuals with comorbid psychosis and DPD differ from those with psychosis or DPD with regard to affective modulation of the startle response?

Research Question 2: Is affective modulation of the startle response influenced by psychopathy level?

Chapter 9 Relationship of Diagnostic Group, Cognition and Emotion Processing to Clinical Outcome

Research Question 1: How do individuals with comorbid psychosis and DPD differ from those with psychosis or DPD with regard to clinical outcome (clinician rated progress, risk and engagement)? Do they differ in their self-reported attitudes and perceptions towards treatment?

Research Question 2: Are indices of clinical outcome (clinician rated progress, risk and engagement) related to previously explored characterisation measures; demographic, cognitive, emotion processing and PPI variables?

Research Question 3: Are indices of clinical outcome (clinician rated progress, risk and engagement) related to self-reported attitudes and perceptions towards treatment?

5 Chapter Five: Demographic, Clinical, Psychosocial and Offending Characteristics of Comorbid Psychosis and DPD.

Chapter Aims and Overview

This chapter presents the sample under investigation and aims to compare the three diagnostic groups (psychosis alone, DPD alone, and comorbidity of these disorders) on a number of demographic, clinical and offending variables to gain a perspective of the similarities and differences between particular groups which may be related to violence aetiology.

Introduction

The presence of psychotic disorder is known to have a small, but independent, relationship with violent behaviour (Fazel, Gulati, et al., 2009; Walsh et al., 2002). Personality disorder (PD) is known to increase the risk of violence as evidenced by inclusion of the criterion on widely used risk-assessment schemes (Douglas et al., 2013), and the antisocial personality disorders specifically (i.e. DPD/ASPD) have been linked with violent and criminal behaviour, reflected by the high rates of ASPD amongst prisoners (Fazel & Danesh, 2002), and the association of ASPD with violence in psychiatric hospitals (Lussier et al., 2009) and the community (Coid et al., 2006). In addition, PD is known to make a substantial contribution to the risk of violence amongst those with a psychotic disorder (Moran et al., 2003b; Witt et al., 2013).

It has been proposed that violent individuals with psychosis do not constitute a homogenous group, and that a proportion have comorbid antisocial personality traits which may go some way to explaining their violent behaviours (Bo et al., 2011; Moran & Hodgins, 2004; Volavka & Citrome, 2008). In high security hospitals, approximately 45% of individuals with a major mental disorder also meet criteria for ASPD (Blackburn et al., 2003), indicating that this is not an insignificant subgroup. Thus, a thorough understanding of the characteristics of this group, as separate from those with either disorder alone, is essential in order to inform effective therapeutic interventions.

Research has gone some way to answering these questions. Three characterisation studies (Joyal et al., 2004; Moran & Hodgins, 2004; Steinert et al., 1998) have identified differences between individuals with psychotic disorder when stratified by ASPD status. One study observed that those with comorbid ASPD were most distinguished from those with schizophrenia alone by poor attention/concentration in childhood, persistent and prolonged substance abuse, poor educational background, and a deficient affective experience (Moran & Hodgins, 2004). The comorbid group had a significantly greater number of total crimes, and (although not significant after correction for multiple comparisons) tended to have a greater number of violent crimes. Another study identified young age at the time of first psychiatric hospitalisation, young age at admission to forensic services, a greater likelihood of having previous convictions prior to the index offence, a greater likelihood of having previously abused drugs, and a lower likelihood of being delusional

at the time of their violent offence to be characteristic of a comorbid group, in addition to a trend towards poorer educational history (Steinert et al., 1998). Further, 43% of the comorbid group came from a 'broken home' compared to 17% of the schizophrenia alone group, suggesting more early psychosocial deprivation in this group. The final study showed that the comorbid group had fewer years of education, more previous convictions and were younger at the age of first conviction (Joyal et al., 2004). No studies yet have directly compared the characteristics of a group with comorbid psychosis and one of the antisocial personality disorders (ASPD/DPD) to those with an antisocial personality disorder alone (ASPD/DPD).

This study aimed to address this gap and further characterise a comorbid group. This will be achieved by directly comparing violent individuals detained in high-security psychiatric hospital with diagnoses of a) psychotic disorder and no DPD, b) DPD but no psychosis, and c) both a psychotic disorder and DPD, on a number of demographic (age, ethnicity, length of hospitalisation), clinical (medication, years since illness onset, comorbidity, substance misuse, psychopathy), psychosocial (childhood psychosocial deprivation) and offence related (offending history, severity of violence) variables that may differentiate these groups and also play a role in short, medium or long term outcomes (Sedgwick, Young, Das, & Kumari, 2016; see Chapter Three). The following hypotheses were made based on the previous available literature (Joyal, Putkonen, Paavola, & Tiihonen, 2004; Moran & Hodgins, 2004; Steinert, Voellner, & Faust, 1998):

Hypothesis 1: With regard to clinical characteristics, the comorbid group will have a greater history of substance abuse, a younger age of onset of psychosis, and higher psychopathy scores (specifically factor one) compared to the psychosis alone group.

Hypothesis 2: With regard to psychosocial characteristics, the comorbid group will have a greater history of psychosocial deprivation compared to the psychosis alone group.

Hypothesis 3: With regard to offending characteristics, the comorbid group will have a greater number of offences and a greater severity of previous offences compared to the psychosis alone group.

Hypothesis 4: Demographic characteristics (age, ethnicity, length of hospitalisation) are not anticipated to differ as a function of group.

Comparisons between the comorbid and DPD group are exploratory due to a lack of previous relevant data.

Method

Participants and Design

Fifty eight males who were currently detained in high-security hospital in the UK participated in this study. Of these 58, 15 were diagnosed with a psychotic disorder (n=12 schizophrenia, n=2 schizoaffective disorder, n=1 delusional disorder) and no comorbid DPD (psychosis group), 17 with dissocial personality disorder and no comorbid psychotic disorder (DPD group), and 26 with a psychotic disorder (17 psychosis, 9 schizoaffective disorder) and DPD (comorbid group). The study used a between-groups design.

All diagnoses were made by the patient's responsible clinician (consultant psychiatrist) using the International Classification of Diseases, 10th edition (ICD-10; World Health Organization, 1992) at admission to hospital following a thorough and detailed clinical interview. As per the hospital protocol, patients are referred for further diagnostic evaluation in the case of uncertainty, for example the International Personality Disorder Examination (Loranger, Sartorius, Andreoli, & et al., 1994). Diagnosis is reviewed every six months at patient Care Programme Approach meetings; this is led by the responsible clinician but is informed by the whole multidisciplinary team involved in the patient's care including psychologists, occupational therapists, nursing staff and social workers.

Responsible clinicians referred patients to the study who were deemed to have capacity to give consent to participate in research, were clinically stable enough to meaningfully partake, did not pose an imminent risk of violence to researchers, did not have a history of traumatic brain injury, and had normal-to-corrected vision and hearing. All patients were free of current substance abuse (subject to random urine analysis checks as part of their routine clinical care).

All participants were detained at a high security forensic hospital, and thus by definition are considered to pose a high risk of violence to themselves or others, which cannot be managed at a lower level of security (National Health Service England, 2014b). The participants' index offences (offences which had precipitated their admission) were as follows: murder/manslaughter; n=18, grievous bodily harm; n=7, actual bodily harm; n=6, wounding/battery/assault; n=12, robbery; n=5, sexual violence; n=5, using violence to secure entry; n=1, arson; n=2, possession of a weapon and threats to kill; n=2, and harassment; n=1. However, it is notable that amongst those with less severe index offences (e.g. harassment, arson) these participants had engaged in severe violent behaviour whilst hospitalised and/or prior to their index offence.

The study was reviewed by and received ethical approval from the National Research and Ethics Service (REC Ref: 14/LO/0238) and West London Mental Health Trust Research and Development (98463/LNW). See Appendices 5 and 6 for approval letters. Participants received £30 into their hospital accounts upon completion of all testing sessions (including those reported in Chapters Six-Nine).

Clinical Characterisation Measures

Medication, Illness Onset and Comorbidity

A detailed review of the participant's hospital files at the time of their participation was conducted, which included extracting all current psychiatric medication, the approximate year of illness onset (for individuals diagnosed with a psychotic disorder) and any current comorbid psychiatric disorders. All of these variables are routinely recorded and updated in patient's electronic clinical record. To assess for dosage differences in antipsychotic medication, chlorpromazine equivalents were calculated.

Substance Misuse

Severity of historical substance misuse was rated by a researcher reviewing the files for eight substances (alcohol, cannabis, solvents, heroin, cocaine/crack, ecstasy, amphetamine, tranquilisers including benzodiazepines) with an option to specify further substances as applicable under 'other' option. The severity of use was categorised as follows: (1) no past use, (2) past use, (3) past harmful use, and (4) past dependence. Harmful use and dependence were assessed using the ICD-10 criteria. The percentage of participants within each group with past harmful use and/or dependency on any substance was calculated, in addition to the mean number of substances for which a) harmful use and b) dependency was evident. Details of historical substance misuse forms a key part of psychiatric assessment in this population, and is routinely assessed for risk assessment purposes (e.g. as an item on the HCR-20).

Psychopathy Checklist – Revised (PCL-R; 2nd Edition) (Hare, 2003)

The PCL-R is a 20 item checklist, normally scored after interview and comprehensive review of forensic records. Items are rated as not present (0), partially present (1), or present (2), allowing a total score of 40 or less. Scores exceeding 25 are typically thought to represent psychopathy in European samples (Cooke et al., 2005), and this cut off point has been used in many experimental studies (Hare, 2003). The PCL-R, as conceptualised by Hare (2003), is composed of two overarching factors relating to a callous, remorseless and arrogant interpersonal style (Factor 1) and a reckless, impulsive, antisocial lifestyle (Factor 2). The PCL-R has shown robust associations with antisocial conduct in meta-analysis (Leistico, Salekin, DeCoster, & Rogers, 2008). It is widely used in clinical forensic settings, and has been applied to individuals with psychosis and PD (e.g. Coid & Ullrich, 2010; Tengström, Grann, Långström, & Kullgren, 2000). For the purpose of this study, psychopathy scores were taken from clinical records where available (n=12). If psychopathy scores were not available, the PCL-R was rated on the basis of file information only, which has been deemed acceptable for research purposes if the information is

detailed enough (Hare, 2003). All participants had a large amount of detailed information contained in their records, often spanning back many years, allowing the adoption of a lifespan perspective when rating.

Psychosocial Characterisation Measure

Childhood Psychosocial Deprivation Scale (Raine, Stoddard, Bihrlé, & Buchsbaum, 1998)

Psychosocial deprivation ratings were obtained using a similar method to Raine et al. (1998). Information was extracted from detailed clinical and forensic records, including (but not limited to) social history reports and the 'early maladjustment' item of the HCR-20. The following eight subscales were rated on a five point scale using standardised operational criteria (0=no evidence, 1=minimal, 2=partial, 3=substantial, 4=extreme): i) physical abuse, ii) sexual abuse, iii) neglect, iv) foster home placement, v) extreme poverty, vi) criminal parent, vii) severe family conflict viii) a broken home. Thus, a sum of these eight subscales gives an indication of the severity and extent of childhood psychosocial deprivation. Previous investigations (Kumari et al. 2013, 2014) have successfully applied these ratings to patients detained in high secure forensic hospitals.

Offending Characterisation Measures

Offending History

The total number of previous offences was extracted from detailed clinical and forensic records. Individual offences, as opposed to number of convictions, were chosen as this may be more reflective of the extent of offending (e.g. an individual might receive one conviction for five counts of robbery).

Gunn and Robertson Scale (Gunn & Robertson, 1976)

This scale was developed to quantify violent behaviour and considers a) the frequency of serious violence across the individual's lifetime (previous record), and b) the severity of the most recent violent act (in this study, the index offence, i.e. the offence that brought the individual into hospital). A rating for the previous record (0-4) and the index offence (0-4) was made using clinical and forensic records. A score of 4 for the previous record indicates at least one seriously violent act in which someone's life or health was seriously endangered. A score of 4 for the index offence reflects lethal or near lethal violence. A total score (0-8) can be generated by summing the two scores. This scale has been used in high secure forensic psychiatric samples (e.g. Kumari, Das, Hodgins, et al., 2005; Kumari et al., 2013), and has previously shown good inter-rater reliability for both subscales and the total score ($r=.82$ to $.95$; Wong, Lumsden, Fenton, & Fenwick, 1993).

Procedure

All suitable participants referred by their responsible clinician were approached and asked if they would be interested in participating in research relating to characterising and understanding outcomes amongst mentally disordered offenders, and given written information about the study. Those interested in taking part were then asked to provide their full, informed, written consent to participate, including giving permission for access to their hospital records. The participant then attended approximately four meetings to complete a number of tasks and self-report measures (described in Chapters Six, Seven, Eight and Nine). All testing was conducted in a quiet, private room on the patient's ward, or in a psychophysiology laboratory.

A comprehensive review of the patient's clinical and forensic record was conducted to obtain relevant background information, complete the psychosocial deprivation scale, Gunn and Robertson scale, substance misuse measure, recording of the number of previous offences and the PCL-R.

Data Treatment

Data were assessed for normality by examining skewness, kurtosis and equality of variance between groups. The skewness and kurtosis values were converted to z scores by dividing them by their standard error. A critical value of $z=\pm 1.96$ was determined as representative of significant ($p<.05$) skewness or kurtosis, as recommended by Field (2009). Equality of variance was assessed via Levene's test, with $p<.05$ indicating significant heterogeneity of variance between groups. Skewness, kurtosis and equality of variance for continuous variables are reported in Table 5.1.

For variables where significant skewness or kurtosis was found, transformation of the variables was attempted using logarithmic transformation. Calculating Log of Number of Previous Offences+1 was successful in normalising the data and thus these values were used for subsequent analysis. Transformations were attempted for Number of Substances with Harmful Use Noted, Number of Substances with Dependency Noted, Subscales of Psychosocial Deprivation and Current Length of Stay but were unsuccessful in normalisation.

Statistical Analysis

Continuous variables were analysed as follows; Age, Psychosocial Deprivation total score, Previous Record subscale of the Gunn and Robertson Violence scale, Log Number of Total Offences: One way analysis of variance (ANOVA), followed by analysis of simple main effects as appropriate. All post-hoc comparison of means was conducted using Hochberg GT2 tests as these control for familywise error and are recommended when sample sizes differ but sample variances are equal (Field, 2009), as was the case for these data.

For PCL-R scores⁶, a 3 (Group: psychosis, DPD, comorbid) x 2 (Factor: Factor 1 and Factor 2) mixed-model ANOVA was performed, with 'Group' as a between subjects variable and 'Factor type' as a within subjects variable, followed by lower order ANOVAs and the analysis of simple main effects as appropriate. As Factor 1 plus Factor 2 does not precisely equate to the Total PCL-R score (two items of the PCL-R do not load onto either factor; 'promiscuous sexual behaviour' and 'many, short term marital relationships'), a one-way ANOVA was conducted on Total PCL-R score with Group as a between subjects factor.

Kruskal-Wallis non-parametric test with follow up Mann-Whitney tests where appropriate were conducted for variables where significant skew or kurtosis was noted (Length of Stay, CPZ Equivalents, Number of Substances with Harmful Use Noted, Number of Substances with Dependency Noted, Index Offence subscale of the Gunn and Robertson Violence scale). Finally, a t-test for possible differences in years since illness onset was conducted between the psychosis and comorbid groups.

Categorical variables including Substance Misuse Severity, Medication type and Ethnicity were subjected to Chi Square analysis. For comorbidity rates, no inferential statistics were calculated for between group differences due to the assumptions of Chi-Square being broken (minimum expected cell count was too low). Comorbidity rates are thus presented descriptively (Table 5.2). Effect sizes are reported as partial eta squared where appropriate.

An assessment of inter-rater reliability was conducted for variables in which judgement was required (PCL-R, Gunn & Robertson violence scale, substance misuse and childhood psychosocial deprivation) using intraclass correlation coefficients (ICC) for continuous variables (absolute agreement; two way random effects model to control for variation in both raters and participants), and Cohen's kappa (κ) for categorical variables. The coefficients were interpreted as described by Altman (1991): <.20 – 'poor'; .21-.40 – 'fair'; .41-.60 – 'moderate'; .61-.80 – 'good' and .81-1.0 – 'very good'. Six participants (2 participants from each group; approximately 10% of the total sample) were rated independently by two raters to check for consistency.

Throughout this thesis the decision has been taken to report statistical trends (i.e. $p < .10$), alongside results at the conventional level of significance ($p < .05$). This was deemed acceptable due to the largely exploratory nature of the studies, the small number of participants, and the relative paucity of previous research on similar samples. In addition, effect sizes are reported throughout the thesis where appropriate, alongside the p-values derived for all analyses. This allows the reader to ascertain the strength and direction of the reported findings, and highlights

⁶ The comorbid group had significant skew for PCL-R Factor 2; however Kolmogorov--Smirnov and Shapiro--Wilk tests were non-significant, indicating an approximately normal distribution. In light of this, and the normal skew/kurtosis values for the rest of the scales between groups, parametric analysis was deemed appropriate.

avenues for future research where trends may be evident although do not meet conventional levels of significance.

Results

Means, standard deviations and inferential statistics for demographic, clinical, psychosocial and offending variables are presented in Table 5.2.

Interrater Reliability

For substance use, there was perfect agreement for the classification (no use, past use, past harmful use or past dependency) of solvents, heroin, cocaine, amphetamine and tranquilisers ($\kappa = 1.00$, $p = .014$) and good agreement for alcohol ($\kappa = .714$, $p = .012$), cannabis ($\kappa = .739$, $p = .011$) and ecstasy ($\kappa = .667$, $p = .083$). For PCL-R scores, consistency was excellent for Factor 1 score (ICC=.963, $p = .002$), Factor 2 score (ICC=.969, $p = .001$) and Total score (ICC=.979, $p < .001$). For childhood psychosocial deprivation, total score consistency was excellent (ICC=.987, $p < .001$). For the Gunn and Robertson severity of violence scale, there was perfect agreement for severity of the index offence ($\kappa = 1.00$, $p = .014$), and good agreement for severity of the previous record ($\kappa = .769$, $p = .001$).

Demographic Characteristics

The groups were matched on age ($p = .800$) but not ethnicity (white vs. non-white; $p = .003$); the DPD group had a higher proportion of white participants compared to both other groups, who did not differ from each other. There was a significant difference in length of stay between the groups (at their time of participation in the study; $p = .048$). Follow up Mann-Whitney tests showed a significantly longer stay in the comorbid group compared to the DPD group ($p = .026$), with a trend for the comorbid group to have a longer stay than psychosis ($p = .070$).

Clinical Characteristics

Medication

There was a significant group difference in the proportion of patients prescribed atypical antipsychotics: the comorbid and psychosis groups were prescribed these more often than the DPD group. There was also a significant group difference for mood stabiliser prescriptions, in that the comorbid group were more likely to be taking this type of medication compared to either the DPD or psychosis group (who did not differ from one another). This likely reflects a higher proportion of schizoaffective disorder within the comorbid group, and six out of nine with a schizoaffective disorder diagnosis were receiving a mood stabiliser. There were no significant group differences in the number of participants that were prescribed a typical psychotic, an antidepressant or an anxiolytic. There was an effect of group for chlorpromazine (CPZ)

equivalents; the comorbid and psychosis groups had a significantly higher dose compared to the DPD group (both $p=.001$), but did not differ from each other ($p=.841$).

Years since Illness Onset

When comparing the psychosis and comorbid groups (as by definition personality disorder requires the presence of traits which often begin in childhood, a discrete ‘onset period’ would be inappropriate; see Chapter One), the comorbid group had significantly more years since onset of psychosis ($p=.019$).

Comorbidity

Amongst the personality disorder groups (DPD and comorbid), a large proportion had additional PD diagnoses including Emotionally Unstable, Paranoid and Narcissistic PDs. Other mental disorders amongst the groups included Autism Spectrum Disorders, Hyperkinetic Disorder, Somatoform Disorder and Generalised Anxiety Disorder.

Substance Misuse

Categorical analysis of the proportion of participants within particular groups with a history of harmful use of any substance ($\chi^2=3.12$ $p=.211$) or dependence on any substance ($\chi^2=1.08$, $p=.583$) revealed no significant group differences. There were also no significant group differences between the number of substances for which harmful use was rated ($p=.166$) or for which dependency was rated ($p=.808$).

Psychopathy

There was a significant main effect of Factor type ($p<.001$, partial $\eta^2=.435$). Inspection of means showed that Factor 2 scores were higher than Factor 1 across all three groups. There was also a significant main effect of Group ($F_{(2, 54)}=29.38$, $p<.001$, partial $\eta^2=.521$): post-hoc comparison of means demonstrated that PCL-R scores were highest amongst the DPD group compared to the psychosis group ($p<.001$), but did not differ from the comorbid group ($p=.117$). Both the DPD and comorbid group scored higher than the psychosis group (both $p<.001$).

There was a significant Group x Factor type interaction ($F_{(2,52)}=3.92$, $p=.026$, partial $\eta^2=.127$). Post-hoc testing demonstrated that Factor 1 scores were significantly different between the groups, with DPD scoring higher than both the comorbid ($p=.009$) and psychosis ($p<.001$) groups, and the comorbid group scoring higher than the psychosis group ($p=.044$). For Factor 2 scores, post-hoc comparisons revealed that the DPD group and comorbid group did not significantly differ from one another ($p=.994$), but both scored significantly higher than the psychosis group (both $p<.001$).

Thus the groups vary as a function of Factor type, with significantly higher Factor 1 scores in the DPD group compared to both comorbid and psychosis groups, and significantly higher Factor 2 scores amongst both the DPD and comorbid groups compared to psychosis. The analysis of total PCL-R scores (Factor 1 + Factor 2 + 2 additional items) revealed a significant main effect of Group and post-hoc comparison of means indicated that all three groups significantly differed from one another: DPD scored higher than psychosis ($p < .001$) and comorbid ($p = .037$), and comorbid scored higher than psychosis ($p < .001$).

Psychosocial Characteristics

Childhood Psychosocial Deprivation

One-way ANOVA revealed a significant main effect of Group in the Total Deprivation scores ($p = .017$, partial $\eta^2 = .139$), with post-hoc comparisons indicating that there was a significant difference was between the psychosis and DPD groups ($p = .015$) but that the comorbid group did not differ from DPD ($p = .128$) or psychosis ($p = .541$) groups. Due to the non-normal distribution of individual subscale scores, follow up Mann-Whitney tests between the psychosis and DPD groups on the eight individual psychosocial deprivation subscales demonstrated significantly higher scores amongst the DPD group for physical abuse ($p = .011$), neglect ($p = .002$), and foster home placement ($p = .007$), with a trend level difference for extreme poverty ($p = .089$).

Table 5.1 - Skewness, Kurtosis and Equality of Variance for Continuous Variables

Measure	<u>Psychosis</u>				<u>DPD</u>				<u>Comorbid</u>				Levene Test for Equality of Variance [†]	P
	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score		
Age	.947	1.63	.037	.033	.582	1.06	.248	.233	.270	.582	-.809	-.897	.710	.496
CPZ Equivalent	-.021	-.037	-1.37	-1.23	2.69	4.89*	8.36	7.86*	2.59	5.68*	7.25	8.17*	1.15	.323
Years since Illness Onset	.245	.423	-1.19	-1.06	-	-	-	-	.290	.625	-.922	-1.02	.275	.603
Current Length of Stay in Hospital	2.79	4.80*	8.79	7.84*	2.15	3.91*	4.06	3.82*	2.73	5.89*	10.36	11.49*	.101	.904
PCL-R Total	.992	1.71	.203	.180	-.660	-1.20	.198	.186	-.495	-1.07	-.474	-.526	.071	.931
PCL-R Factor 1	.994	1.71	.339	.303	-.146	-.265	-1.28	-1.21	-.636	-1.37	-.637	-.707	.988	.379
PCL-R Factor 2	.335	.578	-.777	-.693	-.199	-.362	-.661	-.622	-1.09	2.34*	1.54	1.71	.294	.747
No. Substances with Harmful Use	.841	1.45	-.470	-.419	.237	.432	-.505	-.475	1.88	4.05*	4.27	4.73*	1.45	.244
No. Substances with Dependency	.802	1.38	-.127	-.113	2.60	4.72*	7.38	6.94*	3.04	6.56*	10.48	11.62*	.784	.462
Psychosocial Deprivation Total Score	.170	.293	-1.27	-1.14	-.686	-1.25	-1.11	-1.04	.276	.595	-1.25	-1.38	.646	.528
Physical Abuse	1.87	3.23*	2.50	2.23*	-.259	-.471	-1.10	-1.04	.865	1.86	-.937	-1.04	.760	.473
Sexual Abuse	1.29	2.22*	.185	.165	.240	.437	-1.75	-1.65	2.94	6.33*	10.94	12.14*	9.38	.000*
Neglect	2.54	4.38*	7.07	6.31*	-.800	-1.46	-.698	-.656	.049	.106	-1.59	-1.77	6.58	.003*
Extreme Poverty	1.98	3.40*	3.82	3.41*	-.069	-1.25	-1.80	-1.70	.534	1.15	-.742	-.823	2.44	.097
Foster Home Placement	3.25	5.59*	11.15	9.94*	-.124	-.225	-1.94	-1.82	.723	1.56	-1.34	-1.49	10.8	.000*
Criminal Parent	1.04	1.80	.496	.442	1.16	2.10*	-.065	-.061	1.07	2.30*	-.452	-.501	1.93	.155

<i>Severe Family Conflict</i>	.336	.579	-1.81	-1.62	.473	.860	-1.87	-1.76	1.31	2.82*	.364	.403	3.45	.039*
<i>Broken Home</i>	-.542	-.935	-1.70	-1.52	-.209	-.379	-1.43	-1.34	-.314	-.677	-1.10	-1.22	.613	.545
No. Previous Offences	2.20	3.80*	6.00	5.35*	2.15	3.90*	5.50	5.18*	2.20	4.75*	6.95	7.71*	3.69	.031*
<i>Log+1 Transformation</i>	.248	.428	-.886	-.791	-.046	-.084	.049	.046	-.320	-.689	-.379	-.420	.203	.817
Gunn & Robertson Index Offence	-1.17	-	.593	.529	-1.10	-	.769	.723	-.463	-1.00	-1.16	-1.28	.288	.751
Gunn & Robertson Previous Record	.812	1.40	-.501	-.447	-.886	-1.61	-.109	-.103	-.739	-1.59	.063	.069	1.16	.322

* Significant at $p < .05$; † Based on mean

Table 5.2 - Mean (SD) Scores And Inferential Statistics for Demographic, Clinical, Psychosocial and Offence Related Variables

Variable	<u>Psychosis</u> Mean (SD)	<u>DPD</u> Mean (SD)	<u>Comorbid</u> Mean (SD)	Test Statistic	df	p-value	Direction of Effect
Demographic							
Age (years)	34.9 (7.76)	36.7 (10.9)	36.9 (9.36)	F=.224	2,55	.800	-
Ethnicity (% white)	53.3%	88.2%	34.6%	$\chi^2=12.0$	2	.003*	DPD>COM, PSY
Current Length of Stay in Hospital (months)	42.5 (60.3)	42.0 (61.8)	61.8 (58.8)	H=6.06	2	.048	COM>DPD
Clinical							
<u>PCL-R Score (Total)</u> ^a	11.8 (5.83)	27.1 (6.21)	22.4 (5.42)	F=28.9	2,54	<.001*	DPD>COM>PSY
<i>Factor 1</i>	4.33 (2.99)	10.8 (3.75)	7.59 (3.34)	F=14.4	2,54	<.001*	DPD>COM>PSY
<i>Factor 2</i>	6.73 (3.63)	14.0 (3.61)	13.7 (3.40)	F=22.5	2,54	<.001*	DPD, COM>PSY
Substance Use: Any Harmful Use (%)	46.7	76.5	65.4	$\chi^2=3.12$	2	.211	-
Substance Use: Any Dependence (%)	46.7	29.4	34.6	$\chi^2=1.08$	2	.583	-
Number of Substances with Harmful Use	.60 (.74)	1.18 (.88)	1.31 (1.52)	H=3.59	2	.166	-
Number of Substances with Dependency	.53 (.64)	.65 (1.32)	.65 (1.32)	H=.426	2	.808	-
Years since Onset of Psychosis	12.3 (8.62)	- -	18.7 (7.68)	t=-2.45	39	.019*	COM>PSY
<u>Comorbidity</u>							
<i>Emotionally Unstable PD</i>	1	5	6	-	-	-	-
<i>with Narcissistic PD</i>	-	2	-	-	-	-	-
<i>with Paranoid PD</i>	-	1	-	-	-	-	-
<i>Paranoid PD</i>	0	2	0	-	-	-	-
<i>Narcissistic PD</i>	0	1	0	-	-	-	-
<i>Autism Spectrum Disorder</i>	1	2	1	-	-	-	-

Variable	Psychosis	DPD	Comorbid	Test Statistic	df	p-value	Direction of Effect
<i>Generalised Anxiety Disorder</i>	0	1	0	-	-	-	-
<i>Somatoform Disorder</i>	1	0	0	-	-	-	-
<i>Hyperkinetic Disorder</i>	0	1	0	-	-	-	-
<u>Medication Type</u>							
<i>Typical Antipsychotic</i>	20.0%	5.9%	26.9%	$\chi^2=2.98$	2	.226	-
<i>Atypical Antipsychotic</i>	80.0%	41.2%	84.6%	$\chi^2=10.2$	2	.006*	COM,PSY>DPD
<i>Mood Stabiliser</i>	13.3%	17.6%	46.2%	$\chi^2=6.52$	2	.038*	COM>PSY
<i>Antidepressant</i>	26.7%	17.6%	15.4%	$\chi^2=.815$	2	.665	-
<i>Anxiolytic</i>	6.7%	29.4%	15.4%	$\chi^2=3.00$	2	.223	-
<i>CPZ Equivalent</i>	553.5	229.4	660.7	U=14.4	2	.001	COM, PSY>DPD
Psychosocial							
<u>Psychosocial Total Score</u>	7.27 (5.85)	14.35 (7.12)	9.96 (7.21)	F=4.42	2,55	.017*	DPD>PSY; COM=DPD, PSY
<i>Physical Abuse</i>	.667 (1.29)	2.06 (1.43)	1.19 (1.50)	U=61.5	31	.011*	DPD>PSY
<i>Sexual Abuse</i>	1.00 (1.51)	1.76 (1.68)	.462 (.859)	U=93.0	31	.202	-
<i>Neglect</i>	.400 (.828)	2.12 (1.32)	1.73 (1.48)	U=46.0	31	.002*	DPD>PSY
<i>Extreme Poverty</i>	.667 (1.18)	1.65 (1.50)	1.31 (1.19)	U=82.5	31	.089	-
<i>Foster Home Placement</i>	.400 (1.06)	2.12 (1.76)	1.27 (1.69)	U=57.0	31	.007*	DPD>PSY
<i>Criminal Parent</i>	.800 (.941)	1.12 (1.45)	1.12 (1.47)	U=120.5	31	.794	-
<i>Severe Family Conflict</i>	1.60 (1.72)	1.29 (1.61)	.962 (1.40)	U=111.5	31	.551	-
<i>Broken Home</i>	1.80 (1.37)	2.24 (1.52)	2.02 (1.36)	U=103.5	31	.370	-
Offence Related							
Gunn and Robertson: Index Offence	3.27 (.961)	3.24 (.903)	3.23 (.765)	H=.177	2	.915	-

Variable	<u>Psychosis</u>	<u>DPD</u>	<u>Comorbid</u>	Test Statistic	df	p-value	Direction of Effect
Gunn and Robertson: Previous Record	1.53 (1.36)	3.18 (.951)	2.81 (1.10)	F=9.33	2, 55	<.001*	DPD,COM>PSY
Number of Previous Offences	3.20 (4.20)	18.65 (17.44)	15.73 (14.40)	F=16.59	2, 55	<.001*	DPD, COM>PSY
History of Violent Offences (%)	33.3%	76.5%	69.2%	$\chi^2=7.33$	2	.026*	DPD, COM>PSY
History of Acquisitive Offences (%)	13.3%	70.6%	80.8%	$\chi^2=19.1$	2	<.001*	DPD,COM>PSY
History of Drug Offences (%)	13.3%	11.8%	34.6%	$\chi^2=4.05$	2	.132	-

DPD: Dissocial Personality Disorder; COM: Comorbid; PSY: Psychosis; PCL-R: Psychopathy Checklist Revised.

a – Reduced n for PCL-R scores – comorbid group n= 25

Offending Characteristics

Offending History

There was a significant main effect of Group for number of previous offences ($p < .001$, partial $\eta^2 = .376$). Post-hoc tests indicated significantly fewer previous offences for the psychosis group compared to the other two groups (both $p < .001$), who did not differ from one another ($p = .854$).

Prior to their index offence, the psychosis group were less likely to have a history of violent ($p = .026$) or acquisitive offending ($p < .001$), compared to both other groups. The groups did not differ in their history of drug offences ($p = .132$).

Severity of Violence

There was a significant main effect of group for violence severity in the previous record ($p < .001$, partial $\eta^2 = .253$), but not for the index offence ($p = .915$). Post-hoc comparisons showed that the DPD ($p < .001$) and comorbid ($p = .003$) groups had a more severe history of violence compared to the psychosis group. The DPD group did not differ from the comorbid group ($p = .653$).

Discussion

The findings reported here support the notion that violent offenders with psychosis are not a homogenous group, and that distinct subgroups are evident (Bo et al., 2011; Hodgins, 2008; Volavka & Citrome, 2008). In this sample, offenders with psychosis and comorbid DPD differed from their non-DPD counterparts in psychopathy scores (lower in non-DPD), years since illness onset (fewer years in non-DPD) and their history and extent of offending (fewer previous offences and no/weak history of violence prior to the index offence in non-DPD), yet had similar histories of substance misuse, index offence severity and childhood psychosocial deprivation. On the whole, those with psychosis and DPD did not differ greatly from those with DPD alone; these two groups had similar substance misuse histories, Factor 2 PCL-R scores, childhood psychosocial deprivation, severity of index offence and offending histories.

Diagnoses reported here were DPD as opposed to ASPD. As discussed in Chapter One this diagnosis shares considerable overlap with DSM 5 ASPD, aside from some impulsivity characteristics; in the current sample 97.4% (all participants except 1) in the ASPD/comorbid groups were rated as 1 or 2 on the 'Impulsive' item of the PCL-R, indicating definite or probable impulsivity, increasing the confidence that the group is largely comparable to those with an ASPD diagnosis, and orientation of the results within the ASPD literature seems appropriate.

The observed increase in psychopathy scores amongst the DPD and comorbid groups compared to the psychosis group supports the hypothesis, and is perhaps to be expected given the diagnostic criteria for DPD, which overlaps with the PCL-R criteria (i.e. the ICD-10 specifies callousness, irresponsibility, problems with relationships, aggression/violence, a lack of remorse or guilt and

a failure to accept responsibility which are all represented to some extent amongst items in the PCL-R). This is consistent with the findings of Moran and Hodgins (2004) who, using the three factor model of psychopathy (Cooke & Michie, 2001), showed elevated scores on all factors in the comorbid compared to psychosis alone group. Moran and Hodgins identified a deficient affective experience to best distinguish the comorbid group from those with psychosis but without ASPD. The current findings support this difference and further suggest that the DPD alone group display these traits to a greater extent/severity than the comorbid group, as reflected by significantly higher Factor 1 scores than both other groups. Thus, although the comorbid group do show more deficient affective experience than the psychosis alone group, this is not to the same degree as the DPD alone group. The total PCL-R score was significantly higher in the DPD alone group. This highlights an important role of previous short term marital-type relationships and promiscuous sexual behaviour, as without these items no significant difference between DPD and the comorbid group was noted. Indeed, 12 out of 17 participants in the DPD group were rated as having sexually promiscuous behaviour as 'present' compared to only eight out of 23 in the comorbid group, and the presence of many, short term marital relationships was observed in four DPD participants and only one comorbid participant. This is perhaps unsurprising given the social cognition problems (Penn, Sanna, & Roberts, 2008) and low rate of intimate relationships (Thornicroft et al., 2004) in individuals with psychotic disorder. Alternatively, this could reflect the trend for the comorbid group to have a longer length of hospitalisation, perhaps conferring less opportunity in the community to develop marital-type relationships.

Psychosocial deprivation in general was high in all three groups. There were only four participants (n=2 psychosis, n=2 comorbid) who had no evidence whatsoever of childhood psychosocial deprivation. The highest levels of deprivation were observed in the DPD group, who did not significantly differ from the comorbid group, but had significantly higher scores than the psychosis alone group. Contrary to the hypothesis, the comorbid group did not differ from either group but took an intermediary position. This is consistent with research highlighting high levels of childhood abuse and neglect for those diagnosed with a personality disorder, and specifically paranoid PD and ASPD which were predicted by childhood sexual and physical abuse in one study (Bierer et al., 2003). Further, Luntz and Widom (1994) found that the number of ASPD symptoms was predicted by childhood victimisation experiences (physical abuse, sexual abuse, neglect) in a prospective cohort at 20 year follow up. The current findings support the notion that childhood psychosocial deprivation is related to the development of antisocial personality traits, as evidenced by a non-significant difference in deprivation scores between the two groups with DPD, but a significantly higher rate in those with DPD alone compared to those with only a psychotic disorder.

The psychosocial deprivation subscales which specifically characterised the DPD group in the current investigation compared to psychosis alone were physical abuse, neglect and foster home

placement. This is consistent with recent research in a large, non-clinical sample showing that physical abuse, physical neglect, teasing, and level of father care made the largest contributions to the prediction of ASPD symptoms (Krastins, Francis, Field, & Carr, 2014). Neglect and foster home placement are likely to be associated with ASPD due to a lack of a secure attachment figure during early development. The presence of callous unemotional traits amongst children with disruptive behaviour disorders has been linked to insecure attachment with a caregiver (Pasalich, Dadds, Hawes, & Brennan, 2012), and it is likely that such individuals will be at high risk to go on and develop ASPD (Moffitt, Caspi, Harrington, & Milne, 2002). The mechanism by which physical abuse leads to future antisocial personality characteristics could be related to ‘cycle of violence’ explanations, in that observing/experiencing high levels of violence in childhood leads to adoption of this behaviour as a problem solving strategy for the future. In addition, genetic transmission of traits likely linked to antisocial and violent behaviours (assuming physical abuse is perpetrated by biological relatives) is also a potential explanation, and ASPD traits have been shown to be heritable (Kendler, Aggen, & Patrick, 2012). Thus an abusive parent may give rise to an antisocial/violent child via either environmental or genetic pathways, or likely an interaction of both.

In contrast to the findings of Moran and Hodgins (2004) and thus the given hypothesis, historical substance misuse did not differ between the three groups, both in terms of any harmful use/dependency, or in the number of substances for which harmful use/dependency was rated. This differential may be a reflection of the fact that all patients in this study were offenders and recruited from a high security hospital, whereas in the Moran and Hodgins investigation, approximately 37% of participants were recruited from general psychiatric hospital, and thus may reflect a less ‘severe’ group. Nevertheless, substance misuse was prolific within the sample and very high levels of harmful use of at least one substance were noted amongst all three groups. This emphasises that substance misuse represents a transdiagnostic target for forensic mental health services, especially in light of its known association with reoffending in mentally disordered offender populations (Howard et al., 2013).

Group differences were evident and in line with hypotheses for offence related variables. The groups did not differ in the severity of their index offence, which is largely unsurprising given that all participants were resident in high-security hospital and thus must pose ‘a grave risk of danger to the public’ (National Health Service [NHS] England, 2014b). Extent and severity of previous offending did differ between groups, with the two DPD groups (alone and comorbid with psychosis) showing a greater history of violence than the psychosis alone group. This is consistent with Hodgins’ (2008) ‘early start’ offender subtype, in that these individuals have a history of more offences which tend to begin early in life. This has important implications for early intervention. One study identified that approximately 20% of men presenting with a first episode of psychosis had a history of committing a violent crime before the onset of psychosis

(Hodgins et al., 2011), which could indicate to early intervention services that these individuals are likely to be those that go on to meet criteria for both psychosis and DPD/ASPD, and that interventions should be directed at criminogenic as well as symptomatic factors to reduce the likelihood of future offending and/or violence.

Further, consistent with the hypothesis, the comorbid group had a greater number of years since onset of psychosis than the psychosis group. When considering the typologies of offender described by Volavka and Citrome (2008) and Bo and colleagues (2011), a subtype that offends due to the presence of the positive symptoms of psychosis is described. Thus, it may be that the psychosis alone group's index offence and onset of psychosis occurred contemporaneously, resulting in their admission to forensic psychiatric services, and thus having fewer years since illness onset than the comorbid group at the time of participation. It is likely that the comorbid group's offences were more related to antisocial personality traits than symptoms (Joyal et al., 2004) and thus illness onset may have predated the index offence, resulting in longer illness duration for this group. Length of stay also tended to be longer in the comorbid group compared to the psychosis group, albeit at a trend level only, which was not anticipated when making hypotheses. This may reflect the relative lack of treatment options available for enduring antisocial personality traits when compared to psychotic disorders alone which are usually well managed with antipsychotic medication (Davis, Chen, & Glick, 2003; Lewis et al., 2006; Swartz et al., 2007), including showing some efficacy for the treatment of violent behaviour (Krakowski, Czobor, Citrome, Bark, & Cooper, 2006). The comorbid group likely have more complex needs, requiring more complex interventions. Further research is needed to develop treatments which target antisocial traits, although recent evidence indicates some positive preliminary results for pharmacological (Brown et al., 2014) and psychosocial (Young, Hopkin, et al., 2013) interventions. Additional explanations are probable though, given a significantly reduced length of stay in the DPD alone participants compared to comorbid; it could be that those with only an DPD diagnosis are more likely to be referred back to prison settings after a short period of assessment and/or treatment, due to fewer available treatment options in forensic mental health services making this placement less suitable.

Strengths and Limitations

This study fills a gap in the literature by exploring the characteristics of three diagnostic groups in a well characterised, high risk sample of mentally disordered offenders and specifically comparing a comorbid group to a group with DPD and no psychosis. However, some limitations must be acknowledged. Firstly, there were high levels of comorbidity with other disorders (not under investigation here) amongst participants, which may introduce some characteristics specific to other disorders, and thus confound results. However, comorbidity in clinical samples is an unavoidable reality and thus it is hoped the results reflect high levels of ecological validity, and

are applicable across other samples with additional comorbidities. Additionally, no research confirmation of the diagnosis/diagnoses was made, and the study was reliant on clinical diagnoses made in routine practice. Yet, considering the high level of monitoring, supervision and clinical input received by these patients, we can be relatively confident in the accuracy of diagnoses which were made by experienced consultant forensic psychiatrists highly involved in each participant's care, with input from other members of the multidisciplinary team. Finally, ratings were made based on extraction from hospital files. It is possible that some information was not recorded in these notes, or that a supplemental interview may have added additional information which could not be reliably extracted from records, for example some of the Factor One personality traits of the PCL-R may be more readily observable from clinical interview. However, acceptable inter-rater reliabilities were obtained, somewhat ameliorating this concern.

Chapter Summary

The results presented in this chapter indicate that the comorbid group is more similar to the DPD alone group than the psychosis group in terms of their psychosocial histories, severity of offending and offending histories, in addition to their level of psychopathic traits. This suggests that, despite the presence of psychosis, treatment should also focus on these historical and criminogenic factors amongst both DPD groups, including substance misuse and trauma focussed work for childhood psychosocial deprivation, which appears to be problematic for all three groups. The majority of hypotheses were supported suggesting that the findings presented here are in line with previous investigations, despite diagnoses being DPD as opposed to ASPD.

The following chapter will explore whether these three groups differ on other indices including neuropsychological and emotion processing characteristics, in order to gain a fuller understanding of these subtypes.

6 Chapter Six: Cognitive and Emotion Processing Characteristics of Comorbid Psychosis and DPD

Chapter Aims and Overview

This chapter provides empirical data on the similarities and differences relating to cognition and emotion processing amongst the three clinical groups (psychosis, DPD and comorbid) and compares them to healthy, non-violent control participants. It is important to understand these characteristics, as they inform models of violent behaviour, for example Blair's Integrated Emotional Systems model (Blair, 2005; see Chapter Two), and the Violence Inhibition Mechanism (Blair et al., 1997; see Chapter Three), which can aid our understanding of such behaviours and thus assist in directing therapeutic efforts. First, the systematic review and meta-analysis presented in Chapter Two regarding cognitive and emotional processing characteristics is briefly summarised to justify hypotheses

Introduction

Meta-analytic data presented in Chapter Two indicated that both violent individuals with psychotic disorders and ASPD have poor cognitive functioning compared to healthy controls. Specifically, for general intelligence, IQ scores were significantly lower in the schizophrenia group compared to the ASPD group, who in turn had significantly lower scores than the healthy controls. Memory was impaired amongst individuals with schizophrenia compared to controls and ASPD, and the ASPD group were also significantly lower than controls. For executive function, the two clinical groups likely did not differ from one another, although were both poorer than healthy controls. The effect size of this deficit was larger amongst those with psychosis compared to ASPD, but with the caveat of high heterogeneity amongst the psychosis group. This heterogeneity adds weight to the hypothesis that violent schizophrenia is not a homogenous group, and that there may be subgroups characterised by differing levels of cognitive function.

The emotion perception evidence reviewed in Chapter Two suggested that violent individuals with psychotic disorder are impaired in recognising emotional expressions of emotion, as is consistent with the wider schizophrenia literature (Trémeau, 2006). Specifically when comparing violent and non-violent schizophrenia groups, it would appear that there are subtle differences in the violent group, for example in perceiving facial dominance (Antonius et al., 2013) or discriminating between emotional intensities (Silver et al., 2005). However, a meta-analysis of facial affect processing in schizophrenia found that there were modest associations between affect recognition and neurocognition (i.e. the domains of the MATRICS neuropsychological battery), leading the authors to surmise that neurocognition and social cognition are related and overlapping constructs, and facial affect recognition deficits may represent a more general problem with cognitive function (Ventura et al., 2013).

For ASPD, deficits were also noted in facial affect recognition, compared to healthy controls, with studies indicating specific deficits in recognising happiness, sadness, disgust, neutral and surprise. Experiential emotion was a far less commonly studied phenomenon amongst these groups, but the available evidence suggests high fear in violent schizophrenia (Kumari, Das, et al., 2009), low fear in ASPD, which may be mediated by high psychopathy traits (Kumari, Das, et al., 2009; Loomans et al., 2015) and high cognitive arousal when angry in ASPD (Lobbestael et al., 2009). No studies to date have examined the experience of emotion in a comorbid group.

Only one investigation to date has specifically examined cognitive and emotion processing characteristics amongst individuals with schizophrenia and comorbid ASPD (Tang et al., 2016). This study found that patients with both diagnoses made more perseverative errors on the WCST than those with schizophrenia alone, and also had more difficulty recognising the facial emotions of anger, surprise and disgust. Both groups with schizophrenia performed poorly, relative to healthy controls, on recognising all basic emotions with the exception of happy. This is consistent with another study examining the effects of antisocial personality traits in violent men with schizophrenia, which found that high psychopathy scorers performed worse at recognising sad faces, compared to medium or low psychopathy scorers (Fullam & Dolan, 2006), suggesting that a putatively comorbid group may have characteristics which are distinct from a violent schizophrenia group more broadly.

However, whilst providing interesting preliminary insights into cognition and emotion within comorbid schizophrenia and ASPD, the Tang and colleagues (2016) study had a number of limitations which the current investigation hopes to overcome. Firstly, there was no ASPD alone comparison group, making it difficult to parse apart the different components attributable to each diagnosis and precluding direct group comparisons. Secondly, the groups were not accurately characterised on the level and severity of violent behaviour making the comparability with other violent groups unclear, and comparison with a *violent* group of men with a psychotic disorder yet no ASPD would serve as a better comparison group in this case. The study did correlate life history of aggression scores with poorer recognition of negatively-valenced emotions (sad, angry, fear, disgust), but this correlation was only significant amongst the comorbid group.

Thirdly, the emotion perception task only consisted of two presentations of each emotion, which may have limited power to detect meaningful differences. Finally, although a number of cognitive tests were administered (Non-Verbal Intelligence 3 [TONI-3], digit span, Stroop test, category fluency and the Wisconsin Card Sorting Test [WCST]), the group differences were not reported for all tasks and were investigated only as potential mediators of the emotion processing task. A more robust battery assessing different cognitive domains would be beneficial (i.e. Stroop, WCST and category fluency are all sensitive to executive function).

Thus, it was hypothesised in the current investigation that:

1. The groups with psychotic disorder diagnoses (psychosis alone and/or comorbid groups) would have significantly poorer performance relative to all groups across tests of intelligence and memory, and that the DPD group would score significantly lower compared to healthy controls. It was anticipated that executive dysfunction would be similar amongst clinical groups, but impaired relative to healthy controls.
2. In terms of emotion processing, a deficit in all clinical groups was expected for recognition of emotions compared to healthy controls, with the comorbid group likely performing worse than the psychosis alone group. Exploratory analyses assessing the role of the neuropsychological function on emotion processing were also planned, given the assertion that neurocognition and social cognition may overlap.
3. The psychosis group was expected to show high, and DPD low, experiential fear and anxiety, relative to healthy control participants. No directional hypothesis for the comorbid group was made for experiential emotion due to a lack of relevant previous studies examining experimental measures of experiential emotion amongst this group.

Method

Participants and Design

The participants that make up this sample have been previously described and characterised in Chapter Five. The clinical groups are composed of 15 individuals with a diagnosis of psychotic disorder and no DPD, 17 individuals with DPD and no comorbid psychosis, and 26 individuals with both psychosis and DPD. In addition, this study compared the clinical groups with 30 members of hospital staff (healthy control group). As a requirement to work within the high secure forensic hospital, all staff undergo extensive criminal record checks, allowing us to assume that all staff had no significant history of violent behaviour. All healthy controls were screened using the SCID (non-patient version) (First, Spitzer, Gibbon, & Williams, 2002) to exclude any mental disorder, were free from traumatic brain injury and had normal or corrected to normal vision and hearing. Staff worked in clinical and non-clinical areas in the hospital for example nursing, maintenance, security and reception. The study used a between-groups design.

Measures

General Intelligence

Wechsler Test of Adult Reading (WTAR)

The WTAR is a measure of premorbid intelligence, i.e. IQ (intelligence quotient) before the onset of illness. It is thought to be a measure of ‘crystallised intelligence’ as opposed to ‘fluid intelligence’ (Horn & Cattell, 1967), in that it is sensitive to facets of intelligence that have been taught, rather than involving inductive reasoning or concept formation, for example. Crystallised intelligence is considered to be relatively preserved after traumatic brain injury or illness onset (Nelson & O'Connell, 1978). Thus, reading tests comprised of irregularly spelt words are thought to assess this construct, as the participant cannot rely on decoding them using phonological rules so must have acquired the correct pronunciation through previous learning (Strauss, Sherman, & Spreen 2006).

The WTAR is one such reading test and has shown to be a valid index of premorbid IQ, as evidenced by score stability during recovery from brain injury (R. Green et al., 2008), suggesting it is sensitive to prior cognitive abilities and does not improve as the recovery progresses. WTAR score has also been shown to correlate with childhood cognitive ability in a longitudinal cohort of healthy older people (Dykiert & Deary, 2013), adding further support for its use as a measure sensitive to prior ability. This study also demonstrated score stability prospectively over three years and reported high inter-rater reliability for the measure ($r's > .90$). The WTAR has additionally been shown to have concurrent validity with other premorbid IQ measures such as the Wide Ranging Achievement Test (4th edition; two subtests) ($r's = .50-.62$ C. M. Mullen & Fouty, 2014) and the National Adult Reading Test ($r = .89$, Dykiert & Deary, 2013).

Use in relevant populations: The WTAR has been used in studies of patients with psychosis (Leeson et al., 2011) demonstrating significant cognitive decline after the onset of psychosis for a subgroup of patients, but no cognitive decline in others. Premorbid IQ was correlated with a number of other cognitive variables in the Leeson and colleagues sample, including immediate verbal memory, verbal learning, and planning. In addition, similar tests of premorbid IQ relying on pronunciation accuracy (The National Adult Reading Test) have been used in studies within forensic mental health services with individuals with ASPD and schizophrenia demonstrating no significant differences in premorbid IQ between diagnostic groups, or between clinical groups and healthy controls (Dolan & Fullam, 2006; Kumari, Das, et al., 2009).

Procedure: Participants were required to read aloud a list of 50 irregularly spelled words which were printed on an A4 page across two columns. They were scored on the accuracy of their pronunciation (correct/incorrect) and a total score out of fifty was obtained. Participants were instructed to attempt to read every single word, even if they were unsure. The test was

discontinued after 12 incorrect consecutive responses. The test lasted between two and five minutes. The dependent variable was premorbid full scale IQ, as reported in the WTAR manual.

Memory

Hopkins Verbal Learning Test – Revised (HVLT-R)

The HVLT-R (Benedict, Schretlen, Groninger, & Brandt, 1998) is a measure of verbal learning and memory which allows measurement of immediate, delayed and recognition memory. The HVLT-R has demonstrated construct validity in a large (n=359) sample (Shapiro, Benedict, Schretlen, & Brandt, 1999); a principal components factor analysis, with four components specified, accounted for 78.2% of the variance in a range of neuropsychological test scores (including Brief Visuospatial Memory Test – Revised, Controlled Oral Word Association Test, Visual Motor Integration, Benton Naming Test and Trail Making Test), and the majority of scores for the HVLT-R loaded onto a separate factor suggesting it is distinguishable from other tests of cognitive function. In addition, the strongest correlations were observed between HVLT-R scores, WMS logical memory and WMS Visual Reproduction scores, with more modest correlations observed between verbal and performance IQ. This indicates specificity to the memory construct, and comparable results to other relevant measures (convergent validity). This study also examined the ability of scores to differentiate between dementia patients and healthy controls; scores on five of the HVLT-R summary measures were able to distinguish patients and controls with 90.4% accuracy.

Use in relevant populations: The HVLT-R has been used in individuals with affective and non-affective psychosis (Lewandowski, Cohen, Keshavan, & Öngür, 2011); performance did not differ between these diagnostic groups but was poorer than in healthy controls. Although the HVLT-R does not appear to have been used previously in ASPD, it has been used in a sample of female prisoners (Rocha, Fonseca, Marques, Rocha, & Hoaken, 2015) in which it was shown that lower scores were significantly correlated with the ‘dull and confused’ subscale of the prison behaviour rating scale, reflecting a lack of awareness to surroundings, low energy and mental slowness. Similar verbal learning tests have been used in mentally disordered offender samples, for example the Rey Auditory Verbal Learning Test was administered to violent and non-violent men with schizophrenia, and healthy controls (Chung et al., 2010), revealing significantly worse performance on immediate, delayed and recognition trials in both schizophrenia groups compared to controls.

Procedure: Participants were read a list of 12 words aloud and asked to recall as many as they could immediately afterwards. This same list was repeated another two times, to give a total score out of 36 for immediate recall ability. These twelve words could be roughly categorised into three, semantic groups: precious stones e.g. diamond; animals e.g. tiger; and accommodation types e.g. hotel. After a twenty minute delay, participants were asked to recall as many of the 12 words they

could remember (delayed recall score). Following this, 24 words were read aloud comprising the 12 original words and 12 foil words (six which were semantically related to the original list, e.g. another precious stone, and six unrelated). Participants were required to indicate (yes or no) whether the word was present in the original list to give an index of recognition memory. The task took no longer than 10 minutes (excluding delay time) to complete. The dependent variables were total immediate recall score (score range 0-36), delayed recall score (score range 0-12) and discrimination index (defined as the number of correct words recognised minus the number of incorrect words recognised, score range -12 to +12).

Letter Number Span Test (LNS Test)

The LNS test (Gold, Carpenter, Randolph, Goldberg, & Weinberger, 1997) is a measure of verbal working memory requiring participants to firstly retain, and secondly mentally manipulate and report, a string of numbers and letters so that the numbers are stated first from smallest to largest, and the letters are reported second in alphabetical order. Internal consistency of the LNS has proven to be good, with Cronbach's $\alpha=.85$ (Gold et al., 1997). This test was selected as the verbal working memory test to be included in the 'Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) Consensus Cognitive Battery' (MCCB) due to its high test-retest reliability and strong relationship to global functional status in a sample of 176 individuals with schizophrenia, and retested in 167 individuals four weeks subsequently (Nuechterlein et al., 2008). Its selection for inclusion in this battery by expert consensus, over numerous other tests considered, is a testament to the tasks strong psychometric properties.

Use in relevant populations: The MCCB has been utilised in forensic psychiatric settings, including with forensic inpatients diagnosed with schizophrenia or schizoaffective disorder to predict violent incidents (O'Reilly, Donohoe, Coyle, et al., 2015). When specifically examining working memory scores (examined using the LNS), there was no difference between those patients who acted violently and those who did not act violently over a one year period whilst incarcerated. Similar tests of working memory have been examined to characterise violent ASPD patients, such as the n-back paradigm, demonstrating subtle deficits compared to healthy controls, whereas violent men with schizophrenia demonstrated severe deficits (Kumari et al., 2006).

Procedure: Participants were read a string of mixed letters and numbers at the rate of one character per second. The strings varied in length from 2 characters (e.g. w4) to 7 characters (e.g. 3de76k1), with four trials in each category of string length (24 strings in total). Participants were asked to verbally report the numbers first from smallest to largest, followed by the letters in alphabetical order (for example, 3de76k1 would become 1367dek). Before the test began, participants completed practice trials until they were able to complete a three character example. If the participant could not complete a three character example after seven attempts, the test began regardless. Once the participant was unable to correctly respond to all four items at a given string

length, the test was discontinued. The test took between 5 and 10 minutes to administer. The dependent variable was total number of correct trials completed (score range 0-24).

Wechsler Memory Scales, 4th edition (WMS-IV) – Visual Reproduction

The visual reproduction subtests (immediate and delayed) of the WMS-IV (Wechsler, 2009) were administered as an index of visuospatial memory. The WMS-IV manual (Wechsler, 2009) reports high test-retest reliability for the ten index scores (.79-.82; of which Visual reproduction immediate and delayed are two), and also high split half reliability (.93-.96). The scores on the visual reproduction subtest distinguish healthy controls from individuals with mild/moderate traumatic brain injury, and severe traumatic brain injury (Carlozzi, Grech, & Tulsky, 2013), demonstrating that it is sensitive to deviations from normal functioning and providing evidence for construct validity of the task, given known visual memory impairment in this group (Fisher, Ledbetter, Cohen, Marmor, & Tulsky, 2000). In addition, the WMS visual reproduction scale has demonstrated utility for predicting length of stay amongst general psychiatric patients admitted to an inpatient unit, explaining 21.6% of outcome variance and establishing some ecological validity (Kato, Galynker, Miner, & Rosenblum, 1995). Further, the WMS-R visual reproduction subtests (immediate and delayed recall) have demonstrated concurrent validity with another measure of visual recall (Spangenberg, Henderson, & Wagner, 1997).

Use in relevant populations: This test (albeit a previous version, the WMS-R) has been used in a forensic mental health sample comprised of individuals with both major mental disorder (including psychosis) and ASPD (G. Hill et al., 1997), showing subtle differences in those with major mental disorder when they were stratified by ASPD status; those with ASPD made more elaboration errors (i.e. adding extra information to designs). WMS-R visual reproduction performance has also proven to be impaired amongst non-violent individuals with schizophrenia compared to their unaffected siblings and healthy controls (who did not differ from one another), indicating impaired visual memory may be a marker of the clinical phenotype (Skelley, Goldberg, Egan, Weinberger, & Gold, 2008).

Procedure: This subtest is administered by showing participants images/designs and asking them to subsequently reproduce them. There were five trials (designs) in total, of which the first three consisted of just one image per trial, but the final two trials consisted of two adjacent designs. The complexity of images increased as the test progressed. Participants were shown a design which they were asked to look at for ten seconds, which was measured using a stopwatch. The design was then covered up and the participant was asked to reproduce the image from memory by drawing it in a booklet. They were instructed not to start drawing until the design was covered up, and could not draw whilst viewing the design. After a 30 minute delay participants were asked to reproduce the designs again from memory without showing them the stimuli for a second time. Scoring of both parts (immediate and delayed) was conducted using predetermined criteria as set

out in the WMS-IV manual. Participants were not penalised for recalling the images in a different order to originally presented. The task took no longer than 10 minutes (excluding delay) to administer. The dependent variables were age scaled scores for the immediate and delayed condition, retrieved from the WMS-IV scoring manual (score range 0-20).

Executive Function

Wisconsin Card Sorting Test (WCST)

The WCST is the most extensively used neuropsychological measure of executive function (Rabin, Barr, & Burton, 2005), and specifically assesses the ability to form abstract concepts, to shift and maintain a set, and to utilise feedback (Strauss et al., 2006). The test involves sorting cards (which vary on shape, colour and number) according to an unknown rule, which must be deciphered using trial and error upon receiving feedback from the experimenter. After ten cards have been correctly sorted the rule changes, requiring participants to utilise flexible thinking to come up with a new sorting rule. The WCST has shown to have construct validity in a sample of participants with schizophrenia, i.e. the factor loadings of a number of neuropsychological tests (including the WCST) were similar to those observed in brain injury and older patients (loading onto ‘perceptual organisation’), suggesting that the WCST measures the same construct across populations (Allen et al., 1998). Whilst there is evidence disputing the anatomical specificity of the construct(s) measured by the WCST, i.e. the test is not specific to frontal functioning but reliant on a larger network of neural areas (see Nyhus & Barceló, 2009 for critical review), the number of perseverative errors has shown utility in predicting meaningful outcomes such as global functioning amongst individuals with schizophrenia (Martínez-Arán et al., 2001), and employment at three year follow up for individuals experiencing their first episode of psychosis (Chang et al., 2014).

Use in relevant populations: The WCST has been used in a number of investigations of violence and mental disorder, including those with psychosis (Braun et al., 1995; Chung et al., 2010; Majorek et al., 2009) and ASPD (Barkataki et al., 2005). All investigations comparing healthy controls and violent schizophrenia groups suggest significantly more perseverative errors in the violent schizophrenia group (Barkataki et al., 2005; Braun et al., 1995; Chung et al., 2010; Majorek et al., 2009), although the one investigation which examined performance in ASPD found no significant difference compared to controls, although superior performance compared to violent schizophrenia (Barkataki et al., 2005). In the only study to date assessing WCST performance amongst individuals with both schizophrenia and ASPD, the comorbid group was found to make significantly more perseverative errors than the group with schizophrenia alone and healthy controls (Tang et al., 2016).

Procedure: Participants were presented with a computerised version of the WCST run on the Psychological Experiment Building Language (PEBL) programme (Mueller & Piper, 2014),

which was displayed on a laptop computer with a 14-inch monitor (1920 x 1080 resolution). Participants were required to sort 128 cards in total using the mouse to select their chosen deck (although they were not told how many trials there would be; only to keep sorting until the computer ended the task). Written instructions were displayed on screen and read aloud by the experimenter. Participants were asked to sort cards into four 'key card' decks. There was an unknown rule for sorting the cards (i.e. same shape, same colour, same number), and participants were required to work out which rule was correct by testing their hypothesised rule and then receiving feedback from the computer program (correct/incorrect; which was displayed on the screen once the participant had made their selection). Once 10 consecutive cards were correctly sorted, the rule for sorting changed without warning, meaning participants had to discern that the rule had changed, and discard the rule they were using before in favour of deducing the new sorting rule. The test took approximately 10-15 minutes to administer. The dependent variables were total number of errors (score range 0-128), number of perseverative errors (score range 0-118) and categories completed (each set of ten cards; score range 0-9)

Behavioural Assessment of Dysexecutive Syndrome (BADS) – Key Search and Zoo Map

The BADS battery was developed to provide a measure of 'dysexecutive syndrome' that had high ecological validity, i.e. was relevant to, and reflective of, every day difficulties experienced by people with frontal lobe damage/impairment (B. A. Wilson, Evans, Emslie, Alderman, & Burgess, 1998). It is comprised of six subtests, of which two are used in this investigation which are both sensitive to planning abilities: the Key Search and Zoo Map. Initial investigation of the reliability and validity of the BADS battery was conducted in a sample of individuals with brain-injury, schizophrenia and healthy controls (B. A. Wilson et al., 1998). Inter-rater reliability for the BADS subtests was excellent, and ranged from .88-.99. Notably, the key-search test achieved inter-rater reliability of .99, despite the seemingly complex scoring procedure. Both the Key Search and Zoo Map task profile scores distinguished the schizophrenia and control groups, and the brain injury and control groups. In light of the known association with executive functioning problems and these clinical groups (see Goldberg & Bougakov, 2005 for review), this provides meaningful construct validity.

Use in relevant populations: Comparison of two groups of patients with schizophrenia, chronic vs. acute, demonstrated poorer scores on the Zoo Map subtest for the chronic group compared to acute, but no differences on Key Search (Katz, Tadmor, Felzen, & Hartman-Maeir, 2007). In addition, this study examined the predictive validity of the subtests to relate to functional outcomes in the chronic group. They found that the Key Search subtest was significantly positively correlated with work readiness (i.e. following instructions, maintaining a schedule), and the Zoo Map subtest was significantly positively correlated to communication skills and instrumental activities of daily living (i.e. cooking, shopping). The Zoo Map subtest has been used previously in forensic schizophrenia patients (Majorek et al., 2009; Wolfkuhler et al., 2012),

demonstrating poorer planning compared to healthy controls, but no significant difference compared to non-forensic schizophrenia patients. There are no studies to date using this battery in ASPD/DPD samples, although it has been applied in prisoners in an investigation of head injury (Pitman, Haddlesey, Ramos, Oddy, & Fortescue, 2015), a large proportion of whom are likely to have ASPD (Fazel & Danesh, 2002).

Procedure: For Key Search, participants were presented with a piece of paper on which a 100mm x 100mm blank square was printed, with a small dot 50mm beneath it which indicated where the participant must start. They were told to imagine that the square is a field, and that they had lost their keys somewhere within this field. The task was to draw a search-strategy plan, indicating how they would walk through the field in order to make absolutely sure that they would find their keys. The search strategy was then evaluated for efficacy using a set of pre-determined criteria as described in the BADS manual, including starting their search near a corner, covering all the ground, and using horizontal/vertical lines.

For Zoo Map, participants were presented with a copy of a map for a zoo with written instructions. The map consisted of shaded and unshaded paths, and a number of target and non-target locations. The instructions specified that the participant could only use the unshaded paths once, and lists the target places the participant had to visit (in any order). Participants were required to read the instructions aloud, or could opt for them to be read to them. They were informed that this task would be timed, but that the timing wasn't as important as visiting all the places and obeying the set rules. Participants were asked to draw a route they would follow to visit the target locations as specified by the instructions. The route required adherence to certain rules e.g. only using certain paths once. In order that the experimenter could effectively mark the responses for the sequence in which participants visited different areas, they were required to use a different coloured pen after visiting each location. The experimenter noted the order of colours used. There were two parts delivered consecutively; a high demand condition in which the participant was required to use planning and foresight to determine the best route which adhered to the given rules, and a low demand condition in which they were required to simply follow a route set by the experimenter. Both routes were scored using predetermined criteria, including visiting the locations in a feasible order, not using unshaded paths more than once, and making a continuous route. The scores for both parts were added together to calculate the profile score. The time to complete both parts was noted as this is considered when calculating the profile score.

The Key Search task took no longer than five minutes to administer, whilst the Zoo Map task took between ten and fifteen minutes. The dependent variable for both subtests was the profile score (score range 0-4) as stated in the BADS scoring manual.

Trail Making Test (TMT)

The TMT (Reitan & Wolfson, 1995) is one of the most commonly used tests in neuropsychological batteries (Rabin et al., 2005), and is composed of two parts: A and B. Part A (TMT-A) requires participants to draw a line connecting numbers sequentially, and part B (TMT-B) requires switching between numbers and letters in ascending numerical and alphabetical order (see *Procedure* for more information). Examination of the relationship between the TMT and other neuropsychological measures was conducted in order to elucidate the underlying construct validity; the results demonstrated that the most variance in TMT-A could be attributed to visual-perceptual abilities, whereas TMT-B was largely explained by working memory and task switching (Sánchez-Cubillo et al., 2009). In addition, they demonstrated that an index of B-A minimises visual-perceptual demands and working memory, leaving a relatively ‘pure’ index of cognitive control. In terms of ecological validity, the TMT has shown utility in predicting social functioning at five year follow up in a sample of individuals experiencing their first episode of psychosis (Bodén, Abrahamsson, Holm, & Borg, 2014). In addition, the TMT shows a clear linear relationship with traumatic brain injury severity, suggesting it is sensitive to measuring the extent of neuropsychological dysfunction (Lange, Iverson, Zakrzewski, Ethel-King, & Franzen, 2005).

Use in relevant populations: Both TMT-A (De Sanctis et al., 2013) and TMT-B (Braun et al., 1995) have been used in violent schizophrenia samples, demonstrating poorer performance in the schizophrenia group compared to healthy controls. The test has been used less in ASPD/DPD, although one early investigation of individuals with alcoholism stratified by ASPD status showed no difference in TMT-B time (Malloy, Noel, Rogers, Longabaugh, & Beattie, 1989), and a study of prisoners with varying levels of psychopathy (low vs. medium vs. high) also showed no difference in TMT-B (Hart, Forth, & Hare, 1990).

Procedure: In TMT-A Participants were presented with an A4 sheet on which numbers (1-25) contained within small circles were arranged randomly. Participants were required to draw a line connecting the numbers consecutively. In TMT-B, they were presented with an A4 sheet on which both letters (A-L) within small circles and numbers (1-13) within small circles were arranged randomly. Participants were required to alternate the connective line between letters and numbers so they were connecting in a consecutive number-letter sequence (i.e. 1, A, 2, B, 3, C). Participants were instructed to complete each part as quickly and accurately as possible. The participant’s performance was monitored throughout, and any errors were pointed out to the participant, which they were asked to correct (inevitably resulting in an increase to the completion time). Before beginning each part, a smaller practice sheet was completed in order to check understanding. The time to complete both parts was noted. The test took around 10 minutes to administer. The dependent variables were time to complete TMT-A, time to complete TMT-B and ‘Mental Flexibility score’ (TMT-B time) – (TMT-A time).

Iowa Gambling Task (IGT)

The IGT is a popular and widely used task of affective decision making, or ‘hot executive function’, i.e. “cognitive processes that have an affective, motivational, or incentive/reward component” (De Brito et al., 2013, page 2). It was originally developed as a task to assess decision making capacity in patients with ventromedial prefrontal cortex damage, who appeared impaired in decision making but otherwise cognitively typical (Bechara et al., 1994). The task involves selecting cards from four decks with the aim of winning as much money as possible, two of which are advantageous and two of which are disadvantageous. Out of the four decks, decks A and B are disadvantageous; they provide high immediate gains but also high losses, resulting in a net loss over time if these decks are consistently chosen. Decks C and D are advantageous; they provide more modest gains but lesser losses, resulting in a net gain over time. It has been demonstrated that over the course of the task, healthy participants learn to select from these advantageous decks and avoid disadvantageous decks whereas this is not the case for patients with frontal lobe damage (Bechara, Tranel, Damasio, & Damasio, 1996), an effect which has been separated from a more general working memory deficit (Bechara, Damasio, Tranel, & Anderson, 1998).

Use in relevant populations: Deficits in emotional decision making using the IGT have been noted in numerous populations including substance use disorder, pathological gambling, HIV positive groups and those scoring high on psychopathy, with more mixed results in schizophrenia, ADHD and OCD (see Buelow & Suhr, 2009 for review). The IGT has been used previously in forensic mental health populations, demonstrating no difference in total prize money between those with a primary diagnosis of mental illness compared to those with a primary diagnosis of PD (Young, Gudjonsson, Goodwin, Perkins, & Morris, 2013). This task has shown utility for predicting violence in forensic mental health patients; poor performance on block four of the task predicted inpatient seclusions as a result of predatory violence (Bass & Nussbaum, 2010).

Procedure: Participants were presented with a computerised version of the IGT run on the PEBL program (Mueller & Piper, 2014), which was displayed on a laptop computer with a 14-inch monitor (1920 x 1080 resolution). Written instructions were displayed on screen and read aloud by the experimenter. Participants were told that they had been given a £2000 loan (not real money) and their goal was to maximise the profit on this loan. To do so, they should choose from decks of cards which would allow them to win a prize, but may also cause them to have to pay a penalty, and that sometimes the penalty would be greater than the reward. They were instructed that they could choose from any deck at any time. They were told that they did not know when the game would end, and that they should keep on selecting cards until the computer ended the task. Participants then made 100 deck selections using the mouse. After each selection the reward and penalty (where relevant) were displayed on screen, and the participant could keep track of their total winnings at the bottom of the screen throughout the task. The task lasted approximately ten

minutes, and the dependent variable was the Learning Score, calculated as the difference between block 5 (final 20 selections) and block 1 (first 20 selections) in the number of advantageous (decks C and D) minus disadvantageous (decks A and B) card selections: $(\text{Block 5 (C+D)} - (\text{A+B})) - (\text{Block 1 (C+D)} - (\text{A+B}))$, as in Premkumar and colleagues (2008), to give an index of affective decision making.

Go/No-Go Task

The Go/No-Go paradigm is one of the prototypical tasks used to measure inhibition of a pre-potent motor response, and is thought to be an index of ‘action restraint’, i.e. inhibiting a planned response, as opposed to stopping an action which has already begun (Bari & Robbins, 2013). Thus it can be considered a marker of behavioural impulsivity. The task involves participants responding (usually a button press) to the ‘Go’ stimulus and inhibiting responses to the ‘No-Go’ stimulus, which are determined by the experimenter. The Go stimulus is typically presented at a much higher rate than the No-Go stimulus to create a pre-potent pattern of responding. Although experimental tasks have received less construct validation than self-report questionnaire measures of impulsivity (e.g. the Impulsiveness, Venturesomeness, Empathy Questionnaire; Eysenck & Eysenck, 1975), they offer the advantage of providing observable, objective data which are less constrained by lexical categories which may be interpreted in various ways. They also offer a state, as opposed to trait, measure of impulsivity.

Use in relevant populations: Go/No-Go tasks have been used in multiple studies of violent behaviour, including in both schizophrenia (Barkataki et al., 2008; De Sanctis et al., 2013) and ASPD (Dolan, 2012; Dolan & Park, 2002; Vollm, Richardson, et al., 2010). Results demonstrated more commission errors (i.e. higher behavioural impulsivity) in the ASPD groups compared to healthy controls for two studies (Barkataki et al., 2008; Dolan & Park, 2002), although no difference between groups in another (Vollm, Richardson, et al., 2010). Reduced accuracy on an affective Go/No-Go task was also noted in a violent schizophrenia group compared to controls (De Sanctis et al., 2013), although this paper did not report commission errors specifically, and another study found a reduced number of correct responses to Go trials in a violent schizophrenia group compared to controls but no difference in commission errors (Barkataki et al., 2008).

Procedure: This task was an updated version of the task reported by Wöstmann and colleagues (2013; consisting of only one experimental block now to facilitate quicker administration). The Go/No-Go task was written in Presentation (Neurobehavioral Systems, Inc., Berkeley, CA) and presented using a laptop computer with a 14-inch monitor (1920 x 1080 resolution). The task consisted of 110 go-trials and 40 no-go-trials, presented in random order. The stimuli were presented in the centre of a black screen for 500ms, followed by a black screen lasting for 700ms. Participants were required to respond to a ‘Go’ stimulus (grey circle) every time it was presented by pressing the spacebar. When the ‘No-Go’ stimulus (blue circle) was presented, participants

were required to inhibit their response and not press the spacebar. Participants completed a practice block of ten trials before beginning the task, of which eight were Go trials and two were No-Go trials. The task took five minutes to complete. The dependent variables were the percentage of errors on No-Go trials (commission errors), and mean reaction times (ms) of correct Go and incorrect No-Go trials.

Verbal Fluency and Category Fluency

A test of phonemic fluency (the letters F, A and S) and semantic fluency (animals, fruit and vegetables) was administered as a measure of information production. Verbal fluency tests have been associated with a number of cognitive processes, including verbal IQ (Steinberg, Bieliauskas, Smith, & Ivnik, 2005), in addition to memory and processing speed (Van Beilen et al., 2004). Meta-analytic evidence has shown that verbal fluency is a more sensitive and specific measure of frontal lobe injury than the WCST, as demonstrated by explaining a greater percentage of the between group variance (frontal vs. non-frontal brain injury) (Henry & Crawford, 2004). Internal consistency of the F, A, S test has been demonstrated to be high (Tombaugh, Kozak, & Rees, 1999), and test-retest reliability is also high after short (one to eight weeks; Harrison, Buxton, Husain, & Wise, 2000) as well as long (approximately six months; Levine, Miller, Becker, Selnes, & Cohen, 2004) intervals.

Use in relevant populations: This task has been used previously in violent schizophrenia populations (Robertson & Taylor, 1985), showing a clear deficit on this task in the schizophrenia group compared to controls. Verbal fluency has also been assessed amongst alcoholics, stratified by ASPD status, showing no significant difference between groups (Gillen & Hesselbrock, 1992). A recent study investigated category fluency (animals) amongst individuals with schizophrenia (with and without ASPD) and healthy controls, and found that the score on this task contributed significantly to a group difference in cognitive function, but the direction of the effect is not reported (Tang et al., 2016).

Procedure: Participants were asked to name as many words beginning with a certain letter, or belonging to a certain category, as they could in 60 seconds. There were 3 letter trials (F, A, S) and 3 category trials (fruit, vegetables, animals). They were told that the words they produced needed to all be different, and could not just be variations on words they had already said (for example, quick, quickly, quicker), and that they could not give proper nouns (anything beginning with a capital letter, i.e. a place or a name). They were told that the experimenter would say the letter/category and then start the timer. The task took around six minutes to administer (60 seconds per trial). The dependent variables were total number of correct words which obeyed the stated rules across letter and category trials.

Emotion Perception Task – Recognition

The Ekman and Friesen series of pictures of facial affect (Ekman & Friesen, 1976) has been used widely in investigations of emotion processing; a search of primary research articles citing this series of pictures returns over 2,500 results. The picture set consists of six basic emotions (happy, sad, angry, fearful, surprised and disgusted) plus neutral, photographed in black and white and posed by Caucasian male and female actors. Meta-analytic evidence suggests that these emotions are recognisable across cultures at a better than chance level, although raters from the same racial group do have a slight advantage when discerning the emotions (Elfenbein & Ambady, 2002). Other meta-analyses have demonstrated facial affect recognition is poor in individuals with schizophrenia with a large effect size (which was not influenced by the percentage of Caucasian schizophrenia participants) (Kohler, Walker, Martin, Healey, & Moberg, 2010) and poor performance in those scoring highly on psychopathy which was evident across facial, vocal and postural modalities (Dawel et al., 2012).

Use in relevant populations: This task used happy, sad, angry, fearful and neutral faces. These facial emotions were chosen as the negative emotions (sad, anger, fear) have theoretical relevance to violence, i.e. it is likely violence elicits these emotions in others, and thus may be implicated in preventing further violent action via social reinforcement as stipulated in the Violence Inhibition Mechanism model of aggression (Blair et al., 1997). Happy faces have proven to be amongst the easiest to recognise in violent offenders with schizophrenia (Fullam & Dolan, 2006), although PD offenders have shown a deficit (Dolan & Fullam, 2006) and meta-analytic evidence suggested happiness recognition is also impaired at high levels of psychopathy (Dawel et al., 2012). In addition, attribution of threat (anger) to ambiguous faces has been documented in violent individuals with PD (Schonenberg & Jusyte, 2014), and attribution of anger to neutral faces has been observed in non-violent schizophrenia (Premkumar et al., 2008). Thus, neutral faces were included as these evidently pose some difficulty amongst these groups, and have not been previously assessed in a comorbid psychosis and personality disordered sample, as they were not included in the battery of Tang and colleagues (2016).

Procedure: In this task, images of the five facial expressions of emotion (described above) derived from the Ekman & Friesen (1976) series were displayed at 50% and 100% intensity to participants on a laptop computer with a 14-inch monitor (1920 x 1080 resolution), via the SuperLab 5 program (Cedrus Corporation, San Pedro, CA). Four female and four male faces were chosen, and displayed in black and white with the hair and background images cropped, on a grey background. Each emotion type was shown 12 times (six times at 100% intensity and six times at 50% intensity; six times a male displayed the emotion, six times a female). The stimuli were presented to all participants in the same order, but the presentation order was pseudo-random so

that the same face identity and the same emotion never occurred consecutively. The order of emotion presentation was arranged so that all emotions had equivalent mean serial order positions, and thus the displays of emotion were evenly dispersed throughout the task.

Participants were given a prompt sheet with the words ‘Happy’, ‘Sad’, ‘Angry’, ‘Afraid (scared/frightened)’ and ‘Neutral (no emotion)’ printed in large font (pt. 48) on an A4 sheet of paper. Written instructions appeared on the screen, which were read aloud by the experimenter, instructing the participant to say aloud their chosen emotion as quickly and as accurately as possible and the experimenter would move to the next item. They were given the opportunity to ask any questions before the task began. The experimenter used a mouse to progress to the next trial after the participant had given their response. This method was chosen as many patients detained in the hospital are unfamiliar with technology due to prolonged incarceration/lack of access to computers, and in addition many have extra pyramidal side effects from antipsychotic medication which may impair their ability to quickly select an emotion using a mouse/multiple response buttons. Thus in the interest of collecting meaningful reaction time data the experimenter progressed to the next trial as soon as the participant had spoken their answer aloud, and made a note of their answer on a response sheet. Verbal responding to remove the confounding effects of motor dysfunction has been employed in other studies of emotion perception in violent schizophrenia (Frommann et al., 2013). There was no maximum viewing time for each emotion; the face was shown until the participant gave a response. This part of the task took around ten minutes to administer and the dependent variables were total number of emotions correctly recognised (score range: 0-60) plus emotion specific correct identifications, (score range 0-12) and reaction time in milliseconds.

Emotion Perception Task – Discrimination

The second part of the task involved displaying two of the same emotional expressions side by side (see Figure 6.1), one of which was expressed to a higher intensity than the other (for example, two angry faces but one is displayed at 100% intensity and one is displayed at 50% intensity). Increasing emotional expression intensity makes recognition of disgust, fear and sadness easier amongst patients with dementia (Kumfor et al., 2011), although this benefit is not evident in patients with schizophrenia to the same extent as controls, in recognising happy, sad angry and fearful faces (Kohler et al., 2003).

Use in relevant populations: Simple recognition tasks in violent schizophrenia (Fullam & Dolan, 2006) and PD samples (Dolan & Fullam, 2006) show that recognition is poorer at lower intensities. One investigation has assessed the ability of violent individuals with schizophrenia, non-violent individuals with schizophrenia and healthy controls to discriminate between emotional intensities of happy and sad faces (Silver et al., 2005). This study demonstrated that the violent schizophrenia group were impaired at this task, suggesting that they may be impaired

at picking up subtle displays of emotion or correctly judging a social situation. A task of this type has not been used with a larger range of emotions, nor in a PD group.

Procedure: Each pair consisted of the same person displaying the same emotion at 100%, 75%, 50%, 25% or 0% (neutral). The faces never displayed equivalent intensity, and thus there were 16 possible intensity combinations across four emotion types (happy, sad, angry, and fearful, as by definition ‘neutral’ cannot differ in intensity). Therefore a forced choice paradigm was employed, in which 64 face pairs were presented to participants, and they were instructed to choose which face (left or right) was displaying the stronger emotion by pressing a button (they did not have to identify which emotion was appearing). A key press was deemed acceptable in this part of the task as participants were choosing between only two options (left or right) and thus was considered to not be unduly affected by a lack of familiarity with technology (as having to select one option out of five might have been in the previous emotion perception task). For each emotion type, on 50% of the trials the correct response was the left face, and on 50% was the right. The correct response was varied pseudo-randomly so it never occurred more than three times consecutively (i.e. after three correct left responses the correct response would be right). The Discrimination part of the Emotion Perception Task was programmed in the same SuperLab 5 program (Cedrus Corporation, San Pedro, CA) so it continued immediately after the Recognition part. Written instructions appeared on screen and were read aloud to the participant. The task took around five minutes to complete. The dependent variables were total number of correct discriminations (score range 0-64), and emotion specific discriminations (score range 0-16).

Figure 6.1 - Example Stimuli from Emotion Perception Task - Discrimination Part. Red Box Added Here to Indicate Correct Response



Joystick Operated Runway Task (JORT)

This task provides characterisation of clinically important and previously abstract emotional phenomena, namely anxiety (a conflict about whether or not to approach the target to avoid an unpleasant stimulus) and fear (the need to flee away from the target as fast as possible to avoid an unpleasant stimulus). In this task a cursor dot (representing the participant) is pursued along

an on-screen runway by threat stimulus dot(s) that inflict upon the participant an unpleasant but harmless 115 dB burst of white noise if it catches up to the cursor. The participant controls the speed of the cursor along the runway using a custom made force-sensitive joystick that relates effort to speed in a naturalistic manner: the harder the joystick is pushed the faster the cursor travels along the runway. In half of the JORT trials, the participant is pursued by one threat stimulus and is not required to approach it so can escape with sufficient effort (fear). In the other half, a second threat stimulus appears in front of the cursor, to create a situation in which all three dots move along the runway in the same direction and so movement away from one threat automatically moves it towards the other. This traps the participant in conflict where they must approach threat, and hypothetically elicits anxiety, which is indexed by the degree of approach-withdrawal oscillation. The JORT has received validation from the observation that anxiety scores (but not fear scores) decrease upon the administration of anxiolytic medication (lorazepam) in non-clinical participants (Perkins et al., 2009).

Use in relevant populations: The JORT has not been used previously in forensic mental health populations. Similar constructs, however, have been assessed. One study has demonstrated that violent schizophrenia is characterised by high, and violent ASPD low, experiential fear (Kumari, Das, et al., 2009), but the paradigm used in this study (threat of electric shock) makes it difficult to distinguish between ‘anticipatory fear’ and anxiety, two closely related constructs. This task aims to add relevant data to the existing literature.

Procedure: In this task, participants were required to avoid threat in two different trial types. They were instructed that they were represented by the green cursor on screen, and needed to avoid being caught by the red cursors (see Figure 6.2). In the first trial type, labelled ‘one-way active avoidance’, participants were required to push a force-sensitive joystick in order to escape the red cursor which was pursuing them. In the second type, labelled ‘two-way active avoidance’ participants were required to not only avoid being caught by a red cursor pursuing them, but also to not make contact with a red cursor ahead of them. Thus, the participant must push the joystick hard enough to avoid the approaching threat, but must remain behind the cursor ahead of them, eliciting threat approach-avoidance behaviour. There were two task conditions; under threat of white noise, or no threat of white noise. This was indicated to participants by the presence of a lightning bolt icon which appeared on screen when threat was present. Under the threat of white noise condition, if the participant was caught by a red dot they received an unpleasant (but harmless) burst of white noise (115db) delivered through headphones.

Before beginning the task or hearing the instructions, participants took part in a calibration phase during which they were told to push the joystick as hard as they could and hold it in that position for as long as the word ‘Go’ appeared on the screen. This occurred five times. The purpose of this was to calibrate the experiment to each participant’s maximum strength; this was required in order

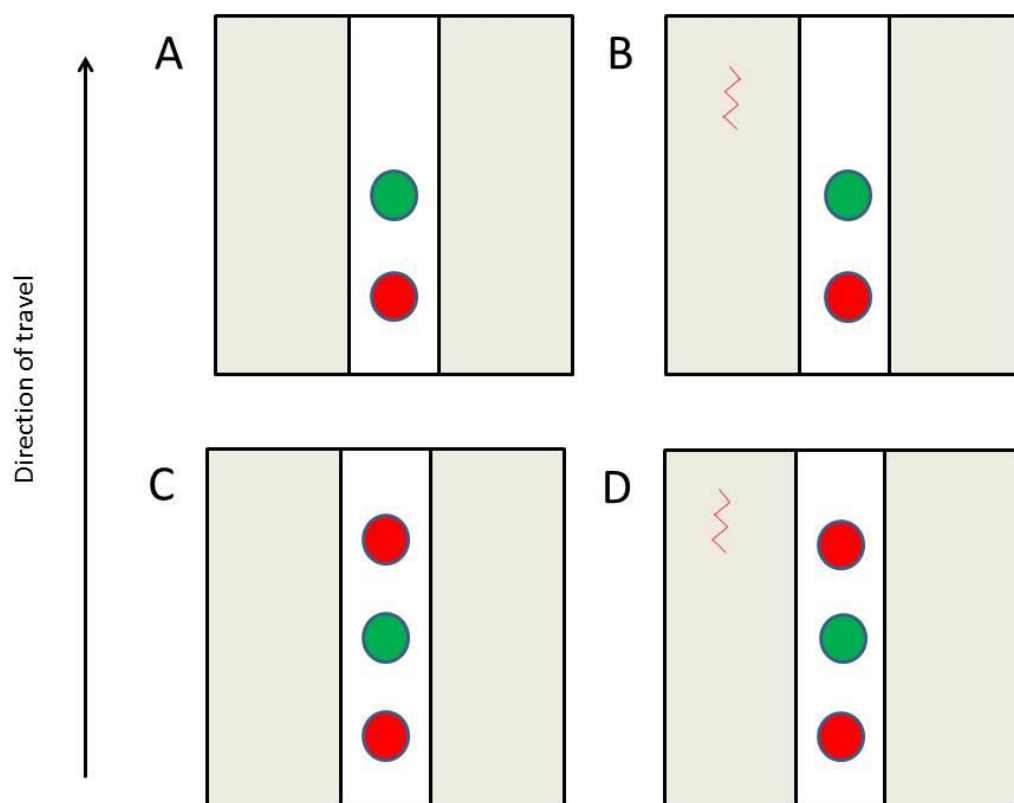
to mirror the high-calorie cost of flight behaviour, and thus successful escape from the threatening stimulus on each trial required at least 50% of the participant's maximum strength. Participants completed a practice of each of the four trial types before they began the task. If they were successful in avoiding hearing the white noise on each of these practice trials, then an example of the white noise was played to them before they began so that they could experience what would happen if they were caught. The task then began consisting of 48 trials (12 of each of the above types) presented in a pseudo-random order to enhance unpredictability and lasted for 17 minutes. The dependent variables were 'fear score' and 'anxiety score' which were calculated as follows:

Fear score = (force joystick pushed under threat) – (force pushed under no threat)

Anxiety score = (standard deviation of force pushed under threat) – (standard deviation pushed under no threat)

Figure 6.2 - JORT Paradigm Schematic Overview

A – One way avoidance, no threat of white noise; **B** – one way avoidance under threat of white noise; **C** – Two way avoidance, no threat of white noise; **D** - Two way avoidance, under threat of white noise.



Procedure

Almost all testing was conducted in a quiet side room on the patients ward, or a quiet meeting room in the hospital (for healthy controls). The only exception was the JORT which was completed in a separate psychophysiology lab. The tests were administered over a number of sessions; the first session involved the neuropsychological battery of paper pencil tests (which regularly ran into two sessions, due to participant fatigue or a lack of willingness to continue), in the second session computer tasks were administered, and in the final session the psychophysiological experiments (see Chapters Seven and Eight) and JORT were completed. Tests were administered in the following order:

Session	Order	Test
1	1	Hopkins Verbal Learning Test
	2	Wechsler Memory Scales Visual Reproduction – Immediate Recall
	3	Trail Making Test Part A and B
	4	BADS Key Search
	5	Hopkins Verbal Learning – Delayed Recall
	6	Wechsler Memory Scales Visual Reproduction – Delayed Recall
	7	Verbal and Category Fluency
	8	BADS Zoo Map
	9	Letter Number Test
	10	Wechsler Test of Adult Reading
2	11	Emotion Perception Task - Recognition
	12	Emotion Perception Task - Discrimination
	13	Go/No-Go Task
	14	Wisconsin Card Sorting Test
	15	Iowa Gambling Task
3	16	Joystick Operated Runway Task

Data Treatment - Normality

Data were assessed for normality by examining skewness, kurtosis and equality of variance between groups. The skewness and kurtosis values were converted to z scores by dividing them by their standard error. A critical value of $z=\pm 1.96$ was determined as representative of significant ($p<.05$) skewness or kurtosis, as recommended by Field (2009). Equality of variance was assessed via Levene's test, with $p<.05$ indicating significant heterogeneity of variance between groups. Skewness and kurtosis for continuous variables are reported in Table 6.1, Levene's Test results are displayed in Table 6.2.

Data Treatment - Outliers

Box plots were inspected for each planned analysis to identify outliers; any participant scoring ± 2.58 standard deviations from their respective group's mean was excluded for that measure (as 99% of scores should fall within these bounds; Field, 2009). In addition, for the Joystick Operated Runway Task, participants that did not complete the whole task were excluded. There was a high rate of non-completion in this task; one psychosis participant, six comorbid and three DPD were excluded on this basis.

See Table 6.2 for number excluded from each task and final sample size.

Statistical Analysis

For variables which met the assumptions of parametric testing, one way ANOVA was employed to assess group differences, with 'Group' as a between subjects factor. Post-hoc testing was Hochberg GT2 tests as these are most appropriate when group sizes are unequal, unless the assumption of homogeneity of variance was broken in which case the Games-Howell correction was applied instead (Field, 2009). The Hochberg GT2 procedure and Games-Howell procedure both control for familywise error (Stoline, 1981), and thus all reported p-values can be considered "corrected". P-values of less than .05 were accepted as significant unless stated otherwise, and p-values less than .10 are reported as trends

For variables with non-normal distribution (significant skew or kurtosis), logarithmic transformation was attempted to normalise the data. Logarithmic transformation was successful for the scales of the Trail Making Test (aside for the Trail Making Mental Flexibility score for the comorbid group, however Kolmogorov-Smirnov and Shapiro-Wilk tests were not significant, indicating approximately normal distribution so parametric testing was deemed appropriate).

For all other non-normally distributed variables, non-parametric Kruskal-Wallis tests were applied to assess for group differences, with 'Group' as the between subjects factor. Post-hoc Mann-Whitney tests were applied as appropriate, with Bonferroni corrected p-values to correct for multiple comparisons and control for familywise error (.05 divided by the number of tests conducted).

In addition to group differences, an assessment of the effect of cognitive function on emotion processing was conducted using Pearson and Spearman correlations as appropriate, between cognitive variables and the emotion perception and discrimination scores. This was to assess whether emotion recognition deficits could be explained by a more general cognitive deficit as has been proposed in a recent meta-analysis (Ventura et al., 2013) and comprehensive systematic review (Bortolon, Capdevielle, & Raffard, 2015). Analysis of covariance (ANCOVA) and non-

parametric equivalents were applied to assess whether group differences in emotion perception were apparent when controlling for the effect of cognition. Non-parametric ANCOVA was Quade's rank ANCOVA (Quade, 1967), which is a rank based method to control for covariates when the data is non-normally distributed (Forstner, 2013). Dependent variables and covariates are ranked, and these ranks are subject to linear regression to obtain the raw (unstandardised) residuals. The residuals are then subject to one-way ANOVA, with the independent variable as group, to give an F-value which accounts for the presence of the covariate.

Categorical variables (ethnicity) were assessed using Chi-Square analysis.

Results

The groups were matched on age (Mean=37.1, SD= 9.9, $F_{(3,84)}=.803$, $p=.496$), but not ethnicity (white vs. non-white; $\chi^2 = 29.9$, $p=.038$). There were significantly more white than non-white participants in the control group, and significantly more non-white than white participants in the comorbid group.

Means and standard deviations for all variables are displayed in Table 6.3, and graphic representation of the cognitive and emotion processing profiles can be observed in Figure 6.3.

General Intelligence

Wechsler Test of Adult Reading

There was a significant difference between groups on their premorbid full scale IQ ($p=.010$, partial $\eta^2=.132$). Post-hoc comparison of means with Games-Howell correction for inequality of variance revealed that the control group had a significantly higher premorbid IQ than the comorbid group ($p=.003$), but there were no other significant group differences.

The mean premorbid IQ scores for each group fell within the ‘normal’ range, although there was variability within groups, spanning the ‘borderline learning disability’⁷ to ‘high average’ ranges (Ranges: PSY: 70-115; DPD: 73-107; COM: 74-107; CONT: 74-110).

⁷ No patient at Broadmoor Hospital has a formal learning disability, as this is a criterion for diversion from the service to more specialist offender services.

Table 6.1 - Skew and Kurtosis Values for Dependent Variables With z-Scores for the Four Study Groups

Measure	<u>Psychosis</u>				<u>DPD</u>				<u>Comorbid</u>				<u>Controls</u>			
	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score
General Intelligence																
WTAR FSIQ	-.773	-1.29	-.802	-.695	-.415	-.735	-.819	-.751	.158	.335	-.962	-1.05	-.842	-1.97*	.459	.551
Memory																
HVLT Immediate Recall	-.169	-.256	-1.32	-1.03	-.274	-.485	.179	.164	-.070	-.142	-.449	-.471	.113	.264	-.267	-.320
HVLT Delayed Recall	.263	.397	-1.17	-.914	-.450	-.798	.580	.532	.172	.351	-.018	-.019	-.543	-1.27	-.233	-.279
HVLT Discrimination	-.836	-1.27	-.760	-.594	-1.10	-1.94	.602	.552	-.857	-1.75	1.81	1.90	-.739	-1.73	-.193	-.231
Letter Number Span Test	-.868	-1.31	.560	.438	-.035	-.063	-.895	-.821	.111	.225	-1.31	-1.38	-.236	-.552	-.295	-.354
WMS Immediate Recall	-.381	-.577	.404	.316	-.060	-.107	-.555	-.508	.393	.801	-.853	-.895	-.279	-.654	-1.22	-1.47
WMS Delayed Recall	-.610	-.924	.465	.363	-.281	-.498	-.670	-.614	.909	1.85	.425	.446	.138	.323	-.789	-.947
Executive Function																
WCST Total Errors	.588	.984	-.570	-.494	.394	.697	.196	.179	-.134	-.290	-.907	-1.01	.552	1.27	-.776	-.918
WCST Perseverative Errors	-.212	-.355	-1.22	-1.06	-.672	-1.19	.959	.879	.079	.170	-.086	-.096	.953	2.20*	.363	.430
WCST Categories Completed	.595	.996	-1.17	-1.02	.645	1.17	-.379	-.356	1.11	2.40*	1.89	2.09*	-.498	-1.17	-1.18	-1.42
TMT Part A	1.02	1.55	.469	.367	1.27	2.24	1.02	.937	.793	1.62	.866	.909	3.56	8.34*	15.0	18.1*
Log Transformation	.200	.345	-.426	-.380	.580	1.03	-.886	-.812	-.070	-.148	-.362	-.395	.847	1.95	.782	.926
TMT Part B	1.08	1.64	.775	.606	.954	1.69	-.180	-.165	.609	1.24	.555	.582	1.64	3.83*	3.25	3.90*
Log Transformation	-.115	-.199	-.724	-.646	.160	.284	-.674	-.618	-.016	-.003	-.345	-.375	.471	1.09	-.878	-1.04
TMT Mental Flexibility	1.63	2.47*	2.12	1.65	1.05	1.86	.380	.348	.595	1.21	.658	.691	.933	2.19*	.927	1.11
Log Transformation	.198	.342	-.966	-.862	-.025	-.044	-.458	-.420	-.960	-2.03*	1.73	1.89	-.787	-1.81	1.47	1.74
IGT Learning Score	.157	.237	-.475	-.371	.427	.756	-.285	-.261	.854	1.74	-.118	-.124	-.088	-.207	-.039	-.047

Measure	<u>Psychosis</u>				<u>DPD</u>				<u>Comorbid</u>				<u>Controls</u>			
	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score
GNG: % Commission Errors	1.39	2.10*	1.98	1.55	2.11	3.74*	6.42	5.89*	.628	1.28	-.273	-.286	1.67	3.91*	2.30	2.77*
GNG: RT Correct Go Trials	1.85	2.91*	4.29	3.48*	.613	1.11	-1.05	-.990	1.15	2.48*	1.31	1.45	.660	1.55	-.256	-.308
GNG: RT Incorrect NoGo Trials	-2.75	-4.32*	8.43	6.84*	.879	1.60	-.275	-.259	.292	.629	.503	.558	-.894	-.209	2.26	2.71*
Verbal Fluency	-1.19	-1.81	2.28	1.78	-.286	-.507	-.567	-.520	-.099	-.201	-.714	-.750	-.352	-.826	-.775	-.930
Category Fluency	.477	.723	1.09	.849	.284	.504	.392	.359	-.214	-.435	-1.48	-1.55	.287	.672	-.085	-.102
Emotion Processing																
EPT - Recognition Total	-.601	-.975	.814	.683	.897	1.63	.531	.500	.056	.121	-.484	-.537	-.467	-1.08	-.486	-.575
<i>Total Happy Correct</i>	-1.43	-2.32*	1.71	1.44	-.941	-1.71	-.344	-.323	-1.24	-2.66*	.846	.938	-.239	-.551	-.505	-.597
<i>Total Sad Correct</i>	-.094	-.153	-.128	-.108	.127	.231	-.822	-.773	-.097	-.210	-1.04	-1.15	-.297	-.685	-.934	-1.11
<i>Total Angry Correct</i>	.969	1.57	.269	.226	.413	.752	-.751	-.707	.504	1.09	-.594	-.659	-.165	-.380	-.401	-.474
<i>Total Fearful Correct</i>	-.068	-.110	-.934	-.785	-.465	-.845	.415	.390	-.442	-.953	-.185	-.205	-.124	-.287	-.207	-.245
<i>Total Neutral Correct</i>	-.811	-1.32	-.493	-.414	-.890	-1.62	-.298	-.280	-1.23	-2.64*	1.21	1.34	-.666	-1.54	.124	.147
EPT - Discrimination Total	-1.17	-1.95	.129	.112	-1.86	-3.29*	4.12	3.78*	-1.30	-2.80*	1.00	1.12	-.909	-2.06*	.313	.365
<i>Total Happy Correct</i>	-1.26	-2.10*	.092	.080	-.253	-.449	-.735	-.674	-1.70	-3.67*	2.79	3.09	-.394	-.893	-.099	-.116
<i>Total Sad Correct</i>	-.551	-.922	-.791	-.685	-1.42	-2.51	1.99	1.82	-1.41	-3.04*	2.19	2.43*	.045	.103	-1.03	-1.20
<i>Total Angry Correct</i>	-.876	-1.47	-.099	-.086	-1.40	-2.48	3.43	3.14*	-.460	-.993	-.849	-.942	-.769	-1.75	.596	.694
<i>Total Fearful Correct</i>	-.862	-1.44	-.493	-.427	-1.81	-3.20*	3.68	3.37*	-1.70	-3.67*	2.89	3.20*	-1.44	-3.27*	1.42	1.66
EPT Recognition RT	1.14	1.86	1.37	1.15	-.115	-.210	-.895	-.842	1.45	3.13*	1.79	1.98*	1.46	3.37*	2.58	3.05*
<i>Log Transformation</i>	.574	.931	-.244	-.205	-.428	-.779	-.989	-.930	.392	.844	.366	.406	.621	1.43	.926	1.10
EPT Discrimination RT	.360	.584	-1.15	-.966	.957	1.74	1.35	1.27	2.98	6.43*	12.6	13.9*	1.46	3.37*	2.69	3.18*
<i>Log Transformation</i>	-.057	-.092	-1.18	-.994	-.032	-.059	-.118	-.111	.652	1.41	2.64	2.93*	.481	1.11	.469	.555
JORT Fear Score	1.31	1.99*	3.35	2.62*	-.449	-.654	-.514	-.386	-.286	-.521	.082	.077	.690	1.62	2.32	2.78*

Measure	<u>Psychosis</u>				<u>DPD</u>				<u>Comorbid</u>				<u>Controls</u>			
	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score
JORT Anxiety Score	.497	.752	-.048	-.037	.597	.869	1.17	.878	-.180	-.327	-.305	-.287	-.449	-1.05	.622	.747

BADS – Behavioural Assessment of Dysexecutive Syndrome; EPT – Emotion Perception Task; FSIQ – Full Scale IQ; HVL – Hopkin's Verbal Learning Test; IGT – Iowa Gambling Task; JORT – Joystick Operated Runway Task; PRI – Perceptual Reasoning Index; RT – Reaction Time; TMT – Trail Making Test; VCI - Verbal Comprehension Index; WCST – Wisconsin Card Sorting Test; WMS – Wechsler Memory Scales; WTAR – Wechsler Test of Adult Reading

Table 6.2 - Levene's Test for Equality of Variance and Final Sample Size for Each Dependent Variable

Measure	Levene's Test for Equality of Variance†	p	Number of Participants Excluded		Final Sample Size for Measure
			Outliers	Non-Completers¹	
General Intelligence					
WTAR (estimated full scale IQ)	3.36	.023*	-	2 COM, 1 PSY, 1 DPD	PSY: 14; DPD: 16; COM: 24; CONT: 30
Memory					
HVLT Immediate Recall	2.87	.041*		1 COM	PSY: 15; DPD: 17; COM: 25; CONT: 30
HVLT Delayed Recall	.754	.523	1 COM	1 COM	PSY: 15; DPD: 17; COM: 24; CONT: 30
HVLT Discrimination Index	2.49	.066	-	1 COM	PSY: 15; DPD: 17; COM: 25; CONT: 30
Letter Number Span Test	1.89	.138	-	1 COM, 1 PSY	PSY: 14; DPD: 16; COM: 25; CONT: 30
WMS Immediate Recall	4.34	.007*	-	1 COM	PSY: 15; DPD: 17; COM: 25; CONT: 30
WMS Delayed Recall	.806	.494	-	1 COM	
Executive Function					
WCST Total Errors	2.78	.046*	1 CONT	1 PSY, 1 COM	PSY: 14; DPD: 17; COM: 25; CONT: 29
WCST Perseverative Errors	4.52	.006*	1 DPD, 1 CONT	1 PSY, 1 COM	PSY: 14; DPD: 16; COM: 25; CONT: 29
WCST Categories Completed	2.22	.092	-	1 PSY, 1 COM	PSY: 14; DPD: 17; COM: 25; CONT: 29
TMT Part A	1.97	.125			
Log Transformed	5.03	.003*	1 CONT	1 COM, 1 DPD	PSY: 15; DPD: 16; COM: 25; CONT: 29
TMT Part B	4.03	<.001*			
Log Transformed	1.58	.201	1 CONT, 1 COM	2 COM, 1 DPD	PSY: 15; DPD: 16; COM: 23; CONT: 29
TMT Mental Flexibility	7.43	<.001*			
Log Transformed	.689	.561	1 CONT, 1 COM	2 COM, 1 DPD	PSY: 15; DPD: 16; COM: 23; CONT: 29
IGT Learning Score	.971	.410	-	1 PSY, 1 COM	PSY: 14; DPD: 17; COM: 25; CONT: 30
Go/NoGo % Commission Errors	.286	.835	1 DPD, 1 CONT	3 PSY, 1 COM	PSY: 12; DPD: 16; COM: 25; CONT: 29
Go/NoGo RT Correct Go	1.59	.197	-	3 PSY, 1 COM	PSY: 12; DPD: 16; COM: 25; CONT: 29

Measure	Levene's Test for Equality of Variance†	p	Number of Participants Excluded		Final Sample Size for Measure
			Outliers	Non-Completers ¹	
Go/NoGo RT Incorrect NoGo	9.18	<.001*	-	3 PSY, 1 COM	PSY: 12; DPD: 16; COM: 25; CONT: 29
Verbal Fluency – FAS	.795	.500	-	1 COM, 1 DPD	PSY: 15; DPD: 16; COM: 25; CONT: 30
Category Fluency – Animals, Fruit, Vegetables	.747	.527	-	1 COM	PSY: 15; DPD: 17; COM: 25; CONT: 30
Emotion Processing					
Emotion Perception Task – Recognition Total	.307	.820		1 CONT, 2 PSY, 1 COM	PSY: 13; DPD: 17; COM: 25; CONT: 29
Total Happy Correct	3.78	.014*			
Total Sad Correct	.027	.994			
Total Angry Correct	.833	.480			
Total Fearful Correct	.513	.675			
Total Neutral Correct	2.82	.044*			
Emotion Perception Task – Discrimination Total	9.21	<.001*	1 DPD, 2 CONT	1 PSY, 1 COM	PSY: 14; DPD: 16; COM: 25; CONT: 28
Total Happy Correct	13.7	<.001*			
Total Sad Correct	5.47	.002*			
Total Angry Correct	7.16	<.001*			
Total Fearful Correct	6.63	<.001*			
EPT Recognition RT	2.52	.064	n/a	1 CONT, 2 PSY, 1 COM	PSY: 13; DPD: 17; COM: 25; CONT: 29
Log Transformed	1.81	.153	n/a		
EPT Discrimination RT	.097	.962	n/a	1 PSY, 1 COM	PSY: 14; DPD: 16; COM: 25; CONT: 28
Log Transformed	.368	.777	n/a		
JORT Fear Score	1.26	.295	1 DPD	4 PSY, 6 DPD, 9 COM	PSY: 11; DPD: 10; COM: 17; CONT: 30
JORT Anxiety Score	3.91	.013*	1 DPD		
1 – Incorporating those excluded for uncompleted task (JORT). BADS – Behavioural Assessment of Dysexecutive Syndrome; COM – Comorbid Group; CONT – Control Group; DPD – Dissocial Personality Disorder Group; EPT – Emotion Perception Task; HVLIT – Hopkin's Verbal Learning Test; IGT – Iowa Gambling Task; JORT – Joystick Operated Runway Task; RT – Reaction Time; PSY – Psychosis Group; TMT – Trail Making Test; WCST – Wisconsin Card Sorting Test; WMS – Wechsler Memory Scales; WTAR – Wechsler Test of Adult Reading					

Table 6.3 - Means (SD) and Inferential Statistics for Each Test

Measure	<u>Psychosis</u>		<u>DPD</u>		<u>Comorbid</u>		<u>Control</u>		Test Statistic	df	p-value	Direction of Effect
	Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)					
General Intelligence												
WTAR (estimated FSIQ)	97.8	(15.4)	93.9	(10.5)	91.1	(10.4)	101.0	(8.97)	F=4.04	3,80	.010*	CONT>COM
Memory												
HVLT Immediate Recall	18.9	(7.28)	18.4	(5.22)	19.1	(4.71)	24.1	(4.46)	F=6.77	3,83	<.001*	CONT>DPD, COM
HVLT Delayed Recall	6.40	(2.41)	6.47	(3.10)	6.54	(1.86)	8.47	(2.52)	F=4.22	3,82	.008*	CONT>COM
HVLT Discrimination Index	9.47	(2.53)	10.2	(1.86)	9.80	(1.61)	10.4	(1.52)	F=1.03	3,83	.384	-
Letter Number Span Test	12.5	(5.16)	10.6	(4.05)	10.6	(3.60)	15.8	(3.32)	F=10.2	3,81	<.001*	CONT>DPD, COM
WMS Immediate Recall	7.27	(3.99)	6.53	(3.84)	6.00	(4.57)	10.6	(2.34)	F=8.43	3, 83	<.001*	CONT>DPD, COM, PSY
WMS Delayed Recall	7.87	(3.14)	6.82	(3.68)	7.08	(4.68)	10.9	(3.54)	F=6.06	3,83	.001*	CONT>DPD, COM
Executive Function												
WCST Total Errors	51.6	(23.2)	53.3	(17.5)	53.0	(14.3)	33.6	(12.2)	F=8.71	3, 81	<.001*	CONT>DPD, COM
WCST Perseverative Errors	21.1	(15.9)	24.3	(9.93)	32.6	(16.8)	23.1	(8.25)	F=3.43	3, 80	.021*	(CONT, DPD, PSY> COM)
WCST Categories Completed	2.86	(.650)	3.18	(.590)	3.04	(1.98)	6.00	(2.72)	H=20.3	3	<.001*	CONT> DPD, COM, PSY
BADS – Key Search Profile Score	2.14	(1.29)	2.19	(1.38)	1.84	(1.25)	3.37	(.999)	H=20.5	3	<.001*	CONT>DPD, COM, PSY
BADS – Zoo Map Profile Score	2.00	(1.30)	1.94	(.680)	1.80	(.913)	2.80	(1.03)	H=13.8	3	.003*	CONT>DPD, COM
TMT Part A (seconds)	43.17	(14.7)	36.9	(21.6)	44.1	(31.9)	28.8	(9.78)	F=4.84	3,81	.004*	CONT> COM, PSY
TMT Part B (seconds)	124.9	(64.9)	102.7	(53.1)	109.6	(41.9)	61.1	(21.5)	F=11.2	3,79	<.001*	CONT> DPD,COM, PSY
TMT Mental Flexibility (seconds)	81.7	(61.7)	65.8	(36.8)	72.2	(37.9)	32.3	(18.5)	F=9.72	3,79	<.001*	CONT>DPD, COM, PSY

Measure	<u>Psychosis</u>		<u>DPD</u>		<u>Comorbid</u>		<u>Control</u>		Test Statistic	df	p-value	Direction of Effect
	Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)					
IGT Learning Score	7.14	(9.27)	7.29	(13.2)	4.80	(11.7)	5.40	(10.6)	F=.243	3,82	.866	-
Go/No-Go % Commission Errors	12.9	(11.1)	14.5	(7.92)	12.1	(9.20)	10.43	(11.8)	H=4.72	3	.194	-
Go/No-Go RT Correct Go (ms)	371.2	(73.6)	358.0	(55.9)	411.2	(68.5)	331.0	(42.2)	H=22.3	3	<.001*	CONT<COM
Go/No-Go RT Incorrect NoGo (ms)	271.3	(30.8)	299.8	(81.3)	352.3	(164.4)	254.6	(109.1)	H=11.6	3	.009	CONT<COM
Verbal Fluency – FAS	38.1	(11.0)	36.6	(13.8)	32.5	(10.9)	38.2	(9.51)	F=1.39	3,82	.252	-
Category Fluency–Animals, Fruit, Vegetables	41.0	(13.2)	41.7	(12.1)	37.7	(8.54)	48.9	(9.48)	F=5.60	3,83	.002*	CONT>COM
Emotion Processing												
Emotion Perception Task Total	43.5	(5.85)	39.8	(5.03)	39.7	(5.81)	43.0	(5.18)	F=2.76	3, 80	.048*	(CONT, PSY>COM)
Total Happy Correct	11.3	(.947)	10.7	(1.40)	11.1	(1.15)	11.2	(.636)				
Total Sad Correct	6.08	(2.75)	4.65	(2.37)	5.52	(2.38)	6.03	(2.34)				
Total Angry Correct	7.31	(2.18)	7.76	(1.71)	7.28	(1.37)	7.69	(1.71)				
Total Fearful Correct	8.92	(1.80)	6.82	(2.72)	6.60	(2.50)	8.17	(2.16)				
Total Neutral Correct	9.85	(1.63)	9.88	(2.03)	9.20	(2.38)	9.86	(1.30)				
Total Discrimination Correct	48.8	(12.0)	53.8	(4.76)	51.2	(7.92)	56.8	(2.96)	H=14.2	3	.003*	CONT> DPD,COM,PSY
Total Happy Correct	12.9	(3.78)	14.5	(.966)	13.8	(2.22)	14.8	(.833)				-
Total Sad Correct	11.2	(3.17)	11.8	(1.91)	11.1	(2.05)	12.2	(1.26)				-
Total Angry Correct	12.1	(2.64)	13.4	(1.59)	12.7	(2.49)	14.4	(1.03)				CONT> DPD,COM,PSY
Total Fearful Correct	12.6	(3.03)	14.2	(1.59)	12.7	(2.49)	15.4	(.911)				CONT> DPD,COM,PSY
EPT- Recognition Total RT (ms)	3472.4	(1018.7)	3290.0	(706.3)	4156.1	(1850.7)	3872.0	(1091.1)	F=1.52	3	.215	-

Measure	<u>Psychosis</u>		<u>DPD</u>		<u>Comorbid</u>		<u>Control</u>		Test	df	p-value	Direction of Effect
	Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)		Statistic			
EPT - Discrimination Total RT (ms)	2728.8	(902.9)	2989.0	(1127.9)	3312.1	(1519.6)	3138.2	(1065.5)	F=.848	3	.472	-
JORT Fear Score	.600	(.454)	.191	(.804)	.037	(.775)	.561	(.947)	H=5.06	3	.167	-
JORT Anxiety Score	.360	(.403)	.087	(.812)	.174	(.502)	.143	(.283)	F=.744	3, 64	.530	-
BADs – Behavioural Assessment of Dysexecutive Syndrome; COM – Comorbid Group; CONT – Control Group; DPD – Dissocial Personality Disorder Group; EPT – Emotion Perception Task; HVLt – Hopkin’s Verbal Learning Test; IGT – Iowa Gambling Task; JORT – Joystick Operated Runway Task; RT – Reaction Time; PSY – Psychosis Group; TMT – Trail Making Test; WCST – Wisconsin Card Sorting Test; WMS – Wechsler Memory Scales; WTAR – Wechsler Test of Adult Reading												

Memory

Hopkins Verbal Learning Test

There was a significant main effect for the Immediate Recall score. Post-hoc comparison of means indicated significantly better performance in the control group compared to the DPD ($p=.003$) and comorbid ($p=.001$) groups, and a trend for better performance compared to the psychosis group ($p=.080$). The clinical groups did not differ from one another. For Delayed Recall, there was also a significant group difference ($p=.006$), which post-hoc testing showed was due to significantly better performance in the control group compared to the comorbid group ($p=.013$), and trend level better performance for controls compared to psychosis ($p=.071$) and DPD ($p=.068$) groups.

There was no significant effect of group for the Discrimination Index ($p=.384$).

Letter Number Span Test

There was a significant group effect on total score ($p<.001$, partial $\eta^2=.274$), which was due to significantly better performance in the control group compared to the comorbid and DPD groups (both $p<.001$), with a trend for the controls to perform better than the psychosis group ($p=.064$). The clinical groups did not differ from one another.

Wechsler Memory Scales – Visual Reproduction

For the immediate recall condition, there was a significant effect of group ($p<.001$, partial $\eta^2=.234$). All three clinical groups performed worse than controls (PSY: $p=.037$, DPD: $p=.003$, COM: $p<.001$), but did not differ from one another.

For the delayed recall condition, there was also a significant effect of group ($p=.001$, partial $\eta^2=.180$) which showed superior performance in controls compared to the DPD ($p=.005$) and comorbid ($p=.003$) groups, and a trend for superior performance compared to the psychosis group ($p=.093$). Again, there was no significant difference between the clinical groups for delayed recall.

Executive Function

Wisconsin Card Sorting Test

There was a significant effect of group on Total Number of Errors on the WCST ($p<.001$, partial $\eta^2=.241$). Post-hoc comparison of means with a Games-Howell correction for heterogeneity of variance revealed that the control group made significantly fewer errors than the comorbid ($p<.001$) and DPD ($p=.008$) groups but differed from the psychosis group at a trend level only ($p=.063$). The clinical groups did not differ from one another.

For Perseverative Errors, there was a significant group effect ($p=.021$, partial $\eta^2=.114$), however no significant group differences remained after applying the correction for inequality of variance. Least significant difference tests (uncorrected) indicated that the direction of difference arose

from more errors in the comorbid group than all other groups, who did not differ from each other. Number of categories completed also revealed a significant group effect ($p < .001$), with follow up non-parametric comparisons (with Bonferroni correction, $.05/6$ $p < .008$ accepted as significant) indicating that the control group completed significantly more categories than the psychosis ($p = .002$), DPD ($p = .001$) and comorbid ($p < .001$) groups, who did not differ from one another (all p 's $> .493$).

Behavioural Assessment of Dysexecutive Syndrome

There was a significant effect of group for both the Zoo Map ($p = .003$) and Key Search ($p < .001$) subtests. Follow up Mann Whitney tests with adjusted p -value for multiple comparisons ($.05/6$, $p < .008$ accepted as significant), revealed significantly poorer performance compared to controls on the Key Search test for the psychosis ($p = .001$), and comorbid ($p < .001$) groups, with the DPD approaching the corrected level of significance ($p = .008$). Similarly, poorer performance on the Zoo Map test compared to controls was observed for the DPD ($p = .006$) and comorbid ($p = .001$) groups, although the psychosis group did not differ at the adjusted level of significance ($p = .043$). The clinical groups did not differ from one another on either test (all p -values greater than $.330$).

Trail Making Test

There was a significant effect of group for Trail Making part A ($p = .004$, partial $\eta^2 = .152$). Comparison of means with Games-Howell correction for inequality of variance showed that the controls performed significantly better than the psychosis and comorbid groups ($p = .003$, and $p = .010$, respectively), but did not differ from the DPD group ($p = .715$).

For Trail Making part B, there was also a significant effect of group ($p < .001$, partial $\eta^2 = .302$). The control group performed significantly better (quicker) than the three clinical groups, who did not differ from one another. This same pattern of results was observed for Trail Making Mental Flexibility score [B minus A] ($p < .001$, partial $\eta^2 = .274$), with the control group performing significantly better than all three clinical groups, who performed comparatively.

Iowa Gambling Task

There was no significant group effect for the learning score ($p = .866$, partial $\eta^2 = .009$).

Go/No-Go Task

There was no significant group effect for the percentage of commission errors ($p = .194$). There was a significant group difference for the reaction times for correct Go ($p < .001$) trials and incorrect NoGo trials ($p = .009$). Post-hoc non-parametric comparisons with a Bonferroni correction applied ($.05/6 = p < .008$ accepted as significant) showed that the comorbid group had longer reaction times compared to controls for both correct Go trials ($p < .001$) and incorrect NoGo trials ($p = .002$). There were no other group differences in reaction time.

Verbal Fluency – FAS

There was no significant effect of group for the total number of words produced across the test ($p=.252$, partial $\eta^2=.048$).

Category Fluency – Animals, Fruit, Vegetables

There was a significant group effect ($p=.002$, partial $\eta^2=.168$); controls were able to produce significantly more words than the comorbid group ($p=.001$). No other group differences were observed.

Emotion Processing

Emotion Perception Task - Recognition

A significant effect of group was observed in Total Emotion Perception Task score ($p=.048$, partial $\eta^2=.094$). Post-hoc comparisons correcting for familywise error and unequal group size were non-significant, however, to gain a perspective on the direction of difference Least Significant Difference (uncorrected) comparisons were performed, revealing significantly lower total scores in the comorbid group compared to the psychosis and control groups. To ascertain whether there was a difference between groups in perception of different emotion types, follow up independent t-tests (or Mann-Whitney tests for the non-normally distributed scales of 'Happy' and Neutral') were conducted between the psychosis and comorbid group, and comorbid and control group. For each set of comparisons, the p-value was adjusted to correct for multiple comparisons, and the threshold for significance was set at $p<.01$ ($.05/5=.01$).

For psychosis vs. comorbid, there were no significant differences observed for the correct recognition of sad ($p=.521$), angry ($p=.962$), happy ($p=.617$) or neutral ($p=.519$), but the comorbid group were significantly poorer at recognising fearful faces ($p=.005$). The same pattern was observed comparing comorbid to controls; a trend towards a deficit in fear recognition at the corrected level of probability ($p=.016$) but no other deficits (happy: $p=.895$; sad: $p=.428$; angry: $p=.342$; neutral: $p=.525$). These differences could not be accounted for by reaction time (i.e. impulsive responding) which did not significantly differ between groups ($p=.215$).

Thus the results suggest significantly poorer recognition of fear in comorbid participants compared to those in the psychosis group. The DPD group took an intermediary position and did not differ from any group on total score, so there was no basis for post-hoc comparison.

Emotion Perception Task – Discrimination

There was a significant effect of group for Discrimination Total Score ($p=.003$). Post-hoc Mann-Whitney tests with corrected p-value (0.5/6, $p<.008$ accepted as significant) indicated that overall, the controls performed better than the psychosis and comorbid groups (PSY: $p=.004$; COM:

$p=.002$), but were not different from the DPD group at the corrected level of significance ($p=.018$). The clinical groups did not differ from one another (all $p's > .250$).

When examining the effect of emotion type between groups, follow up Mann-Whitney tests (with corrected p -value for each set of comparisons; $.05/4 = p < .0125$ accepted as significant) demonstrated that all three clinical groups were poorer at distinguishing the intensity of angry (PSY: $p < .001$; DPD: $p=.008$; COM: $p=.012$) and fearful (PSY: $p=.001$; DPD: $p=.001$; COM: $p < .001$) faces than the control group. No significant differences were noted for the discrimination of happy or sad faces. These differences could not be accounted for by overall reaction time (i.e. impulsive responding) which did not significantly differ between groups ($p=.472$).

Joystick Operated Runway Task

There was no significant group effect for the fear ($p=.167$) or anxiety ($p=.530$) score on the JORT.

Figure 6.3 - Neuropsychological and Emotion Processing Profiles of Clinical Groups Compared to Healthy Controls

A – Memory Profile of Clinical Groups Compared to Healthy Controls

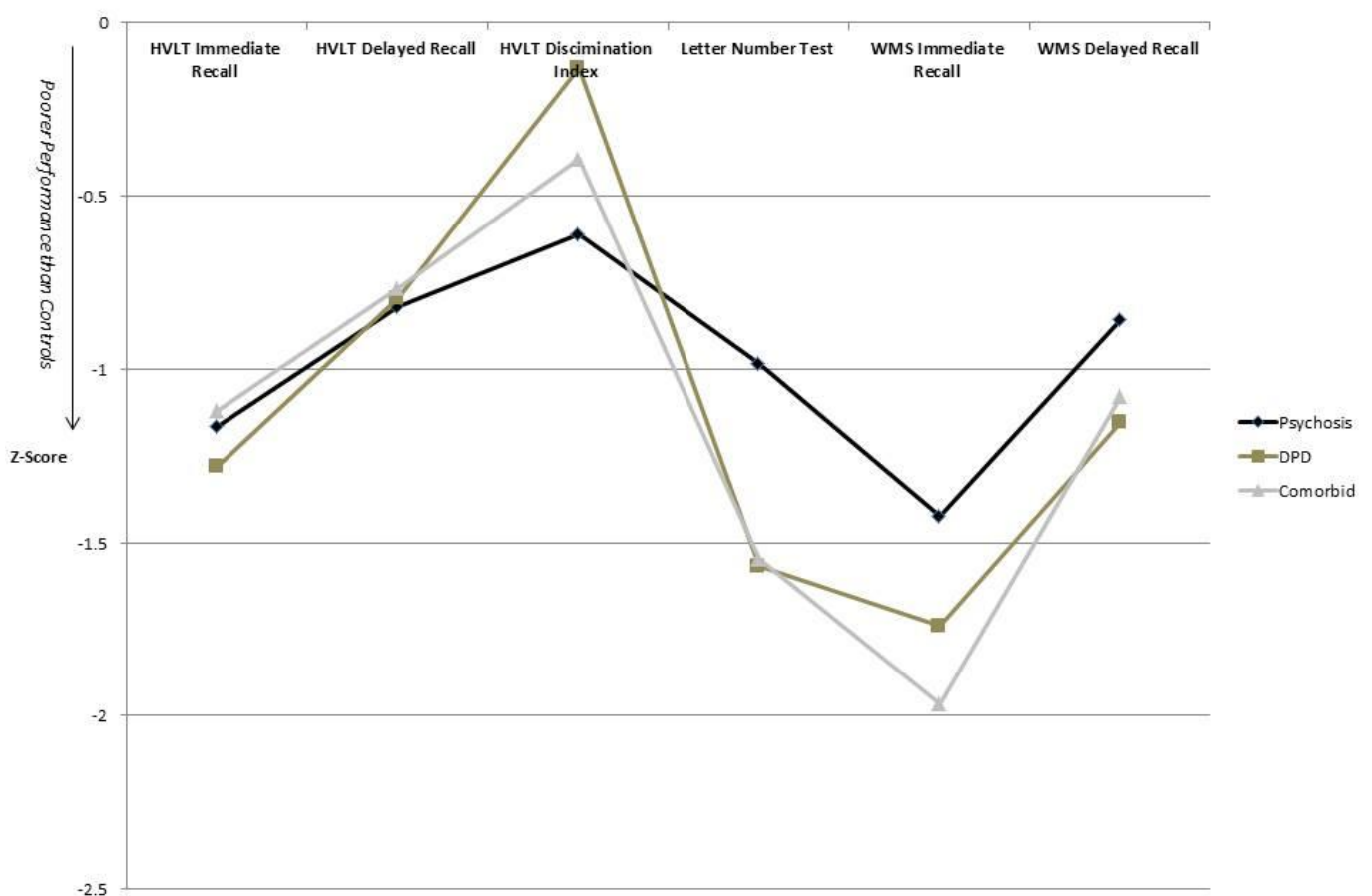
B – Executive Function and Language Profiles of Clinical Groups Compared to Healthy Controls

C – Emotion Processing Profiles of Clinical Groups Compared to Healthy Controls

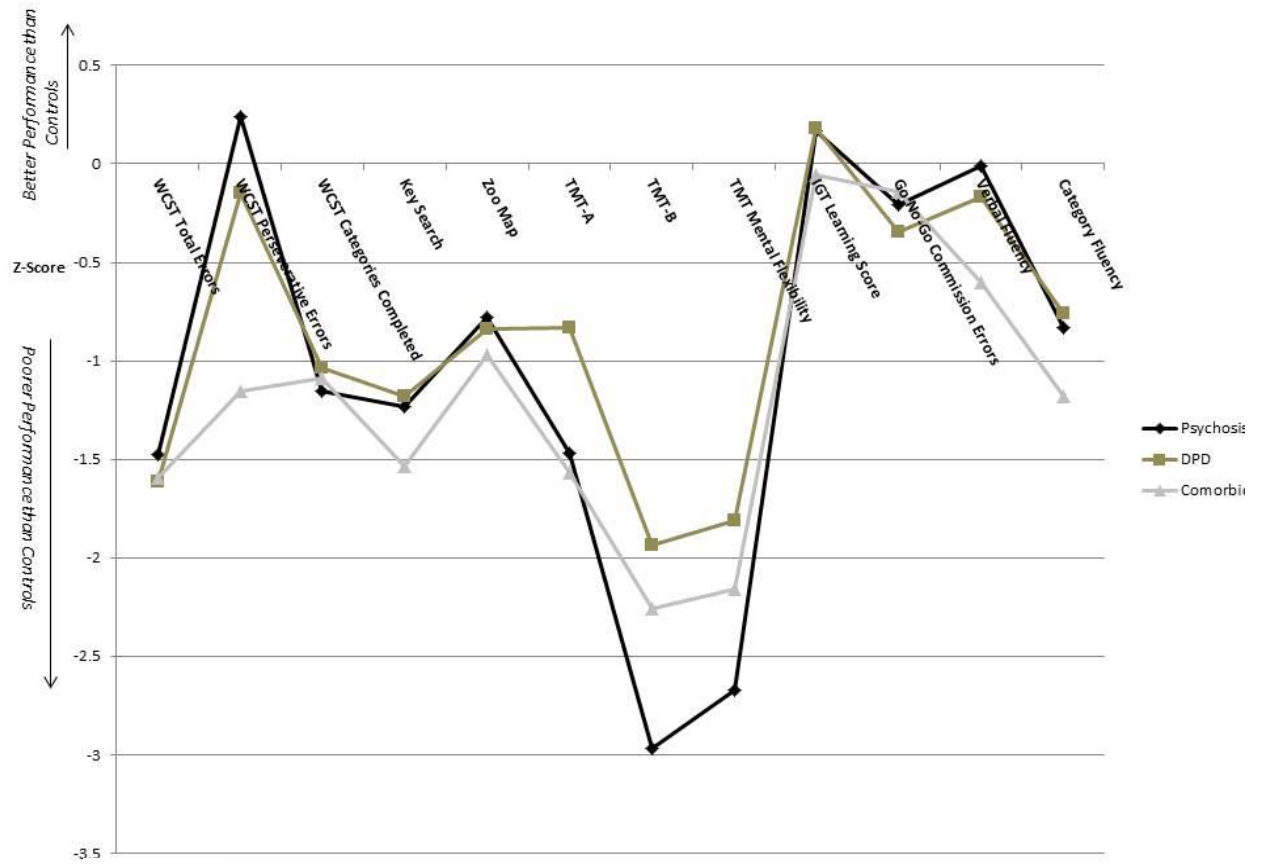
Figures show Z-Scores (standard deviation units) of neuropsychological and emotion processing tasks standardised against mean and standard deviation of Control group score for each task. Thus, the zero line represents the mean score of the Control group. Scores greater than zero represent a better performance, and less than zero a poorer performance than Controls, i.e. scores in which a lower score is better (e.g. WCST total number of errors) have been reversed for ease of interpretation.

DPD – Dissocial Personality Disorder Group; EPT – Emotion Perception Task; HVL – Hopkin's Verbal Learning Test; IGT – Iowa Gambling Task; JORT – Joystick Operated Runway Task;; TMT – Trail Making Test; WCST – Wisconsin Card Sorting Test; WMS – Wechsler Memory Scales.

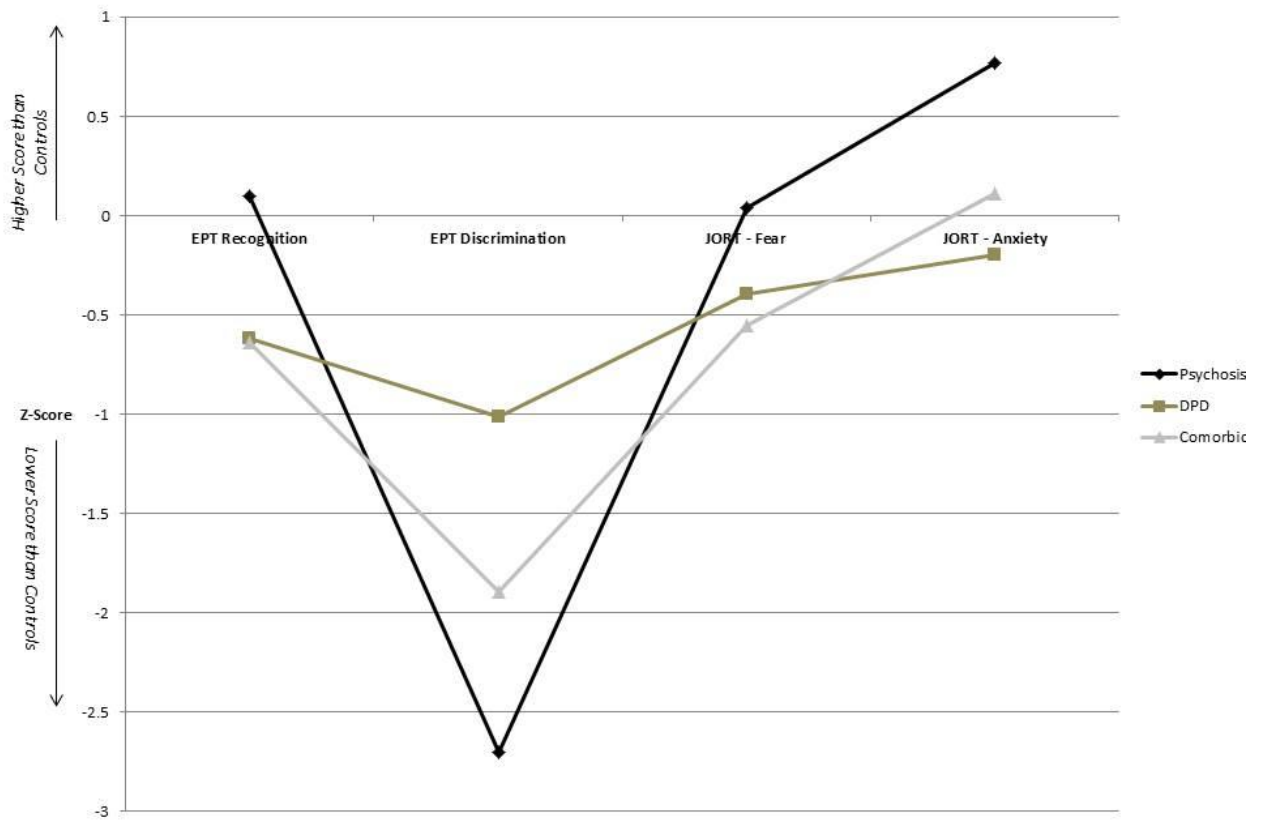
A



B



C



Emotion Perception Task – Recognition

The Recognition part of the Emotion Perception task was strongly correlated with many of the neuropsychological variables at the conventional level of significance: WTAR full scale IQ, all subtests of the HVLTL, Letter Number Span test, both immediate and delayed WMS subtests, WCST total errors and categories completed, and the TMT mental flexibility score. In addition, a number of these correlations remained significant once Bonferroni correction for multiple comparisons was applied ($.05/15=.003$, $p>.003$ accepted as significant), specifically WTAR full scale IQ, HVLTL delayed recall, Letter Number Span, WCST total errors and WCST categories completed. See Table 6.4.

The strongest correlation was with WCST Total Errors ($r= -.384$), and the WCST is a good marker of overall cognitive function as it has been hypothesised to utilise many cognitive skills including abstract reasoning, concept formation, working memory and cognitive flexibility (Hartman, Steketee, Silva, Lanning, & Andersson, 2003; Nyhus & Barceló, 2009) thus this variable was selected to enter as a covariate when re-running the one-way ANOVA to assess for group differences. The main effect of Group on Emotion Recognition was no longer significant ($F_{(4, 77)}=1.09$, $p=.358$, partial $\eta^2=.041$).

Emotion Perception Task – Discrimination

Consistently, neuropsychological measures also significantly correlated with the Discrimination part of the EPT at the conventional level of significance: WTAR full scale IQ, all scales of the HVLTL, both WMS subtests, WCST total errors and categories completed, BADS key search, TMT mental flexibility and category fluency. Seven out of ten of these correlations remained significant after controlling for multiple comparisons, see Table 6.4.

A non-parametric ANCOVA (Quade, 1967) to assess for group differences on the EPT-Discrimination total score, whilst controlling for WCST Total Errors (to be consistent with above), revealed that the significant group difference observed previously was lost ($F_{(3)}=1.45$, $p=.236$, partial $\eta^2=.051$).

Table 6.4 - Pearson and Spearman Correlations Between Emotion Perception Task Subscales and Neuropsychological Measures Across the Whole Sample

	Recognition		Discrimination	
	<i>r</i>	<i>p</i>	<i>rho</i>	<i>p</i>
WTAR FSIQ	.370	.001*	.252	.021
HVLT – Immediate Recall	.294	.007	.364	.001*
HVLT – Delayed Recall	.333	.002*	.425	<.001*
HVLT – Discrimination Index	.229	.037	.258	.017
Letter Number Span	.360	.001*	.100	.363
WMS – Immediate Recall	.240	.029	.368	.001*
WMS – Delayed Recall	.255	.020	.389	<.001*
WCST – Total Errors	-.384	<.001*	-.377	<.001*
WCST – Perseverative Errors	-.034	.764	-.105	.345
WCST – Categories Completed	.361 ^a	<.001*	.434	<.001*
BADS – Key Search	.196 ^a	.077	.423	<.001*
BADS – Zoo Map	.188 ^a	.090	.120	.276
TMT – Mental Flexibility	-.278	.012	-.298	.006
Verbal Fluency	.071	.524	.100	.363
Category Fluency	.174	.115	.343	.001*

Superscript 'a' denotes Spearman Correlations were used in Recognition analysis due to non-normal distribution of data. All Discrimination correlations are Spearman.

'' denotes correlation is significant at Bonferroni corrected level*

BADS – Behavioural Assessment of Dysexecutive Syndrome; HVLT – Hopkin's Verbal Learning Test; IGT – Iowa Gambling Task; JORT – Joystick Operated Runway Task; RT – Reaction Time; PSY – Psychosis Group; TMT – Trail Making Test;; WCST – Wisconsin Card Sorting Test; WMS – Wechsler Memory Scales; WTAR – Wechsler Test of Adult Reading

Discussion

This chapter aimed to examine cognitive and emotion processing characteristics of three clinical groups, namely, psychosis alone, DPD alone, comorbid psychosis and DPD, relative to one another and a group of healthy controls. Hypotheses were based on meta-analytic findings presented in Chapter Two.

For premorbid intelligence, the comorbid group were the most impaired, scoring significantly lower than the healthy controls, although there were no differences between this group and the other two clinical groups, or between healthy controls and the other clinical groups. Of note, the mean scores for all groups still fall within the 'normal' range of intelligence (Wechsler, 2008). One explanation for this differential may be that the WTAR score has been shown to be negatively associated with race (African Americans scoring lower vs. Caucasian) and years of educational attainment (Silverberg, Hanks, & Tompkins, 2013), and the comorbid group had a significantly higher number of non-white participants than the control group, and have been shown to have lower levels of educational attainment compared to those with psychosis alone in previous research (Joyal et al., 2004; P. Moran & Hodgins, 2004; Steinert et al., 1998).

For memory, the meta-analysis suggested that the psychosis groups would have the most difficulty. This hypothesis was partially supported, in that the comorbid group performed consistently poorly across verbal, visual and working memory domains compared to healthy controls, but this was only evident at a trend level for the psychosis group in the verbal memory, delayed visual recall and working memory domains. This provides support for the assertion that there is a distinction between violent men with psychosis with and without DPD. The comorbid group was the only group to perform significantly more poorly on the delayed recall subtest of the Hopkins Verbal Learning Test relative to healthy controls. Memory deficits were also evident in the DPD alone group compared to healthy controls across verbal, visual and working memory domains. This is consistent with Schug and Raine (2009), who showed a specific memory deficit amongst antisocial men with schizophrenia compared to non-antisocial men with schizophrenia in their meta-analysis, which they suggested was perhaps indicative of a temporo-limbic contribution to violence as opposed to frontal, and this may hold across other diagnostic groups including DPD in the presence of severe violence.

For executive function, it was anticipated that all three clinical groups would perform worse than control participants, and would not differ from each other. This hypothesis was largely supported on tests of concept formation and set shifting (WCST categories completed), planning (BADS key search) and cognitive control (Trail Making Test part B, and Mental Flexibility score), in which no differences between clinical groups were observed, and controls performed consistently better. However, the comorbid and DPD groups tended to show poorer performance than the psychosis alone group on WCST total errors and BADS Zoo Map, and the comorbid group

performed most poorly on WCST perseverative errors, Go/No-Go reaction times, and category fluency, in that this group significantly differed from healthy controls when the other clinical groups did not. Despite often not *significantly* differing from the other clinical groups, the significantly poorer performance in the comorbid group relative to controls is suggestive of poorer executive function in this group, and difference between clinical groups may have become more evident with larger group sizes.

Taken together, this evidence tentatively suggests the most widespread impairment in the comorbid group, consistent with ‘double dose’ explanations of cognitive dysfunction, i.e. the impairments evident in the DPD and psychosis alone groups seem to be present to a greater extent in the comorbid group. The comorbid group had the lowest premorbid IQ, were poorer than controls on all indices of memory function (and additionally poorer than other clinical groups on the delayed recall of the HVLTL), and differed significantly from controls across all indices of executive function (where this was not the case for other clinical groups on WCST perseverative errors, Go/No-Go reaction times and category fluency). This is consistent with the findings of Tang and colleagues (2016), which showed more perseverative errors on the WCST for a comorbid group compared to psychosis alone.

The relative strength of the psychosis alone group compared to the other groups (i.e. they did not significantly differ from healthy controls on ten indices, whereas the comorbid group was almost always poorer, and the DPD group was only equivalent on eight indices) is unexpected given the well documented cognitive impairments evident in schizophrenia and other psychotic illness, and evidence presented in Chapter Two suggesting more severe cognitive problems in schizophrenia relative to ASPD. It may be that these individuals, who likely are violent primarily due to hallucinations or delusions, are more able to utilise their cognitive abilities to plan and carry out sophisticated violent acts under the influence of delusional thought, leading to admission to high secure services and distinguishing them from other schizophrenia samples reported previously in the literature. Alternatively, a high baseline level of cognitive functioning and thus likely community functioning (M. Green, 1996) may preclude their identification by mental health services in the community, leading to a lack of treatment provision and thus untreated psychotic symptoms which could result in violence. Further, the differential could potentially reflect suboptimal effort in the DPD groups (DPD alone and comorbid), whose personality traits including ‘unconcern for others’ and ‘persistent attitude of irresponsibility’ may have lead them to withhold their full effort during the assessment, perhaps hoping to move through the tasks more quickly in order to obtain their monetary reward sooner/relieve boredom (in-keeping with psychopathic traits such as ‘need for stimulation/proneness to boredom’). There does not appear to be existing literature regarding suboptimal effort in the antisocial personality disorders, and this would be a useful avenue for future research. In addition, the inclusion of effort tests, such as the Effort Index of the Repeatable Battery for Assessment of Neuropsychological Status

(Silverberg et al., 2007) and malingering tests such as the Test of Memory Malingering (Tombaugh, 1997), would improve further studies of this type.

Alternatively, the relatively superior performance could be due to long term compliance with medication (which is highly likely in such a structured and regulated environment); second generation antipsychotics in particular have been shown to improve cognitive functioning, specifically in the areas of learning and processing speed amongst individuals with schizophrenia (Woodward, Purdon, Meltzer, & Zald, 2005). There is also preliminary evidence to suggest an improvement in social cognition (facial affect recognition) with the use of clozapine (Machado de Sousa & Hallak, 2008). Thus, whilst the psychosis group may have received effective treatment which ameliorated, at least partially, cognitive symptoms, the comorbid and DPD groups may have residual personality disorder symptoms which could result in lower test scores, for example high levels of inattentiveness have been noted amongst mentally disordered offenders with a primary diagnosis of personality disorder (Young et al., 2015), and poor impulse control is noted as part of the ICD-10 criteria for personality disorders (World Health Organization, 1992). Thus, in combination, traits such as these may be conferring a disadvantage to the groups with a personality disorder during formal cognitive testing.

Further considering the effect of medication, the characterisation of the sample as reported in Chapter Five indicated that there was a significantly higher proportion of comorbid individuals prescribed a mood stabiliser, relative to the other two clinical groups. A meta-analysis (Wingo et al., 2009) identified that one such mood stabiliser (lithium) when prescribed for bipolar disorder had “few and minor negative effects on cognition”, but seemed to mainly influence immediate verbal memory with a small effect size (Hedge’s $g=0.24$). Other studies have found that lithium does not differentially affect cognition relative to other mood stabilisers, specifically carbamazepine (Joffe, Macdonald and Kutcher, 1988) and valproate (Senturk et al., 2007). With respect to emotion processing, the effect of mood-stabilising medication still remains largely unknown (Townsend and Altshuler, 2012), although some preliminary evidence suggests that the function of neural structures involved in emotion processing improve with the use of lamotrigine in patients diagnosed with bipolar disorder (Jogia et al., 2008). Thus, it is possible that the over representation of mood stabilisers in the comorbid group contributed to the observed deficits in immediate verbal memory, but is unlikely have affected other cognitive domains.

The emotion processing literature reviewed as part of Chapter Two suggested that facial affect perception would be impaired across all clinical groups. This hypothesis was not supported. The comorbid group performed significantly worse than both healthy controls and the psychosis alone group, but did not differ from the DPD group at an uncorrected level of significance. The DPD and psychosis groups did not differ from healthy controls on their total score. Examination of whether there was an emotion specific deficit in the comorbid group compared to the psychosis

and control groups revealed that fear recognition was specifically impaired in the comorbid group. This is consistent with literature supporting a fearful face recognition deficit amongst antisocial groups, and has important relevance to violence; the Violence Inhibition Mechanism (Blair et al., 1997) states that aversive facial cues from a potential victim (e.g. displaying fear) prevent escalation of behaviour from the perpetrator via social conditioning, however if the ability to recognise and therefore respond to this display is compromised, then inhibitory mechanisms are removed. Fear recognition in the Tang et al. (2016) sample did not differ between schizophrenia and comorbid groups, however, as previously discussed this was based on only two presentations of a fearful face which may have limited power to detect meaningful differences.

The discrimination part of the task also revealed group differences, in that the psychosis and comorbid groups were significantly impaired at correctly identifying the stronger emotional display compared to controls across the sum of all emotions, with the DPD group also showing this effect at a trend level. This was specific to angry and fearful faces, and all groups significantly differed from controls when responding to these emotions. This suggests that whilst the psychosis and DPD groups may not have significant difficulty recognising and naming emotional expressions, all three clinical groups struggle to gauge the intensity of emotion which has implications for socially appropriate responding. This finding is in line with the findings in Chapter Two suggesting more complex social processing tasks raise issues for violent offenders with schizophrenia and/or ASPD, and is particularly consistent with that of Silver and colleagues (2005) who demonstrated that violent schizophrenia patients, but not non-violent schizophrenia patients, were poorer at discriminating emotional intensity compared to controls. The current findings would support this deficit as being present in violent offenders with a psychotic disorder, both with and without comorbid DPD. The non-significant difference across all emotions between DPD and control groups, albeit being evident at a trend level, may have arisen due to relatively small sample sizes and thus paradigms such as this warrant further investigation in personality disordered offender groups.

The results of the correlational analyses assessing the contribution of the neuropsychological measures to the emotion perception scores revealed that cognitive ability across all domains (general intelligence, memory, executive function) was related to performance on both subtests of the emotion perception task. Once cognitive function was controlled for, the effect of group on emotion recognition was lost. This is consistent with meta-analytic evidence suggesting the neurocognition and social cognition have considerable overlap (Ventura et al., 2013). This is suggestive of a common or more general cognitive dysfunction which mediates both deficits. However, whether these problems differentially impact on outcome is yet to be elucidated. Of note, a prospective study discussed in Chapter Three (Brugman et al., 2016) identified poor perception of sadness at 70% (but not 40% or 100%) intensity amongst forensic inpatients without psychosis to be a predictor of the number of future violent incidents and the severity of future

verbal aggression; the authors posit that at 40% intensity the emotion is too difficult to see so there were floor effects, whereas 100% was too easy and ceiling effects were present. Thus the more subtle expression at 70% was a useful prognostic indicator, and adds further evidence that poor reading of subtle or ambiguous facial expressions could be related to violence. Further, social cognition but not neurocognition was related to inpatient violence in a prospective study of forensic inpatients with schizophrenia (O'Reilly, Donohoe, Coyle, et al., 2015). These studies highlight the importance of a comprehensive assessment of neuropsychological characteristics, as although they may be interrelated, they are likely to have different implications for guiding clinical intervention.

In sum, the facial emotion task applied here suggests that the comorbid group in particular has difficulties in facial affect recognition. Although this may reflect a more general cognitive deficit, the picture painted for this group is one of a confusing social world in which it is difficult to correctly identify both the emotion being expressed and also the strength of such an expression. Such misinterpretations may potentially result in aberrant behavioural responding if the social scene is not understood correctly.

In terms of experiential emotion, it was hypothesised that the psychosis group would show high, and DPD low, experiential fear and anxiety. No directional hypothesis for the comorbid group was made. The JORT task showed no significant differences between any groups on fear or anxiety, resulting in the null hypothesis being retained in this case. However, there was a reduced sample size for this measure primarily due to a high number of participants refusing to complete the task in its entirety, possibly as a result of the length of the task (17 minutes), the high amount of effort required (at least 50% of maximum strength over 48 trials) and/or the aversive stimuli (loud white noise). This task may not have been suitable for use in such a comprehensive battery of tests given the potential for participant fatigue, especially considering that this was the last task to be completed. Issues such as these are a consideration for further studies within this population.

Strengths and Limitations

This study had a number of limitations. Firstly, not all participants completed all tasks, resulting in variable sample sizes per task (see Table 6.2). This was largely due to participant non-cooperation which is perhaps expected with a challenging forensic population, a number of whom have high levels of antisocial personality traits (including low agreeableness, proneness to boredom, etc.). There were also a relatively high number of outliers, perhaps reflecting the fact that these patients were recruited from a highly specialist service, and thus may be more likely to have extreme presentations of particular traits. Secondly, the groups were not matched on ethnicity. This is of particular relevance in the emotion recognition and discrimination tasks which

used only Caucasian faces, as it is known that facial affect recognition is facilitated when observing individuals of one's own race (Elfenbein & Ambady, 2002). Thus the comorbid group may have been at a disadvantage compared to the control group (who had a significantly higher proportion of white participants). However the strongest differences on the recognition part of the task appeared to arise between the comorbid and psychosis groups, who did not differ on ethnicity, suggesting that this effect could not be wholly explained by racial differences. It would also have been desirable to account for the effect of symptoms on all outcomes, as these may have affected performance, e.g. intrusive auditory hallucinations may have adversely influenced a participant's ability to concentrate on formal cognitive testing. However, the large majority of patients referred to the study were reasonably clinically stable, as any individual with major difficulties would likely not have been referred by their responsible clinician, and the inclusion criteria stipulated clinical stability to the degree that the individual could meaningfully take part.

The study indexed traumatic brain injury as an exclusion criterion. This, however, was assessed via responsible clinicians and no formal measure quantifying less severe head injuries was utilised. Research has shown a high rate of head injury amongst offenders (Davies, Williams, Hinder, Burgess, & Mounce, 2012; Schofield et al., 2006; Slaughter, Fann, & Ehde, 2003; Williams, Cordan, Mewse, Tonks, & Burgess, 2010), perhaps related to the increased likelihood of engaging in risk-taking, thrill seeking behaviours, or an increased propensity to be involved in fights. In addition, head injury may not have been voluntarily reported by offenders unless it was specifically assessed in clinical practice. This could have affected the results of the neuropsychological assessments, although there is no reason to presume that head injury would be overrepresented in one particular group. Further, as discussed in Chapter Five, there are a number of other comorbidities within the sample other than those under investigation which are known to have their own distinct cognitive/emotion processing characteristics, for example autism spectrum conditions (Happé & Frith, 1996) and borderline/emotionally unstable personality disorder (Ruocco, 2005) and these may have influenced the findings. However, it is hoped that by not excluding these individuals the results are more representative of what may be encountered in clinical practice, where comorbidity appears to be the rule as opposed to the exception (e.g. Blackburn et al., 2003).

The strengths of the study should also be acknowledged. The only study (Tang et al., 2016) to date which has specifically focussed on men with psychosis and one of the antisocial personality disorders did not include a non-psychotic personality disorder group, which this study did, revealing that this PD alone group appear more similar to a comorbid group than psychosis alone. In addition, the Tang et al. study used only a few presentations of each face in their emotion processing task. The current study utilised twelve presentations which should provide a more robust assessment of the group characteristics. In addition, the specific cognitive deficits of the comorbid group were assessed using a comprehensive neuropsychological battery. All clinical

participants were detained in high security hospital at their time of participation so were characterised by high levels of risk and violence, so the results reflect characteristics associated with violent behaviour as opposed to more vague concepts such as ‘aggression’ or ‘antisocial’, as have been used in other studies.

Chapter Summary

This chapter has demonstrated that, on the whole, individuals with both psychosis and DPD appear to be more impaired across cognitive domains compared to controls, which was less often observed in the psychosis and DPD groups. In terms of emotion processing, all three clinical groups struggled to distinguish the intensity of emotions compared to controls, and specifically fearful and angry faces which has theoretical relevance to violence. When separating the participants with psychosis by DPD status, there is a differential effect on emotion perception, namely that those with DPD perform more poorly at recognising fearful faces. This supports the assertion that these individuals constitute a distinct group amongst violent men with psychosis, who may have differing treatment needs. The next two chapters will aim to further examine cognitive and affective traits of these three groups using psychophysiological methods: prepulse inhibition of the startle response (cognitive) and affectively modulated startle response (emotion).

7 Chapter Seven: Sensorimotor Gating Characteristics of Comorbid Psychosis and DPD

Chapter Aims and Overview

The previous chapter demonstrated that the three clinical groups differed on some cognitive indices based on the results of neuropsychological tests, and this chapter aims to extend these findings by examining sensorimotor gating function between groups using a well-established psychophysiological model, namely prepulse inhibition (PPI) of the acoustic startle response indexed via psychophysiological recording of electromyographic activity. Specifically, this chapter assesses mentally disordered offenders with psychosis, DPD, or comorbidity of these diagnoses, and compares them to healthy controls to assess whether they have differing sensorimotor gating (PPI). This chapter will give an overview of PPI and its previous examination in mentally disordered offenders, before presenting group differences in PPI, and then examining possible correlates of this effect.

Introduction

Acoustic Startle Response (ASR)

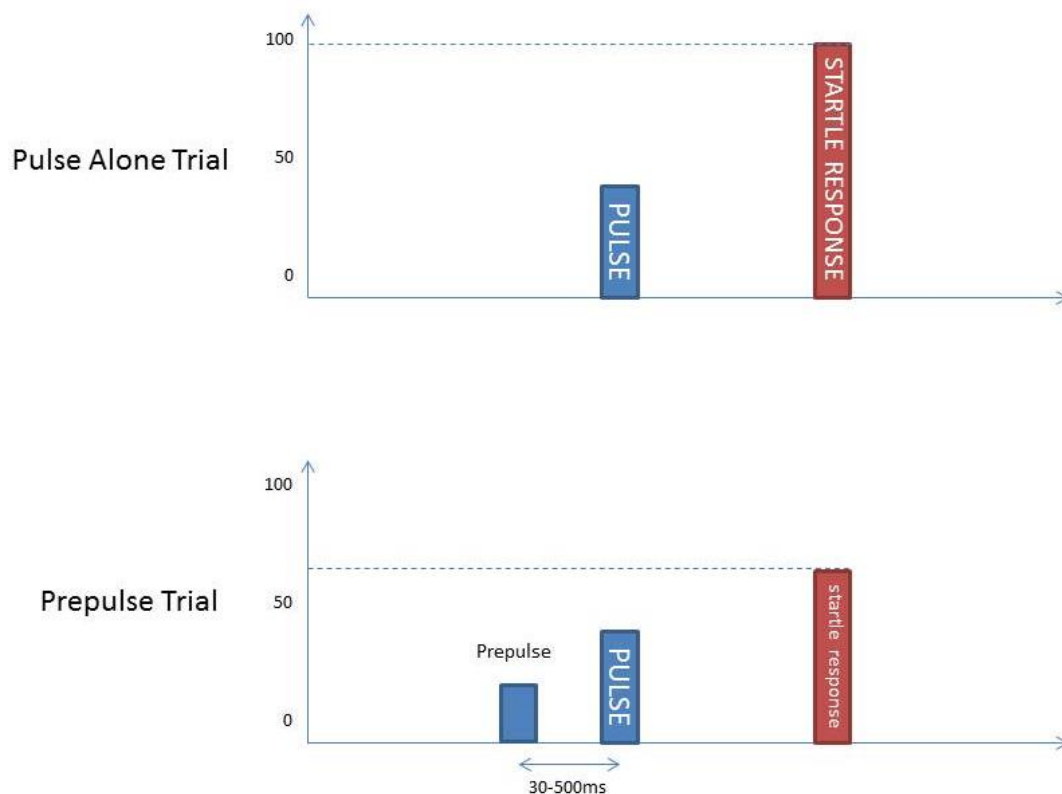
Koch (1999, p. 108) describes the startle reflex as “a fast twitch of facial and body muscles evoked by a sudden and intense tactile, visual or acoustic stimulus. The startle pattern consists of eye-lid-closure and a contraction of facial, neck and skeletal muscles, as well as an arrest of ongoing behaviours and an acceleration of the heart rate.” It is thought to be a primarily defensive reaction in response to potential threat, which serves to reduce injury from a hypothetical blow, and sets into motion the fight or flight response. In humans, the basic ASR is commonly measured electromyographically via the orbicularis oculi muscle; it has a fast latency (<100 ms) and is thought to be mediated via a trisynaptic pathway involving cochlear root neurons, the pontine reticular nucleus and spinal motor neurons (Lee, Lopez, Meloni, & Davis, 1996). The ASR is a useful measure as it has a non-zero baseline, i.e. it can be both enhanced and attenuated under certain experimental conditions, so can provide a reliable index of sensorimotor response plasticity (Koch, 1999). The ASR has been utilised in experimental studies of cognition, especially early information processing characteristics, via the prepulse inhibition paradigm.

Prepulse Inhibition (PPI)

Prepulse inhibition of the startle response describes the phenomenon of a reduced response to a startling stimulus when it is preceded briefly by a weaker, non-startling stimulus (F. Graham, 1975, see Figure 7.1). Processing of the prepulse is thought to limit available neural resources when the pulse arises soon after, resulting in an attenuated response to this stimulus. This mechanism is conceptualised as an operational index of sensorimotor gating, i.e. the brain’s ability to filter out irrelevant environmental stimuli (Braff, Geyer, & Swerdlow, 2001). PPI has

been extensively studied in both animal and human subjects; in animals it has been demonstrated to be mediated by brain stem circuits and modulated by forebrain circuits including the prefrontal cortex, thalamus, hippocampus, amygdala, nucleus accumbens, striatum, ventral pallidum, globus pallidus and efferents to the pedunculopontine nucleus (see Swerdlow, Geyer, & Braff, 2001 for review). In humans, functional magnetic resonance imaging (MRI) has identified hippocampal, striatal, thalamic and frontal and parietal cortical regions to be involved with tactile/acoustic PPI (Hazlett et al., 2008; Kumari et al., 2007; Kumari et al., 2003), which was supported by a structural MRI study which observed positive correlations between grey matter volume and acoustic PPI in the hippocampus, basal ganglia, superior temporal gyrus, thalamus and inferior frontal gyrus (Kumari, Antonova, et al., 2005).

Figure 7.1 - Demonstration of Prepulse Inhibition Effect



In order for the prepulse stimulus to inhibit the pulse in humans, it must be presented between 30ms and 500ms before the pulse onset (F. Graham, 1975). The interval between prepulse and pulse has been shown to alter the magnitude of the startle response, with the greatest inhibition apparent at stimulus onset asynchronies (SOA; prepulse onset-to-pulse onset) of around 120ms, with a 20-ms presentation of the prepulse (Braff et al., 2001).

PPI in Schizophrenia

Much research has focussed on the disruption of PPI amongst those with a diagnosis of schizophrenia. Gating deficits in this group are consistent with some of the prominent symptoms of schizophrenia, including the inability to filter out perceptual experiences such as hallucinations, and with cognitive difficulties including attentional capacity. The PPI deficit was first demonstrated by Braff et al. (1978), who showed that PPI was reduced in individuals with schizophrenia compared to healthy controls at 60ms prepulse-to-pulse intervals. A large literature supporting this finding has followed (see Braff et al., 2001 for review), and PPI deficits have also been observed in family members of those with schizophrenia, those with an at risk mental state, and those with schizotypal personality disorder (Cadenhead, Swerdlow, Shafer, Diaz, & Braff, 2000; Giakoumaki, 2012; Kumari, Das, Zachariah, Ettinger, & Sharma, 2005; Winton-Brown et al., 2015), suggesting these deficits extend across the schizophrenia spectrum and may have a genetic basis.

PPI has shown to be correlated with a number of clinically relevant variables amongst those with schizophrenia. This includes the positive symptoms of schizophrenia, specifically thought disorder (Perry & Braff, 1994; Perry, Geyer, & Braff, 1999) and auditory hallucinations (Kumari et al., 2008) however the latter study found that diminished PPI was only associated with ‘uncontrollable’ verbal hallucinations (i.e. the patient felt that they had no control over their occurrence and that they were unable to dismiss them), which suggests that typical sensorimotor gating may be protective amongst those experiencing hallucinations as it enables them to focus on their activities of daily living whilst filtering out distracting stimuli.

There is evidence to suggest that second generation/atypical antipsychotic medication can ‘normalise’ PPI amongst those with schizophrenia. Cross-sectional studies have found support for atypical agents (Swerdlow et al., 2006), and specifically clozapine and risperidone (Kumari & Sharma, 2002; Kumari, Soni, & Sharma, 2002; Oranje, Van Oel, Gispen-de Wied, Verbaten, & Kahn, 2002). Longitudinal studies have been more mixed in their findings with some showing improvement in PPI with second generation agents (Aggernaes et al., 2010; Quednow et al., 2006; Wynn et al., 2007), and others showing no change in PPI with treatment (Mackeprang, Kristiansen, & Glenthøj, 2002). However, the study with the longest follow up period to date (Hammer, Oranje, Fagerlund, Bro, & Glenthøj, 2011) showed improvement in PPI amongst a group of antipsychotic naïve patients who were assessed six years later after receiving treatment. Although the improvement in PPI did not correlate with improvements in symptom measures or medication doses, the authors suggest that the improvement was very likely due to medication or disease related factors as a comparison group of healthy participants showed a decline in PPI over the same period.

PPI and Violence

Only one study has assessed the relationship between PPI and violence; this was conducted in three patient groups (violent men with schizophrenia, violent men with ASPD, and non-violent men with schizophrenia) and healthy controls (Kumari, Das, Hodgins, et al., 2005). The results demonstrated that the three patient groups had poorer PPI compared to the healthy controls, but did not differ from one another. The ASPD group did not demonstrate the typical habituation pattern of reduced PPI with increasing prepulse to-pulse intervals, and had the lowest PPI amongst the three clinical groups (although non-significantly so), and the psychosis groups displayed more subtle PPI deficits. This suggests a potential role for antisocial personality traits in mediating PPI, which has not been fully explored to date.

There was a moderate relationship between severity of past violence and PPI across the groups. The authors (Kumari et al., 2005) suggested that their results might infer that violent individuals become overstimulated and thus fail to restrict themselves in violent situations, leading to more severe violence. It could also potentially reflect an inability to problem solve by selecting relevant, salient information in highly emotionally charged situations due to overstimulation, resulting in instinctual violence being the only solution available to them. Other potential variables may play a role in the relationship between PPI and violence, and recent neuroimaging data indicate reduced thalamic volume amongst violent men with a history of psychosocial deprivation, including physical and sexual abuse (Kumari et al., 2013). Given the importance of this structure in sensory gating (i.e. all sensory stimuli must be relayed through the thalamus), childhood deprivation could be relevant to PPI functioning.

Thus, this study aimed to 1) expand the above findings by examining the sensorimotor gating characteristics (PPI) and indices relevant to this (amplitude and habituation of the startle response) amongst individuals diagnosed with both a psychotic disorder and DPD, in addition to the three groups already studied (psychosis alone, DPD alone, and healthy controls) and 2) to clarify and explore potential correlates of PPI amongst violent groups, specifically antisocial personality traits, previous violence and psychosocial deprivation.

It was hypothesised that:

- 1) All three clinical groups will demonstrate lower PPI than the healthy control group, with the DPD group showing lower PPI than the psychosis group (Kumari, Das, Hodgins, et al., 2005). No directional hypothesis was made for the comorbid group due to a lack of relevant previous data.
- 2) High levels of psychopathy (antisocial personality traits; Kumari, Das, Hodgins, et al., 2005), previous violence (Kumari, Das, Hodgins, et al., 2005) and psychosocial deprivation (Kumari et al., 2013) will be negatively associated with PPI.

Method

Participants and Design

This experiment involved 74 males, divided across the four groups previously described and characterised in Chapters Five and Six: patients with a psychotic disorder (n=12), patients with DPD (n=14), patients with both a psychotic disorder and DPD (comorbid: n=21) and healthy control participants (n=27). Fourteen participants did not complete this session for the following reasons: they were unable to move from their ward due to seclusion/lack of staff (n=3; 1 PSY, 1 DPD; 1 COM), withdrawal of consent before this session (n=3; 1 PSY; 2 COM), did not provide enough data due to a lack of blink responsivity or equipment failure (n=4; 2 CONT; 1 DPD; 1 COM), had an unstable baseline (noisy trace; n=1 CONT) and two individuals (n=1 PSY; n=1 DPD) who reported distress as a result of the preceding experiment (involving viewing emotionally valenced images; see Chapter Eight) and thus declined to continue the session (involving this paradigm), and one who refused (n=1 COM).

Inclusion and exclusion criteria have been described previously (Chapter Five/Six). As PPI is sensitive to smoking (nicotine increases PPI; Hong, Wonodi, Lewis, & Thaker, 2008; Kumari, Soni, & Sharma, 2001; Postma et al., 2006), any control participants who were smokers (n=6) were asked to refrain from smoking for two hours prior to testing. All patients were non-smokers as there is a no smoking policy in place within the hospital. Demographic, clinical and offence related variables (where relevant) for the reduced size groups are displayed in Table 7.1, see Chapter Five for full description of sample characterisation measures.

Psychophysiological Data Collection and Scoring

A commercially available human startle response monitoring system (SRH-Lab, San Diego, California) was used to generate and deliver the acoustic startle stimuli, and to record and score the electromyographic (EMG) activity for 1000 ms starting from the onset of the acoustic startle stimulus. The pulse-alone stimulus was a 40-ms presentation of 112-dB (A) white noise and the prepulse stimulus a 20-ms presentation of 85-dB (A) white noise, both over 70-dB (A) continuous background noise. Acoustic stimuli were presented to participants binaurally through headphones.

The session began with a 2-min acclimatisation period consisting of 70-dB (A) continuous white noise. Participants then received four blocks of 12 trials each, after an initial pulse-alone trial. Each block consisted of three pulse-alone trials, three prepulse trials with a 30-ms prepulse-to-pulse (onset-to-onset) interval, three prepulse trials with a 60-ms prepulse-to-pulse interval and three prepulse trials with a 120-ms prepulse-to-pulse interval, presented in a pseudorandom order with a mean inter-trial-interval of 15 s (range 9-23 s) to attenuate potential habituation effects as much as possible.

Eye-blink component of the startle response was indexed by recording EMG activity of the orbicularis oculi muscle directly beneath the right eye, by positioning two miniature silver/silver chloride electrodes. Recorded EMG activity was band-pass filtered, as recommended by the SRH-Lab. A 50-Hz filter was used to eliminate the 50-Hz interference. The EMG data were at first inspected on trial-to-trial basis offline to exclude unusable trials for a particular participant, and then scored blind to diagnoses, using the analytic programme of this system for response amplitude (in arbitrary Analog-to-Digit units; 1 unit=2.62 μ V). Responses (<5%) were rejected if there was no visible blink response with the peak occurring within 120-ms of pulse presentation.

PPI value was computed for each participant separately for each trial type as $(a-b/a) \times 100$, where “a”=pulse-alone amplitude and “b”=amplitude over prepulse trials. Percent PPI, rather than the absolute amount of PPI (i.e. arithmetic difference between pulse-alone and prepulse trials), was used since this procedure reduces the influence of individual differences in startle responsiveness.

General Procedure

Participants were told that the experiment was to measure their attention to a number of brief auditory clicks. No specific instructions were given as to attend or ignore them. Participants were requested to keep their eyes open during the experiment.

This experiment was always presented after the affective modulation of startle experiment (see Chapter Eight), as the current experiment used stronger acoustic stimuli (112 dB, compared to 100 dB) to elicit startle. Thus it was necessary to administer PPI later in the experimental battery, as if it had been administered first, habituation to the relatively stronger stimuli may have taken place leading to difficulties in eliciting measurable startle responses in the subsequent experiment (affective modulation).

Data Treatment – Normality

As in previous chapters, normality was assessed via reviewing of z-scores for skewness and kurtosis with a critical value of ± 1.96 as recommended by Field (2009). Equality of variance was assessed via Levene’s test, with $p < .050$ indicating significant heterogeneity of variance between groups. Skewness, kurtosis and equality of variance for continuous variables are reported in Table 7.2.

Statistical Analysis

Group differences in demographic, clinical and offence related continuous variables were examined using one way analysis of variance (ANOVA) when variables were normally distributed (e.g. age), post-hoc comparisons using Hochberg GT2 tests were applied; these tests are recommended when group sizes differ but variances are equal (Field, 2009). Where variables were non-normally distributed, logarithmic transformation was attempted; this was successful for

‘Number of Previous Offences’ only and thus the log-transformed variable was used for this analysis. Kruskal-Wallis non-parametric test was used when the assumptions of normality were violated (e.g. number of substances with harmful use or dependency, psychosocial deprivation), with post-hoc Mann-Whitney tests where appropriate (with Bonferroni correction applied). Group differences for categorical variables (e.g. ethnicity) were assessed using chi square, and the difference in time since illness onset was assessed using an independent t-test (two groups compared).

As the amplitude scores for pulse-alone trials within blocks did not meet the assumptions for parametric testing (significant skew/kurtosis and unequal variance; see Table 7.2), a Kruskal-Wallis non-parametric test was employed to assess whether amplitude for pulse-alone trials differed between groups, followed up with post-hoc Mann Whitney tests with Bonferroni correction applied. To assess habituation from the first to the last block of pulse-alone trials, percentage change of amplitude from block 1 to block 4 was calculated; the variable met assumptions for parametric testing so was subjected to a one-way ANOVA with Percentage Change as the within-subjects factor and Group as the between-subjects factor.

Next, the effects of Group on PPI were evaluated with a 4 (Group) x 3 (Trial Type: PPI with 30-ms, 60-ms, 120-ms prepulse-to-pulse interval trials) ANOVA with Trial Type as a within-subjects factor and Group as a between-subjects factor, followed by lower order ANOVAs and the analysis of simple main effects and post-hoc comparisons using Hochberg GT2 tests. Field (2009) states that multiple comparison tests perform well under small deviations from normality, which was deemed to be the case for these variables (as only the comorbid group displayed skewness/kurtosis), and variance between groups was equal. Differences in group sizes were accounted for by using the appropriate post-hoc procedure (Hochberg GT2). Effect sizes, where relevant, are reported as partial eta squared (partial η^2).

Correlational analyses (Spearman’s Rho) were carried out to examine the relationship of startle measures (pulse-alone amplitude, PPI) with the ratings of psychopathy, violence and childhood psychosocial deprivation across all patients in order to increase the power of finding an effect.

All analyses were performed by SPSS windows (version 22). The α level for significance (two-tailed) was set at $p < .05$ in all analyses unless specified otherwise.

Table 7.1 - Demographic, Clinical and Offence Related Variables for the Four Groups, with Inferential Statistics

Variable	Psychosis Mean (SD)	DPD Mean (SD)	Comorbid Mean (SD)	Control Mean (SD)	Test Statistic	df	p- value	Effect Size	Direction of Effect
Demographic									
Age (years)	35.8 (7.99)	37.4 (10.9)	36.7 (9.39)	39.3 (10.4)	F=.446	3, 70	.721	.019	-
Ethnicity (% white)	41.7%	85.7%	28.6%	96.3%	$\chi^2=29.8$	3	<.001*		CONT, DPD>COM CONT>PSY
WTAR Estimated FSIQ	98.8 (14.5)	94.2 (10.7)	92.2 (9.50)	100.4 (8.88)	H=8.89	3	.031*		CONT>COM
Clinical									
<u>PCL-R Score (Total)</u>	11.3 (5.93)	26.9 (6.70)	23.5 (4.71)		H=22.7	2	<.001*		DPD, COM>PSY
<i>Factor 1</i>	4.17 (2.98)	10.3 (3.93)	8.08 (3.02)		F=11.3	2, 44	<.001*	.339	DPD, COM>PSY
<i>Factor 2</i>	6.49 (3.67)	14.1 (3.86)	14.2 (2.97)		F=22.3	2, 44	<.001*	.503	DPD, COM>PSY
Substance Use: Any Harmful Use (%)	50%	71.4%	66.7%		$\chi^2=1.42$	2	.492		-
Substance Use: Any Dependence (%)	41.7%	35.7%	33.3%		$\chi^2=.231$	2	.891		-
Number of Substances with Harmful Use	.583 (.669)	1.07 (.917)	1.19 (1.40)		H=2.33	2	.312		-
Number of Substances with Dependency	.500 (.674)	.786 (1.42)	.619 (1.36)		H=.172	2	.918		-
Years since Onset of Psychosis	12.9 (8.92)	-	-	18.8 (7.49)	t=-2.01	31	.053		(COM>PSY)
<u>Comorbidity</u>									
<i>Emotionally Unstable PD</i>	1	4	5						
<i>with Narcissistic PD</i>	-	1	-						
<i>with Paranoid PD</i>	-	1	-						
<i>Paranoid PD</i>	0	2	0						

Variable	Psychosis		DPD		Comorbid		Control	Test Statistic	df	p-value	Effect Size	Direction of Effect	
<i>Narcissistic PD</i>	0		1		0								
<i>Autism Spectrum Disorder</i>	1		0		0								
<i>Generalised Anxiety Disorder</i>	0		1		0								
<i>Hyperkinetic Disorder</i>	0		1		0								
<u>Medication Type (%)</u>													
<i>Typical Antipsychotic</i>	25.0%		7.1%		28.6%			$\chi^2=2.44$	2	.296			-
<i>Atypical Antipsychotic</i>	75%		42.9%		81.0%			$\chi^2=5.97$	2	.051			(COM, PSY>DPD)
<i>Mood Stabiliser</i>	8.3%		21.4%		38.1%			$\chi^2=3.73$	2	.155			-
<i>Antidepressant</i>	33.3%		21.4%		14.3%			$\chi^2=1.65$	2	.437			-
<i>Anxiolytic</i>	0%		35.7%		14.3%			$\chi^2=6.04$	2	.049*			DPD>PSY, COM
CPZ Equivalent	541.0 (304.2)		271.4 (437.5)		601.3 (498.4)			H=9.21	2	.010*			COM,PSY>DPD
Psychosocial													
Psychosocial Total Score	7.42	(6.16)	16.1	(6.40)	10.5	(7.54)			H=9.96		.007*		DPD>COM, PSY
Offence Related													
Gunn and Robertson: Index Offence	3.42	(.792)	3.36	(.745)	3.19	(.814)			F=.370	2,44	.693	.017	-
Gunn and Robertson: Previous Record	1.50	(1.24)	3.14	(.949)	2.71	(1.15)			F=7.48	2,44	.002*	.254	DPD, COM>PSY
Gunn and Robertson: Total	4.92	(1.08)	6.50	(1.16)	5.76	(1.37)			F=5.22	2,44	.009*	.192	DPD>PSY
Number of Previous Offences	3.67	(4.58)	20.1	(18.3)	15.6	(14.0)			F=13.0	2,44	<.001*	.372	DPD, COM>PSY

COM: Comorbid; CPZ; Chlorpromazine, DPD: Dissocial Personality Disorder; PD: Personality Disorder; PSY: Psychosis; PCL-R: Psychopathy Checklist Revised; WTAR FSIQ: Wechsler Test of Adult Reading Full Scale IQ.

Table 7.2 - Skewness and Kurtosis Across Variables with Levene's Test for Equality of Variance

Variable	Psychosis				DPD				Comorbid				Controls				Levene's Test (p-value)
	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	
Startle Variables																	
Pulse-alone	1.25	1.97*	.227	.185	.652	1.09	.018	.016	.399	.796	-.744	-.765	1.01	2.25*	.081	.093	<.001*
PPI 30ms onset	.597	.937	.686	.556	-.755	-1.27	.493	.427	-1.05	-2.10*	1.20	1.24	-.038	-.085	-.756	-.866	.189
PPI 60ms onset	.437	.686	-.974	-.790	-.437	-.731	.798	.691	-1.90	-3.78*	3.78	3.89*	-.006	-.014	-.178	-.204	.481
PPI 120ms onset	.192	.302	-1.69	-1.38	.723	1.21	-.631	-.547	.054	.109	.093	.096	-.564	-1.26	1.17	1.34	.604
Pulse-alone Block 1	1.19	1.87	-.197	-.160	1.14	1.91	.952	.825	1.13	2.25*	.726	.747	.724	1.62	-.636	-.729	<.001*
Pulse-alone Block 2	1.86	2.92	3.45	2.80*	1.06	1.77	.314	.272	.379	.755	-.549	-.565	.724	1.62	-.636	-.729	<.001*
Pulse-alone Block 3	1.39	2.19*	.825	.670	.945	1.58	.501	.434	-.010	-.020	-.736	-.758	1.46	3.26*	1.41	1.62	<.001*
Pulse-alone Block 4	1.74	2.73	2.45	1.99*	.807	1.35	.403	.349	.269	.536	-.595	-.612	1.56	3.49*	1.90	2.17*	<.001*
Percentage Change (Block 1 to Block 4)	.659	1.03	1.74	1.41	-.132	-.221	-1.31	-1.13	.226	.451	.375	.385	-.244	-.553	-.081	-.094	.290
Characterisation Variables																	
Age (years)	.925	1.45	-.210	-.171	.763	1.24	.505	.424	.513	1.00	-.680	-.685	.722	1.61	-.281	-.323	.786
WTAR Estimated FSIQ	-.909	-1.43	-.134	-.109	-.469	-.762	-.615	-.516	.124	.242	-.714	-.719	-.923	-2.06*	.455	.522	.096
PCL-R Score (Total)	1.32	2.07*	1.31	1.06	-.569	-.923	-.382	-.321	-.479	-.935	-.095	-.096					.328
Factor 1	1.17	1.83	1.29	1.05	.082	.134	-1.50	-1.26	-.809	-1.58	-.122	-.123					.160
Factor 2	.618	.969	-.125	-.101	-.241	-.390	-.992	-.833	-.476	-.930	-.320	-.322					.404

Variable		<u>Psychosis</u>				<u>DPD</u>			<u>Comorbid</u>				<u>Controls</u>	<u>Levene's Test</u> (p-value)
No. Substances Harmful Use	.735	1.15	-.190	-.154	.507	.823	-.394	-.330	2.10	4.10*	5.92	5.97*		.347
No. Substances Dependency	1.07	1.68	.352	.286	2.63	4.27*	7.38	6.20*	3.34	6.52*	12.57	12.7*		.586
Years since Onset of Psychosis	.254	.399	-1.37	-1.11					-.043	-.084	-1.16	-1.17		.344
Psychosocial Deprivation Total	.171	.268	-1.37	-1.11	-1.28	-2.08*	.634	.532	.204	.399	-1.32	-1.33		.591
Gunn and Robertson: Index Offence	-.988	-1.55	-.464	-.376	-.849	-1.38	-.580	-.487	-.496	-.969	-1.15	-1.16		.992
Gunn and Robertson: Previous Record	.852	1.34	-.091	-.074	-.854	-1.39	.221	.185	-.863	-1.69	.650	.655		.542
Gunn and Robertson: Total	.192	.301	.219	.177	-.172	-.289	-1.42	-1.23	.091	.182	-.444	-.457		.432
No. Previous Offences	1.91	3.00*	4.56	3.70*	1.36	2.20*	2.44	2.05*	1.92	3.75*	5.41	5.45*		.092
Log Transformed	.113	-1.21	.177	-.978	.212	.354	.360	.312	-.386	-.770	-.436	-.448		.347

COM: Comorbid; DPD: Dissocial Personality Disorder; PD: Personality Disorder; PPI: Prepulse Inhibition; PSY: Psychosis; PCL-R: Psychopathy Checklist Revised; WTAR FSIQ: Wechsler Test of Adult Reading Full Scale IQ.

Results

Sample Characteristics

As shown in Table 7.1, the four study groups were well matched in terms of current age ($p=.721$) but there was a significant Group effect in premorbid IQ ($p=.048$) and ethnicity ($p<.001$). The comorbid group had a significantly lower estimated premorbid full scale IQ than the controls. The control and DPD groups also had a significantly higher proportion of white participants than the comorbid group, and the control group had a higher proportion of white participants than the psychosis group.

Habituation and Amplitude

There was habituation of the startle response with repeated presentation of pulse-alone trials as indicated by a mean percentage decrease in all four groups when comparing amplitude in Block One to amplitude in Block Four (ranging from approximately 12% decrease to approximately 24% decrease; see (Table 7.3). The magnitude of habituation did not differ between groups ($F_{(3,70)}=.474$, $p=.702$, partial $\eta^2=.020$).

There was also a significant effect of Group on Amplitude ($H_{(3)}=8.72$, $p=.033$) indicating significantly lower pulse-alone amplitude, on average, over the entire session in the comorbid group ($p=.003$) relative to the control group. The psychosis, DPD and control groups did not differ significantly from one another (all $p>.120$).

Table 7.3 - Mean (Standard Error Of The Mean, SEM) Response Amplitudes Over the Four Blocks of Three Pulse-Alone Trials Each in the Four Study Groups

	Mean (SEM) of Startle Amplitude (analogue-to-digital units)			
	Psychosis	DPD	Comorbid	Controls
Block 1	498.17 (74.22)	350.40 (68.71)	300.16 (56.10)	482.69 (49.48)
Block 2	350.19 (56.54)	291.19 (52.34)	220.94 (42.74)	425.30 (37.69)
Block 3	360.72 (52.51)	239.98 (48.61)	214.07 (36.69)	378.94 (35.00)
Block 4	368.08 (55.09)	227.43 (51.00)	214.94 (41.64)	379.32 (36.73)
Overall	394.29 (55.05)	277.25 (50.96)	237.53 (41.61)	416.56 (36.68)
Mean % Change*	-15.69%	-24.49%	-22.88%	-17.17%
*Block 1 to Block 4; % change calculated for each subject and a mean of these values per group is reported, thus controls for inter-individual variation in startle amplitude. Raw (uncorrected) amplitudes are reported across blocks.				

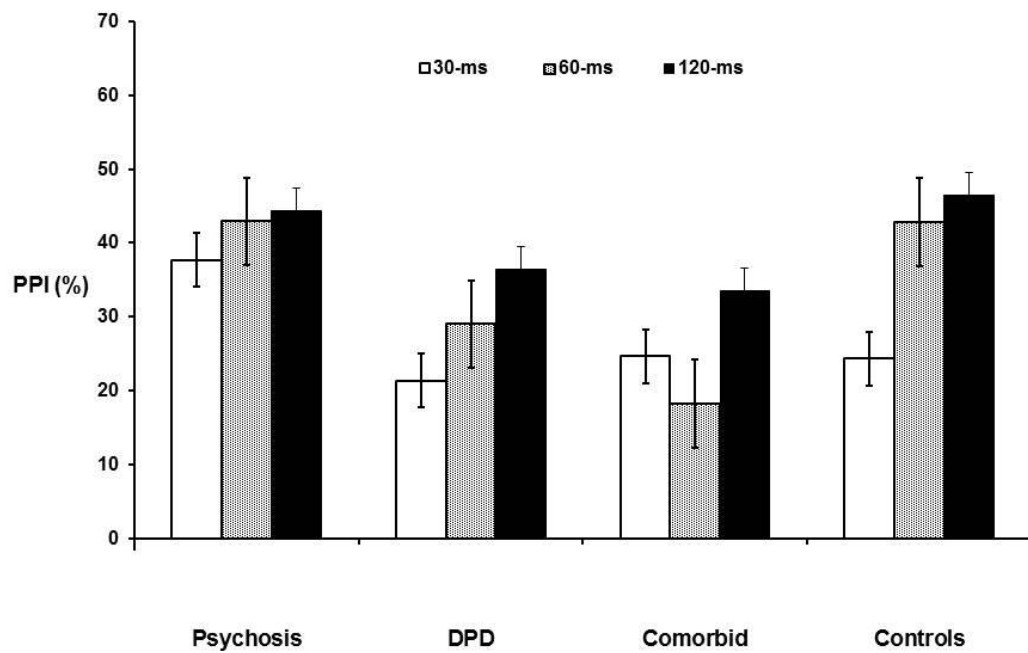
PPI

The overall 4 x 3 (Group x Trial Type) ANOVA revealed significant main effects of Trial Type ($F_{(2,140)}=13.07$, $p<.001$, partial $\eta^2=.16$) with a linear trend (linear $F_{(1,70)}=23.05$, $p<.001$, partial $\eta^2=.25$) indicating significantly greater PPI on 120-ms prepulse trials, relative to 30-ms prepulse trials, across all groups.

There was also a significant main effect of Group ($F_{(3, 70)}=4.68$, $p=.005$, partial $\eta^2=.17$) due to significantly lower PPI in the comorbid group, relative to the control ($p=.030$) and psychosis ($p=.020$) groups. Other group comparisons were non-significant ($p>.150$).

Furthermore, there was a significant Group x Trial Type interaction ($F_{(6,140)}=3.11$, $p=.007$, partial $\eta^2=.12$) which upon further analysis revealed a significant Group effect ($F_{(3,70)}=6.08$, $p=.001$, partial $\eta^2=.21$) in PPI on 60-ms (but not on 30-ms or 120-ms) prepulse-to-pulse interval trials showing significantly lower PPI in the comorbid group, relative to the healthy participant ($p=.001$) and psychosis ($p=.010$) groups (see Figure 7.2 for PPI with three different trial types, classified by Group).

Figure 7.2 - PPI with 30-ms, 60-ms and 120-ms Prepulse-To-Pulse Intervals, Classified by Group. Error Bars are ± 1 SEM



Relationships between the Ratings of Psychopathy, Violence and Psychosocial Deprivation and Startle Measures

Across the entire clinical sample (i.e. excluding controls, diagnostic groups collapsed, Table 7.4), PCL-R factor 2 scores (behavioural/impulsive/lifestyle factor) were negatively correlated with 30-ms and 60-ms PPI, and with the pulse-alone amplitude at a trend level ($p=.092$). PCL-R factor 2 score was also correlated negatively with 120-ms PPI (in the same direction but not significant, $p=.107$). Psychosocial deprivation scores correlated negatively with 120-ms PPI (and at a trend level with 30-ms PPI, $p=.053$). Ratings of violence (Gunn & Robertson scale) correlated negatively with 30-ms PPI. However, none of the reported correlations would meet the threshold for significance if correction for multiple comparison was applied for each set of analyses (each startle category set at $p<.010$).

Table 7.4 - Correlations between the Ratings of Psychopathy, Violence and Psychosocial Deprivation and Startle Measures

	Pulse-alone		30-ms PPI		60-ms PPI		120-ms PPI	
All Patients	r_s	(p)	r_s	(p)	r_s	(p)	r_s	(p)
PCL- R- Factor 1	.004	(.977)	-.164	(.269)	-.024	(.872)	-.052	(.727)
PCL- R- Factor 2	-.248	(.092)	-.360	(.013)	-.328	(.024)	-.238	(.107)
PCL- R-Total	-.109	(.464)	-.272	(.065)	-.142	(.340)	-.152	(.309)
Psychosocial Deprivation	.041	(.786)	-.284	(.053)	-.209	(.159)	-.338	(.020)
Gunn & Robertson - Total	.044	(.771)	-.341	(.019)	-.139	(.351)	-.146	(.326)
Values in bold show significant correlations at $p<.05$								
<i>PCL-R – Psychopathy Checklist – Revised; DPD – Dissocial Personality Disorder</i>								

Discussion

This study aimed to compare prepulse inhibition (PPI) of the startle response amongst three groups of mentally disordered violent offenders and compare them to healthy, non-violent controls. Further, potential variables that may be relevant to PPI were investigated including previous violence, psychopathy level and psychosocial deprivation.

In this study habituation of the startle response (as measured by percentage change of response from Block 1 to Block 4) did not differ as a function of group. Habituation to a stimulus which is repeatedly presented has been proposed as a measure of sensorimotor gating, and a deficit here is thought to represent the potential for cognitive disruption by overwhelming sensory input (Braff, Grillon, & Geyer, 1992; Geyer & Braff, 1987). A number of studies have found evidence of habituation deficits in groups of patients with schizophrenia (Akdog et al., 2003; Bolino et al., 1992; Geyer & Braff, 1982; Meincke, Light, Geyer, Braff, & Gouzoulis-Mayfrank, 2004; Parwani et al., 2000), but equally a number have failed to observe this effect (Braff, Swerdlow, & Geyer, 1999; Cadenhead et al., 2000; Kumari & Sharma, 2002; Kumari, Soni, Mathew, & Sharma, 2000). The studies reporting a habituation deficit in schizophrenia have normally employed a long session involving the presentation of more than 100 pulse-alone trials, which was not the case in the present which was focussed primarily on investigating possible group differences in PPI.

The comorbid group showed the lowest startle amplitude in response to pulse-alone trials across the whole session, when compared to the control group. All other groups did not significantly differ from one another in this regard. A number of factors are known to influence the amplitude of the startle response, including depression (decreased amplitude; Kaviani et al., 2004), anxiety (increased amplitude; Kaviani et al., 2004; Kumari, Kaviani, Raven, Gray, & Checkley, 2001) and antisocial personality traits (decreased amplitude; Loomans, Tulen, & van Marle, 2015). Startle amplitude is also observed to be lowered by some antipsychotic drugs including clozapine (S. Graham, Langley, Bradshaw, & Szabadi, 2001), and low baseline startle amplitude amongst a group of patients with schizophrenia was corrected by the typical antipsychotic amisulpride, but not with atypical antipsychotic olanzapine (Quednow et al., 2006). Thus, it may be that a combination of taking antipsychotic medication and being characterised by high levels of antisocial personality traits combined additively to result in a lower startle response amongst the comorbid group.

In terms of the PPI findings, there was a significant effect of trial type indicating more inhibition at 120ms prepulse-pulse intervals than 30ms prepulse-pulse intervals. This is consistent with previous findings amongst healthy and clinical populations (see Braff et al., 2001 for review), although it is different to the findings of Kumari, Das and colleagues (2005) who did not observe this linear pattern amongst the violent ASPD group previously studied. This may be because relatively fewer trial types of prepulse-pulse interval were examined in this study (Kumari, Das

and colleagues used 90ms and 150ms onset periods in addition to the three examined here). The finding that ASPD participants did not have increasing inhibition with increasing onset periods appears to have come from unusually high inhibition at 90ms intervals in the previous study, which this study did not examine. There may also be discrete differences between the ASPD and DPD diagnoses, particularly as Factor 2 scores were observed to negatively correlate with PPI across the sample, and this factor is more akin to the behaviourally defined DSM-IV ASPD, than DPD which is characterised by more emotional deficiency (see Chapter One). Thus the influence of antisocial behavioural traits (as opposed to interpersonal/affective components) appears to be of relevance to the magnitude of inhibition. Indeed, the effect size in the Kumari et al (2005) study comparing PPI in the ASPD group and healthy controls was of large magnitude (partial $\eta^2=.43$) whereas in this study the comparison of DPD and healthy controls showed a small effect (partial $\eta^2=.084$), suggesting that these two study groups were likely quite distinct.

Contrary to the hypotheses, PPI was not superior in the control group compared to the psychosis and DPD groups. However, PPI was poorest amongst the comorbid group, an effect which appears to be mediated mostly by the 60ms prepulse-pulse interval; the comorbid group showed significantly less inhibition on 60ms trials compared to both the control and psychosis groups. The relevance of the 60ms trial compared to 30ms and 120ms is unclear, and is unlikely to be attributed to conscious attentional processing of the prepulse as this has shown to be achievable on only approximately 50% of trials, and to have no meaningful effect on PPI (Postma, Kumari, Hines, & Gray, 2001). Further, if conscious processing had occurred, PPI would likely be facilitated as opposed to reduced, as is seen in this case. Thus, this finding is in need of replication. One explanation for poorer PPI amongst the comorbid group is age of onset for psychosis, which showed a trend to be earlier amongst the comorbid group and has previously been shown to impair PPI (Kumari et al., 2000). However, a post-hoc exploratory ANCOVA comparing the psychosis and comorbid groups on mean PPI whilst controlling for age of onset of psychosis still showed a significant effect of group with a small reduction in effect size (controlling for age of onset: $F_{(2, 30)}=4.52$, $p=.019$, partial $\eta^2=.204$; without controlling for age of onset $F_{(1,31)}=9.31$, $p=.005$, partial $\eta^2=.231$).

The normal range PPI in the psychosis group somewhat replicates the subtler PPI deficit amongst men with schizophrenia in the only other investigation of PPI amongst violent groups, and was previously hypothesised to be due to this group receiving treatment with antipsychotic medication (Kumari, Das et al., 2005), which has been shown to restore PPI to within the normal range in some cases (Aggernaes et al., 2010; Kumari, Soni, & Sharma, 1999; Quednow et al., 2006; Wynn et al., 2007). However, this explanation does not fit for the current findings when considering that there was no difference in the proportion of patients prescribed second generation antipsychotics in the comorbid and psychosis groups (see Table 7.1). Thus some other factor which distinguishes the groups must be driving this difference. A greater proportion of mood stabilising medication

in the comorbid group may be considered, although this difference was no longer statistically significant as in Chapters Five and Six due to the reduced sample size reported here. In any case, no association between the amplitude of the startle response or percentage of PPI has been found with mood stabiliser use in a previous study involving bipolar patients (Sánchez-Morla et al., 2016). Antisocial personality traits are a likely candidate, and these traits correlate negatively with PPI across the sample. Thus the effect of antisocial personality traits may be a strong determinant of PPI, which appear to be resistant to the restorative effects of antipsychotic medications.

When examining the correlates of PPI across the whole sample, there were significant correlations at 30ms and 60ms PPI for factor two of the PCL-R, which was present at a trend level for the pulse-alone trials and in the same direction (albeit at a non-significant level, $p=.107$) for 120ms trials. This is in line with the suggested hypothesis and strengthens the cause for a role of antisocial personality traits in mediating PPI and the ASR more generally (discussed above). The finding that violence score was significantly negatively associated with 30ms PPI trials supports the hypothesis relating to PPI and violence, and replicates the previously reported finding that poorer PPI was associated with a greater history of previous violence (Kumari, Das et al., 2005). This can be interpreted as described by Kumari and colleagues (2005): violent individuals may become overstimulated at times of high stress and thus fail to restrict themselves, resulting in frequent, serious violent behaviour.

Psychosocial deprivation was significantly negatively correlated with 120ms PPI trials and with 30ms PPI trials at a trend level, in accordance with hypotheses. Early developmental stress has been shown to reduce PPI ability in animal studies (Ellenbroek, Van Den Kroonenberg, & Cools, 1998; Heidbreder et al., 2000; Koenig et al., 2005), and some initial evidence from human studies has corroborated these findings; in a study of neonates, maternal social stress (high social isolation and less social recognition) was associated with developing significantly less PPI four months after birth, when compared to neonates whose mothers reported less social isolation and more social recognition (Huggenberger, Suter, Blumenthal, & Schachinger, 2013). The study confirmed that maternal stress was linked to neonatal stress as the maternal awakening cortisol levels were positively correlated with infant mean cortisol level. This indicates that early developmental experiences can exert an effect on PPI functioning, as the typical development of increasing PPI with age (Gebhardt, Schulz-Juergensen, & Eggert, 2012) was not seen amongst infants with early environmental stressors. In addition, childhood psychosocial deprivation (conceptualised in the same way as in the current study) was found to be associated with reduced thalamic volume amongst violent individuals with schizophrenia and ASPD (Kumari et al., 2013), and the volume of this region has also been related to PPI (Kumari, Antonova, et al., 2005).

Strengths and Limitations

There are a number of strengths to the current investigation, including the examination of a clinically relevant, well characterised sample. Further, PPI is an objective measure of cognitive functioning and thus is not liable to deception or low effort from participants, or experimenter bias (startle amplitudes scored blind to diagnosis group). These factors may have been present during other sessions of the current investigation, for example during the neuropsychological assessment. Thus, the finding that the comorbid group has a distinct sensorimotor gating profile when compared to either diagnosis alone supports the notion that this subgroup is distinct in its characteristics.

Some limitations must also be acknowledged. Firstly, there was a reduced sample size due to participant non-participation or equipment failures. This may have reduced the power to detect true significant effects, although similar sample sizes have been reported in other studies of this type (i.e. Kumari, Das et al. 2005). This may have been related to the order of the experiments conducted in this battery of tests; two of participants reported distress as a result of participating in the preceding experiment (affective modulation of the startle response), leading to non-participation in subsequent experiments. However, as noted in the Methods section, this order was necessary to prevent habituation to the startle stimuli. It could be suggested that the rate of non-completion introduces a type of sampling bias, in that only those who were stable enough to be moved from their wards were able to take part, or that only those with acceptable physiological responsivity were included. However, these appear to be unavoidable obstacles when carrying out clinical research in an environment where changes in presentation are common and there is high use of polypharmacy (Stone-Brown et al., 2013).

Secondly, there may be some collinearity between the examined correlates of PPI (i.e. childhood abuse is known to be associated with future violence; see Perepletchikova & Kaufman, 2010 for review), and thus it may be that these relationships can be explained by some common, latent variable that was not accounted for in the current investigation. In addition, the correlations reported would not reach significance if multiple comparisons had been controlled for, which again may be related to reduced power due to a small sample. However, these can be viewed as hypothesis generating and should be explored further in future research. Previously Kumari, Das and colleagues (2005) hypothesised that a common variable might belie the observed PPI deficits in the violent clinical groups, and proposed substance abuse as a potential candidate. However the results of this investigation would not support this as substance misuse histories do not appear to differ between groups (see Table 7.1), yet PPI does.

Finally, the groups were not matched for premorbid IQ and ethnicity, but there is no reason to presume that these parameters should have unduly affected the findings; one study found no association between PPI and neurocognition (including a measure of reading ability, thus similar

to the WTAR) in over 300 comparisons (Swerdlow et al., 2006). Further, although in one study differences in PPI were observed between African American and European American participants, the results demonstrated that there was *greater* PPI amongst African Americans (Hasenkamp et al., 2008), and thus the finding of reduced PPI in the comorbid group (who had a higher proportion of non-white participants) is unlikely to be due to ethnic differences.

Chapter Summary

This chapter demonstrates diverse sensorimotor gating profiles of subgroups of violent offenders with those with comorbid psychosis and DPD showing the most impairment in this domain as they were significantly poorer at filtering information than those with psychosis alone and healthy controls. The DPD group took an intermediary position and does not differ from any group. There is preliminary evidence to suggest that antisocial personality traits, psychosocial deprivation and a history of violence are correlated with PPI. In combination with evidence presented in previous chapters, this chapter further supports the existence of a distinct subgroup and is consistent with a ‘double dose’ of deficit explanation amongst those with both diagnoses. The next chapter will explore, using psychophysiological methodology, emotion processing characteristics of these four groups by assessing affective modulation of the startle response.

8 Chapter Eight: Affective Modulation of the Startle Response in Comorbid Psychosis and DPD

Chapter Aims and Overview

This chapter aims to further explore emotion processing amongst the study groups using a well-established psychophysiological method to assess appetitive and defensive responding. An overview of the experimental paradigm, namely affective modulation of the startle response, is given focussing on previous work in the disorders of schizophrenia and psychopathy. Between group differences are then reported, followed by an examination of the effect of psychopathy traits.

Introduction

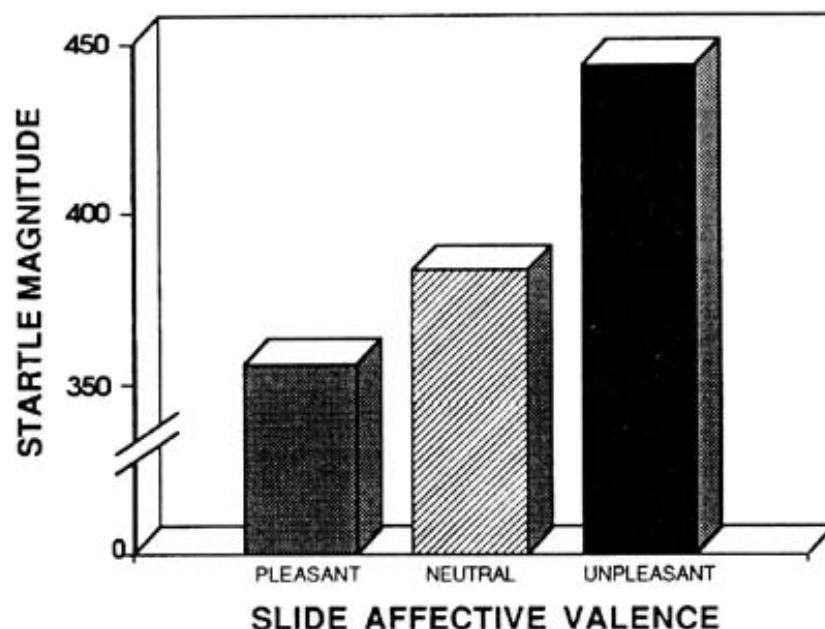
Affective Modulation of the Startle Response

Although the range of human emotion is seemingly vast and complex, it has been proposed to be under the control of two primitive systems: the appetitive and defensive systems, mediating approach and avoidance behaviours, respectively (Lang, Davis, & Ohman, 2000). Approach behaviours incorporate feeding, nurturing and sexual behaviours, whilst defensive behaviours include fleeing from threat, defensive aggression and avoiding pain. Fear is thought to be driven via the defensive system, and is expressed as either ‘defensive immobility’ i.e. the organism becomes immobile but is primed to respond to any further threat, or ‘defensive action’ i.e. fight/flight responses (Campbell, Wood, & McBride, 1997). The acoustic startle response is thought to represent part of a primarily defensive immobility reaction; upon exposure to hearing the sudden, aversive stimulus, the reflex is instigated and the organism is primed to respond to any further threat (Koch, 1999). During the experience of fear, there is an exaggerated startle response as this defensive action is consistent with the threatening stimulus eliciting the fearfulness. Conversely, if a startle reflex is elicited during a non-fearful state, the startle has a relatively smaller magnitude as it is not consistent with a defensive reaction.

The acoustic startle response has served as a useful measure of emotional responsiveness in psychiatric research, as the modulation of this response can give an index of the extent to which an individual is experiencing a fearful state, facilitating a better understanding of the characteristics of a number of disorders including post-traumatic stress disorder, psychosis and anxiety disorders (Grillon & Baas, 2003). This method is beneficial as it does not rely on self-report or experimenter observation, removing a number of associated biases which may distort the true association. Experimentally, the effect is most commonly examined using positive, negative and neutral images, and was observed for the first time by Vrana, Spence, and Lang (1988). They demonstrated in a group of healthy, undergraduate students that startle amplitude was mediated by the valence of the presented images, in that the responses were largest to unpleasant images (e.g. body mutilation, weapons) and smallest to pleasant images (e.g. opposite

sex nudes, babies), both relative to neutral images (e.g. household objects; see Figure 8.1). This effect has been reproduced by many different groups using varying affective modalities, including still images, videos, sounds and odours (see Grillon & Baas, 2003 for review; Kaviani et al., 2004; Kaviani, Wilson, Checkley, Kumari, & Gray, 1998; Kumari et al., 1996), and the potentiation of startle in response to negative images has been shown to be present even when images are not consciously perceived (i.e. the startle tone is presented before conscious processing can occur; Reagh & Knight, 2013).

Figure 8.1 - Affective Modulation of the Startle Response amongst Healthy Undergraduates. Taken from Vrana, Spence and Lang (1988), who first demonstrated the effect in humans

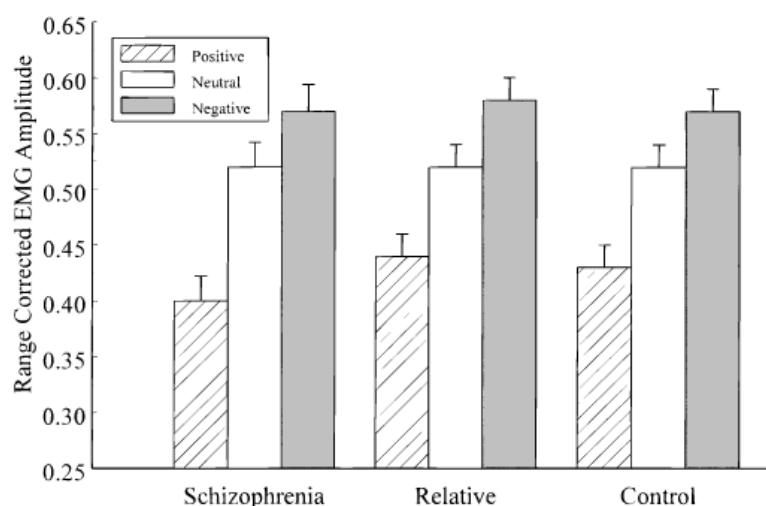


Previous Findings in Schizophrenia

The affective startle modulation paradigm has been examined previously amongst non-violent schizophrenia groups (Curtis, Lebow, Lake, Katsanis, & Iacono, 1999; Dominelli et al., 2014; Schlenker, Cohen, & Hopmann, 1995; Volz, Hamm, Kirsch, & Rey, 2003; Yee et al., 2010). All of these investigations have demonstrated that individuals with schizophrenia show a similar pattern of modulation of the startle response as healthy controls when presented with emotional images, i.e. the smallest startle response to positive images, and largest to negative images, both relative to neutral. Normal modulation has been repeatedly demonstrated, including amongst healthy individuals with high levels of social anhedonia (putatively ‘at risk’ for schizophrenia spectrum disorders) compared to those with low levels of such traits (Gooding, Davidson, Putnam, & Tallent, 2002), amongst first degree relatives of individuals with schizophrenia (Curtis et al., 1999) and amongst those at ultra-high risk for psychosis and those experiencing a first episode of psychosis (Yee et al., 2010). See Figure 8.2.

However, when examining the self-reported experiences of the same images amongst individuals with schizophrenia, some discrepancies arise. For example, although Curtis et al. (1999) found the typical linear pattern of psychophysiological responding to the presented images, they observed that the patients with schizophrenia rated the positive images as less positive, and the negative images less negative, than controls (i.e. a more ‘flattened’ experience). The findings tend to suggest that the appetitive and defensive motivational systems are intact amongst those with a psychotic disorder, and that the anhedonic features of schizophrenia may be more associated with higher order functioning, related to appraisal for example.

Figure 8.2 - Affective Modulation of Startle Response amongst individuals with Schizophrenia, their Unaffected Relatives, and Healthy Controls. Taken from Curtis et al., (1999)

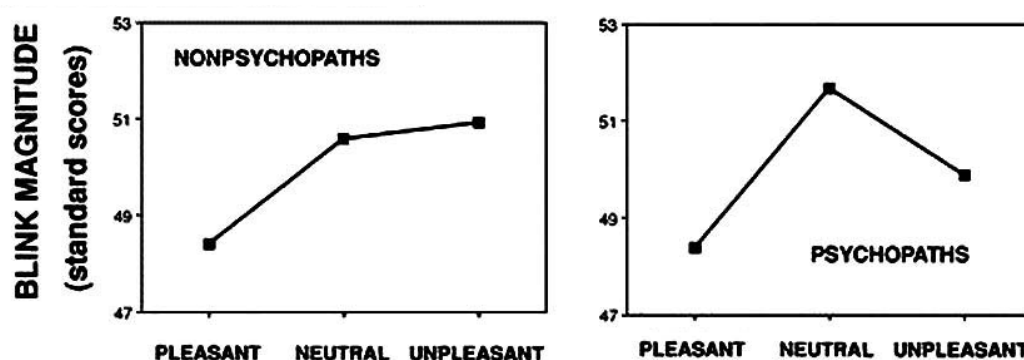


Previous Findings in the Antisocial Personality Disorders

This paradigm has been used extensively to examine emotional deficits amongst individuals with high levels of psychopathic traits. This effect was first examined by Patrick, Bradley, and Lang (1993), who hypothesised that if Cleckley’s (1941) description of the ‘fearless’ psychopath was correct, individuals scoring highly on the PCL-R would show diminished startle responses to negatively valenced images, compared to those with lower scores. They examined imprisoned sexual offenders who were rated using the PCL-R. The results supported their hypothesis, and demonstrated that those who met criteria for psychopathy (scored over 30) had an atypical pattern of responding, with the largest responses seen for neutral images and small responses seen for positive and negative images (See Figure 8.3). When examining the results more specifically by separating the groups into those scoring highly on Factor One (arrogant and deceitful interpersonal style and a lack of emotional responsiveness) but equally on Factor

Two (impulsive and antisocial behaviour), they observed that the effect was most evident amongst those with high Factor One scores, suggesting that such traits mediate the observed deficit in emotional responding.

Figure 8.3 - Affective Modulation of the Startle Response amongst Sexual Offenders divided by Psychopathy Status. Modified from Patrick, Bradley and Lang (1993).



Consistent with this, a large sample of prisoners (n=108) who met criteria for psychopathy (n=35) showed an attenuated startle response in response to aversive images relative to neutral, when compared to those prisoners who did not meet threshold for psychopathy (Vaidyanathan, Hall, Patrick, & Bernat, 2011). Again, this study identified Factor One traits to mediate the effect of reduced startle to negative images; PCL-R Factor One scores were significantly negatively correlated with startle amplitude in response to negative images, and were identified as a significant predictor of aversive modulation in a regression model (in contrast to Factor Two scores which were non-significant in the model). Attenuation in response to negative images has also been demonstrated in a sample of Spanish prisoners meeting criteria for psychopathy, confirming the cross-cultural validity of the finding (Pastor, Moltó, Vila, & Lang, 2003).

One study examining male forensic psychiatric patients who met criteria for psychopathy (based on the psychopathy checklist - screening version) demonstrated no significant effect of valence on the amplitude of startle response, which was shown to be present amongst the comparison groups of forensic psychiatric patients with borderline personality disorder and healthy, non-offender controls (Herpertz et al., 2001). Thus, although there was no attenuation of startle in response to negative images, there was also no significant modulation for any of the stimuli, indicating a more general emotional hypo-responsivity. Similar findings appear evident for ASPD groups; there was no amplitude attenuation for negative compared to neutral images in the aforementioned study (Vaidyanathan et al., 2011) when dividing participants by DSM-IV ASPD status, and a study of alcohol dependent individuals with and without ASPD showed no effect of image valence on the modulation of startle amongst the ASPD group (Miranda Jr, Meyerson, Myers, & Lovallo, 2003). As DSM-IV defined ASPD is more akin to Factor Two of the PCL-R,

it could be that these individuals were more characterised by a reckless, impulsive lifestyle and criminal behaviours as opposed to affective deficits, which appear to be more pertinent in mediating the affective modulation of startle.

The Current Study

To date, there have been no studies assessing individuals with both a psychotic disorder and one of the antisocial personality disorders. This is of considerable interest as the evidence as it currently stands suggests no dysfunction in the appetitive/defensive system of those with a psychotic disorder, yet this appears to be disrupted amongst those with severe antisocial traits (high psychopathy scorers). Thus the functionality of such systems in a comorbid group is as yet unknown. Further, no studies have applied the affective startle paradigm to violent individuals with a diagnosis of a psychotic disorder. It may be that whilst non-violent individuals with schizophrenia do not exhibit deficits, aberrance could characterise groups who have committed extreme acts of violence, when considering explanations of violent behaviour often involve ideas surrounding a lack of fearfulness or appreciation of consequences (see Blair, 2005 for review). In addition, whilst DSM-IV ASPD has been investigated using the affective startle paradigm, it is yet to be established whether the observed deficits are also present amongst those with ICD-10 DPD.

Thus this study aimed to assess the affective modulation of the startle response amongst the four study groups (psychosis, DPD, comorbid and controls), and to assess whether this modulation differed as a function of group. Facets relevant to the startle response, including habituation and startle onset asynchrony, are examined to assess whether these differ between groups and may account for any observed group differences. In addition, the effect of psychopathic traits was explored due to the strong previous associations reported in the literature.

The following hypotheses were formulated:

1. The psychosis and healthy control groups will show the typical valence-modulation of the startle response, whilst the DPD group will not show the typical enhanced response to negative images relative to neutral (due to antisocial traits akin to psychopathy). No directional hypothesis was made for the comorbid group due to a lack of relevant previous data.
2. Those meeting the clinical cut-off for psychopathy (score 25 or above on the Psychopathy Checklist – Revised) will show an atypical response pattern with attenuated startle amplitude to negative images relative to neutral. In addition, the startle response to negatively valenced images will be negatively correlated with psychopathy score.

Method

Participants and Design

This study employed a cross sectional, between-subjects design. Participants comprised a subsample of those described in previous chapters; however, there were a reduced number of participants who took part in the current experiment. Firstly, six participants had no detectable blink response (1 psychosis, 1 DPD, 2 comorbid and 2 controls). For those who had a variable blink response, or did not wish to complete the whole session, the decision was made a priori to exclude participants who had missing data for over 50% of trials within a given valence as their response could not be considered robust. Thus, any participant who had fewer than eight responses per valence category was excluded. The proportion of trials for which data were missing for each participant (i.e. the number of non-responses/undetectable blinks) was examined by valence category. This resulted in 2 psychosis, 4 DPD, 9 comorbid and 11 control participants being excluded. There were 2 psychosis participants and 1 comorbid participant who did not comply with the experimental procedure (i.e. falling asleep, talking to the experimenter throughout), and a total of 10 clinical participants did not provide any data for the current experiment (2 psychosis, 2 DPD and 6 comorbid) [refusal to view the images (2), equipment failure (2), withdrawal of consent before this session (3), difficulties with obtaining staff to escort the patient from the ward (2), or being unable to leave the ward due to being in seclusion (1)].

Thus a total of 43 participants were included: eight psychosis, ten DPD, eight comorbid and 17 control participants.

Post- Hoc Sensitivity Analysis

Due to the substantially reduced number of participants, a post-hoc sensitivity analysis was carried out using G*Power version 3 (Faul, Erdfelder, Lang, & Buchner, 2007) to ascertain the required effect size which would allow a significant interaction to be detected, as a Group x Valence interaction was the effect of interest in this experiment. Using a repeated measures ANOVA to detect a within-between interaction ($\alpha=.05$, power= 80%), and specifying eight participants per group (the smallest group size observed in this case) with a correlation between repeated measures set at the lowest correlation level between conditions (i.e. the most conservative estimate; standardised amplitude for Positive images and standardised amplitude for Neutral images, $r=.785$), an effect size of $f=.187$ would be required, a small-medium effect size (Cohen, 1988). Previous research suggests medium-large effect sizes are obtained for the Valence by Group interaction, including amongst those with schizophrenia (partial eta squared = .168, large effect; Dominelli et al., 2014) and high levels of psychopathic traits (partial eta squared =

.100, medium effect; Baskin-Sommers, Curtin, & Newman, 2013), indicating that it was feasible to find a significant interaction.

Affective Startle Experiment

All participants viewed the same 72 photographic images taken from the International Affective Picture System (IAPS); these are images which have been developed for the study of emotion and have been categorised as pleasant, unpleasant and neutral in content by numerous samples of healthy volunteers, rating images on valence, dominance and arousal (Lang, Bradley, & Cuthbert, 2005).

In the current study, 24 images had positive emotional valence (e.g. erotic images, food items, family scenes, adventure scenes; IAPS nos. 1920, 2030, 4250, 4607, 7450, 7470, 8080, 8180, 2070*, 2091*, 2260*, 2430*, 2660*, 4002*, 4420*, 4660*, 4664*, 4669*, 7200*, 7330*, 7430*, 7460*, 8496*, 8510*; asterisk indicates that startle probe was presented), 24 had neutral valence (e.g. household objects, abstract art; IAPS nos. 2200, 7025, 7100, 7182, 7207, 7234, 7237, 7950, 5530*, 7002*, 7009*, 7010*, 7030*, 7031*, 7090*, 7150*, 7170*, 7185*, 7224*, 7233*, 7235*, 7490*, 7550*, 7700*; asterisk indicates that startle probe was presented), and 24 had negative emotional valence (e.g. threatening scenes, weapons, mutilated bodies, accident victims; IAPS nos. 1220, 3063, 3100, 3110, 3180, 6370, 6510, 9433, 1050*, 3030*, 3053*, 3071*, 3080*, 3120*, 3150*, 3500*, 3530*, 3550*, 6244*, 6250*, 6300*, 6313*, 6550*, 9420**; asterisk indicates that startle probe was presented). The positive and negative images were comparable on mean arousal based on the normative data for males (average=6). Images were presented in a fixed order, comprising four blocks of 18 images, with six randomly ordered pictures from each valence included in each block. Each image was presented for six seconds, followed by a blank slide for six seconds, with an inter-trial interval of between 2-10 seconds. The startle probe (50ms burst of 100dB white noise with an almost instantaneous rise time) was presented on four out of six images for each valence in each block, and four startle probes were presented with a blank slide in each block to reduce the predictability of startle probe onset (total of 16 startles per block; 64 startles across whole task). Startle probes were presented either 150ms, 3 seconds, 3.5 seconds or 4 seconds after picture onset (each onset time occurred once for each valence, in each block). The session began with a five minute acclimatisation period, during which no images were shown but the participants heard 70dB white noise through the headphones, which was present throughout the entire experimental session. Following this acclimatisation period but before the onset of images, three startle probes were presented to reduce habituation in response to the image probes.

A commercially available computerised human startle response monitoring system (SRH-Lab, San Diego, California) was used to deliver the startle stimuli and record electromyographic (EMG) activity for 1000 ms, starting from the probe–stimulus onset. Acoustic stimuli were

presented binaurally through headphones. Eye-blink component of the startle response was indexed by recording EMG activity of the orbicularis oculi muscle directly beneath the left eye, by positioning two miniature silver/silver chloride electrodes. The ground electrode was attached to the mastoid behind the left ear. Recorded EMG activity was band-pass filtered, as recommended by the SRH-Lab. A 50-Hz filter was used to eliminate the 50-Hz interference. The EMG data were at first inspected on trial-to-trial basis offline to exclude unusable trials for a particular participant, and then scored, blind to diagnoses, using the analytic programme of this system for response amplitude (in arbitrary Analog-to-Digit units; 1 unit=2.62 μ V). Responses were rejected if there was no visible blink response with the peak occurring within 120-ms of pulse presentation.

Procedure

Participants were told that they would be shown a series of images whilst some sounds were played through the headphones. They were asked to pay attention to the images, but no specific instructions regarding the sounds were given. They were told that the images would be pleasant, neutral or unpleasant in nature, and were reminded that they could stop the experiment at any point if they found the images too distressing. The experiment took place in a soundproof laboratory. Images were presented on a 420 x 560 mm television monitor approximately one meter away from the participant. Participants were seated in a large, comfortable chair and the lights were turned off whilst images were presented to minimise other distracting objects in the room. For clinical participants, a member of nursing staff outside of the participant's care team and an experimenter were present (sat behind, out of the line of sight) throughout the experiment. The experiment lasted approximately 37 minutes in total.

PCL-R scores were obtained via a thorough review of the participant's clinical and forensic records, as described in Chapter Five.

Data Treatment

As in previous chapters, normality was assessed via reviewing of z-scores for skewness and kurtosis with a critical value of ± 1.96 as recommended by Field (2009). Equality of variance was assessed via Levene's test, with $p < .05$ indicating significant heterogeneity of variance between groups. Skewness, kurtosis and equality of variance for continuous variables are reported in Table 8.1.

To control for variation in individual blink magnitudes, amplitudes were standardised into T-Scores. For each participant, the mean and standard deviation of blink amplitude for blank trials (no image presented with startle tone) was obtained, and then the valence specific mean amplitude (positive, neutral and negative). Thus the relative magnitude of blinks in one valence category could be compared relative to blink amplitude to blank trials, using the following equation:

$$T = ((\text{Mean Amplitude}_{(\text{pos/neg/neu})} - \text{Mean Amplitude}_{(\text{blank trials})} / \text{SD}_{(\text{blank trials})}) \times 10) + 50$$

This procedure yields standardised blink magnitude scores with a mean of 50 and a standard deviation of 10. This method is used in other studies of this type (e.g. Kring, Germans Gard, & Gard, 2011; Vaidyanathan et al., 2011) and is part of the current recommendations for startle research (Blumenthal et al., 2005).

Untransformed (raw) startle amplitudes are also presented for comparison purposes, as this method is reported in some literature (e.g. Herpetz et al., 2001, Kumari et al., 1996).

Statistical Analysis

To assess for differences in demographic variables (age, chlorpromazine equivalents and ethnicity) one-way ANOVA, Kruskal-Wallis and chi-square tests were applied as appropriate. Exploratory analyses comparing responders with non-responders (i.e. those who provided useable startle data compared to those who did not) on a number of characterisation measures were conducted using independent sample t-tests. Habituation of the startle response was assessed by Group by calculating the mean of each participant's percentage change from Block One to Block Four, and these values were subject to Kruskal-Wallis non-parametric test due to non-normal distribution.

To assess for the effect of diagnosis group on affective modulation of startle, a 3 (Valence: Positive, Neutral, Negative) by 4 (Group: Psychosis, DPD, Comorbid, Control) repeated measures ANOVA was conducted with standardised amplitude magnitude (T Scores) as the dependent variable. The analysis was repeated with the raw (unstandardized) magnitude scores to confirm that the standardisation procedure had not unduly affected results. To assess for the effect of psychopathy, a 3 (Valence: Positive, Neutral, Negative) by 3 (Group: Psychopathic, Non-Psychopathic, Control) repeated measures ANOVA was conducted, with the standardised amplitude as the dependent variable, followed by planned post-hoc paired t-tests to assess the differences in amplitude magnitude as a function of valence. Pearson correlations (two tailed) were performed to ascertain the relationship between standardised startle amplitude per valence category and measures of psychopathy, including PCL-R total score, factor one and factor two scores.

All analyses were performed by SPSS windows (version 22). The α level for significance (two-tailed) was set at $p < .05$ in all analyses unless specified otherwise.

Table 8.1 - Skewness, Kurtosis and Equality of Variance for Continuous Variables

Dependent Variable	<u>Psychosis</u>				<u>DPD</u>				<u>Comorbid</u>				<u>Controls</u>				<u>Levene's Test p-value</u>
	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	Skewness	z score	Kurtosis	z score	
Age	1.43	1.90	1.69	1.14	.313	.456	-.148	-.111	.948	1.26	.428	.289	.967	1.76	.363	.341	.677
CPZ Equivalents	.177	.235	-1.71	-1.15	2.14	3.12*	4.91	3.68*	.410	.545	-1.49	-1.00	-	-	-	-	.864
Violence Score	.294	.390	-1.08	-.728	.041	.060	-1.46	-1.09	.190	.253	-1.30	-.878	-	-	-	-	.248
PCL-R Total	.944	1.26	-.343	-.231	-.311	-.453	-.526	-.394	-.970	-1.29	2.36	1.60	-	-	-	-	.722
PCL-R Factor 1	1.05	1.40	.496	.335	-.239	-.348	-1.02	-.765	-.914	-1.22	.693	.468	-	-	-	-	.375
PCL-R Factor 2	.611	.812	-.398	-.268	.038	.056	-1.48	-1.11	-1.32	-1.76	1.64	1.10	-	-	-	-	.570
Mean Standardised Amplitude – Positive	.785	1.04	.193	.130	.702	1.02	-.871	-.653	-1.05	-1.40	2.11	1.42	.903	1.64	.787	.740	.078
Mean Standardised Amplitude – Neutral	.655	.870	-1.44	-.974	1.21	1.77	1.66	1.24	-1.49	-1.98*	3.62	2.45*	1.02	1.85	.636	.598	<.001*
Mean Standardised Amplitude – Negative	.072	.095	-1.05	-.709	.488	.710	-.843	-.632	-1.03	-1.37	1.71	1.15	.972	1.77	.183	.173	.079
% Change B1-B4	.624	.830	-.284	-.192	3.10	4.51*	9.70	7.27*	-1.47	-1.96*	1.36	.921	.408	.743	-.716	-.674	.011*

CPZ: Chlorpromazine; PCL-R: Psychopathy Checklist – Revised; F1: Factor One (Affective); F2: Factor 2 (Behavioural)

Results

Sample Characteristics

The groups were matched on age ($F_{(3,39)}=.952$, $p=.425$, partial $\eta^2 = .068$) and the clinical groups were matched on chlorpromazine equivalents ($H_{(2)}=4.84$, $p=.089$) and frequency and severity of previous violence ($F_{(2,23)}=2.43$, $p=.110$, partial $\eta^2 = .174$).

There was a significant difference between the groups ethnicity ($\chi^2_{(3)}= 16.45$, $p=.001$); there were significantly more non-white participants in the comorbid group compared to the healthy control and DPD groups, although there was no difference between the psychosis group and any other group. The DPD and comorbid groups had higher Total ($F_{(2,23)}=17.8$, $p<.001$, partial $\eta^2 = .607$) and Factor Two ($F_{(2,23)}=16.0$, $p<.001$, partial $\eta^2 = .581$) PCL-R scores compared to the psychosis group (both $p<.001$), and the DPD group had higher Factor One scores than the psychosis group ($F_{(2,23)}=6.38$, $p=.006$, partial $\eta^2 = .357$) but the comorbid group did not differ from either group ($p's>.122$). Mean scores for characterisation variables can be observed in Table 8.2.

Table 8.2 - Characterisation Variables across Study Groups

	Mean (SD)			
	Psychosis	DPD	Comorbid	Controls
Age (years)	34.5 (8.12)	36.8 (9.37)	31.3 (7.27)	37.8 (10.9)
% White	50.0%	90.0%	25.0%	94.1%
CPZ Equivalents	549.2 (352.9)	300.0 (512.1)	486.0 (376.6)	-
Violence Score	4.88 (1.36)	6.40 (1.17)	5.63 (1.85)	-
PCL-R Total	12.4 (6.95)	28.3 (4.95)	24.2 (5.39)	-
PCL-R F1	4.63 (3.38)	10.5 (3.78)	8.34 (3.17)	-
PCL-R F2	7.25 (3.85)	15.1 (2.38)	14.4 (3.25)	-

CPZ: Chlorpromazine; PCL-R: Psychopathy Checklist – Revised; F1: Factor One (Affective); F2: Factor 2 (Behavioural)

Responders vs. Non-Responders

To assess whether there was any factor which systematically differed between responders and non-responders, a between groups comparison of the characteristics of responders and non-responders was conducted. There were no significant differences observed between those participants who provided useable blink data compared to those who did not in terms of chlorpromazine equivalents ($t_{(43)}=-.564$, $p=.564$), age ($t_{(73)}=-1.71$, $p=.092$), ethnicity ($\chi^2_{(1)}<.001$, $p=.983$), psychopathy score ($t_{(43)}= -.446$, $p=.658$), history of psychosocial deprivation ($t_{(43)}=-.088$, $p=.930$), or frequency/severity of previous violence ($t_{(43)}=-.930$, $p=.474$).

Habituation

Each participant's percentage change from Block 1 to Block 4 was calculated, and a mean of these values was taken. Unexpectedly, the DPD group appeared to increase in the magnitude of their startle response across blocks on average (see Table 8.3). However, upon further inspection this effect appeared to be due to one participant who showed a very large increase in startle response from Block One to Block Four (an increase of 757%)⁸, and was highly influencing the result. When this participant was excluded, the mean percentage change for all groups was in the expected direction (see Table 8.3). A non-parametric Kruskal-Wallis test (with outlier excluded) indicated that the groups did not significantly differ in their mean rate of habituation ($H_{(3)}=.922$, $p=.820$).

Table 8.3 - Mean (SD) and Percentage Change in Startle Amplitude across Four Experimental Blocks

	Mean (SD) Amplitude [AD units]				Mean % Change B1-B4
	Block 1	Block 2	Block 3	Block 4	
Psychosis	334.12 (406.06)	230.48 (246.63)	218.77 (248.63)	209.47 (178.08)	-27.34
DPD	260.58 (140.98)	261.80 (219.07)	277.07 (269.95)	251.49 (270.56)	51.30
<i>Excluding Outlier</i>	279.74 (78.97)	193.05 (78.97)	198.91 (107.65)	166.63 (98.00)	-33.53
Comorbid	257.70 (139.80)	198.91 (107.65)	173.96 (129.79)	142.99 (114.94)	-44.20
Control	453.36 (338.95)	329.05 (278.12)	325.49 (285.18)	281.28 (225.63)	-34.65

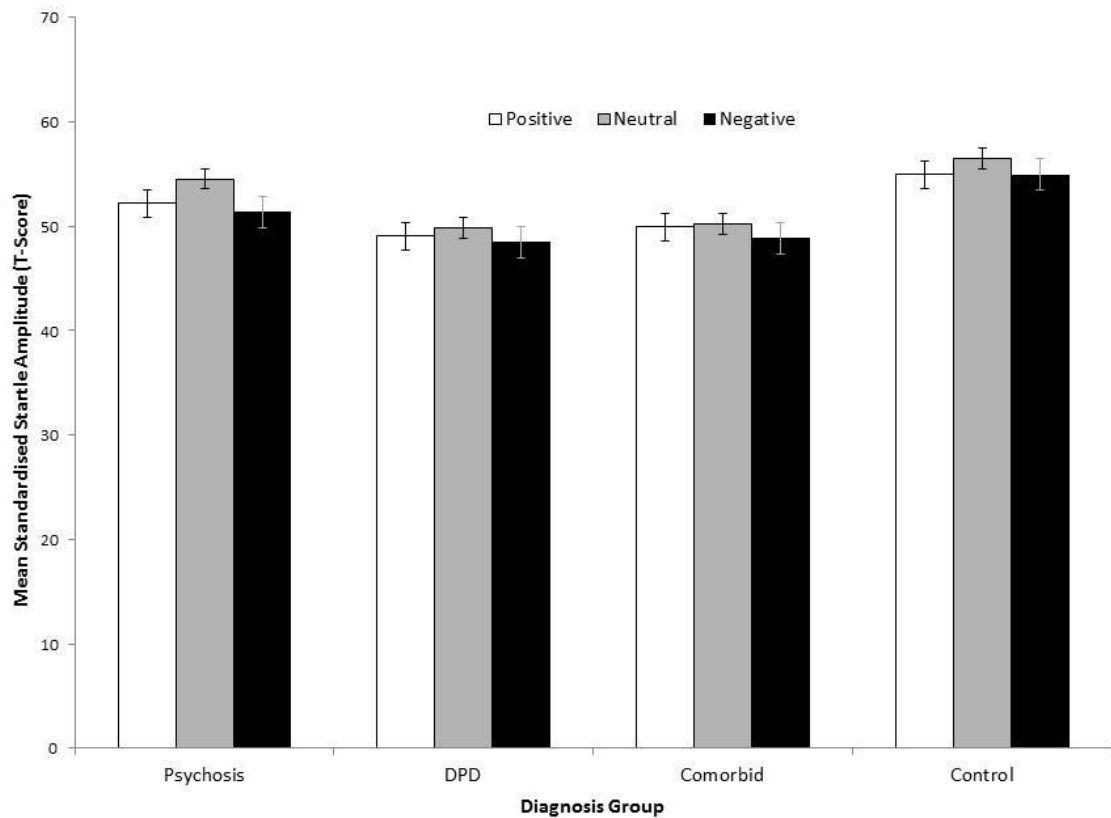
Affective Modulation – Standardised Scores

There was a significant main effect of Valence ($F_{(2,38)}=4.27$, $p=.021$, partial $\eta^2 = .183$), although this did not have the expected linear trend (Linear: $F_{(1)}=1.45$, $p=.236$, partial $\eta^2 = .036$) and was present with a quadratic trend (Quadratic: $F_{(1)}=6.97$, $p=.012$, partial $\eta^2 = .152$). A post-hoc paired t-test revealed that, across the whole sample, there was a greater magnitude of blink response to neutral images compared to both positive ($t_{(42)}=-2.08$, $p=.044$) and negative ($t_{(42)}=2.92$, $p=.005$)

⁸ All subsequent analyses were run with and without this participant, with no difference observed in the interpretation of results.

images. There was no significant difference in the magnitude of response between positive and negative images ($t_{(42)}=1.01$, $p=.316$). No Group x Valence interaction ($F_{(6,78)}=.372$, $p=.895$, partial $\eta^2 = .028$) was observed. See Figure 8.4 for graphical representation of results.

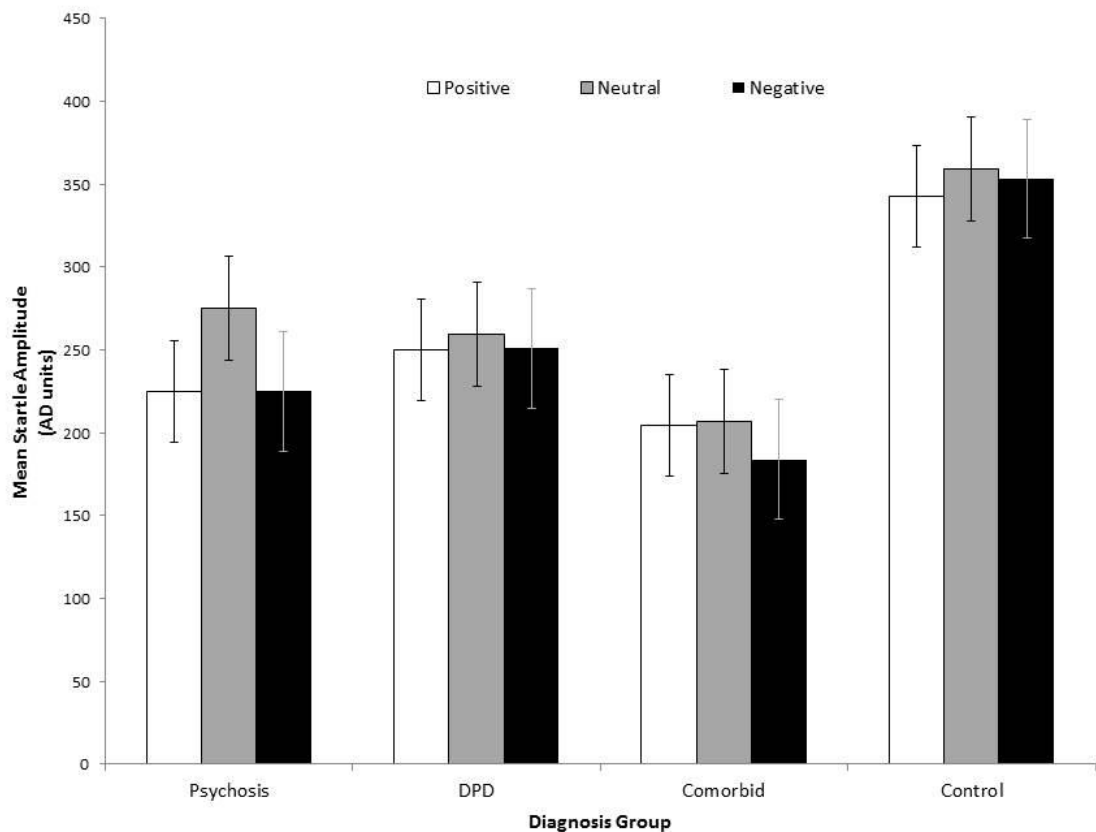
Figure 8.4 - Standardised Startle Amplitudes by Group across the three Valence Categories. Error bars are ± 1 SEM



Affective Modulation – Raw Amplitudes

The analysis was repeated using raw (unstandardized) amplitudes to assess whether the standardisation process had affected results. The main effect of Valence now only approached statistical significance ($F_{(2,38)} = 2.53$, $p = .093$, partial $\eta^2 = .118$), although the significant quadratic trend remained ($F_{(1)} = 5.20$, $p = .028$, partial $\eta^2 = .118$). As before, no significant Group x Valence interaction was observed ($F_{(6,78)} = .740$, $p = .619$, partial $\eta^2 = .054$). There was also no main effect of Group ($F_{(3,39)} = 1.00$, $p = .401$, partial $\eta^2 = .072$), indicating that the groups did not differ in their overall startle responsivity. The ‘shape’ of results remained comparable, as can be observed in Figure 8.5, the largest responses across all groups tended to be towards neutral images.

Figure 8.5 - Raw Unstandardised Startle Amplitudes by Group across the Three Valence Categories. Error bars are ± 1 SEM



Startle Onset Asynchrony

To assess whether modulation differed by startle onset asynchrony, i.e. whether modulation differed on trials where the tone was presented before conscious processing of the image could occur (150ms after picture onset), the raw startle amplitude of 150ms interval trials (positive neutral and negative valence) were subject to a non-parametric within group Friedman test. The

results indicated that there was no effect of valence on such trials ($\chi^2_{(2)} = 2.76$, $p = .252$), whereas the mean amplitudes across the other three trial types (3000ms, 3500ms and 4000ms; conscious processing range) showed a main effect of valence ($\chi^2_{(2)} = 10.1$, $p = .006$), with the same modulation pattern as reported in the previous analyses; post-hoc Wilcoxon signed rank tests revealed that mean amplitude on neutral trials was significantly higher than positive and negative trials ($z = -3.68$, $p < .001$; $z = -3.06$, $p = .002$, respectively), but positive and negative amplitudes did not differ from one another ($z = -.179$, $p = .074$).

Effect of Psychopathy

Clinical participants were divided into those who met the conventional European cut off for psychopathy (≥ 25 , $n = 12$) and those who did not (≤ 24 , $n = 14$), and were compared to control participants. There was a significant main effect of Valence ($F_{(2,39)} = 4.94$, $p = .009$, partial $\eta^2 = .110$), with a quadratic trend ($F_{(1)} = 7.06$, $p = .011$, partial $\eta^2 = .150$) as was seen across the whole group in the diagnostic analysis indicating the greatest response to neutral images. However, there was no Group x Valence interaction ($F_{(4,80)} = .407$, $p = .803$, partial $\eta^2 = .020$), indicating that modulation of the startle response did not alter as a function of psychopathy status.

There were no significant correlations between the standardised startle magnitudes for each valence category and the measures of psychopathy (PCL-R Total score, Factor One and Factor Two) across all clinical participants⁹. See Table 8.4.

Table 8.4 - Person Correlation Coefficients for Amplitude across Valence Categories and Psychopathy Scores

Standardised Startle Amplitude	<u>PCL-R Total</u>		<u>Factor 1</u>		<u>Factor 2</u>	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
Positive Images	-.322	.109	-.171	.404	-.368	.065
Neutral Images	-.317	.114	-.263	.194	-.322	.108
Negative Images	-.273	.178	-.264	.193	-.192	.346

⁹ Correlations with the raw startle amplitudes were also conducted but no significant associations were found.

Discussion

This chapter aimed to assess appetitive and defensive responding amongst the four described groups via affective modulation of the startle response. Contrary to prior research and the hypotheses, no Group by Valence interaction was observed, and *all groups* showed an atypical response pattern relative to previous studies in healthy groups, in which the startle response was not potentiated, but *attenuated*, in response to aversive images compared to neutral.

This suggests that all four groups may be characterised by low levels of defensivity in response to fearful stimuli. This is perhaps most unexpected in the healthy control group which comprised of forensic hospital staff. However, a previous report of affective modulation of the startle response has also noted a lack of aversive potentiation amongst forensic hospital employees (Loomans et al., 2015). In this study, as in the current study, forensic hospital employees showed the largest response to neutral images at startle latencies greater than 800ms, but a more typical, aversive potentiation was observed in community controls. The authors suggested that this may be an adaptive response to the working conditions they encounter, and that low levels of fearfulness may confer benefit in such a role where encountering expressed aggression and/or violence is likely. They administered the Psychopathic Personality Inventory – Revised (PPI-R; Lilienfeld & Widows, 2005) to non-clinical participants and noted increased ‘self-centred impulsivity’ (analogous to PCL-R Factor Two) amongst forensic hospital employees compared to community controls, so posit that this may be the mediating factor.

This is in contrast to studies of offenders who meet cut-off for psychopathy, which found that Factor One appeared to mediate the lack of fear potentiation (Patrick, 1994; Vaidyanathan et al., 2011), a differential which may be representative of the fact that the PPI-R is a self-report measure, which may be limited in its ability to detect the inherently socially-undesirable traits of psychopathy. The current study did not assess levels of psychopathy amongst healthy controls, which represents a limitation to be further explored in future research to clarify this effect, perhaps using the PCL-R as opposed to more subjective, self-report measures. Although psychopathy scores did not correlate with affective startle reactivity in the current study, this relationship was only assessed in clinical participants and thus the relationship in non-clinical participants is unknown.

Also counter to the suggested hypothesis, no effect of psychopathy was observed on affective modulation of the startle response, as assessed by group comparisons or correlational analysis. Attenuation of the startle response to negative, relative to neutral, images was observed in the psychopathic group as has been reported previously (Pastor et al., 2003; Patrick, 1994; Patrick et al., 1993; Vaidyanathan et al., 2011), but was also observed amongst the non-psychopathic and control groups. This is in contrast with previous literature suggesting that individuals who do not meet criteria for psychopathy show typical potentiation of startle in response to aversive images

(Vaidyanathan et al., 2011). It is possible that the assessment of psychopathy in the current study was somewhat limited as it was reliant on a review of clinical and forensic records, and did not involve an interview component as other studies have incorporated (discussed in Chapter Five). The affective/interpersonal traits (which have been identified to be so crucial in emotional modulation of startle) would arguably have been more difficult to assess as part of a file review when compared to an interview, and thus it may be that the scores are not accurately reflecting these traits. However, it could also be due to a limited range of psychopathy scores amongst the sample; the participants included in this analysis tended to have relatively high PCL-R scores, with only seven (27%) scoring below 20 (out of a maximum 40). Thus there may have been limited variance in the data to detect an effect.

The atypical response pattern in the psychosis group is also an unexpected finding. Previous studies tend to find that affective modulation is comparable with healthy controls amongst individuals with schizophrenia (Curtis et al., 1999; Dominelli et al., 2014; Schlenker et al., 1995; Volz et al., 2003; Yee et al., 2010). The fact that the pattern of modulation is similar across all three clinical groups could reflect that some common underlying feature is driving this effect. A fear deficit has been proposed as a mechanism by which violence can emerge (Eysenck & Gudjonsson, 1989; Trasler, 1978); it is suggested that during early socialisation aggressive acts are punished by caregivers, and due to the averseness of experiencing punishment, the behaviour is associated with negativity and unlikely to be repeated. However, for those with low fearfulness, the punishment is not experienced as unpleasant to the same degree, and thus the link between unpleasantness and aggression is not strongly formed. Hypothetically, this leads to the removal of inhibitive factors which may prevent violence at later developmental stages. Thus, the clinical groups, whom are all characterised by substantial violent behaviour, may all share a common “low fear” trait, or a lack of defensivity.

Developmental perspectives on the emergence of violent behaviour have hypothesised low autonomic arousal to be a factor (discussed in Raine, 2002). This theory suggests that the state of low arousal is inherently aversive and so the individual engages in risk taking, perhaps violent, behaviours in order to increase arousal. Indeed, autonomic under-arousal is characteristic of children who display fearless and uninhibited temperaments (Fowles, Kochanska, & Murray, 2000). Thus, it may be that all participants in this study are characterised by lower than normal arousal (i.e. of the appetitive and defensive systems), resulting in risk taking behaviours (e.g. violence or a ‘dangerous’ job) and thus have lower levels of responsiveness in experimental paradigms such as these. This may have resulted in floor effects, leaving any affective modulation of the startle response difficult to detect.

Medication is another factor to consider when interpreting the current findings. Antipsychotic (S. Graham et al., 2001; S. Graham et al., 2004) and anxiolytic (Abduljawad, Langley, Bradshaw, &

Szabadi, 1997; Schächinger, Müller, Strobel, Langewitz, & Ritz, 1999) agents have shown to reduce the magnitude of the startle response, and given the high rate of polypharmacy in the current study, it is possible that responses were blunted across the clinical groups due to medication use. Although there was no significant difference in chlorpromazine equivalents between groups, this serves only as a crude measure of dopaminergic affinity (Atkins, Burgess, Bottomley, & Riccio, 1997) and thus drugs working via other neurotransmitter systems are unaccounted for. This diminishing of the startle response could also contribute to floor effects, as discussed above. However, this is unlikely to account for the flattened response style observed in the control group, and although a formal measure of medication status in healthy controls was not taken, all control participants were screened for Axis I mental disorder and thus were unlikely to be currently taking a prescribed psychiatric medication.

Another explanation for the lack of affective modulation observed across the groups is a distinct attentional style. Levenston, Patrick, Bradley, and Lang (2000) propose that the emotion processing deficits observed amongst individuals with high levels of psychopathic traits could be explained by a “bottle-neck” model of attention. That is, such individuals process only goal-relevant information and fail to process peripheral information which may give more clues or context to the situation. In the case of emotion modulated startle, it has been suggested that the lack of affective modulation is because the startle response is measured before the individual has had a chance to integrate the complex image and experience an emotional reaction. This hypothesis was tested amongst individuals scoring within the psychopathic range by using novel and familiar images during the paradigm (Baskin-Sommers et al., 2013). As hypothesised, there was typical affective modulation (as seen in healthy controls) when participants viewed the stimuli they were familiar with, but not when the stimuli were novel. This supports the idea that increased perceptual load (i.e. novel stimuli) reduces the capacity to respond affectively amongst individuals with high psychopathy scores. Relevant data have also been shown amongst a schizophrenia sample, whereby the typical affective modulation was only observed at later pulse onset latencies, and that at very early latencies (150ms, 300ms) there was no affective modulation amongst the schizophrenia group, although this was evident in healthy comparison subjects (Volz et al., 2003). This suggests that early attentional processing may affect the way in which such stimuli are processed, and previous studies indicate specific difficulties amongst relevant groups, making it a factor to consider in the current investigation.

This explanation is strengthened by the fact that there was no valence modulation of the startle response at picture onset to startle latencies of 150ms. This is consistent with previous findings which showed that forensic hospital inpatients with ASPD also showed no modulation of the startle response at short picture onset to startle latencies (300ms; Loomans et al., 2015). Alternatively, it could represent that the inherent, defensive systems which operate at pre-conscious levels are absent in this ‘low fear’ group. A group of healthy participants was shown

to have startle potentiation of negative images relative to neutral, but not positive attenuation, when they were presented at preconscious levels of processing (17ms interval; Reagh & Knight, 2013).

It is notable that a proportion of participants reported some distress as a result of viewing the images (n=3 participants; n=2 DPD and n=1 psychosis), and this is a consideration for future research with this population, many of whom experience trauma symptoms after committing serious offences (estimates suggest between 22% and 42% experience offence related PTSD; Crisford, Dare, & Evangeli, 2008; Gray et al., 2003; Kruppa, Hickey, & Hubbard, 1995; Papanastassiou, Waldron, Boyle, & Chesterman, 2004; Pollock, 1999). On some occasions, responsible clinicians were happy to refer participants for other investigations of this PhD project, but requested that this particular experiment was not completed for these trauma related reasons. Thus careful selection of participants should be encouraged in future research with this population, including a thorough consideration of trauma experiences and symptoms by referring clinicians.

Strengths and Limitations

The findings of the current investigation are somewhat limited due to the reduced number of participants included in each group. Despite the post-hoc power calculation suggesting an interaction effect was possible to detect, it may be that the amount of variance across conditions was limited leading to a reduced ability to see a more subtle effect. The number of non-responders (i.e. no detectable blinks) and variable responders (i.e. less than 50% of trials with observable blinks) in the current sample was high (non-responders: n=15; 19% of total sample; variable responders: n=18, 23% of total sample). Giakoumaki and colleagues (2013) examined cognitive and personality correlates of startle reactivity amongst a large cohort (n=1004) of young, healthy males, and observed 'sensitivity to reward' traits were linearly associated with startle responsivity, with the highest levels of these traits observed amongst those with no or low responsivity. In addition, non-responsivity was associated with poorer performance on measures of strategy and spatial working memory, and reduced target detection with an impulsive response style in a test of vigilance. These characteristics seem especially pertinent when considering the current sample, which shows an array of neuropsychological deficits (see Chapter Six). Furthermore, a large proportion of participants were characterised by high levels of psychopathic traits and such individuals are known to have enhanced behavioural approach including sensitivity to reward (Hughes, Moore, Morris, & Corr, 2012). In addition, other studies within forensic hospitals have shown comparable levels of non-responsiveness, for example nine out of 25 individuals (36%) meeting criteria for psychopathy showed no responsiveness in one study (Herpertz et al., 2001).

It is notable that a larger proportion of participants showed non-responsivity in the current experiment when compared to the PPI experiment in Chapter Seven. Possible explanations for this could include a lower amplitude startle tone in this experiment relevant to the PPI experiment, or intentional disengagement with the emotional stimuli due to potential distressing feelings. In addition, the length of the experiment and possible perceived boredom could have led to active disengagement or non-compliance with experimental procedures e.g. sleeping, talking etc. In addition, practical considerations resulted in non-completion in a number of cases, including being unable to move the participant from their ward (e.g. due to the participant being put into seclusion), or refusal to complete the whole experiment due to it being perceived by the patients as too long. This latter factor has also been noted by other research groups (Dackis, Rogosch, & Cicchetti, 2015) and future groups working in this area should perhaps be mindful of creating shorter experiments when assessing participants with likely attentional difficulties as have been observed in mentally disordered offenders (Young et al., 2015). In addition, some clinical participants believed that images had been specifically selected for them in order to assess their violent cognitions which at times resulted in suspicion or distress, so mindful awareness of such factors and appropriate reassurance before and after the experiment is another consideration for future researchers working with this population.

The strengths of the study include the assessment, for the first time, of a violent group diagnosed with a psychotic disorder, both with and without an additional DPD diagnosis. The use of a psychophysiological method bypasses issues surrounding the validity of self-report, and gives an objective insight into the emotion processing characteristics of an under-researched population. Another strength is the use of well validated stimuli to induce emotion (IAPS). However, as no self-assessment of the images was conducted, it is possible that the stimuli did not induce the intended emotions amongst participants, and particularly in a sample where their life experiences may have exposed them to truly aversive experiences, these images may not have been sufficient to evoke a response. Previous studies have demonstrated that personal appraisal of the images is important (e.g. Dominelli et al., 2014), and some have suggested that only negative stimuli truly inducing fear (as opposed to disgust, for example) induce the enhanced startle response (Kaviani, Gray, Checkley, Kumari, & Wilson, 1999). However, other studies of this kind in very similar populations (e.g. forensic hospital participants with borderline personality disorder) have used similar IAPS images and still observed a modulated response (e.g. Herpertz et al., 2001).

Chapter Summary

In conclusion, this chapter has demonstrated that appetitive and defensive responding amongst violent individuals with psychosis, DPD and comorbidity of these diagnoses is very similar, and does not differ from a group of forensic hospital staff. All four groups show atypical responding: that is, attenuation of the startle response to both pleasant and unpleasant images compared to neutral. The reported findings are contrary to the hypotheses formulated based on the previous

literature. The data can be considered preliminary, and should be expanded upon in larger groups in order to confirm the findings. Future research should also include a group of community control participants, as this investigation and one other have highlighted potential differences in fear processing amongst staff working in forensic hospitals. This is an important consideration for the field of forensic mental health research, as these individuals are often used as a comparison group in experimental studies. Opposing previous research, no effect of psychopathy was found on the modulation of the startle response, which may have been due to the reduced variance of psychopathy scores amongst the sample. This chapter found no group differences and thus supports the notion that whilst the comorbid group differs in a certain ways from the other two clinical groups (see Chapters Five, Six and Seven), similarities are also evident.

The next chapter will explore how the three groups differ in terms of clinical outcome whilst hospitalised, and assess how the characteristics reported in the thesis so far (clinical, offence related, psychosocial, cognitive, emotion processing and PPI) relate to outcome.

9 Chapter Nine: Relationship of Diagnostic Group, Cognition and Emotion Processing to Clinical Outcomes.

Chapter Aims and Overview

This chapter aims to consider the relevance of previous findings in clinical practice, by exploring whether clinical outcomes (clinician rated progress, risk and engagement) differ amongst the three clinical groups whilst they are hospitalised. Possible group differences in self-reported motivation to engage in therapy, and attitudes and perceptions towards treatment are also examined. In addition, this chapter assesses whether the characteristics described in previous chapters (neuropsychological, emotion processing, clinical, demographic, offence related, PPI) are associated with clinical outcome across the whole sample, in order to assess the translational value of such characteristics. Self-reported motivation and attitudes towards therapy are also examined in relation to outcome.

Introduction

Chapter Three presented evidence from a systematic review relating to objective predictors of outcome in forensic mental health populations. This review indicated putative predictive utility of cognitive measures, in addition to a number of ‘static’ demographic factors. The findings will be briefly summarised below in order to inform hypotheses.

Cognitive measures i.e. the Stroop test (Foster et al., 1993; Nazmie et al., 2013), memory assessed via verbal learning (O'Reilly, Donohoe, Coyle, et al., 2015) and impulsivity as measured by electroencephalographic recording of the contingent negative variation event (Howard & Lumsden, 1996), have shown an association with poor outcome (violent behaviour whilst an inpatient; community reoffending). Poor social cognition, as measured by the Managing Emotions subtest of the Mayer-Salovey-Caruso Emotional Intelligence Test, was shown to be related to increased violence amongst individuals with psychosis at one year follow up (O'Reilly, Donohoe, Coyle, et al., 2015). Other aspects of social cognition such as assessing emotion from the eyes have also been shown to be related to poorer clinical outcome and higher levels of unmet risk and need amongst forensic inpatients with psychosis (Murphy, 2007), and poorer ability to identify sadness at 70% intensity was related to the number and severity of violent incidents amongst forensic inpatients without a schizophrenia spectrum diagnosis (Brugman et al., 2016).

In terms of how outcomes differ amongst different diagnostic groups whilst in hospital, the evidence is mixed and previous findings do not appear to facilitate a consensus position. When examining the outcome of inpatient violence, two studies found no association of ‘diagnosis’ (as a broad, all-encompassing predictor) on violence (Ball, Young, Dotson, Brothers, & Robbins, 1994; Thomas et al., 2009), and of a further two that examined schizophrenia specifically one found that this diagnosis was not related to violence (Hoptman, Yates, Patalinjug, Wack, & Convit, 1999), and one found it to be protective against violent behaviour (Lussier et al., 2009).

This latter study also found that ASPD, but not other PDs, was related to inpatient violence (Lussier et al., 2009). For the outcome of length of stay, three studies found that having a psychotic disorder was associated with a longer length of stay (B. Green & Baglioni, 1998; Long & Dolley, 2012; Rice, Quinsey, & Houghton, 1990), although one study found the opposite (shorter stay) (M. Moran, Fragala, Wise, & Novak, 1999), and one found no significant effect (Andreasson et al., 2014). In addition, three studies (Edwards, Steed, & Murray, 2002; Skipworth, Brinded, Chaplow, & Frampton, 2006; Steadman, Pasewark, Hawkins, Kiser, & Bieber, 1983), found no effect for ‘diagnosis’ on length of stay (which included psychosis); however, it is notable that in two of these studies there was a very small proportion of offenders not diagnosed with a psychotic illness, suggesting limited power to find an effect. When compiling evidence across diagnostic categories, the most convincing predictors for inpatient violence included young age, history of violence and number of previous psychiatric admissions. For length of stay, severity of index offence and number of previous absconding events emerged as consistent predictors across groups.

For more distal outcomes following discharge from hospital, the evidence tends to suggest PD is a risk factor. When examining the outcome of reoffending, PD was examined by nine studies (Bailey & Macculloch, 1992; Coid, Hickey, et al., 2007; Howard et al., 2013; Philipse, Koeter, van der Staak, & van den Brink, 2006; Phillips et al., 2005; Quinsey & Maguire, 1986; Quinsey et al., 1995; Rice & Harris, 1996; Rice, Harris, et al., 1990), with 78% of studies finding a positive association with reoffending. Six studies examined psychosis (Baxter, Rabe-Hesketh, & Parrott, 1999; Philipse et al., 2006; Quinsey & Maguire, 1986; Rice & Harris, 1996; Rice, Quinsey, et al., 1990; Tennent & Way, 1984), with 50% finding that this was negatively associated, and the remainder finding no association, with reoffending. However, four studies (Edwards et al., 2002; Friendship, McClintock, Rutter, & Maden, 1999; Maden, Rutter, McClintock, Friendship, & Gunn, 1999; Skipworth et al., 2006) found that “diagnosis” as a predictor (encapsulating both PD and psychosis) was unrelated to reoffending, somewhat weakening these initially strong findings. This differential pattern of results likely reflects the diagnostic homogeneity of these four studies, in which the vast majority of patients had psychotic disorders and only small numbers were diagnosed with personality disorder.

Thus, whilst long term outcomes for individuals with PD seem to be poorer than those with psychosis, for the more proximal outcomes whilst hospitalised the picture is more mixed. When considering this alongside moderate evidence that individuals with psychosis may have a longer length of stay, the findings regarding reoffending being more prevalent amongst PD offenders may be explained by simply having greater opportunity to reoffend. More studies examining whether diagnostic groups which are prevalent in forensic mental health services (i.e. psychosis, personality disorder, comorbidity of these diagnoses) differ in terms of their clinical outcome are

warranted, in order to help to clarify these mixed findings and to identify areas of potential unmet need.

This chapter aims to examine proximal outcomes of hospitalised offenders, including clinical progress, risk and engagement outcomes. Firstly, these outcomes will be examined by diagnostic group. In addition, self-reported motivation to engage in treatment, and perceptions and attitudes to treatment between groups is explored. Secondly, characteristics described in Chapters Five, Six and Seven (clinical, offending, psychosocial, cognitive and emotion processing traits), and self-reported motivation, perceptions and attitudes to treatment will be examined to assess their relationship with clinical outcome across the whole sample. This provides important further data relating to how objective markers relate to outcome in this population, both within and across diagnostic categories. In addition, the contributions of potentially ‘therapy-interfering attitudes’, such as low motivation to engage, lack of trust in the hospital, or reluctance to open up are assessed. Previous studies have tended to focus on one specific diagnostic group (e.g. psychosis groups; Murphy, 2007; O'Reilly, Donohoe, Coyle, et al., 2015). By examining outcomes across the whole sample, it can be ascertained whether there are treatment targets which are relevant to a wide range of mentally disordered offenders.

The following hypotheses were tested:

Hypothesis 1: Young age, number of previous psychiatric admissions, severity of previous offending, PPI, performance on tests of facial affect recognition and measures of executive function and memory will be positively correlated with indices of outcome across the whole sample.

Hypothesis 2: Poor motivation to engage in treatment, and negative attitudes and perceptions of treatment will be associated with poorer outcomes across the whole sample.

No directional hypothesis is made in relation to the group comparisons regarding outcome or motivations/attitudes, as previous literature has provided inconclusive or conflicting evidence.

Method

Participants and Design

This study utilises the same participants as described in previous chapters, however one participant with comorbid psychosis and DPD was not included as he withdrew his consent before outcome measures were collected. Therefore, there were 57 mentally disordered offenders with the following diagnostic distribution: 15 with psychosis, 17 with DPD and 25 with comorbid psychosis and DPD. This study employs a cross sectional design. Clinician reported outcome measures and other facets relevant to outcome (see below) were extracted at the time of the patient's participation and compared firstly between diagnostic groups, and secondly the

relationship with experimental measures of cognition and emotion processing, and self-reported attitudes towards treatment, was assessed across the whole sample.

Care Programme Approach Meetings

Relevant outcome measures were extracted from care programme approach (CPA) meeting documentation. CPA meetings are recommended for patients with complex needs, including those with a risk of harm to others and those detained under the Mental Health Act (Department of Health, 2008), and involve a multidisciplinary team meeting to review the patient's progress and coordinate future care. The patient and patient's representatives (family members, legal representation) are often present at the meeting. At Broadmoor Hospital these occur for all patients every six months. All therapeutic disciplines involved in the patient's care (medical, psychology, occupational therapy, nursing, social work, vocational/educational services) are required to submit a report describing the progress and activities of that patient within that discipline over the previous six months, and to set goals for the next six months. A number of standardised outcome measures (see below) are also rated in the meeting by the responsible clinician, with input from all members of the clinical team.

Outcome Measures

Health of the Nation Outcome Scale – Secure Version (HoNOS-Secure)

The HoNOS was developed as an assessment tool to measure a number of personal, physical and social difficulties amongst individuals experiencing mental health problems (Wing, Curtis, & Beevor, 1996). A specific version for use in secure settings has subsequently been developed: the HoNOS-Secure (Sugarman & Walker, 2004). The HoNOS-Secure was not designed to be a risk assessment instrument, but rather a needs assessment to track clinical progress. It measures recent problems (within past two weeks) along 12 scales in four domains including behavioural, physical, symptomatic and social (see Table 9.1 for items). Items are rated from 0 (not a problem) to 4 (a very severe problem), to give domain specific and also a total score. The HoNOS-Secure is rated by the patient's clinical team at six-monthly intervals during routine CPA meetings.

The HoNOS-Secure has demonstrated good reliability (Dickens, Sugarman, Picchioni, & Long, 2010), including internal consistency (Cronbach's $\alpha = .79$) and good inter-rater reliability (median intra-class correlation = .66, range .28-.88). In addition, it has shown construct validity, correlating moderately with other need and risk assessment measures including the Camberwell Assessment of Need – Forensic Version ($r = .43-.79$) (Abou-Sinna & Luebbbers, 2012) and the Short Term Assessment of Risk and Treatability ($r = .57-.78$) (Quinn, Miles, & Kinane, 2013). The HoNOS-Secure has been used previously as an outcome measure in forensic mental health research, with Murphy (2007) demonstrating that HoNOS-Secure scores three years after admission were related to theory of mind ability in patients diagnosed with schizophrenia.

The HCR-20 (Douglas, Webster, Hart, Eaves, & Ogloff, 2001), so named for its 20 items, is one of the most widely used measures for predicting future violence (Khiroya et al., 2009). It considers ten historical (static) items, five current 'clinical' items, and five items relating to future risk (see Table 9.1), with each item being rated as 0 (not present), 1 (partially present) or 2 (present). Although for clinical purposes a total score is not generated, for research purposes this is deemed acceptable to give an indication of total risk (Douglas et al., 2001). However, as the historical items are static by definition, for outcomes research the sum of the clinical and risk management items is more appropriate, as these have the capacity to change based on an updated assessment of the patient. This strategy has been adopted in other studies of high secure hospital populations (e.g. Morrissey, Beeley, & Milton, 2014). A meta-analysis confirmed that the HCR-20 has good predictive validity for future physical aggression, with medium-large effect sizes cited for the Clinical ($d=0.74$) and Risk Management ($d= 0.62$) scales (O'Shea, Mitchell, Picchioni, & Dickens, 2013). The instrument also has good inter-rater reliability, with studies reporting values ranging from 0.68 to 0.98 (Douglas, Guy, Reeves, & Weir, 2010).

The HCR-20 is routinely updated by the multidisciplinary team to coincide with the six monthly CPA meeting. Recently, an updated version of the HCR-20, HCRv3 (Douglas et al., 2014), has been developed. Although largely equivalent, there have been some modifications (see Table 9.1 for comparison of items). In this study, the majority of patients had HCR-20 (version 2) assessments which were retrieved from file review at the time of participation. However, for a minority of participants tested towards the end of the study, the hospital had begun to use version three. Thus, the scores for the clinical items were recorded as normal (as these have not changed substantially in the revision), but items R1 and R2 were not extracted from the version three reports as these were deemed to be conceptually different from the version two items (see Table 9.1). Thus, based on a review of the patient's corresponding CPA nursing report (where future plans are specifically assessed and any destabilisers should be noted), a researcher rated R1 and R2 in accordance with version two scoring. This procedure assured that HCR-20 C+R scores were broadly equivalent across participants.

Number of Incidents

The number of incidents each participant had been involved in over the CPA reporting period was retrieved from the hospital's incident database. An incident is reported when a patient is involved in an event which is relevant to risk/security, for example exhibiting violent/aggressive behaviour or language, refusing to take medication, making an escape attempt, being in possession of prohibited items, etc. The incident was recorded if the participant was clearly engaged in aggression, rule breaking or inappropriate behaviour, but not incidents which were not the fault

of the participant e.g. being involved in an accident, missing a dose of medication due to staff changeover, etc., which are also recorded on the database.

Modified Overt Aggression Scale (MOAS)

The MOAS (Kay, Wolkenfelf, & Murrill, 1988) is a measure designed to quantify the severity of aggression. It categorises violent incidents into four categories; verbal aggression, aggression against property, aggression against self, and aggression against others. Within each category, the incident is rated on a five point scale to represent the severity. For example, within the verbal aggression category, a score of zero would correspond to no verbal aggression, whereas a score of four would correspond to “threatens violence toward others or self repeatedly or deliberately (e.g. to gain money or sex)”. Thus, each category is given a score ranging from 0-4, and scores are then weighted to give a total score; the verbal aggression score is multiplied by one, property aggression by two, autoaggression (self-harm) by three and physical aggression by four. The measure was designed to rate behaviour over the past week, however in the current study it was rated for the three months preceding the patient’s participation in the study following a review of incidents recorded in the incident database (described above). This was to ensure that there was a sufficient period over which violent behaviour could emerge, as due to the highly structured and regulated environment of a secure hospital the expression of aggression is a relatively rare occurrence. The measure has shown to have good psychometric properties including inter-rater reliability and correlations with other validated measures of overt aggression (Steinert, Wolfle, & Gebhardt, 2000).

In the current study, inter-rater reliability (intraclass correlation) was calculated for the weighted score as described in Chapter Five (i.e. six cases; two from each diagnostic group, absolute agreement; two way random effects model to control for variation in both raters and participants) which revealed excellent agreement between raters (ICC=.812, $p=.013$).

Level of Attendance/Engagement with Therapeutic Activities

Level of attendance at therapeutic activities was rated by a researcher after reading CPA reports (nursing one to one sessions, individual psychology, group psychology, occupational therapy and vocational/educational services) which specifically comment on the number of sessions attended, or give an overview of the attendance level. Attendance was classified along the following Likert scale: 0- complete refusal; 1- minimal; 2- intermittent; 3- regular; 4 – complete attendance. There was also an ‘NA’ option if the patient had not been offered that particular activity over the reporting period, for example they were on a waiting list to attend a group. This meant that patient’s scores were not unfairly reduced due to not having that particular activity in their current care plan. A mean of the score across disciplines (excluding any NA ratings) was then made to give an overall engagement score.

Inter-rater reliability (intraclass correlation) was calculated for the overall engagement score as described in Chapter Five (i.e. six cases; two from each diagnostic group, absolute agreement; two way random effects model to control for variation in both raters and participants) which revealed excellent agreement between raters ($ICC=.933$, $p=.001$).

Outcome Variables

In order to reduce the number of discrete outcome measures, all measures relating to 'risk/violence' were combined to make a composite outcome score. This was achieved by calculating the mean z-scores for the following outcome measures: HCR-20 C+R items, number of incidents and MOAS score. This was deemed the most appropriate option in order to limit the number of comparisons/correlations, and to gain an overview of the 'risk/violence' outcomes of participants. As these measures all purport to measure a similar construct, it appears conceptually and theoretically appropriate to combine them. See Table 9.2 for how combined scores were calculated. The scales were also significantly correlated with each other (See Table 9.3).

Thus three facets of outcome were examined; 1) Clinical Progress (HoNOS-Secure), 2) Risk/Violence and 3) Engagement with therapeutic activities.

Predictors

Examined objective predictors were informed by the literature review conducted in Chapter Three. This indicated that some static variables showed predictive ability in predicting proximal outcomes for mentally disordered offenders, including young age, history of violence and previous psychiatric admissions, so these variables were examined as predictors (with previous violence operationalised via the Gunn & Robertson total score; see Chapter Five). Number of absconding events was also identified as a potential predictor, but was not examined here as no patients at Broadmoor Hospital are permitted leave from the hospital, making absconding events practically impossible during the current admission. Chapter Three also indicated predictive validity for some neuropsychological and social cognitive measures, although these have not been examined previously across a group with varying diagnoses (with the exception of Foster et al., 1993, although 19 of 23 participants had a primary diagnosis of psychosis, making this a largely diagnostically homogenous group). Thus, domain scores were created by calculating mean z-scores for the domains 'executive function', 'memory' and 'facial affect recognition', by selecting key dependent variables from the tests reported in Chapter Six, see Table 9.2. Scores were inversed where necessary (e.g. WCST Total and Perseverative Errors, Trail Making Test Mental Flexibility, Go No-Go Percentage of Commission Errors) so that a higher score reflected a better performance within all domains. Psychopathy level has consistently emerged as a predictor of negative outcome (Fullam & Dolan, 2008; Hare, 2006), and thus was also examined here.

In addition, some novel predictors amongst this population were examined including prepulse inhibition (PPI; see Chapter Seven) as this has previously shown a relationship with the outcome of cognitive behavioural therapy (CBT) for psychosis (Kumari et al., 2012), so may theoretically be a predictor in this similar sample. Psychosocial deprivation was examined as this has previously shown to be related to a higher rate of disengagement from therapy and more suicide attempts during therapy, amongst a first episode psychosis sample (Conus, Cotton, Schimmelmann, McGorry, & Lambert, 2010). Indices of affective modulation of the startle response and the Joystick Operated Runway Task were not included due to a substantially reduced number of clinical participants who had useable data for these measures ($n = 26$ and $n = 38$, respectively).

Two self-report measures were also included that have theoretical relevance to outcome. These measures assess individual's motivation to engage in treatment and their perceptions and attitudes towards treatment.

Patient Motivation Inventory (PMI) (Gudjonsson, Young, & Yates, 2007)

The PMI is a 16 item questionnaire in which participants are asked to respond 'true' or 'false' to statements relating to motivation for treatment. The scale comprises three factors: 'internal motivation' (seven items, relating to patients reporting an interest in their treatment, score range 0-7), 'lack of confidence in the unit' (six items, relating to feelings of coercion or anticipation that the hospital will not be helpful for the patient, score range 0-6), and 'feelings of failure' (three items, relating to patients having a negative view of themselves unless they are therapeutically engaged score range 0-3). The measure was assessed for initial reliability and feasibility in 116 mentally disordered offenders from forensic mental health services at varying levels of security. Internal consistency as measured by Cronbach's α for 'internal motivation' and 'lack of confidence in the unit' was found to be satisfactory ($\alpha = .79$ and $.75$, respectively), whereas 'feelings of failure' was somewhat lower ($\alpha = .65$).

The measure has been used in forensic mental health research to assess whether motivation to therapeutically engage is related to outcome, including in a trial of 'adherence therapy' for medication adherence (Cavezza, Aurora, & Ogloff, 2013), which found no significant difference between the therapy group and control group on any subscale before or after therapy. No significant differences in total PMI score was noted between completers vs. non-completers of a cognitive skills group designed for mentally disordered offenders (Rees-Jones, Gudjonsson, & Young, 2012), however reasons for non-completion included factors unrelated to motivation (e.g. discharge, deterioration in mental state), so this may not be a reflection of the measure's ability to measure motivation for treatment. As yet, there has been no study directly examining how the measure relates to treatment engagement or outcome.

Patient Perception Questionnaire (PPQ) (Gudjonsson et al., 2007)

The PPQ is a 29 item questionnaire designed to measure the perception and attitudes towards treatment at the hospital and how ready patients felt for discharge. Patients are asked to rate their agreement to the statements on a seven point Likert scale from 1 ('not at all') to 7 ('very much so'). The scale comprises three factors: 'treatment engagement' (14 items, relating to the patient holding positive perceptions about their treatment at hospital, score range 14-98), 'reluctance to open up' (11 items, relating to an unwillingness to disclose problems to clinicians and a fear of negative consequences if they do, score range 11-77), and 'readiness for discharge' (four items, relating to whether the patient believes themselves to be at a stage where discharge to the community would be suitable, score range 4-28). All three scales have satisfactory internal validity as measured by Cronbach's α (.89, .81 and .76, respectively).

The measure has been used in the adherence therapy trial mentioned above (Cavezza et al., 2013), but no change in scores was observed across the trial or between treatment groups (adherence therapy vs. health education); unexpectedly, a significant difference in readiness for discharge was noted between groups at baseline, but this did not change in direction or magnitude over the course of therapy. Thus, this measure has not yet been found to be directly related to treatment engagement or outcome.

Table 9.1 - Items for Clinician Rated Outcome Measures

HoNOS-Secure (items rated 0-4)	HCR-20 v2 (items rated 0-2)	HCR v3 (items rated 0-2)
<i>Behavioural:</i>	H1- Previous violence	H1- Violence
1. Overactive, aggressive or disruptive behaviour	H2- Young age at first violent incident	H2- Other antisocial behaviour
2. Non-accidental self-injury	H3- Relationship instability	H3- Relationships
3. Problem drinking or drug-taking	H4- Employment problems	H4- Employment
<i>Physical:</i>	H5- Substance use problems	H5- Substance use
4. Cognitive problems	H6- Major mental illness	H6- Major mental disorder
5. Physical illness or disability		
<i>Symptomatic:</i>	H7- Psychopathy	H7- Personality disorder
6. Problems with depressed mood	H8- Early maladjustment	H8- Traumatic experiences
7. Problems with hallucinations or delusions	H9- Personality disorder	H9- Violent attitudes
8. Other mental or behavioural problems	H10- Prior supervision failure	H10- Treatment or supervision response
<i>Social:</i>	C1- Lack of insight	C1- Insight
9. Problems with relationships	C2- Negative attitudes	C2- Violent ideation or intent
10. Problems with activities of daily living	C3- Active symptoms of major mental illness	C3- Symptoms of major mental disorder
11. Problems with occupation	C4- Impulsivity	C4- Instability
12. Problems with living conditions	C5- Unresponsive to treatment	C5- Treatment or supervision response
	<i>R1- Plans lack feasibility</i>	<i>R1- Professional services and plans</i>
	<i>R2- Exposure to destabilisers</i>	<i>R2- Living situation</i>
	R3- Lack of personal support	R3- Personal support
	R4-Non-compliance with remediation attempts	R4-Treatment or supervision response
	R5- Stress	R5- Stress or coping
<i>H- Historical Factor; C – Clinical Factor; R – Risk Management Factor; HoNOS – Health of the Nation Outcome Scales</i>		

Table 9.2 - Variables Used to Calculate Composite Scores

Composite Score	Calculated from mean of the following z-scores:
Risk/Violence (Outcome)	HCR-20 C+R scales, Number of incidents, MOAS
Executive Function (Predictor)	WCST Total Errors*, WCST Perseverative Errors*, WCST Categories Completed, Iowa Gambling Task Learning Score, Go/No-Go Percent Commission Errors*, Verbal Fluency, Category Fluency, BADS Zoo Map Profile Score, BADS Key Search Profile Score, Trail Making Test Mental Flexibility*
Memory (Predictor)	HVLT Immediate Recall, HVLT Delayed Recall, HVLT Discrimination Index, Letter Number Span Test, WMS Visual Reproduction Immediate Recall, WMS Visual Reproduction Delayed Recall
Facial Affect Recognition (Predictor)	Total Emotion Perception Task – Recognition (including happy, sad, angry, neutral, fearful subscales) and Total Emotion Perception Task – Discrimination (including happy, sad, angry and fearful subscales)
* Scores inversed	
<i>BADS – Behavioural Assessment of Dysexecutive Function; HCR-20 C+R – Historical Clinical Risk Management, Clinical and Risk Management Scales; HoNOS – Health of the Nation Outcome Scales; HVLT – Hopkins Verbal Learning Test; MOAS – Modified Overt Aggression Scale; WCST – Wisconsin Card Sorting Test; WMS – Wechsler Memory Scales</i>	

Procedure

All scores for outcome measures and objective static predictors were retrieved from/rated following a thorough review of patient hospital records (see Chapter Five for details of how static predictor variables were scored). The scores for the HoNOS, HCR-20, number of incidents and engagement ratings were retrieved from the patient's most recent CPA meeting on file at the time of their final research session (mean interval between CPA meeting and participation = 1.93 months, median=2, range=0-5 months).

Neuropsychological scores were obtained as described in Chapter Six. Self-report measures were administered to participants during one of the research sessions in a quiet, private room on the patient's ward. Participants were offered to have the questionnaires read aloud to them if they preferred, and the majority of participants took this option.

Data Treatment – Normality

As in previous chapters, normality was assessed via skew and kurtosis values, with any corresponding z-scores ± 1.96 indicating significant skew or kurtosis. See Table 9.3.

Statistical Analysis

For between group comparisons non-parametric Kruskal-Wallis tests were employed due to non-normal distribution of the outcome measures. To examine the correlates of outcome, Spearman correlations (two-tailed) between predictors and outcome variables were conducted as all outcome variables had significant skew and kurtosis. However, for exploratory analyses with the HCR-20 C+R scale, Pearson correlations (two-tailed) was performed as this scale was normally distributed.

All analyses were run using SPSS version 22, α was set at .05 unless stated otherwise, and trends are reported at less than .10. All analyses were run excluding cases pairwise i.e. with all cases for which data was available. See Table 9.3 for the total number of valid cases for each variable.

Table 9.3- Normality Values, Means and Standard Deviations for Outcome and Predictor Variables, and Number of Cases with Data Available

Outcome Variable (possible score range)	Valid n	Skewness	z score	Kurtosis	z score	Mean	(SD)	Risk/Violence Correlations		
								rho 3	rho 4	rho 5
1. HoNOS-Secure Total (0-48)	57	.760	2.40*	.445	.715	8.46	(5.00)	-	-	-
2. Risk/Violence Composite Outcome	57	1.20	3.81*	1.45	2.33*	0.01	(.777)	.878**	.844**	.809**
3. <i>HCR-20 C+R Scales (0-20)</i>	53	-.154	-.470	-.459	-.712	10.7	(3.87)	1	.586**	.599**
4. <i>MOAS (0-40)</i>	56	2.12	6.63*	4.26	6.79*	3.66	(6.12)	.586**	1	.665**
5. <i>Number of Incidents</i>	57	4.44	14.0*	24.8	39.9*	3.28	(6.68)	.599**	.665*	1
7. Engagement (0-4)	57	-1.16	-3.67*	1.69	2.71*	3.21	(.770)	-	-	-
Predictor Variables										
Age	57	.521	1.65	-.272	-.436	36.3	(9.39)			
No. Previous Psychiatric Admissions	52	-.200	-.604	-1.23	-1.89	3.10	(1.74)			
Gunn & Robertson – Total Violence	57	-.180	-.567	-.352	-.564	5.77	(1.44)			
PCL-R Total Score	57	-.279	-.882	-.866	-1.39	21.0	(8.16)			
Psychosocial Deprivation Total	57	.089	.281	-1.36	-2.18*	10.5	(7.30)			
WCST Total Errors	55	.312	.970	-.352	-.555	2.93	(2.09)			
WCST Perseverative Errors	55	.414	1.29	.671	1.06	28.3	16.83)			

<u>Outcome</u> Variable (possible score range)	Valid n	Skewness	z score	Kurtosis	z score	Mean	(SD)	Risk/Violence Correlations		
								<i>rho</i> 3	<i>rho</i> 4	<i>rho</i> 5
WCST Categories Completed	55	.568	1.77	-.455	-.719	53.2	(17.7)			
IGT Learning Score	55	.621	1.93	-.136	-.214	6.25	(11.5)			
Go No-Go Percent Commission Errors	50	1.62	4.81*	4.39	6.63*	14.2	(10.2)			
Trail Making Test Mental Flexibility	55	1.22	3.80*	1.31	2.07*	75.2	(47.6)			
BADS Key Search	56	.052	.164	-1.08	-1.72	2.05	(1.30)			
BADS Zoo Map	56	.220	.691	-.077	-.123	1.89	(.947)			
Verbal Fluency	56	-.180	-.564	-.665	-1.06	35.2	(11.7)			
Category Fluency	57	.287	.908	.122	.196	39.8	(11.0)			
HVLT Immediate Recall	57	-.013	-.042	-.670	-1.08	18.8	(5.54)			
HVLT Delayed Recall	57	-.198	-.627	.251	.402	6.37	(2.53)			
HVLT Discrimination Index	57	-.919	-2.90*	.708	1.14	9.84	(1.94)			
WMS Visual Reproduction – Immediate	57	.174	.549	-.938	-1.51	6.49	(4.18)			
WMS Visual Reproduction - Delayed	57	.458	1.45	-.093	-.150	7.21	(3.99)			
Letter Number Span Test	55	.075	.232	-.711	-1.12	11.1	(4.17)			
Emotion Perception Task - Recognition	54	.084	.259	-.478	-.747	40.7	(5.74)			

Outcome Variable (possible score range)	Valid n	Skewness	z score	Kurtosis	z score	Mean	(SD)	Risk/Violence Correlations		
								<i>rho</i> 3	<i>rho</i> 4	<i>rho</i> 5
Emotion Perception Task -Discrimination	55	-1.48	-4.60*	1.43	2.26*	50.9	(8.90)			
Mean PPI	47	-.138	-.398	.391	.574	30.6	(16.0)			
PMI Internal Motivation	53	-1.46	-4.45*	1.10	1.70	5.58	(2.07)			
PMI Lack of Confidence in Unit	52	-.215	-.651	-1.04	-1.60	3.13	(1.93)			
PMI Feelings of Failure	54	-.020	-.062	-1.38	-2.16*	1.56	(1.13)			
PPQ Treatment Engagement	48	-.309	-.901	-.959	-1.42	66.7	(18.2)			
PPQ Reluctance to Open Up	51	.179	.536	-.702	-1.07	40.3	(14.3)			
PPQ Readiness for Discharge	55	-.501	-1.56	-.960	-1.52	18.8	(7.18)			

* - $p < .05$; ** $p < .01$

BADS – Behavioural Assessment of Dysexecutive Function; HCR-20 C+R – Historical Clinical Risk Management, Clinical and Risk Management Scales; HoNOS – Health of the Nation Outcome Scales; HVLIT – Hopkins Verbal Learning Test; IGT – Iowa Gambling Task; MOAS – Modified Overt Aggression Scale; PMI – Patient Motivation Inventory; PPI – Prepulse Inhibition; PPQ – Patient Perception Questionnaire; WCST – Wisconsin Card Sorting Test; WMS – Wechsler Memory Scales

Results

Diagnosis

There was a trend for the comorbid group to attend significantly fewer therapeutic activities at the time of their participation than the psychosis and DPD groups ($p=.056$), although the groups did not differ on other indices of outcome; they also did not differ on self-reported motivation to engage in therapy, or perceptions and attitudes towards treatment. See Table 9.4.

Table 9.4 - Outcome Measures and Self-Reported Motivation, Attitude and Perception Towards Treatment Mean (SD) by Diagnostic Group, with Inferential Statistics

Measure	Psychosis Mean (SD)	DPD Mean (SD)	Comorbid Mean (SD)	Inferential Statistics
<i>Objective</i>				
Clinical Progress	8.13 (6.09)	8.27 (4.79)	8.38 (4.50)	$H_{(2)}=.980$, $p=.613$
Risk/Violence z-score	.026 (.994)	-.078 (.609)	.041 (.760)	$H_{(2)}=.903$, $p=.637$
Engagement	3.35 (.876)	3.37 (.401)	2.92 (.798)	$H_{(2)}=5.75$, $p=.056$
<i>Self-Report</i>				
PMI Internal Motivation	6.00 (1.90)	6.12 (1.62)	5.13 (2.14)	$H_{(2)}=3.32$, $p=.191$
PMI Lack of Confidence in Unit	3.36 (1.57)	3.71 (2.17)	2.57 (1.85)	$H_{(2)}=4.48$, $p=.106$
PMI Feelings of Failure	1.58 (1.08)	1.18 (1.13)	1.85 (1.12)	$F_{(2,52)}=1.85$, $p=.167$
PPQ Treatment Engagement	71.8 (18.2)	69.5 (16.5)	62.8 (18.5)	$F_{(2,46)}=1.21$, $p=.308$
PPQ Reluctance to Open Up	35.8 (15.5)	36.4 (9.53)	44.7 (14.9)	$F_{(2,49)}=2.51$, $p=.094$
PPQ Readiness for Discharge	18.6 (6.29)	18.8 (7.90)	18.8 (7.25)	$F_{(2,53)}=.004$, $p=.996$

Experimental Measures: Relationship to Outcome

None of the static predictors, except number of previous psychiatric admissions, was associated with current outcome. A greater number of previous psychiatric admissions were significantly associated with higher scores relating to Risk/Violence and poorer attendance at therapeutic activities. Across the experimental indices, poorer memory, executive function and facial affect recognition was associated with poorer clinical progress as measured by HoNOS-Total score, at the conventional level of significance. For Risk/Violence outcomes, poorer executive functioning and facial affect recognition was significantly associated with higher risk/violence, as was memory at a trend level. Higher Engagement scores were significantly correlated with higher executive functioning and memory scores. See Table 9.5.

If correcting for multiple comparisons, many of these associations would not be significant. However, given the small sample size and consistency with previous literature describing facets of neurocognition and social cognition being sensitive to outcome, further exploratory correlations were performed where initial predictors were significant, or significant at a trend level, to ascertain which precise measures of cognitive function were associated with current outcome.

Number of Previous Admissions

The greater the number of previous psychiatric admissions, the fewer therapeutic activities the patient attended. In addition, the number of previous admissions was positively correlated with the number of incidents a patient had been involved in ($\rho=.308$, $p=.026$) and the MOAS weighted score ($\rho=.331$, $p=.018$)

Table 9.5 - Spearman Correlations between Predictors and Outcome Measures

Predictor	Clinical Progress		Risk/Violence		Engagement	
	<i>rho</i>	<i>p</i>	<i>rho</i>	<i>p</i>	<i>rho</i>	<i>p</i>
<i>Objective Predictors</i>						
Age	-.129	.341	-.074	.583	.034	.802
No. Prev. Psychiatric Admissions	.138	.331	.310	.025*	-.433	<.001* [†]
Gunn & Robertson – Total	.051	.708	.019	.887	-.070	.603
PCL-R Total Score	-.132	.328	.208	.121	-.138	.305
Psychosocial Deprivation Total	.013	.923	-.214	.110	.125	.345
Memory z-score	-.405	.002* [†]	-.225	.092	.335	.011*
Executive Function z-score	-.444	.001* [†]	-.269	.043*	.444	.001* [†]
Facial Affect Recognition z-score	-.276	.042*	-.292	.030*	.181	.186
Mean PPI	-.213	.151	-.101	.501	.040	.787
<i>Self-Report Predictors</i>						
PMI Internal Motivation	-.022	.873	-.187	.180	.236	.089
PMI Lack of Confidence in Unit	-.094	.506	-.346	.012*	.329	.017*
PMI Feelings of Failure	-.113	.415	.169	.221	-.137	.325
PPQ Treatment Engagement	-.070	.636	-.219	.135	.380	.008*
PPQ Reluctance to Open Up	.182	.202	.242	.088	-.408	.003*
PPQ Readiness for Discharge	-.105	.444	.195	.153	-.075	.584
NB – Correlations between Memory, Executive Function and Facial Affect Recognition remained significant when ‘Cognitive Problems’ item excluded from HoNOS total score (p’s= .002, .001 and .027, respectively)						
<i>PCL-R – Psychopathy Checklist- Revised; PPI – Prepulse Inhibition; PMI – Patient Motivation Inventory; PPQ – Patient Perception Questionnaire</i>						
* Significant at conventional level, $p < .05$; [†] Significant after Bonferroni adjustment for multiple comparisons ($p < .003$)						

Executive Function

For HoNOS-Total score (clinical progress), significant correlations emerged with Verbal Fluency ($\rho=-.470$, $p<.001$), category fluency ($\rho=-.393$, $p=.003$) Trail Making Test Mental Flexibility ($\rho=.398$, $p=.003$), Go/No-Go Percentage of Commission Errors ($\rho=.357$, $p=.011$), WCST Total Errors ($\rho=.316$, $p=.019$) and WCST Categories Completed ($\rho=-.277$, $p=.041$).

For Engagement, there were significant correlations between WCST Total Errors ($\rho=-.302$, $p=.025$), Trail Making Test Mental Flexibility ($\rho=-.423$, $p=.001$), Verbal Fluency ($\rho=.357$, $p=.007$) and Zoo-Map profile score ($\rho=.281$, $p=.036$).

For the various facets of Risk/Violence, only the HCR-20 C+R scales were significantly correlated with any of the executive function measures; there were no associations with number of incidents, or MOAS weighted score. The sum of the HCR-20 C+R scales was significantly associated with WCST Total Errors ($r=.434$, $p=.001$), Trail Making Test Mental Flexibility ($\rho=.360$, $p=.009$) Category Fluency ($\rho=-.284$, $p=.039$) and Verbal Fluency ($r=-.329$, $p=.017$).

Memory

The HoNOS-Total score (clinical progress) correlated significantly with the Letter Number Span test ($\rho=-.584$, $p<.001$), and both the immediate and delayed subtests of the WMS Visual Reproduction test ($\rho=-.432$, $p<.001$, $\rho=-.358$, $p=.006$, respectively).

For Engagement, there were significant correlations with the immediate subtest of the WMS Visual Reproduction test ($\rho=.447$, $p<.001$) and the Letter Number Span test ($\rho=.451$, $p=.001$), with trend level correlations for the WMS Visual Reproduction delayed recall ($\rho=.251$, $p=.059$), and HVLIT delayed recall ($\rho=.226$, $p=.091$).

Of the various facets of Risk/Violence, the HCR-20 C+R scales showed significant correlations with WMS Visual Reproduction immediate recall subscale ($r=-.373$, $p=.006$) Letter Number Span test ($r=-.331$, $p=.018$) and the HVLIT Delayed recall ($r=-.328$, $p=.016$). There were no significant correlations with the number of incidents or the MOAS total weighted score.

Facial Affect Recognition

HoNOS-Total score was significantly correlated with the total number of correct identifications of fearful faces ($\rho=-.388$, $p=.004$), and the score for sad intensity discrimination ($\rho=-.338$, $p=.012$). There were trend level correlations for the EPT – Recognition total score ($\rho=-.152$, $p=.066$) and EPT Discrimination score ($\rho=-.238$, $p=.080$), as well as the score for correct anger intensity discrimination ($\rho=-.250$, $p=.066$).

The EPT-Recognition task total score showed significant correlations with the HCR-20 C+R scales ($r=-.357$, $p=.011$), and the MOAS weighted score ($\rho=-.334$, $p=.014$). Correct

identifications of fearful faces significantly correlated with the HCR-20 C+R score ($\rho=-.337$, $p=.017$), MOAS ($\rho=-.288$, $p=.035$) and number of incidents ($\rho=-.275$, $p=.044$). The correct identification of neutral faces correlated with HCR-20 C+R scales ($\rho=-.324$, $p=.022$) and the number of incidents ($\rho=-.391$, $p=.003$).

Initial correlations did not suggest a relationship between Engagement and facial affect recognition so there was no basis for further exploration.

Self-Report Measures: Relationship to Outcome

None of the self-report measures correlated with clinical progress as rated by the HoNOS-Total score. For Risk/Violence outcomes, exploration of the specific subscales revealed that the Lack of Confidence in the Unit subscale of the PMI significantly correlated with number of incidents ($\rho=-.386$, $p=.005$) and MOAS score ($\rho=-.389$, $p=.004$). For Engagement, there were significant correlations with the PPQ subscales Treatment Engagement and Reluctance to open up.

Discussion

The results presented in this chapter suggest that poorer neurocognitive and social cognitive functioning is meaningfully associated with poorer outcome, as measured by clinician rated clinical progress, risk/violence outcomes and engagement with therapeutic activities. This is important as it may suggest that problems in these areas prevent a positive outcome, and thus represent an important therapeutic target in forensic mental health services. In addition, patients reporting a lack of confidence in the hospital were involved in more incidents, and those reporting poorer perceptions towards therapy and a reluctance to open up were less engaged in therapeutic activity. Thus, aspects of the hypotheses were supported. Specifically, all experimental predictors (with the exception of PPI) and certain subscales of the self-report measures were associated in the expected direction with outcomes, although only one static predictor (previous number of admissions) was associated with outcomes.

The results of the group comparison indicated that the three groups (psychosis, DPD and comorbid) do not differ in terms of their clinical or risk outcomes, although there was a trend for the comorbid group to have poorer attendance at therapeutic activities than the other two groups. This is reflective of their willingness to engage; only therapeutic activities that were offered to the patient were included in the score calculation (i.e. if a patient was not offered psychological therapy at that time in their care plan, then engagement with psychology would not be considered when rating attendance). This is in line with previous research which found that non-completers of a cognitive skills group for individuals with a primary diagnosis of a psychotic disorder were more likely to have comorbid ASPD and/or psychopathy than those who completed the group (Cullen, Soria, Clarke, Dean, & Fahy, 2011). In addition, amongst forensic psychiatric inpatients

attending a sex offender group, lower attendance was significantly predicted by an intellectual disability/cognitive impairment, and borderline personality disorder (Stinson, 2016). As demonstrated in Chapter Six, the comorbid group in particular tended to perform consistently poorly relative to the control group across a range of cognitive tasks, and thus this may be a factor underlying their poor engagement, which is strengthened with the positive correlation observed between executive function and memory with engagement across the whole sample.

Although no statistically significant group differences were observed for scores on the psychometric measures employed, the direction of effects for some scales appeared to suggest that the comorbid group had less confidence in the unit, lower internal motivation and greater feelings of failure, in addition to a greater reluctance to open up. It may be that in a larger sample these differences would become more apparent (i.e. this could be a reflection of a reduced sample size, as some participants did not complete these measures).

However, the current design could not ascertain with certainty whether a particular diagnostic group is responding more poorly to treatment/more likely to have a poorer outcome. Cross sectional analysis presents the limitation that all included patients were at varying stages of their care pathways, so outcome may be expected to differ based on the length of time they have been receiving treatment. For example, patients who participated near to their admission may have been deemed by the clinical team to be more/less risky than was accurate due to little available evidence or clinical observation at the time the rating was made. Further, attitudes and perceptions to treatment may change over the course of an individuals' admission. Thus, prospective cohort studies of admissions patients would be an avenue of future research in order to establish whether certain diagnostic groups have higher levels of unmet need/treatment non-responsivity or therapy interfering attitudes.

Yet the merits of such an approach may be outweighed by the emerging position that mental health research is adopting, which advocates a focus on underlying characteristics and mechanisms of mental disorder as opposed to a diagnostic framework (Insel et al., 2010). The results of the correlational analysis support this position, in that the 'dynamic' experimental characterisation measures correlated more consistently with measures of outcome, relative to 'static' or historical factors, and outcome was poorly differentiated by diagnostic group. Although few of these associations would remain significant after Bonferroni correction for multiple comparisons, the relative paucity of previous relevant data makes this research largely exploratory and not confirmatory, thus such strict statistical procedures are not always necessary (Bender & Lange, 2001) and may even prevent discovery of true associations with a small effect size. The results should certainly be viewed with the caveat that they are preliminary and hypothesis generating and larger confirmatory studies are required before clinical implications are formally drawn.

The HoNOS-Secure Total score correlated with executive function, memory and facial affect recognition at the conventional level of significance. This is a measure of clinical progress, so the results suggest that poorer functioning on the aforementioned measures is related to poorer outcome as rated by the patient's clinical team, i.e. more problems across domains relevant to progressing through forensic mental health services. These findings are in line with previous data suggesting that executive functioning can predict negative outcome (poorer response to CBT) amongst older adults with anxiety (Mohlman & Gorman, 2005), and that brain areas relevant to working memory (dorsolateral prefrontal cortex – cerebellum connectivity) are associated with a positive outcome to CBT amongst individuals with psychosis (Kumari, Peters, et al., 2009). Tasks assessing aspects of facial affect recognition (reading emotion from the eyes) have previously correlated with HoNOS Total score in mentally disordered offenders with a diagnosis of schizophrenia (Murphy, 2007), as were a number of neurocognitive measures including the Stroop colour word test, and the Trail Making Test part B, which significantly correlated with the social subscale of the HoNOS-Secure.

For risk and violence outcomes, executive function significantly correlated with the composite z-score, with memory and facial affect recognition associating at a trend level. When examining the more specific components of risk/violence, it emerged that measures of executive function and memory correlated with the clinician rated measure (HCR-20 clinical and risk scales), whereas measures of facial affect recognition additionally correlated with more objective measures of violence such as the number and severity of incidents. This strengthens the position that tests sensitive to social cognition are beneficial for violence prediction, as has been highlighted in other studies specifically focussing on the behavioural expression of aggression (Brugman et al., 2016; O'Reilly, Donohoe, Coyle, et al., 2015). It seems significant that out of all the emotions examined, the correct recognition of fearful faces was negatively correlated with both the number and severity of incidents, as this is consistent with the work of Blair and colleagues (1997) who suggest that negative displays of emotion such as fearfulness deter the perpetrator from committing violent acts. In addition, poor recognition of neutral faces was also associated with a greater number of incidents, which could point towards a hostile attribution bias amongst this population, i.e. incorrectly attributing negative emotion to an ambiguous situation, as has been demonstrated previously amongst ASPD offenders (Schonenberg & Jusyte, 2014).

The finding of poorer executive function and facets of memory being associated with higher risk outcomes is consistent with results described in Chapter Two, suggesting that both these domains are poorer amongst violent groups relative to healthy groups, and with the results of another meta-analysis indicating memory function is more problematic amongst violent relative to non-violent individuals diagnosed with schizophrenia (Schug & Raine, 2009). It is possible that common neural structures which mediate both violence and memory (Dolan, 2010; Soderstrom et al., 2002) may be a link between these observations. As suggested in Chapter Two, poor cognitive

functioning may precipitate violent or risky behaviours in a number of ways, including compromised problem solving, behavioural disinhibition, a lack of flexible thinking or an inability to draw on strategies presented in therapy due to poor learning or recall. Thus it may be that these characteristics, which are arguably observable from clinical assessment, may be related to clinicians attributing higher risk scores to such individuals.

Lack of confidence in the unit (or in this case, the hospital) was also associated with risk outcomes, and specifically a greater number of incidents and a higher MOAS score. This suggests that patients who feel that their stay in hospital is unlikely to benefit them, or feel coerced into treatment, are more likely to behave in an aggressive manner. This may reflect an anti-authoritarian stance: patients who are repeatedly instructed on what they must do in terms of therapy, medication and the use of their time (as is necessary in secure settings) may react against this by behaving aggressively or attempting to resist the hospital/ward regime, especially if they perceive such interventions not to be helpful. Alternatively, a lack of confidence could perhaps reflect feeling unsafe within the hospital, and thus acts of aggression are more defensively mediated.

Engagement was positively correlated with executive function and memory, and negatively correlated with the number of previous psychiatric admissions. In addition, engagement correlated with the treatment engagement and reluctance to open up scales of the PPQ which, as these are theoretically related constructs, provides support for the validity of the ratings of engagement made as part of the study. It may be that a higher number of previous admissions to hospital (which was also associated with a greater number of incidents and weighted MOAS score) reflect a proneness to treatment resistance, which may be mediated via poor engagement with therapeutic services. Alternatively, it could represent a higher general level of psychopathology, or be representative of higher risk thus the patient had been moved around many secure placements or repeatedly deemed to require treatment under the mental health act. The lack of a measure of current symptoms in the present study makes this difficult to unpick, and represents a limitation which should be addressed in future.

However, the data would suggest that executive dysfunction and memory make a specific contribution to engagement problems. Difficulties with mental flexibility (Trail Making Test, WCST), planning (Zoo Map) and information production (verbal and category fluency), could reduce engagement with therapeutic activities via problems contributing meaningfully to therapy (information production) or possessing the mental flexibility to have core belief or delusions challenged, for example ability to think flexibly about delusions has been associated with a positive therapeutic outcome for those with psychosis (Garety et al., 1997). Such difficulties having beliefs challenged may also be relevant to a 'reluctance to open up' as measured by the PPQ; perhaps previous negative experiences of having beliefs challenged and having difficulty

accepting this has led to a reluctance to engage again. Complex tasks which are offered as part as occupational or vocational therapies (for example carpentry, metal work, catering, gardening) may also be difficult for those with executive dysfunction, as these are often goal-directed activities which require planning, monitoring and coordination of many behavioural aspects. Difficulty here may be compounded by memory problems which may manifest via poor recall of skills that have been previously taught, for example. Such issues may reduce the positive experience that patients are able to obtain from engaging in therapeutic activities, and thus may represent a barrier to them engaging meaningfully on a regular basis.

Continued research into predictors and correlates of outcome in forensic mental health services is imperative. The current ‘payment by results’ system, defined as “the payment system in England under which commissioners pay healthcare providers for each patient seen or treated, taking into account the complexity of the patient’s healthcare needs” (Department of Health Payment by Results Team, 2012), uses a tool to assign patients to ‘clusters’ based upon their needs and likely resource requirements, and healthcare providers will receive payment based on the cluster to which a patient is assigned. This tool was originally designed for use in general mental health services, and modified for use in forensic mental health services by asking selected multidisciplinary teams to cluster fictional and real patients into the set clusters. As such, the forensic tool has no statistical underpinning or evidence base (Gibbons & McCarthy, 2015). Thus, advancing our knowledge of how measurable factors such as neurocognition, social cognition and PPI relate to outcome in this population could assist in providing a more efficacious method of predicting outcome, which could be of use to patients, clinicians and commissioners alike, especially for such high cost services (S. Wilson et al., 2011).

Strengths and Limitations

This study provides some of the first evidence that common characteristics evident across diagnostic categories are relevant to outcome. Previous research of this type has focussed on specific diagnostic groups, for example schizophrenia and schizoaffective disorder (Murphy, 2007; O'Reilly, Donohoe, Coyle, et al., 2015), or excluded large groups of forensic inpatients e.g. those with psychosis (Brugman et al., 2016). The results here are thus more representative and suggest that interventions aimed at improving cognition and social cognition could be beneficial to a wide range of forensic psychiatric patients, and is a strength of the current investigation. As mentioned above, the limitations regarding the cross-sectional design and lack of measurement of symptoms are areas of improvement for future research. In addition, the time that outcome was measured and the time of assessment was not necessarily contemporaneous, as outcome measures may have been rated up to five months previous to assessment. However, as most patients within high security forensic mental health services have a relatively long stay (average eight years; Völlm, 2014), this delay is comparatively small in the context of their overall hospitalisation time,

and should give some indication as to their recent functioning levels. Further, as included patients were from a variety of different wards, the person/team rating the clinician rated outcome measures was not consistent across participants, which could result in some clinicians having a bias towards rating more highly than others, for example. However, all clinicians using such instruments were trained in their use which should minimise some of these factors. It is an additional strength that this study examined the relationship of experimental measures with outcome measures used in routine clinical practice, as this is likely to enhance the applicability and relevance of results to services using similar methods to assess outcome. Thus, the results can be considered to provide ecologically valid insights. Finally, the limitations of self-report must be acknowledged for the psychometric measures, which could be particularly relevant in those with antisocial personality traits who may have deceitfulness as part of their presentation, or more generally amongst all groups, reduced insight into their own difficulties.

Chapter Summary

This chapter explored the relevance of previously examined experimental measures and self-report measures to facets of clinical outcome in mentally disordered offenders. Although based on a relatively small sample, the correlational results (previous psychiatric admissions, executive function, memory and facial affect recognition correlating with various indices of outcome) were largely consistent with previous literature and strengthen the case for the development and refinement of specific interventions targeting cognitive and social cognitive functioning. The results also advocate for thorough neuropsychological assessment of patients using such services, which should be used to inform formulation and treatment planning. Although not statistically significant, there is trend-level evidence to suggest that the comorbid group are less engaged in therapeutic activities, which may be mediated through poorer cognitive skills.

10 Chapter Ten: Discussion

Chapter Aims and Overview

This chapter will provide a summary and synthesis of the findings reported in the thesis. The hypotheses set out in Chapter Four are reported alongside the findings to assess whether these were supported or not. The implications for clinical practice (therapeutic interventions; early intervention), and recommendations for future research are suggested. Finally, methodological considerations of the thesis are discussed to give an overview of the strengths and limitations of the evidence.

Overview of Thesis Findings

The data presented in this thesis contribute towards the overarching aim of characterising a specific subgroup of mentally disordered offenders, namely those with comorbid psychosis and an antisocial personality disorder, specifically dissocial personality disorder (DPD). The research questions, hypotheses and findings from each chapter are summarised in Table 10.1.

The first thing to note is that this comorbid group does appear to be distinct compared to those diagnosed with psychosis alone; they tended to have more widespread neurocognitive difficulties (Chapter Six), and poorer recognition of fearful emotion (Chapter Six). Further, this comorbid group was characterised by problems with sensorimotor gating, with significantly less prepulse inhibition (PPI) than those with psychosis alone (Chapter Seven). They had a greater number of previous offences, significantly longer illness duration, higher psychopathy scores, a greater number of previous convictions for violent and acquisitive offences, as well as a more severe history of violence (Chapter Five). There were fewer differences between the comorbid group and the DPD alone group, whom they rarely significantly differed from, although the direction of results was towards poorer performance in the comorbid group on measures of neurocognition, social cognition and PPI. The only variable on which they did significantly differ was the interpersonal/affective traits of psychopathy (Factor One; higher in DPD alone, Chapter Five). This suggests that hospitalised offenders with both psychosis and DPD present more similarly to those with DPD alone, which is a novel finding as existing research has not previously compared the comorbid group to a relevant personality disorder group.

Secondly, there were some characteristics which were common across all groups. All clinical groups demonstrated poorer performance on neuropsychological measures of memory and executive function compared to controls, albeit occasionally only at a trend level for the psychosis group (Chapter Six). Discriminating facial emotion intensity was also poor across all clinical groups compared to healthy controls (Chapter Six). The groups were not distinguished by their appetitive and defensive responding profiles in response to positively, neutrally and negatively valenced images (Chapter Eight), nor by their experiential fear and anxiety on a behavioural task (Chapter Six). These results suggest that the groups do not differ with regards to their experienced

emotions, even relative to healthy controls. There were no significant differences in the history or extent of substance use amongst the clinical groups, history of convictions for drug offences, nor the severity of the index offence. A history of childhood psychosocial deprivation was common amongst the three clinical groups, although tended to be less prevalent amongst the psychosis alone group relative to the DPD group, with the comorbid group taking an intermediary position and not differing from either group.

Finally, this thesis also examined how the groups differed with respect to clinical outcome. Although there were no significant group differences in the level of clinician rated progress, or on facets sensitive to risk/violence, there was a trend ($p=.056$) for the comorbid group to attend fewer therapeutic activities. Better performance on a number of neurocognitive and social cognitive measures as well as number of previous psychiatric admissions and self-reported attitudes and motivation towards treatment, were associated with indices of outcome (Chapter Nine). Thus, whilst recognition and characterisation of a distinct subgroup of offenders is important in order to understand their treatment needs, the evidence also suggests that certain characteristics *across groups* may be relevant to outcome and thus potential treatment targets.

Table 10.1 - Research Question, Hypotheses and Findings from Chapters Five to Nine

Chapter	Research Question	Hypothesis	Finding
5 – Characteristics	How do individuals with comorbid psychosis and DPD differ from those with psychosis or DPD with regard to their demographic, clinical, psychosocial and offending characteristics?	The comorbid group will have a greater number of offences, a greater history of substance abuse, and a younger age of onset of psychosis than the psychosis group. Comparisons between the comorbid and DPD group are exploratory due to a lack of previous relevant data.	Relative to the psychosis alone group, the comorbid group had a greater number of previous offences, significantly longer illness duration, higher psychopathy scores, a greater number of violent and acquisitive offences, as well as more severe history of violence. The two groups had similar histories of substance misuse, index offence severity and childhood psychosocial deprivation. The comorbid and DPD groups were differentiated only by Factor One and Total PCL-R scores (higher in DPD), but did not differ on any other indices.
6 – Neuropsychology & Emotion Processing	How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to cognitive function?	All clinical groups will perform more poorly than healthy control participants on tasks of cognitive function, but groups with psychosis (psychosis group or comorbid group) will also score significantly lower relative to the DPD group on tasks assessing memory and general intelligence.	For general intelligence, the comorbid group scored significantly lower than controls whereas the other clinical groups did not. For memory, comorbid and DPD groups were poorer than controls for the majority of tasks, and the psychosis group tended to differ only at a trend level. For executive function, all clinical groups tended to be poorer than controls, with the comorbid group showing specific difficulties on category fluency, Go/No-Go reaction time, and perseverative errors on the WCST compared to controls.

Chapter	Research Question	Hypothesis	Finding
	How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to facial affect recognition?	All clinical groups will perform more poorly compared to the healthy control group on tasks assessing facial affect recognition, and the comorbid group will perform more poorly than the psychosis alone group.	The comorbid group was poorer than the psychosis and control groups at recognising fearful faces. The DPD group did not differ from any group. All three clinical groups were poorer than healthy controls at discriminating between intensities for angry and fearful faces.
	How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to experiential fear and anxiety?	The psychosis group will show high, and the DPD group low, experiential fear and anxiety relative to healthy controls. No directional hypothesis is made for the comorbid group due to a lack of relevant previous data.	There were no group differences observed in experiential fear and anxiety.
7 - Prepulse Inhibition(PPI)	How do individuals with comorbid psychosis and DPD differ from those with psychosis, DPD and healthy control groups with regard to sensorimotor gating?	All the clinical groups will demonstrate lower PPI than the healthy control group, with the DPD group showing lower PPI than the psychosis group. No directional hypothesis is made for the comorbid group due to a lack of relevant previous data.	The comorbid group showed significantly lower PPI than the healthy controls and the psychosis group. This effect was most pronounced in PPI on 60ms prepulse-pulse intervals. There were no other significant group differences.

Chapter	Research Question	Hypothesis	Finding
7 – Prepulse Inhibition (PPI)	Is sensorimotor gating influenced by psychopathy, psychosocial deprivation or severity of previous violence?	High levels of psychopathy (antisocial personality traits), previous violence, and psychosocial deprivation will be negatively associated with PPI.	There was preliminary evidence to suggest that antisocial personality traits, a history of violence and psychosocial deprivation are negatively correlated with PPI, with the strongest evidence for antisocial behavioural traits (Factor Two of the PCL-R). These correlations, however, would not survive correction for multiple comparisons.
8 – Affective Startle	How do individuals with comorbid psychosis and DPD differ from those with psychosis or DPD with regard to affective modulation of the startle response?	The psychosis and healthy control groups will show the typical valence-modulation of the startle response, whilst the DPD group will not show the typical enhanced response to negative images. No directional hypothesis is made for the comorbid group due to a lack of relevant previous data.	No Group by Valence interaction was observed, and all groups showed an atypical response pattern relative to previous studies in healthy groups, in which the startle response was not potentiated, but attenuated, in response to aversive images compared to neutral.

Chapter	Research Question	Hypothesis	Finding
8- Affective Startle	Is affective modulation of the startle response influenced by psychopathy level?	Those meeting the clinical cut-off for psychopathy (score 25 or above on the Psychopathy Checklist – Revised) will show an atypical response pattern with attenuated startle amplitude to negative images, relative to neutral. In addition, the startle response to negatively valenced images will be negatively correlated with psychopathy score.	No effect of psychopathy was observed on affective modulation of the startle response, as assessed by group comparisons or correlational analysis. Attenuation of the startle response to negative, relative to neutral, images was observed in the psychopathic group, but was also observed amongst the non-psychopathic and control groups.
9 – Outcomes	How do individuals with comorbid psychosis and DPD differ from those with psychosis or DPD with regard to clinical outcome (clinician rated progress, risk and engagement), and self-reported perception and attitudes towards therapy?	No directional hypothesis is made as previous literature has provided inconclusive or conflicting evidence.	The three clinical groups did not significantly differ in terms of their clinical or risk outcomes, but there was a trend ($p=.056$) for the comorbid group to have poorer attendance at therapeutic activities than the other two groups. There were no significant group differences regarding motivation to engage in treatment, or perceptions and attitudes towards therapy.

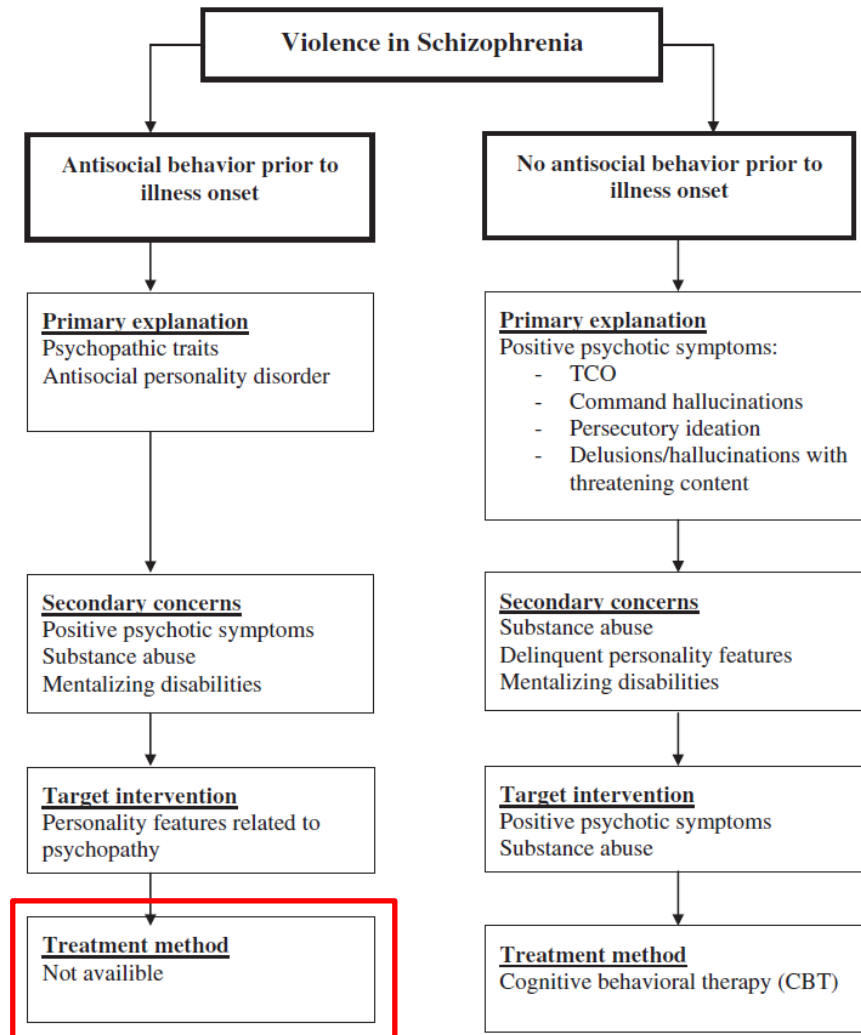
Chapter	Research Question	Hypothesis	Finding
9 - Outcomes	Are indices of clinical outcome (clinician rated progress, risk and engagement) related to previously explored characterisation measures; demographic, cognitive, emotion processing and PPI variables?	Young age, number of previous psychiatric admissions, severity of previous offending, performance on tests of facial affect recognition and measures of memory and executive function, will be correlated with indices of outcome across the whole sample.	The HoNOS-Secure Total score negatively correlated with executive function, memory and facial affect recognition.
	Do self-report measures of motivation, perception and attitudes towards treatment relate to outcomes?	Therapy interfering attitudes and perceptions will be associated with poorer outcomes.	Risk and violence outcomes correlated negatively with executive function and positively with a greater number of previous psychiatric admissions, with memory and facial affect recognition associating negatively at a trend level. Engagement was positively correlated with executive function and memory, and negatively correlated with the number of previous psychiatric admissions. Executive function tasks that consistently emerged as predictors included the Trail Making Test Mental Flexibility, Wisconsin Card Sort Test and Verbal Fluency. Risk and violence outcomes were positively correlated with ‘Lack of Confidence in the Unit’; Engagement was positively correlated with ‘Treatment Engagement’ and negatively correlated with ‘Reluctance to Open Up’

Clinical Implications

The findings presented in this thesis suggest that those with comorbid psychosis and DPD are more similar in their characteristics (neurocognitive, social cognitive, historical/static factors) to those with DPD alone, than those with psychosis alone. Although these groups may differ on their presenting symptoms or other unmeasured characteristics, the results suggest that interventions which are effective amongst antisocial/dissocial PD groups may also be effective in a comorbid psychosis and antisocial/dissocial PD group. This raises concerns as there are few treatment options currently available for the management or amelioration of dissocial/antisocial PD, as summarised by Bo and colleagues (2011), in their review concerning individuals with psychosis and antisocial personality traits, it is often considered that treatment is simply “not available” (Figure 10.1). These sentiments are echoed by two recent systematic reviews which highlighted very few studies providing good quality evidence of effective psychosocial treatment for personality disordered offenders (Barnao & Ward, 2015; Rampling et al., 2016).

When considering the characterisation data (Chapters Five, Six and Seven) alongside the outcomes data (Chapter Nine) and the literature reviewed in Chapter Three, it would seem to suggest that some of the factors contributing to poor outcome are neurocognitive and social cognitive problems, and that these appear to be areas of weakness for all clinical groups relative to controls, although the comorbid group tended to score the most poorly as they significantly differed from controls on almost every measure, and regularly had lower scores (although not always significantly so) than the DPD and psychosis groups. Thus it is feasible to suggest intervention in these areas for mentally disordered offenders. What is also notable was that such associations between characteristics and outcome emerged when diagnostic groupings were collapsed and the whole sample was investigated. Although this may be simply due to greater statistical power, it could also signify that taking a transdiagnostic approach would be beneficial in terms of patient outcomes but also in terms of cost effectiveness (restricting therapies to specific diagnostic groups inherently limits the number of patients who can take part). The following sections will explore potential therapeutic options for improving neurocognition and social cognition by reviewing the literature regarding cognitive remediation therapy, cognitive skills groups, and pharmacological options. Finally, the benefits of early intervention will be briefly outlined and any further therapeutic considerations explored.

Figure 10.1- Summary Diagram taken from Bo et al., (2011) delineating Treatment Relevant Factors for Violence in Schizophrenia (highlight added)



Cognitive remediation therapy (CRT) was defined by expert consensus as “a behavioural training based intervention that aims to improve cognitive processes (attention, memory, executive function, social cognition or metacognition) with the goal of durability and generalization” (Kurtz, 2016). CRT has two differing delivery methods; ‘drill and practice’ which involves the rehearsal of cognitive tasks by the participant, and is reliant on the principles of massed practice, or alternatively ‘drill and strategy’ which typically involves the same rehearsal of cognitive tasks, but takes place with a therapist who facilitates the promotion of cognitive strategies (Paquin, Wilson, Cellard, Lecomte, & Potvin, 2014).

The specific skills and techniques utilised by the CRT therapist include making links between the cognitive tasks and daily life explicit, in order to facilitate the transfer of skills into regular use. Further, the introduction of specific psychologically-informed strategies such as ‘chunking’ related information together, use of mnemonics or lists can be applied for memory difficulties, whilst help with sequential planning and breaking complex tasks into manageable steps can be applied for executive function problems. Some cognitive remediation programmes place a heavy emphasis on developing metacognition (e.g. as described in Reeder et al., 2016). This occurs by encouraging the client to rate the perceived difficulty of a task before attempting it, estimate the amount of time it will take, and decide which strategies will be used to effectively complete it. These are then additionally rated after completion of the task to allow the client to identify whether they are over/underestimating the difficulty of cognitive tasks, allowing too much/too little time, and to assess the efficacy of their chosen strategies. In this way, it is anticipated that the client will gain a greater understanding of their own cognitive strengths and weaknesses, and be able to identify tasks in their daily lives which may be particularly challenging, time consuming, etc. and utilise strategies that they have developed through CRT to complete these effectively.

There is a good evidence base for CRT improving cognitive skills in schizophrenia, with meta-analytic evidence suggesting a positive medium effect size ($d=.45$) on global cognition scores (Wykes, Huddy, Cellard, McGurk, & Czobor, 2011). Meta-analysis of the CRT literature also suggests functional gains for those with schizophrenia, particularly if it is combined with other interventions such as social skills training, supported employment, vocational rehabilitation and social information processing groups (McGurk, Twamley, Sitzler, McHugo, & Mueser, 2007).

There has been little application of CRT to personality disorder groups, although two case reports (Arza et al., 2009; Reeder, Stevens, Liddement, & Huddy, 2014) and one pilot study (Vita et al., 2016) have assessed the feasibility and acceptability of CRT in borderline personality disorder (BPD), which is another cluster B disorder and thus conceptually similar to the antisocial personality disorders. Both case reports demonstrated the benefit of CRT on cognitive function and functional outcomes amongst the five (Arza et al., 2009) and two (Reeder et al., 2014) cases

reported. Of note, the latter of these reports described two women who were using low-secure services and thus had demonstrated challenging behaviour, lending support to the notion that such therapies may be acceptable within similar (forensic) mental health services. The larger pilot study (Vita et al., 2016) incorporated 15 BPD patients who received a computerised form of CRT and 15 BPD patients who received a non-cognitive intervention in addition to their treatment as usual. After 16 weeks of twice-weekly treatment, the CRT group showed improvements in working memory and global functioning compared to treatment as usual, although did not improve across a number of other cognitive domains (verbal memory, verbal fluency, executive function), or on other measures of outcome (HoNOS, clinical global impression, symptoms of BPD). The authors conclude that the intervention is feasible although limited in its therapeutic scope. This may be due to the fact that the type of CRT which was applied was ‘drill and practice’ type, and thus did not involve a therapist to facilitate transfer of the skills learnt into daily life, or to promote or suggest cognitive strategies, which has been shown to improve the treatment effect (McGurk et al., 2007; Wykes et al., 2011). The two case studies reported above both utilised a therapist supported method.

When looking specifically at CRT in forensic settings, only one study to date has examined this amongst schizophrenia inpatients (Ahmed et al., 2015). The hospital at which the study took place, however, admits both general psychiatric and forensic inpatients, and thus only approximately half of included participants had a forensic history (57%). The intervention involved computerised CRT three times weekly (50 minutes) and ten minutes of group discussion designed to facilitate transfer of learning; the control condition was matched in terms of frequency and duration, but involved computer games replacing CRT, followed by a group discussion of “healthy behaviours”. Therefore although the computerised part was more akin to ‘drill and practice’, a therapist element was retained. The CRT group demonstrated significant improvement compared to the control group on indices of attention, working memory, verbal learning, overall cognitive functioning, negative symptoms, excitement/agitation symptoms, and reductions at three week follow up in verbal aggression and physical aggression. This is an important finding as it suggests cognitive remediation may be effective at targeting violent behaviours in addition to improving cognitive functioning, which in turn is likely to influence functional outcome. It also provides support for the notion that cognition and violent behaviour may be linked, for example via poor decision making in provocative situations or difficulties predicting the consequences of outcomes (see Chapter Two). Such promising findings suggest CRT should be examined further in forensic mental health services, and there is an ongoing randomised controlled trial amongst a national cohort of forensic patients assessing the efficacy of such an intervention at present (O'Reilly, Donohoe, O'Sullivan, et al., 2015).

The only other study to assess neurocognitive CRT in a relevant group was conducted amongst prisoners who were categorised into differential offender subtypes; psychopathic and

externalising (Baskin-Sommers, Curtin, & Newman, 2015). Offenders with schizophrenia, bipolar disorder or other psychosis were excluded. The premise of this study was to target cognitive deficits which were purportedly specific to each subtype. Thus the psychopathic subgroup received CRT (drill and practice type) which employed tasks to target attention to context (thought to be lacking in psychopathic groups, see Chapter Eight discussion), and the externalising subtype received CRT targeting affective cognitive control, i.e. allowing the participant to practice inhibiting themselves under motivational or affective contexts. The groups were split so that half of each offender subgroup received the subtype specific intervention, and the other half received the intervention which was specific to the other group. Results showed that following six, weekly hour long sessions of practicing tasks, those who had received subtype specific interventions improved in the types of tasks they had been practising, and the psychopathic group also showed generalised improvement to other tasks, indicating that they had developed a generalizable cognitive skill. However, although the externalising subgroup showed specific improvements on the tasks they had been practising, there was not robust evidence that these skills had been generalised to other tasks, and in fact those who had received CRT not matched to their specific deficits had deteriorated in task performance. This study highlights that cognitive change is possible in antisocial subgroups with no additional mental illness, and indicates a promising line of potential treatment for a group who currently have few potential treatment options.

However, this study investigated a type of CRT which did not involve a therapist to assist in strategy formation/use or facilitate of transfer to daily life, nor did it assess any functional outcomes such as institutional behaviour or attendance at therapy. The sole reliance on laboratory measures of cognition as outcome measures limits the applicability of the findings, and investigation of CRT strategies in antisocial populations thus remains a key area for future development, particularly with regard to ecologically valid outcomes and the role of the therapist. The data presented in this thesis in both Chapters Two and Six indicate cognitive deficits amongst mentally disordered offenders with DPD/ASPD in areas including memory and executive function, and thus a more global approach aiming to target many facets of cognition could be a preferable strategy to improve outcomes for this group.

Group Therapy Interventions

A number of group therapies have emerged which purport to target cognitive or social cognitive deficits. A number of group therapies have emerged which purport to target cognitive or social cognitive deficits. One such programme is Social Cognition and Interaction Training (SCIT), which was developed by Penn and colleagues (2007). The authors state that this programme specifically targets three core areas of social cognition: emotion perception, attributional style and

theory of mind, as well as processes thought to be related including cognitive inflexibility, reasoning biases (such as jumping to conclusions) and intolerance of ambiguity. The specific therapeutic techniques used to achieve this comprise of psychoeducational material about emotion, including the link between emotion and behaviour, training on how to recognise emotions, and how to distinguish between justified and unjustified suspiciousness. Materials such as video clips of social scenarios are used to generate discussion and questions, in addition to interactive games such as ‘twenty questions’ where clients must learn to gather more information before coming to a firm conclusion. Similar activities where clients are shown photos and asked to generate facts and guesses about the social scene are also utilised. The final part of the therapy involves clients bringing their own difficult social experiences to the group where they can be assisted in identifying the appropriate affect, distinguishing between facts and guesses and brainstorming potential solutions with other group members.

Two studies report social cognition group training (specifically the SCIT programme) in a sample of forensic inpatients with schizophrenia spectrum disorder. One conducted in the United States (Combs et al., 2007) demonstrated significant improvement for the treatment group, relative to controls (who received a coping skills group), on indices of facial affect recognition, social perception, theory of mind, attributional style, cognitive flexibility and a reduction in aggressive incidents on the ward. These changes were independent of symptom improvement suggesting a domain specific improvement. Participants also noted that their interactions with others had improved, as had the quality and size of their social network. A number of these effects were maintained at six month follow up, although the anti-aggressive effect was not examined (Combs et al., 2009). One study conducted in the United Kingdom showed that social cognition training was feasible and well accepted in forensic inpatient wards for patients with schizophrenia. An improvement in facial affect recognition was noted amongst the treatment group compared to treatment as usual, as well as a majority of participants indicating that they had met, or felt able to meet, the social goal they had set at the start of the group (Taylor et al., 2015).

These studies demonstrate that social cognition is malleable and responsive to treatment, and may represent a central target for clinicians working in forensic services. Further studies assessing and replicating the ability of such groups to have an effect on outcomes such as violent behaviours at longer follow up periods are warranted. This is especially pertinent when considering improvements in facial affect recognition reduced the severity of offending amongst young offenders (Hubble, Bowen, Moore, & van Goozen, 2015), and the association between poor facial affect recognition and objective measures of violence reported in the current thesis (Chapter Nine; fearful face recognition negatively correlated with MOAS score, neutral face recognition negatively correlated with the number of incidents). These findings are consistent with the wider literature suggesting social cognitive deficits were related to poorer outcome in forensic

populations (Chapter Three), and further emphasise the potential for therapeutic gains with social cognition training groups.

Cognitive skills programmes are the basis for most of the therapeutic programmes delivered to offenders across Europe and North America (E. Ross & Hoaken, 2010). However, ‘cognitive skills’ in this context tends to refer to ‘thinking styles’ and ‘criminal attitudes’ (Young, 2010) as opposed to cognitive functioning, although some programmes appear to incorporate factors relevant to the current thesis. For example, Reasoning and Rehabilitation (R&R), a programme which runs for 36 two-hour sessions and is used within the prison system, was assessed for efficacy within medium secure units in the United Kingdom for individuals with a psychotic disorder (Cullen et al., 2012a, 2012b). This incorporated modules on problem solving, social skills, creative thinking and critical reasoning which may have tapped into some of the domains reported here. The programme reported a high non-completion rate (50%), which was predicted by having comorbid ASPD amongst other things, but did report positive outcomes for group completers with respect to social problem-solving and incidents of verbal aggression.

Some of the perceived drawbacks of this programme (high rate of non-completion, high number of sessions) were addressed in a modified version of R&R; R&R2 (Young & Ross, 2007), which was specifically designed for offenders with mental health problems and consists of only 16, 90 minute sessions. This programme specifically includes a neurocognitive module (focussing on improving attentional control, impulse control, memory and constructive planning), in addition to problem solving, emotional control, social skills and critical reasoning modules. The group has shown to be effective amongst offender inpatients with serious mental illness (C-Y Yip et al., 2013) and personality disorder (Young, Hopkin, et al., 2013), with retention in treatment reported at 80% and 78% respectively, accompanied by reductions in violent attitudes and improved social problem solving. Although these programmes appear to provide beneficial cognitive strategies to participants, it may be necessary to improve participant’s ‘baseline’ levels of cognition before meaningful gains can be made in therapy, and thus offering a focussed neurocognitive intervention such as CRT prior to more structured group work could be feasible (E. Ross & Hoaken, 2010).

Pharmacological Interventions

Although non-pharmacological treatments such as CRT have shown efficacy in ameliorating the cognitive deficits observed in schizophrenia, such therapies are not always widely available (Aquila & Citrome, 2015), especially given the high frequency of sessions that are recommended (e.g. Ahmed et al., 2015 reported three sessions per week). Thus, research has continued in the search for an effective pharmacological agent to target cognitive symptoms, which would have the advantage of being available to a wider range of individuals. There is meta-analytic evidence to suggest that newer, second-generation antipsychotics have a more beneficial effect on cognitive

function than first generation agents, albeit with a small effect size (Hedge's $g=.24$) on composite global cognition scores (Woodward, Purdon, Meltzer, & Zald, 2005). However, this analysis has been criticised for including studies which had very short follow up periods (range 4-104 weeks, median 23 weeks) which may not leave sufficient time for change to occur, or be liable to practice effects of the neuropsychological assessment. A meta-analysis (Désaméricq et al., 2014) including studies with longer follow up periods (at least 26 weeks; median trial length of included studies was 52 weeks) also demonstrated superiority for second-generation antipsychotics (quetiapine, olanzapine, ziprasidone, amisulpride and risperidone) on the global cognition score (effect sizes between 0.16 and 0.27), relative to first generation drugs (haloperidol).

Due to the small effect sizes reported across meta-analyses, however, alternative neurotransmitter systems have been targeted. Yet, to date such attempts have not proved successful. Glutamate positive modulators were found to have no superior effect on cognition over placebo in a meta-analysis of 17 studies (Iwata et al., 2015), and although acetylcholinesterase inhibitors did show some superiority for certain domains of cognition in individual studies (attention, visual memory, verbal memory, language and executive function), the authors of a meta-analysis concluded that the evidence was weak due to methodological limitations, and future work was needed (Singh, Kour, & Jayaram, 2012). Examination of the effect of medication on social cognition has also suffered from methodological weaknesses of individual studies; a review (Vingerhoets, Bloemen, Bakker, & van Amelsvoort, 2013) highlighted small sample sizes, a lack of control group and short/inconsistent length of follow up period to be some of the issues with the limited literature base. The authors suggest dopamine, serotonin and oxytocin to be potential targets of interest in the treatment of social cognition problems.

Pharmacological options for the antisocial personality disorders are not well investigated. A Cochrane review (Vollm, Gibbon, et al., 2010) identified only eight studies which examined pharmacological agents in individuals with ASPD or DPD, and none of the studies specifically selected for the personality disorder but included individuals with substance misuse problems/aggression, some of whom also met criteria for ASPD/DPD. None of the studies investigated cognitive outcomes, and thus ability of pharmacological agents to improve cognition/social cognition in ASPD/DPD is still unknown. A more recently published case series of seven men detained in high security hospital with ASPD (Brown et al., 2014) demonstrated clozapine to be effective in improving the clinical presentation of those with ASPD. Although again no specific neurocognitive outcomes were measured, there was a reduction in impulsive-behavioural dyscontrol symptoms in all patients which may arguably improve ability to concentrate on, and complete tasks requiring more sophisticated cognitive functions. As a second generation antipsychotic, clozapine may therefore be a potential therapeutic option for cognitive problems in ASPD/DPD, especially considering the evidence to suggest that such agents may mediate cognitive benefit amongst individuals with schizophrenia (Désaméricq et al., 2014;

Woodward et al., 2005). Clozapine is also putatively supported as an agent for ameliorating violence and aggression amongst schizophrenia spectrum individuals with problematic violent behaviour (Victoroff, Coburn, Reeve, Sampson, & Shillcutt, 2014), and has shown efficacy in improving PPI (Kumari & Sharma, 2002; Kumari et al., 2000; Oranje et al., 2002), further supporting its use amongst forensic hospital patients.

Early Identification

A study examined a large number (n=301) of individuals presenting to mental-health services with a first episode of psychosis, and identified a significant proportion who had previous criminal convictions; 33.9% of men and 10% of women, of which 19.9% and 4.6% had a history of violent crimes, respectively (Hodgins et al., 2011). This further confirms that there are a large proportion of individuals who have difficulties relating to both psychosis and antisocial behaviours, likely requiring different treatment options. One study has provided evidence to suggest that antisocial behaviours are not taken into account when treatment planning (Hodgins et al., 2009). A cohort of inpatients with severe mental illness (principally psychotic disorder, but also including bipolar and severe depression) were contacted two years after discharge whilst in the community, and their characteristics and treatments assessed at both time points. A large proportion (59%) had engaged in antisocial behaviour (violence/aggression towards others, drug/alcohol use, committing a crime) both at baseline and at follow up, although during the intervening period they had not been offered any specific treatments regarding their antisocial behaviours. For example, whilst 35% of patients were noted to have been using illicit drugs, only 3.8% were receiving treatment for substance misuse, and whilst 39.8% had been involved in at least one aggressive incident six months prior to the interview, only 1.3% were receiving anger management treatment.

This suggests that there is a need to identify individuals who present to services with psychosis and a history of antisocial behaviour, who appear to be relatively numerous (around a third of men; Hodgins et al. 2011). Thorough assessment of previous violent/aggressive/antisocial behaviours should be conducted, and appropriate treatments should be offered as this may prevent admission to costly forensic services. This thesis provides tentative evidence that comorbid individuals may have more difficulties engaging with therapeutic services whilst hospitalised, and that problems with executive function, facial affect recognition and memory (all of which tended to be present to the greatest extent amongst comorbid participants) were associated with a negative outcome. Thus intervening early in an acute inpatient admission or a community setting may prevent the individual accruing more criminal convictions and the creation of further victims, as well as reducing costs for the taxpayer via the avoidance of lengthy hospital stays.

Other Therapeutic Considerations

One of the limitations noted in the psychophysiological experiments was the lower rate of participation. One of the reasons cited for this was suspicion that the affective images presented may be of personal relevance to the participants, and had been specifically chosen to ‘test’ them. Bearing this in mind, interventions which target delusional, and specifically paranoid, thinking may be of benefit in this population. Indeed, delusional thinking which induces anger in participants has been shown to be related to violent behaviour amongst individuals with psychosis (Ulrich, Keers & Coid, 2014). One study examined a brief intervention which targeted reasoning biases in order to attempt to reduce paranoid thinking (Garety et al., 2015). The computerised intervention which provided education about reasoning biases and strategies to overcome them, reduced state paranoia and improved reasoning. Mediation analyses suggested that changes in belief flexibility represented the mechanism for improved paranoia. Moderators of the effect included poor working memory and high negative symptoms. Although this study was designed as a proof of concept experiment, the promising results suggest that paranoia can be targeted effectively through altering reasoning biases. The moderating effect of poor working memory is of consideration in the current population, and it may be that interventions aimed at improving cognition i.e. CRT, could be offered. Interventions relevant to paranoia may also be of merit when considering that those who scored highly on the ‘reluctance to open up’ subscale, also showed poor engagement in therapeutic activities. Further research is needed to explore the exact mechanism mediating poor engagement, but if patients do not trust health care professionals due to paranoid ideation, this may be a worthwhile target in therapy.

When it comes to the therapeutic considerations for poor PPI, research to date has provided more evidence for ameliorating such deficits using pharmacological agents (see Chapter Seven) as compared to psychological. However, poor PPI has predicted poorer response to CBT for psychosis amongst individuals with schizophrenia (Kumari et al., 2012). This suggests that improving PPI could confer benefits for treatment response. The mechanism by which poor PPI leads to poorer CBT response was hypothesised to be a reduced ability to filter out intrusive thoughts and/or voices. Thus, these individuals were thought to be less able to engage with and retain the content of therapy. If this is the case, then it could be that attentional control training (in addition to medication) would be a worthwhile strategy to pursue in future research, to allow individuals to focus on salient aspects of their environment and ignore irrelevant or unhelpful input. Indeed, some have suggested that PPI deficits amongst individuals with schizophrenia are due to problems with selective attention (Scholes & Martin-Iverson, 2010). Computer tasks requiring the participant to divide their attention between two tasks could be an example of this (for example as reported in MacKay-Brandt, 2011). Although PPI was not correlated with outcome in the current study, there was no assessment of any individual therapy and a broader approach to outcome was taken. Thus a relationship between PPI and outcome may emerge if

more specific therapies were examined (e.g. CBT approach), and this could represent a further use of PPI for therapeutic benefit (predictor of treatment response).

Future Research Directions

This thesis has provided initial characterisation of a prevalent clinical group in forensic mental health services, however there is much still to understand about individuals with psychosis and comorbid DPD/ASPD. Studies should assess longer term outcomes for this group, including once they have been discharged from forensic services, as evidence presented in Chapter Three suggests that personality disorder is a relatively strong predictor of reoffending, and this may be even more so for individuals with both psychosis and DPD given the neurocognitive and social cognitive deficits detailed in Chapter Six. Further prospective studies on short and medium term outcomes for individuals utilising forensic mental health services amongst these diagnostic groups are also warranted, given the limitations of cross sectional analysis discussed in Chapter Nine. In addition, a greater variety of outcome measures should be assessed including symptomatic improvement or functioning, for example. Response to specific therapeutic interventions would also be of benefit, given that there is some evidence to suggest a lack of responsiveness to the anti-aggressive effects of antipsychotic medication (Swanson et al., 2008) and high rates of treatment non-completion (Cullen et al., 2011) amongst a comorbid group. Such research would help to further understand the needs of this group and thus direct services appropriately.

Evidence based therapeutic interventions for mentally disordered offenders are lacking in general, and particular attention should be drawn to two recent systematic reviews which both highlight the paucity of evidence for clinicians to base their practice upon (Barnao & Ward, 2015; Rampling et al., 2016). Both reviews highlighted a lack of interventions targeting substance misuse or trauma, both of which were found in the current thesis (Chapter Five) to be common historical characteristics across all diagnostic groups. There have been some small, pilot studies suggesting positive outcomes for substance misuse groups amongst mentally disordered offenders, but these have suffered from methodological shortcomings such as a lack of a control group, small sample sizes and short or absent follow up periods, and tend to be reports of evaluated clinical practice (Derry & Batson, 2008; Morris & Moore, 2009; Ritchie, Weldon, Freeman, Macpherson, & Davies, 2011). One case study of a sexual offender with schizophrenia reports a positive outcome for offence-related trauma symptoms using eye movement desensitisation and reprocessing (EMDR) therapy (Clark, Tyler, Gannon, & Kingham, 2013), and the authors note that this therapy was particularly suited to him given his low verbal skills and level of articulation, which made talking focussed therapies more difficult. This is worth bearing in mind given the high levels of adverse childhood experiences combined with the neuropsychological difficulties noted in the current sample.

Thus the development and rigorous evaluation of therapeutic interventions for mentally disordered offenders remains a high priority for future research, especially amongst those with ASPD/DPD as currently there appear to be very few interventions with a strong evidence base (Rampling et al., 2016; Vollm, Gibbon, et al., 2010), and current treatments tend to focus on mental health related issues as opposed to criminogenic factors (Barnao & Ward, 2015) which may be more relevant to a personality disordered group. Although a number of studies have examined the neuropsychological/social cognitive/structural and functional brain characteristics of mentally disordered offenders (see Chapter Two), to date there appears to be little translation of such information into treatment (Baskin-Sommers et al., 2015). Such translation is vital in order to inform high-cost forensic mental health services, especially when cost-cutting is likely in NHS services in the imminent future (NHS England, 2014a); the treatments offered must be evidence based.

The literature reviewed in Chapter Two revealed very few studies which examined experiential emotion amongst offenders with ASPD/DPD, and particularly few amongst violent individuals with psychosis. The two experimental paradigms examined in this thesis (affective modulation of the startle response and the Joystick Operated Runway Task) did not show any significant differences between groups, even when compared to healthy controls, however both were limited by a reduced number of participants and by an potentially inappropriate control group. Forensic hospital staff have been demonstrated previously to be characterised by low levels of defensivity relative to community controls (Loomans et al., 2015), and thus examination of experiential emotion using similar paradigms is an avenue for future investigation. This should include larger samples with a more representative comparison group, before a position is taken regarding the specific characteristics of mentally disordered offender groups.

Methodological Considerations

The clinical participants in this sample were recruited from a specialist high security hospital, which confers a number of strengths and weaknesses. Firstly, the large majority have undergone a number of extremely thorough assessment procedures as part of their routine care, meaning they were well characterised in terms of their offending, psychosocial and clinical histories which were available for extraction from the clinical records. Thus, although a number of the study variables were rated from reading file information (e.g. PCL-R, psychosocial deprivation, clinical engagement), the ratings were made with reasonable confidence given the amount of information available, and acceptable inter-rater reliabilities were obtained for measures which required rating. In addition, for the engagement ratings some construct validity was obtained by these scores significantly correlating with the treatment engagement subscale of the Patient Perception Questionnaire). However, it is acknowledged that certain characteristics, such as the interpersonal/affective component (Factor One) of psychopathy would perhaps have been more

accurately assessed via an interview where these behaviours could have been more readily observed.

Pertaining to this, diagnosis (psychosis and/or DPD) was not confirmed with an additional research interview, and diagnostic groupings were made on the basis of the current clinical diagnosis. However, arguably experienced clinicians who are highly involved in each individual patient's care are better placed to formally diagnose, and such diagnoses can thus be considered to have high ecological validity. Indeed, patients within high-secure services are monitored around the clock by staff so there is a large amount of information regarding each individual's presentation. It may have been beneficial to assess whether those with DPD diagnoses (either alone or comorbid with psychosis) also met criteria for ASPD, in order to orientate results within the wider literature which tends to focus on ASPD. However, the lack of evidence relating to DPD specifically is a limitation of the current evidence base which this thesis has somewhat addressed.

In addition, a number of patients were diagnosed with further comorbid disorders which may have skewed findings somewhat. Yet comorbidity tends to be the rule as opposed to the exception in forensic mental health services (Blackburn, Logan, Donnelly, & Renwick, 2003) and recruiting sufficient 'pure' groups from within one service would have been neither feasible nor arguably provide clinically applicable results. The main comorbidities in the current sample were with emotionally unstable personality disorder (1 psychosis, 5 DPD and 6 comorbid) and autism spectrum disorder (1 psychosis, 2 DPD and 1 comorbid). A recent meta-analysis (Unoka & Richman, 2016) has examined the influence of comorbid disorders on neuropsychological functioning in borderline personality disorder (BPD; aligned to ICD-10 emotionally unstable personality disorder). It was observed that BPD patients with an additional cluster B diagnosis (such as ASPD) were more impaired than those with BPD alone on the domains of decision making and executive function, and that those with BPD and a history of substance abuse also had greater difficulties with memory, visuospatial processing and verbal IQ than those with BPD alone. Thus comorbidity with emotionally unstable personality disorder and/or those with a history of substance abuse may have further impaired individuals with DPD, compared to those with DPD presenting as a sole diagnosis. However, the number of individuals with emotionally unstable personality disorder was approximately matched across the DPD and comorbid groups, and substance abuse history did not differ between groups, suggesting that these are unlikely to be factors driving the poor performance in the comorbid group. Similarly, autism spectrum disorder has been shown to be associated with poorer emotion recognition and poorer performance on a go/no-go task relative to healthy controls (C. Wilson et al., 2014), but the distribution of such individuals was approximately equal across groups and thus should have had minimal impact on the results of group comparisons. Larger studies in future should aim to assess the impact of additional comorbidities amongst violent groups.

There is evidence suggesting that psychopathic individuals may be able to control their own physiological responding, which may have had an impact on the results of the psychophysiological experiments. For example, one investigation (Steinberg & Schwartz, 1976) concluded that with the provision of specific instructions and feedback, psychopaths were able to alter their electrodermal responding to a comparable level as controls were (both groups able to alter responding). Another investigation (Bate, Boduszek, Dhingra and Bale, 2014) found that undergraduate students with high levels of psychopathic traits and high intelligence had typical galvanic skin responses to evocative images, whereas those with low intelligence showed abnormal responding (attenuated responsivity). The authors suggest that one explanation for this is that those with high intelligence may be more able to control their responding and therefore show normative results. However, this evidence is unlikely to affect the results of the current investigation. Firstly, as there was no difference between psychopaths and controls in the Steinberg & Schwartz (1976) investigation, there is no reason to assume that the offender groups presented here would be more able to voluntarily alter their responding on the psychophysiological experiments. Secondly, no specific feedback was given to alter responding, as was in the aforementioned study. Thirdly, the experiments reported in the thesis measure the startle response, which is a reflex, and therefore by definition should not be under voluntary control. Finally, as reported in Chapter Six, the sample reported here was characterised by generally low levels of cognitive functioning, which based on the suggestion of Bate and colleagues (2014), would make them less able to alter their responsivity.

The studies reported here were limited by the lack of assessment of symptoms amongst the groups. It has been demonstrated that individuals with schizophrenia and a primarily negative symptoms presentation differ from those with a primarily positive presentation, with regard to attention and executive functions (Brazo et al., 2005). Aspects of social cognition have also shown to be negatively correlated with negative symptoms (Lincoln, Mehl, Kesting, & Rief, 2011), and positive symptoms of psychosis have been shown to be related to diminished PPI (Kumari et al., 2008; Perry & Braff, 1994; Perry et al., 1999). Thus the psychosis groups may be heterogeneous in regard to their symptom profiles and thus examined characteristics. It is also possible that distracting auditory verbal hallucinations amongst individuals with psychosis impaired performance on experimental measures due to difficulty concentrating, or that impulsive behaviour associated with DPD resulted in hurried and thus less accurate responding. However, it is notable that previous studies within the same hospital have shown lower levels of general psychopathology relative to community samples (e.g. Barkataki et al., 2005), likely due to higher medication compliance and greater monitoring. The decision not to include a measure of symptoms was largely due to time constraints with an already lengthy testing battery, and the focus of this thesis being on cognition and affective characteristics meant the inclusion of such measures was deemed more relevant. Lengthening testing sessions would likely have resulted in

a higher rate of patient non-participation, and number of sessions was frequently cited as a reason that patients did not wish to take part. However the measurement of symptoms is important for future studies as this could provide a more accurate characterisation of the clinical groups and allow for the consideration of such variables in subsequent analyses.

The specialist nature of the service which participants were recruited from may mean that generalisability of findings is lessened. For example, meta-analytic evidence suggests that a very large proportion (47%) of individuals residing in the prison system meet criteria for ASPD (Fazel & Danesh, 2002). Thus, the question is raised as to what differentiates those individuals with DPD who are determined to require treatment in high security hospital as opposed to incarceration in the prison system. The Offender Personality Disorder Strategy (NHS England and the National Offender Management Service, 2015) sets out criteria which delineate why an offender may be placed in a hospital setting as opposed to prison, and stresses that “hospital placement should be reserved for offenders who can *only be managed* in a hospital setting” (page 17). The criteria they suggest to determine this include: a) uncertain or disputed diagnosis or risk; repeated failure in a prison setting; irretrievable breakdown of relationships in custody b) comorbid mental illness, c) complexity compounded by borderline IQ, highly impulsive threatening or violent behaviour, deliberate self-harm, or uncertain/changing diagnosis or medication needs, d) complexity added by other therapy interfering behaviours such as litigiousness, breaches of boundaries or pathological attachments, e) complexity or need around neurological difficulties/acquired brain injury, f) need for rare or bespoke intervention not readily available in prison, and g) legal status, i.e. a hospital order but no criminal justice system sanction. Thus, the DPD group studied here is likely qualitatively different from individuals detained in a prison setting, and probably from those deemed to only require medium secure hospital placement and thus perceived as lower risk. Compared to prisoners, the PD individuals reported here are likely to be characterised by higher risk and more complex needs including potentially lower IQ. Thus the results presented here are likely only applicable to a male high-security forensic hospital group and future studies should aim to recruit a broader range of DPD offenders, including those from medium security and prison settings. In addition, the similarities and/or differences of the characteristics of female offenders are an outstanding area for research.

The decision was taken in the current thesis to report statistical trends at $p < .10$. Although this practice has been discouraged by some (Goldstein, 2010), others have noted that such trends are important to report when examining a small sample in a largely exploratory fashion (Schumm, Pratt, Hartenstein, Jenkins, & Johnson, 2013). An analysis of studies reported in seven reputable, scientific journals from 2005-2009 noted a substantial proportion of authors reported statistical trends or set their alpha level at .10 (in 2008 ranging from 4.9% to 35.1%, dependent on the journal), suggesting that this practice is acceptable within the scientific community (Schumm et al., 2013). In addition, effect sizes are reported throughout the thesis where appropriate, alongside

the p-values derived for all analyses. This allows the reader to ascertain the strength and direction of the reported findings, and highlights directions for future research where trends may be evident although do not meet conventional levels of significance due to the small sample size reported here.

Finally, the suitability of the healthy control group has been previously discussed with regard to their emotional responsiveness (see Chapter Eight, and ‘Future Research Directions’ above). It should also be noted that a number of assumptions were made with regard to the control group; firstly whilst they were screened for axis one disorders, there was no screen for personality disorder. Although it is highly unlikely that hospital staff would meet criteria for DPD given the criteria requiring aggression/violence, irresponsibility and callousness, this cannot be formally ruled out. Secondly, staff were not asked about violent behaviours. All staff working within the hospital have to undergo an enhanced criminal records check, making it reasonable to assume that the large majority will not have previous violent behaviours, or at least behaviours which have led to arrest. However future research should be mindful of accurately characterising healthy control participants, and of recruiting individuals from the wider community as opposed to solely employees of the institution.

Conclusion

This chapter suggested a number of potential therapeutic options for mentally disordered offenders based on the findings presented in previous chapters. There is an urgent need for more evidence based therapeutic interventions for individuals utilising forensic mental health services, and specifically targeting areas which appear problematic across groups including substance misuse and the potential trauma related sequela of childhood psychosocial deprivation (Chapter Five). For the social and cognitive deficits observed in Chapter Six, therapies such as CRT, social cognition groups, and cognitive skills groups (focussing on neurocognition), in addition to pharmacological options such as clozapine may be beneficial for all of the examined groups. However, to date there has been little evaluation of such therapies in forensic populations and thus the efficacy of these options requires evaluation. Second generation agents such as clozapine may also be helpful in ameliorating PPI dysfunction (Chapter Seven), and these seem particularly promising when considering the potential anti-aggressive effects. However, there is less evidence to suggest antipsychotic medication can confer functional gains in cognitive function. More research is required here, as is more research required into experiential emotional deficits across mentally disordered offenders (Chapter Eight) as the current thesis was limited in the conclusions it could draw due to a small sample size and a potentially inappropriate control group. The evidence presented here suggests that interventions targeting cognition (both ‘neurocognition’ and social cognition) is a promising way forward, as facets relevant to this were correlated with outcome across the sample (executive function, memory and facial affect recognition).

This thesis has also demonstrated that violent men with psychosis differ dependent on the presence of additional DPD; this is most evident in their historical characteristics, but also extends to poorer sensorimotor gating, poorer fear recognition, and putatively poorer neurocognition in the comorbid group. Early recognition of this subgroup may be the key in preventing the further creation of victims and to direct appropriate treatments, before it is necessary for individuals to be admitted to expensive forensic settings. Larger studies over longer periods are needed to fully understand the potential distinct treatment needs of this group, but tentative evidence suggests that they may be less engaged with the therapies offered to them, potentially due to neurocognitive and social cognitive problems which are preventing them from meaningful participation.

In conclusion, this thesis has found support for the following:

- Mentally disordered offenders with psychosis and comorbid DPD differ from their non-DPD counterparts on a number of variables, including history and severity of previous offending, PCL-R scores, recognition of fearful faces, information processing as assessed by prepulse inhibition, and have a tendency towards poorer cognitive function.
- They also have a number of similarities, including history of substance abuse, history of psychosocial deprivation, ability to discriminate emotional intensity and defensive and appetitive responding.
- Clinical outcome does not significantly differ between groups, although there is a trend for the comorbid group to attend fewer therapeutic activities. This should be investigated further in larger samples.
- Across the whole sample, indices of memory, executive function and facial affect recognition are correlated with outcomes. This suggests interventions like CRT, social cognition groups and cognitive skills groups, in addition to second generation antipsychotics may be of therapeutic benefit to such clinical groups, although further examination in larger samples is required.

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Appendices

Appendix 1 - Preferred Reporting in Systematic Reviews and Meta-Analysis (PRISMA) Checklist Chapter Two

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	43
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	N/A for chapter
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	43/44
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	44
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	45
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	44/46

Section/topic	#	Checklist item	Reported on page #
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	44
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	45
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	45
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	45/46
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	46
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	46
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	46/47
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	46/47
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	47
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	48/49
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	292-320
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	-
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	53-56

Section/topic	#	Checklist item	Reported on page #
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	53-56
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	53-56
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	55-56
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	68-75
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	76
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	75
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	N/A

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Appendix 2 - Studies Included in Chapter Two

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
Abu-Akel, (2004)	n=12 violent schizophrenia n=12 non-violent schizophrenia 100% male	Violent patients resident on maximum security ward, and had a minimum of 3 assaults against others.	No	Non-violent schizophrenia	ToM task – includes 1 st order ToM, 2 nd order ToM and a faux pas task	- Violent group was better at higher level theory of mind tasks (2nd order ToM and the cognitive component of the faux pas), but worse at faux pas recognition (approaching sig) and empathic inference (approaching significant). - Violent group significantly better at cognitive mental state understanding. - Regression model shows there is an inverse relationship between empathic inference, or faux pas recognition, and violence. Demonstrating cognitive mental state understanding decreases the likelihood for violence. - All ToM variables account for 16% of variance in violence.
Adams, Meloy, & Mortiz, (1990)	n=37 Schizophrenia 100% male	Inpatient violence measured using VBRS Outpatient violence using Wolfgang scores.	No	Violent vs. non-violent inpatients	Luria-Nebraska Neuropsychological Battery [classified as impaired or not impaired]	The severely violent (outpatient) group was strongly associated with impaired status. However, only 1/13 moderately violent patients were impaired. No relationship between inpatient violence and neuropsychological scores.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
Antonius et al., (2013)	n=10 high aggression schizophrenia 60% male n=10 low aggression schizophrenia 80% male	Self-reported aggression on aggression questionnaire. High vs. low aggression based on median split.	No	High vs. Low violence in schizophrenia	Rating dominance in neutral faces, which were assessed for closeness to other facial emotions using a computer paradigm (angry, happy, fearful, surprised, sad, disgusted)	- Two groups did not differ on dominance ratings overall. - Group x Fear interaction was evident; low aggression group attributed less dominance to the fearful faces. No relationship between dominance and fear in high aggression group, suggesting that they are not picking up on micro-fear expressions and still perceiving faces as dominant.
Arborelius, Fors, Svensson, Sygel, & Kristiansson, (2013)	n= 15 offenders with psychotic disorder n= 15 offenders with autism spectrum disorder n=7 healthy controls	All sentenced to forensic psychiatric treatment having been convicted of violent criminal acts.	No	Healthy Controls	Shown a film clip of a man wanting to use the bathroom but being unable to go because it was occupied.	- Significantly fewer patients with psychosis, compared to controls, attributed the emotion of anger to the man, suggesting they are less able to use contextual information to make a judgement about his mental state. - However, schizophrenia group not significantly different from autism spectrum patients.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	100% male					
Bagcioglu et al., (2014)	n=55 offenders with ASPD[n=34 with comorbid ADHD] 100% male n=39 healthy community controls. Control gender NR	Offences were murder, GBH, ABH, rape, robbery/ pick-pocketing, sexual assault, embezzlement/ forgery, multiple types of violence.	Yes	Healthy controls	Emotion recognition test 4 male and 4 female models happy, surprised, fearful, sad, angry, disgusted, neutral. 7 displays of each emotion.	• Mean correct responses of disgusted faces was significantly lower in ASPD group, compared to both ASPD+ADHD and controls. • ASPD also worse than controls at recognising neutral faces, despite spending significantly more time looking at them.
Barkataki et al., (2005) ^{\$}	ASPD n=14 Violent Schizophrenia = 13 Non-Violent Schizophrenia = 15 Healthy Controls = 15 100% male	Measured using Gunn & Robertson Scale Violent groups had at least a rating of 4 for previous violence (fatal or near fatal violence).	Yes	Non-violent schizophrenia Healthy controls Schizophrenia vs. PD	WAIS-III NART Logical Memory I and II from WMS Executive Golf task WCST TOL SCWT CPT-IP AMIPB	• Both schizophrenia groups impaired on all measures compared to controls • ASPD lower but not significantly worse than controls, apart from in speed of processing. • VSZ worse than ASPD on: FSIQ, memory, EGT, WCST, Stroop, CPT, motor speed. However biggest deficit is in EF. • VS worse than NVS on WCST perseverative errors and Stroop processing. No other differences.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
Barkataki et al., (2008) ^{\$}	ASPD n=14 Violent Schizophrenia = 12 Non-Violent Schizophrenia = 12 Healthy Controls = 14 100% male	Violent groups had to have a history of violent behaviour that would score at least 5 on the Gunn & Robertson scale	Yes	Healthy controls Non-violent schizophrenia	WAIS-III Go/No-Go	- VSZ and NVS sig lower FSIQ than controls. ASPD equivalent to controls, VSZ significantly lower than ASPD. - ASPD group made significantly more commission errors than the control group in both NoGo20 and NoGo40. - ASPD and VSZ performed significantly worse during NoGo20 than in NoGo40
Braun et al. (1995) ^{\$}	n=31 outpatients with schizophrenia n=30 healthy community controls 100% male	Assessed using number of incidents of aggressive behaviour causing injury to another person. Schizophrenia group – 33% had been sentenced, range of violent assaults in group was 2-27.	No	Healthy controls	Verbal Fluency Trail Making Test A Trail Making Test B WCST	VSZ group significantly worse on verbal fluency, TMT and WCST compared to healthy controls.
Chung, Chung, Jung, Chang, & Hong, (2010) ^{\$}	n=51 violent schizophrenia	Measured using OAS.	No	Non-violent schizophrenia	Korean WAIS (short form) WCST	No significant difference between homicidal and non-homicidal

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n= 50 male non-violent schizophrenia n=50 healthy controls 100% male	Violent group had committed murder.		Healthy controls.	RAVLT RCFT	schizophrenia groups on any neuropsychological measures. Controls better than both schizophrenia groups on all tasks except RCFT copying trial and Stroop Intelligence Index.
De Brito, Viding, Kumari, Blackwood, & Hodgins, (2013) ^{\$}	n=17 violent offenders with ASPD plus psychopathy, n=28 violent offenders with ASPD but without psychopathy. n=21 healthy controls 100% male	Convicted of murder, rape, attempted murder or GBH as confirmed by criminal records.	Yes	Healthy controls	WAIS-III Digit span backwards Spatial alteration task (concept formation task) Probabilistic response reversal task (learning task based on contingencies) Cambridge gambling task Passive avoidance learning task	- No significant difference on FSIQ - Healthy controls better than ASPD+P at digit span, and better than ASPD-P at trend level. ASPD groups did not differ from one another. - ASPD offenders had poorer verbal working memory (cool executive functioning), made more risky decisions, failed to learn from punishment and did not change their behaviour in spite of changing contingencies (hot executive function) compared to healthy controls, within the ASPD group those who met criteria for psychopathy did not differ from those who did not..

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
De Sanctis et al., (2013) ^{\$}	n= 21 violent schizophrenia 81% male n=21 non-violent schizophrenia 81% male n=28 healthy controls 79% male	Life history of aggression, completed on the basis of chart review, staff and patient interview. To be in violent group had to have a confirmed episode of physical assault directed at another person within the past year, a score of >20 on the LHA scale and a score of 3 or more on the Physical Aggression against people scale.	No	Non-violent schizophrenia Healthy controls	- Trail making part A - IAPS pictures shown at rate of 1/1000ms, go/no-go task requiring response to all pictures unless repeated twice in a row.	- Violent group quicker on TMT A compared to NVS, but worse than HCs. - Both schizophrenia groups worse on go/no-go aspect of task compared to HCs, but comparable to each other. - Reaction time increased for negative vs. neutral stimuli in NVS and controls, but not in VS. - HCs showed a characteristically slowed ERP response to negative stimuli relative to neutral stimuli, and this same slowing pattern was observed in NVS, however not observed in VS suggesting a general lack of sensitivity to negative valence. - Both NVS and VS showed delayed onset of response sensitivity to valenced inputs, this was particularly pronounced in VS. - Inability to process the emotional context of a given situation accurately and quickly may lead to incorrect appraisal of social cues.
Demirbuga et al., (2013)	n= 41 outpatients, violent schizophrenia.	Referred for forensic psychiatric	Yes	Non-violent schizophrenia	Emotion recognition task.	No significant differences between violent and non-violent

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	85% male n=35 outpatients, non-violent schizophrenia 66% male	evaluation for legal competence after a court decision.	Premorbid ASPD an exclusion criteria.		56 photos of 4 males and 4 females showing happy, surprised, fearful, sad, angry, disgusted, neutral.	schizophrenia groups for recognition accuracy. • Accuracy towards specific emotions was non-significant after a Bonferroni correction, however angry, disgusted and fearful were <.05, although direction in groups not stated. • Significant positive correlation between accurate responses to sad and angry faces and general psychopathology score on the PANSS in the violent group.
Dolan & Fullam, (2004)	n=89 ASPD, divided into high and low psychopathy. n=20 healthy controls 100% male	All subjects incarcerated for violent offences. Also noted to have extensive acquisitive histories.	Yes	Healthy controls	ToM task – first order false belief, second order false belief, faux pas. Facial emotional expression task – happy, sad, angry, afraid, surprise, disgust, distress. Complex emotions – scheming, guilt, thoughtful, admiring, quizzical, flirting, bored, interested and arrogant.	• No significant differences between groups, (high psychopathy, low psychopathy, control) on false belief and faux pas tasks, however both ASPD groups impaired on attribution of mental state to listener and speaker, and on the empathic understanding question. • ASPD and low psychopathy poorer than controls on a number of basic and complex emotion recognition tasks. • ASPD with psychopathic traits do not have marked difficulties in reading basic or complex emotions,

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
					Forced choice task between 2 emotions. Basic and complex emotions examined on full face and just eyes.	they perform remarkably similar to healthy controls.
Dolan & Fullam, (2006) ^{\$}	n= 49 offenders with ICD 10 dissocial PD. n=49 healthy volunteers. 100% male	Recruited from prison or high security hospital.	Yes	Healthy controls	Face affect recognition test: anger, disgust, fear, happy, sad, surprised (25%, 50%, 75%, 100%) 4 trials at each intensity level for each expression. Psychopathy assessed using PCL:SV	• PD group worse at recognising sad, happy and surprised than controls, PD group lower accuracy for sad and happy affect even at 100% intensity. • Psychopathy group worse than low psychopathy group at recognising sad faces, even at 100% intensity, at a trend level (p=.062) • PD groups spent significantly longer viewing each face. • Significant negative correlation between psychopathy total score and recognition accuracy for sad faces. Happy correct recognition significantly negatively correlated with facet 4.
Dolan & Park, (2002) ^{\$}	n=29 ASPD offenders from high secure hospital	Recruited from forensic hospitals (noted in discussion most offences were homicide).	Yes	Healthy controls	ToL ID/ED Shift Match to sample Delayed match to sample Go/No-Go	• ASPD significantly worse at ToL, fewer problems solved in minimum number of moves • Significantly fewer stages completed on ID/ED, significantly more external dimension shift errors.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=20 healthy controls 100% male				NART	- Significantly longer response latency on match to sample. - Significantly fewer correct on delayed match to sample. - Significantly more errors of commission on Go/No-Go. - No significant difference on IQ.
Dolan, (2012) ^s	n=96 ASPD offenders from medium and high security forensic hospitals. n=49 healthy controls Compares high, medium and low psychopathy scorers. 100% male .	Recruited from forensic hospitals	Yes	Healthy controls	CANTAB – stockings of Cambridge, attentional set-shifting task, Go/no-go task. NART	- No group differences on predicted IQ. - PLANNING- all ASPD showed a reduction in the no. of problems solved with the minimum number of moves. However only the low psychopathy subgroup differed significantly from controls (more excess moves and fewer perfect solutions). - SET-SHIFTING – all ASPD impaired compared to HCs, but this did not vary as a function of psychopathy. - RESPONSE REVERSAL – no differences between groups when those who met criterion and completed the task were considered. - RESPONSE INHIBITION – medium psychopathy scorers showed the greatest impairments, significantly

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
						worse than HCs and LP. High psychopathy group did not differ from controls in their ability to inhibit responses, and showed longer mean reaction times than HCs suggesting they do not have a problem with impulsive responding.
Domes, Mense, Vohs, & Habermeyer, (2013) ^s	n=35 inmates from prison/forensic hospital with ASPD. n=34 prisoners with no ASPD. n= 24 healthy controls 100% male	Recruited from prison or forensic psychiatric hospital. Offenses include: child molestation, rape, manslaughter, murder, robbery.	Yes	Healthy controls Healthy offenders	Emotional Stroop Task – violence related, negative and neutral words were presented printed in different colours and a colour word printed in white were presented on the same screen. Participants had to decipher whether the colour was congruent with the word by pressing a button. HAWIE	• IQ comparable between groups. • Offenders with ASPD showed a significantly stronger attentional bias towards violence related and negative bias words compared to healthy controls (only on congruent trials). • Attentional bias towards negative or violence-related stimuli was not different in offenders with ASPD compared to offenders without ASPD.
Enticott, Ogloff, Bradshaw, & Fitzgerald, (2008) ^s	n=18 inpatients with schizophrenia 72% male	Violence established as all recruited from secure facility, all	No	Healthy Controls	NART Spatial Stroop Negative Priming	• Violent schizophrenia group showed reaction times which were not significantly increased as a result of negative priming, suggesting that

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n= 18 healthy adults. 67% male	had a history of violent offending				automatic inhibition of the distractor item was absent or less pronounced. - Perhaps reflecting dysfunction of prefrontal neural networks. Impulsivity (SR) not associated with cognitive inhibition, suggesting behavioural and cognitive inhibition may be distinct. - No difference in spatial Stroop.
Frommann, Stroth, Brinkmeyer, Wolwer, & Luckhaus, (2013)	n= 19 forensic psychiatric inpatients with schizophrenia. n=19 non-violent schizophrenia. 100% male	Index offences = bodily injury x 14, manslaughter x 2 and attempted manslaughter x 3.	Yes ASPD excluded	Non-violent schizophrenia	Emotion recognition task 70 pictures, Ekman & Friesen, 5 males 5 females. happy, angry, fearful, sad, surprised, disgusted, neutral. Faces shown for 500ms, then verbally responded to by showing list on screen. List shown for max of 8 secs.	- Violent group had significantly worse recognition overall, and on neutral and fearful faces specifically. They were non-significantly worse across all faces. - Poorer performance associated with higher PCL:SV scores, significant for total score and factor 1. - Forensic patients also had significantly higher N250 amplitudes for fearful emotion compared to happy, this may reflect a higher salience/arousal evoked by emotional faces, violence may be facilitated by an increased arousal which may in turn be the result of an information processing deficit.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
					Benton Facial Recognition Test (non-affective) PCL:SV Raven Matrices Task for IQ	
Fullam & Dolan, (2006)	n=54 violent schizophrenia, Categorised into high (n=16), medium (n=20) and low (n=18) psychopathy scorers 100% male	Recruited from medium and maximum security hospitals, UK.	N/A	Comparing levels of antisocial traits.	Facial affect recognition task angry, disgusted, fearful, sad, happy, surprised	• High psychopathy scorers were worse at recognising sad at low intensity compared to low psychopathy, and worse at recognising sad overall (collapsed across intensities) • Medium psychopathy significantly worse at recognising fear at high intensity compared to low psychopathy. • Factor 2 score on PCL: SV was a significant predictor of recognition of low intensity sad affect.
Fullam & Dolan, (2008)	n= 33 violent forensic inpatients with schizophrenia n=49 non-violent forensic	Violence established as all recruited from secure facility. Violent incidents taken from hospital records.	No (Although psychopathy assessed)	High vs. Low Violence in Schizophrenia. (NB- all patients in forensic services, but	NART WASI (Vocabulary & Matrix Reasoning) CANTAB-2 Stop Task	• No significant difference between violent and non-violent groups after Bonferroni correction, however before this IQ seemed to be reduced in violent group. • Low IQ could predict violent status.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	inpatients with schizophrenia 100% male			control group have had no violent incidents whilst hospitalised)		
Gregory et al., (2012) ^s	n=17 violent offenders with ASPD+ Psychopathy n=27 violent offenders with ASPD- Psychopathy n=22 healthy non-offenders	All offenders either murder, rape, attempted murder or GBH	Yes	Healthy controls	WAIS	Both ASPD groups had lower IQ than the HCs, but did not differ from each other.
Hanlon, Coda, Cobia, & Rubin, (2012)	n= 7 individuals with violent schizophrenia n= 7 non-violent outpatients with schizophrenia. 100% male	Violent group were charged with or convicted of murder of a family member.	No	Non-violent schizophrenia	WAIS-III (digit span) WMS-III (letter number sequencing) CVLT TMT Verbal Fluency WCST	Violent men had poorer verbal memory (immediate and delayed), and poorer executive function as measured by WCST trials to complete 1st, categories completed, perseverative errors, perseverative responses.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
Hill, Chesterman, Murphy, Tidmarsh, & Lumsden, (1997)	n=37 violent schizophrenia n= 26 other violent Axis I n= 22 violent with no Axis I diagnosis 100% male	Violence established as all high-secure hospital admissions	Yes	Schizophrenia vs. PD	WMS visual reproduction	- No significant differences between groups on number of rotations or errors - Presence of ASPD in mental illness associated with significantly more perseverative and elaborative errors.
Kashiwagi et al. (2015)	n=30 violent male inpatients with schizophrenia n=24 non-violent male inpatients with schizophrenia	All had committed murder, attempted murder or caused injury to others	No	Non-violent schizophrenia	BACS- Japanese Version, including: Verbal memory task Digit sequencing task Token motor test Verbal fluency Symbol coding test ToL	- VSZ performed significantly better than the NVSZ group on working memory and executive function tasks. - The results remained significant for executive function after controlling for previous substance abuse and anti-Parkinsonian drug dosage, but the effect on working memory was no longer found.
Kiehl, Smith, Hare, & Liddle, (2000)	n=12 violent men with schizophrenia n= 13 psychopathic offenders	Inmates of a federal maximum security facility, Canada.	Yes	Schizophrenia vs. PD	Go/No-Go Task	Violent schizophrenia patients made more commission errors than non-psychopathic offenders, and at a trend level, more than psychopathic offenders.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=11 non-psychopathic offenders 100% male	Either participating in treatment programmes for violent/sexual offences or serving life sentence.				- ERP analyses showed the greatest frontal negativity (N275) during no-go trials in non-psychotic non-psychopaths, which was attenuated in VSZ men and absent in psychopathic group. - Supports the hypothesis that similar, but not identical, neural circuits play a role in the disorders of behavioural inhibition that occur in schizophrenia and psychopathy (i.e. behaviourally VSZ worse, but neurally psychopaths show deficit).
Kosson, Lorenz, & Newman, (2006)	n=25 ASPD + psychopathy n=26 ASPD alone n=36 prisoners with neither ASPD nor psychopathy 100% male	Incarcerated in state prison in USA.	No – although thought disorder or psychotropic medication are exclusion criteria	Healthy offenders	Lexical decision making task – presented with words and non-words, half the words affective, half non-affective.	- ASPD + psychopathy inmates displayed less affective facilitation than controls, and less than ASPD alone inmates (i.e. were slower at processing whether affective words were real words; less salience). ASPD alone inmates did not differ from controls. - Degree of emotional facilitation in ASPD + psychopathy group was significantly negatively correlated with number of charges for non-violent crime, which was not the case in the ASPD alone group,

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
						demonstrating real world significance.
Krakowski, Convit, Jaeger, Lin, & Volavka, (1989)	All schizophrenia inpatients n=22 in high violence group n= 17 in low violence group n=22 non-violent patients. Subsample completed neuropsychology measures, but in larger sample: 68% male high violence 85% male low violence 85% male non-violent patients.	High and low violence groups were taken from specialist unit in hospital where they had been moved from if they had exhibited at least 2 instances of violent behaviour. HIGH- 2 or more incidents on specialist unit after transfer. LOW – 1 or no incidents on the specialist unit after transfer. Control group never been violent during	No	High vs. Low Violence in Schizophrenia.	WAIS-R Boston naming test Verbal Fluency Pearson Individual Achievement Test Benton Visual Retention Test Finger Localisation Raven Coloured Progressive Matrices Purdue pegboard	• High violence group worse than both controls and low violence group on: BVRT correct answers and number of errors, and picture completion • High violence group were worse than control patients for: WAIS PIQ, and a number of these subtests. • Trend for High violence to be worse than low violent for PIQ. • Suggest specific deficits in visuospatial functioning.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
		this or previous admissions.				
Kumari et al., (2006) ^{\$}	ASPD n=10 V. Schizophrenia = 12 Non-Violent Scz = 13 Healthy Controls = 13 100% male	History of significant violence. Recruited from high and medium secure hospitals	Yes	Violent vs. non-violent schizophrenia Healthy controls Schizophrenia vs. PD	WAIS III NART n-back	- No significant differences in NART IQ - HCs highest IQ, significantly higher than both SCZ groups, VSZ significantly lower than ASPD. - VSZ had significantly poorer performance at 1-back and 2-back compared to healthy controls, non-violent schizophrenia, and at a trend level, ASPD. These became non-significant once controlling for FSIQ, but were still apparent at a trend level.
Kumari et al., (2009) ^{\$}	n=13 violent schizophrenia n=13 violent ASPD n= 13 non-violent schizophrenia n=14 healthy controls 100% male	In high secure forensic hospital, clinical and forensic records examined. At least a score of 5 on the Gunn and Robertson Violence score (0-8).	Yes	Non-violent schizophrenia Healthy Controls Schizophrenia vs. PD	Anticipatory fear paradigm – under threat of electric shock or safe. After coming out of scanner rated feeling of safe-fearful on visual analogue scale during safe or shock cycles, and the belief that the shock would be administered.	- ASPD showed lowest, and VSZ the highest levels of anticipatory fear during shock condition and safe condition. - ASPD had lower shock anticipation than healthy controls and both SCZ groups. VSZ differed in shock anticipation from HCs at trend level.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
					NART	
Lafayette, Frankle, Pollock, Dyer, & Goff, (2003)	All schizophrenia/ schizoaffective outpatients. History of violent arrest – n= 34 82% male History of non-violent arrest- n=23 87% male No history of arrest, n = 38 59% male	Official police arrest records examined. To be included in violent arrest group: murder, forcible rape, robbery and aggravated assault. Self-reported history of violence also taken.	No	Violent vs. non-violent schizophrenia	WASI-III NART Stroop WCST Trails A & B Finger Tapping Test Verbal Fluency	No difference in any neuropsychological scores between groups.
Lapierre et al., (1995) ^{\$}	n=31 patients with schizophrenia, of whom 13 had an additional	Assessed using “History of Aggression Protocol”	No	Healthy controls	Verbal Fluency WCST Trails A & B Porteus Maze WAIS ROCFT	The general trend for the group was that the number of previous violent incidents was positively correlated with number of categories completed on the WCST and total score on the Verbal Fluency Test.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	diagnosis of ASPD n=30 healthy controls 100% male	All participants had exhibited at least one violent behaviour resulting in injury (mean 7.8)			Go/No-Go	Better neuropsychological performance, more history of violence.
Lobbestael, Arntz, Cima, & Chakhssi, (2009)	n=21 patients with ASPD, 76% male n=45 borderline PD, 27% male n=46 cluster C PD, 37% male n=35 non-patient controls, 46% male	Recruited from forensic institutions or mental health care.	Yes	Healthy controls	Single Category Implicit Association Task – one assessing ‘self’ and ‘anger’ associations, and one assessing ‘aggressor’ and ‘swearword’ associations. Completed after anger induction, positive mood induction, or under neutral conditions. Psychophysiological measurements taken.	- ASPD patients did not differ from healthy controls on the amount of self-reported anger after anger induction - However, ASPD showed a slowing heart rate, and stronger self-anger associations than the other groups. - This suggests a physiological hypo-responsivity coupled with a cognitive hyper-responsivity, which may reflect the ability to engage in predatory-type violence when angry.
Loomans, Tulen, & van Marle, (2015)	n=22 ASPD n=31 ASPD plus psychopathy	Recruited from forensic psychiatric centre.	Presence of psychosis or primary mood	Healthy Controls	Affective startle task – eye blink startle responses to positive,	The ASPD alone and community control groups showed increased startle responses to negative images in comparison to positive, but this

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=50 forensic hospital employee's n=33 community controls		disorder <i>at the time of testing</i> was an exclusion criterion.		negative and neutral images.	effect was not present in ASPD + psychopathy or forensic hospital employees.
Majorek et al., (2009) ^s	n=33 violent schizophrenia. 97% male n=38 individuals with schizophrenia in regular psychiatric care. 47% male n=29 healthy controls 34% male	Inpatients in high secure facility.	No	Violent vs. Non-Violent Schizophrenia Healthy controls	Spot the word test HAWIE – “Hamburg Wechsler Intelligenz Test fur Erwach-sene” WCST Zoo Map (part 1) ToM task- Social scenarios, had to sequence 4 pictures to make sense, and infer mental states to characters.	- Forensic patients made more WCST errors, no difference on perseverative errors, or on other neuropsychological tasks. - ToM mental state inference was better in forensic patients after variance from “excitement” component of PANSS was removed (as this differed between groups). Remained unchanged after covarying out cognitive component of PANSS, and after covarying for WCST results (also different between groups). - This suggests that it is the excitement factor which impairs forensic patients in understanding emotional situations.
Moran & Hodgins, (2004)	n= 51 schizophrenia and comorbid ASPD	Three quarters of sample had committed at	N/A	Schizophrenia with ASPD vs. no comorbidity	IQ	Global IQ did not differ between groups

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=181 schizophrenia and no comorbid ASPD 100% male	least one offence; 88% of comorbid group had at least one conviction.				However, tendency for schizophrenia with comorbid ASPD group to have lower verbal IQ (non-significant after Bonferroni correction).
Muller et al., (2008) ^s	n=10 dissocial personality disorder (all also meet criteria for psychopathy). n=10 healthy controls. 100% male.	Recruited from a forensic psychiatric facility	Yes	Healthy controls	Emotion induction with IAPS pictures, participants rate on valence and arousal. Cognitive task: participants had to respond to an X with their right, middle finger, and an O with their left index finger. Presentation of letter differed on which side of the screen (congruent/incongruent with response key).	- No significant differences between groups on subjective arousal or valence ratings. - For control participants, error rates were higher with negative emotions than with positive emotions at trend level, and when repeated in a larger sample of controls (n=43) this was found to be significant. - In the psychopathy group there was no effect of the emotional context on error rates. - Conclude that emotion-cognition interaction is disturbed in psychopathy, cognitive resources are not drained in the way they are in controls when mood is low/negative.
Murphy, (1998)	n=37 violent schizophrenia,	In high security forensic hospital	No	Schizophrenia vs. PD	ToM – first and second order false belief, and deception. WAIS-R	- VSZ lower FSIQ than PD. - PD better at second order ToM than VSZ.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=23 with at least one PD but no evidence of psychosis. 100% male				WMS-R ROCFT Classical Weigel	Higher IQ, cognitive flexibility and better memory associated with better ToM.
Murphy, (2003)	n=13 violent schizophrenia n=13 violent PD 100% male	All in high security care. Gunn and Robertson scale.	No	Schizophrenia vs. PD	WAIS-R- digit span, similarities, digit symbol, block design NART WMS-R (prose and design recall) AMIPB Classical Weigel	- No difference between groups for FSIQ or NART, or WAIS subscales. - Schizophrenia group worse than PD for delayed prose recall on WMS. - Schizophrenia worse than PD for motor speed on AMIPB.
Murphy, (2006)	n=13 violent PD n=13 violent schizophrenia n=13 violent ASD. 100% male	In high security forensic hospital	No	Schizophrenia vs. PD	RET MAT – 1 st and second order false beliefs. WAIS-III	- VSZ and ASD groups significantly worse on the RET and the MAT than the PD group, although did not differ from one another. - AS and PD had sig higher WAIS-III scores than VSZ.
Murphy, (2011)	n=69 violent schizophrenia/sch izo affective disorder n= 24 violent PD	All in high security care.	No	Schizophrenia vs. PD	WAIS-III Hayling Test Brixton Test RET	No significant differences between groups on any tests

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	100% male					
Nestor, Haycock, Doiron, Kelly, and Kelly (1995)	n=24 severely VSZ inpatients n = 22 less severely VSZ inpatients	Severe violence included murder, serious assault etc., less severely violent included mainly property damage/trespassing.	No	Violent vs. non-violent schizophrenia	WAIS – R Wide Range Achievement Test – Revised WMS WCST TMT – B	- Severely violent group showed significantly better full scale IQ, verbal IQ, spelling and reading. - No other significant differences.
Nijman, Cima, & Merckelbach, (2003)	n=111 offenders with diagnosis of psychotic disorder n=197 offenders with non-psychotic disorder diagnosis (70% cluster B PD) 100% male	In forensic psychiatric care.	No	Schizophrenia vs. PD	WAIS	- No significant difference in IQ between groups - Psychotic offenders had significantly higher verbal IQ than non-psychotic, who were better on performance IQ.
Pera-Guardiola et al. (2016) ^{\$}	n= 91 male ASPD offenders from high security department of	In high security prison.	Yes	Healthy Controls	WCST	ASPD and low psychopathy had a greater number of perseverative errors and perseverative responses than healthy controls and the ASPD and high psychopathy.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	penitentiary; divided into high (n=31), medium (n=47) and low (n=13) psychopathy n= 24 male healthy controls					• ASPD and high psychopathy did not differ from controls • ASPD and medium psychopathy did not differ from any group • Factor One scores predictive of perseverative errors and responses.
Prehn et al., (2013) ^{\$}	n=15 ASPD offenders with comorbid BPD. n=17 healthy controls 100% male	Recruited from high secure forensic treatment facilities and penal institutions	Yes	Healthy controls	Verbal n-back task. Second condition involved the presentation of IAPS pictures in the background of the working memory task, p's instructed to ignore and continue with the working memory task.	• No significant differences between HCs and PD group on working memory performance. • PD offenders showed slower RTs during the presentation of highly salient pictures compared to neutral/low salient, independently of working memory load. • Emotional reactivity and behavioural interference were both independent of cognitive load – PD may be more prone to detect and process emotionally salient stimuli.
Rasmussen, Levander, & Sletvold, (1995)	n=13 violent schizophrenia 100% male	Recruited from a unit for violent aggressive patients	No (Although psychopathy quantified)	Non-violent schizophrenia Healthy Controls	Finger tapping Go-No Go Necker cube test Trail Making Perceptual Maze Test	• Finger tapping – controls had best performance, VSZ performed the most poorly.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=13 non-violent schizophrenia, recruited from a general psychiatric wards 100% male n=13 healthy controls (nursing staff) Gender NR				Trigram Tests (lexical decision tasks)	- Go-No Go – VSZ had significantly more failed inhibitions than both the other groups. - Necker cube – no group differences. - Trail Making – In general, VSZ group performed better than NVSZ. Both schizophrenia groups worse on part B than on part A. - Perceptual Maze – controls better than both schizophrenia groups.
Riser & Kosson, (2013)	ASPD +/- psychopathy. Controls are offenders with no ASPD or psychopathy. 100% male Different numbers per condition: <i>Local bias – ASPD n = 20</i>	Recruited from prisons.	Yes	Healthy offenders	Global-local task. Designed to differentially activate left and right hemisphere, global condition where participants report the large letter 80% of time, local condition where participants report the letter making up the larger letter 80% of time. Neutral condition is 50-50.	- The ASPD + P group responded more slowly in the local condition to local trials than both the controls and the ASPD-P groups (these 2 groups did not differ from one another). - ASPD+P also responded more slowly than ASPD-P on global trials in the local condition, but did not differ from controls. - This supports a left-hemispheric activation hypothesis, in that activities associated with the LH are specifically impaired.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	ASPD+P n=18 Control n=32 <i>Global bias-</i> ASPD n=20 ASPD+P n=21 Control n= 40 <i>Neutral block</i> ASPD n= 41 ASPD+P n=42 Control n= 73					
Robertson & Taylor, (1985) ^{\$}	n= 61 offenders with schizophrenia n=41 healthy controls with no history of violence 100% male	Men held in prison on criminal charges, or in maximum security hospital after conviction (n=15)	No	Healthy controls	Verbal Fluency (animals, S, F) Digit Span Picture Completion Picture Arrangement Visual Retention Visual Recognition	VSZ group significantly worse than healthy controls on verbal fluency, digit span, performance IQ, visual retention and visual recognition.
Roszyk, Izdebska, & Peichert, (2013) ^{\$}	n=65 offenders with ASPD n=65 healthy controls	All convicted of either murder (n=6), assault (n=13), rape (n=17) or child	No	Healthy controls	SCWT Tower of London	- ASPD significantly longer on Stroop test (colour naming) in comparison with HCs, and made significantly more mistakes. - ASPD made significantly more moves to complete the tower of

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	100% male	sexual offences (n=27)				London task, took longer to complete, longer to plan, and made more rule violations in comparison to controls.
Roy, Herrera, Parent, & Costa, (1987)	n= 11 patients with schizophrenia in high violence group. n=9 schizophrenia in low violence group. 100% male	Lions violence scale. High violence group had a mean total of 16.22 assaults across 3 months, low violence 1.45	No	High vs. low violence	WAIS-R and subtests	Low violent patients had a significantly lower performance IQ, and significantly lower digit-symbol and block design subtests.
Schiffer et al., (2014) ^{\$}	n=21 offenders with ASPD n= 23 non-offenders with a history of substance misuse, but no current use.	Incarcerated; recorded as violent offenders.	Yes	Healthy controls	SCWT	- Similar error interference for both groups. - ASPD group exhibited a significantly smaller Stroop effect than non-offenders. - May be related to cognitive instability or inability to use additional information in the face of a pre-potent response.
Schonenberg & Jusyte, (2014)	n=55 ASPD offenders.	All prisoners.	Yes - No history of schizophre	Healthy controls	Male faces morphed to create three continuous dimensions: 1. Happy-	Angry-fearful dimension: ASPD group made significantly more angry responses under conditions of

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=55 healthy controls 100% male	Buss-Perry Aggression Questionnaire used to quantify; higher scores amongst prisoners than controls.	a, mental retardation or BPD. 4 had major depression, 2 dysthymia		fearful, 2. Happy-angry, 3. Fearful-angry. Had to identify the emotion at different intensities (i.e. 10% happy, 90% fearful) and say how intense the identified emotion was using a forced choice paradigm.	maximal ambiguity (50% fear, 50% angry). - Angry-happy dimensions: ASPD more angry responses at maximal and high ambiguity (30% angry/70%happy, and 50%/50%) - ASPD group rated the 50/50 expressions as more intensely angry than controls. - Suggests hostile attribution bias.
Schonenberg, Louis, Mayer, & Jusyte, (2013)	n=32 ASPD offenders. n=32 healthy controls. 100% male	Sentenced for repeated GBH, none accused of domestic violence, sexual offences or drug-related crime. BPAQ used to quantify.	Yes	Healthy controls	Angry, happy, fearful and neutral expressions ranging from 0% to 100% in intensity at 2% increments (51 intensity levels) Participants pressed button as soon as they could identify emotion.	- No difference for happy faces, at TREND level ASPD participants required longer for fearful faces (p=.068), but ASPD required significantly longer to recognise anger. - To control for the effects of speed/accuracy trade-offs, analysed pattern of errors – more errors in both groups for anger and fear, but did not differ between groups.
Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, (2010) ^s	n=17 ASPD offenders. n=20 healthy controls	Prisoners meeting criteria for psychopathy.	Yes	Healthy controls OFC lesion group	ToM task assessing 1 st and 2 nd order cognitive, affective and physical representations.	OFC lesion group and psychopathy groups were impaired in 2nd order affective ToM in comparison to healthy controls. No significant differences on cognitive or physical second order.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=27 orbitofrontal cortex lesion patients 100% male					- Similar responding patterns suggest OFC involved in psychopathy deficits in emotion processing. - Self-reported psychopathy scores were negatively correlated with accuracy in the affective ToM conditions.
Silver, Goodman, Knoll, Isakov, & Modai, (2005) ^{\$}	n=35 violent schizophrenia n=35 schizophrenia inpatients with no history of violence n=46 healthy controls 100% male	Resident on maximum security ward; requires inability to contain violence on other locked wards. Crimes include murder, rape and recurrent acts of violence against a person.	No	Non-violent schizophrenia Healthy controls	Penn Emotion Acuity Test (happy, sad, neutral) Differentiation of Facial Emotions Abstraction, Inhibition and Working Memory Task Penn Face Memory Test Visual Object Learning Test JLOT CPT Digit Span Dot Test (visual working memory) Finger Tapping MMSE	- Violent and non-violent groups did not differ on any of the cognitive variables. Both groups performed worse than controls. - Violent patients better at recognising emotions than non-violent. Violent patients better at recognising neutral faces compared to non-violent. Both groups worse than controls. - Violent patients poorer at discriminating intensity of emotions than non-violent (happy and sad). Non-violent and controls do not differ.
Swann, Lijffijt, Lane, Steinberg, &	n=34 ASPD	Participants are on probation/parole.	Yes	Healthy controls	CPT (Rapid-response impulsivity – Immediate Memory Task)	Compared to controls, the ASPD group demonstrated slower reaction times to commission errors on the

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
Moeller, (2009) ^{\$}	n=30 healthy controls 100% male				Reward-delay impulsivity: single key impulsivity paradigm (how long can you wait for a reward) Reward-delay impulsivity: two-choice impulsivity paradigm (small reward after 54 seconds, large reward after 15 s)	immediate memory task, even after controlling for age and education. - Severity of ASPD symptoms correlated positively with impulsive responses on the IMT. - Suggests ASPD is characterised by increased rapid-response impulsivity, but not by inattentiveness or reward-delay.
Tang et al. (2016)	n=30 male inpatients with schizophrenia and ASPD n=30 male inpatients with schizophrenia and no ASPD n=30 healthy community controls	Are diagnosed with ASPD; have significantly higher life history of aggression scores than the other two groups.	Yes	Schizophrenia with no ASPD Healthy Controls	Facial Emotion Perception Task (happy, sad, anger, surprise, disgust, fear) WCST Stroop Digit Span Verbal Fluency Test of Non-Verbal Intelligence – 3	- Comorbid schizophrenia and ASPD group had more WCST perseverative errors than individuals with just schizophrenia, and healthy controls. - Poorer perception of all facial emotions except happy in patients with comorbid ASPD and schizophrenia, relative to healthy controls. - Poorer perception of anger, surprise and disgust amongst comorbid group compared to schizophrenia alone. - Life history of aggression score negatively correlated with correct

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
						perception of negatively-valenced facial emotions in comorbid group.
Verona, Sprague, & Sadeh, (2012)	n=16 ASPD n=14 psychopathy (also meets ASPD criteria) n= 15 offenders with low psychopathic traits, did not meet ASPD criteria. Gender for groups not reported, but for whole group including controls 74% are male.	Individuals with a history of legal convictions. Life history of aggression scale Forms of aggression questionnaire	Yes	Healthy offenders	Linguistic Go/No-Go task. Press button on words written in normal font, and no-go on italicised words. 96 words selected from the affective norms for English words (32 emotionally neutral, 32 general negative and 32 offender negative words).	• No significant differences for behavioural data • Control offenders – there was modulation of the frontal P3 amplitude to negative emotional words when inhibitory control was required. • Psychopathy – blunted processing of negative emotional words regardless of inhibitory demands of task. • ASPD – enhanced processing of negative emotion words in both go and no-go trials, suggesting a failure to modulate negative emotional processing when inhibitory control is required. • ASPD groups enhanced P3 to negative, relative to neutral, words, correlated with an inability to control their behaviour under emotional conditions in real life situations (greater verbal and self-directed aggression). • ASPD may be associated with an inability to ignore emotional context when engaging in inhibitory control.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
Viljoen, Iverson, Ward, & Brink, (2004) ^{\$}	n=25 violent schizophrenia inpatients Compared against normative scores from RBANS manual, and published community dwelling (non-violent) schizophrenia samples 100% male	All forensic inpatients. 96% of sample had history of some type of violent offence, including homicide, attempted murder, assault or sexual assault.	No	Healthy Controls Non-violent schizophrenia	Repeatable battery for the assessment of neuropsychological status (RBANS)	- Group demonstrated large deviations from normative scores in: immediate memory, delayed memory, visual-spatial and constructional skills, expressive language, attention/processing speed, and total score. All large effect sizes, largest effect in immediate memory (excluding total score). - However, no differences in comparison to community dwelling schizophrenia patients. Although, non-significantly lower in all domains apart from attention across all three published comparison groups.
Vollm et al., (2010) ^{\$}	n=15 ASPD n=13 healthy controls 100% male	Recruited from prisons and forensic hospitals	Yes	Healthy controls	Go/No-Go	No significant difference in reaction time or number of errors between groups.
Wolfkuhler et al., (2012) ^{\$}	n= 30 forensic inpatients with schizophrenia 97% male	Forensic inpatients with offenses including: criminal assault (n=1) serial	No	Non-violent schizophrenia Healthy controls	Japanese and Caucasian Brief Affect Recognition Test 56 photos, 7 emotions	- WCST and BADS: both SCZ groups made more errors than controls but did not differ between each other. - NVS worse than controls on all seven emotions except sadness. VSZ

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	n=30 schizophrenia general psychiatric inpatients 60% male n=20 healthy controls 45% male	sexual offences (n=4), severe bodily harm (n=9), manslaughter (n=9), obstructing the police (n=1), encroachment on traffic (n=1), drink driving (n=1), theft/robbery (n=9), arson (n=3), coercion (n=1).			angry, disgust, fear, happy, sad, surprised, contempt. 8 appearances of each. Attention deficits controlled for by showing neutral faces and asking to identify gender. WCST BADS Zoo Map part 1	worse than controls apart from disgust and fear. - Forensic group better than non-forensic at disgust. - As excitement differed between groups, this was covaried out. Then forensic group outperformed non-forensic group on happiness, fear, disgust and total emotion recognition in Caucasian faces. - When covarying out depression and anxiety component, disgust difference remained but no other differences. - In forensic group: emotion recognition (total score) correlated inversely with the amount of antipsychotic medication, inverse relationship for emotion recognition with the cognitive component and the positive component of the PANSS
Yang et al., (2010) ^{\$}	n=22 violent schizophrenia 16% male n=18 healthy violent offenders	Violent groups were accused of homicide undergoing forensic	Axis II assessed but not reported whether excluded.	Non-violent schizophrenia Healthy Controls	WAIS-R Chinese version (Similarities, Arithmetic, Picture Completion, Digit Symbol Coding)	Healthy controls had significantly higher FSIQ than the other three groups but these groups did not differ from one another.

Reference	Participants (n, diagnosis, % male)	Violence Status	Was Comorbidity with Axis I/II controlled for?	Comparison Group(s)	Measures Used	Main Findings
	13% male n=19 non-violent schizophrenia 19% male n=32 healthy, non-violent controls 13% male	psychiatric evaluation.		Healthy Offenders		

\$ - Included in Meta-Analysis

Abbreviations: ABH – Actual Bodily Harm; ADHD – Attention Deficit Hyperactivity Disorder; AMIPB – Adult Memory and Information Processing Battery; ASD – Autism Spectrum Disorder; ASPD – Antisocial Personality Disorder; BADS – Behavioural Assessment of Dysexecutive Syndrome; BPAQ - Buss-Perry Aggression Questionnaire; BPD – Borderline Personality Disorder; CANTAB – Cambridge Automated Neuropsychological Test Battery; CPT – Continuous Performance Test; CVLT – California Verbal Learning Test; ERP – Event Related Potential; FSIQ – Full Scale IQ; GBH – Grievous Bodily Harm; HCs – Healthy Control’s; IAPS – International Affective Picture System; JLOT – Judgement of Line Orientation Test; MAT – Modified Advanced Test; MMSE – Mini Mental State Examination; NART – National Adult Reading Test; NR – Not reported; NVS – Non-Violent Schizophrenia; OAS – Observation of Aggression Scale; OFC – Orbitofrontal Cortex; PANSS – Positive and Negative Syndrome Scale; PD – Personality Disorder; PCL-SV – Psychopathy Checklist – Screening Version; RAVLT – Rey Auditory Verbal Learning Test; RBANS – Repeatable Battery for Assessment of Neuropsychological Status; RCFT – Rey-Osterith Complex Figure Test; RET – Revised Eyes Test; SCWT –Stroop Colour/Word Test; SCZ – Schizophrenia; TMT – Trail Making Test; ToL – Tower of London; ToM – Theory of Mind; VBRS – Violent Behaviour Rating Scale; VSZ – Violent Schizophrenia; WAIS – Wechsler Adult Intelligence Scale; WASI – Wechsler Abbreviated Scale of Intelligence; WCST – Wisconsin Card Sort Test; WMS – Wechsler Memory Scales.

Appendix 3 - Studies Included in Chapter Three

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
Andreasson et al., 2014	n= 125 forensic psychiatric clients, 19% (n=24) female Sweden	Length of Stay	Absconding Restriction order Severity of offence	Mood disorder	Anxiety disorder Education Employment Homelessness Immigrant Impulse control disorder Inpatient violence Male gender Neurodevelopmental disorder Parent Personality disorder Previous prison sentence Previous psychiatric contact Psychosis Single Substance use whilst hospitalised Suicidal behaviour Young age at time of offence/admission	Cox regression, stepwise
Bailey & Macculloch, 1992 (Bailey & Macculloch, 1992)(Bailey & Macculloch, 1992)	n=112 patients discharged from high secure hospital. UK	Reoffending	Detained under psychopathic disorder Personality disorder	Restriction order/conditional discharge	-	Chi-square; t-test

Study	Sample and Location	Outcome	Positive	<u>Extracted Predictors</u>		Analysis Method
				Negative	No Association	
Baldwin et al., 1992	n= 385 male 'Not guilty by reason of insanity', discharged over 20 year period. USA	Length of Stay	Premorbid competence Race Severity of offence	-	Disability subgroup Education Employment Previous offences Prior admission to general psychiatric hospital Single Socioeconomic status Young age at time of offence/admission Young age at first hospitalisation/psychiatric contact	Multiple Regression
Ball et al., 1994 (Ball et al., 1994)(Ball et al., 1994)	n=232 consecutive admissions to forensic inpatient service during a 5 month period. 95.7% male USA	Inpatient Violence	History of Violence Number of previous psychiatric admissions Longer length of stay	-	Childhood history of abuse/neglect Combat history Diagnosis Family deviance e.g. parental alcohol/drug use Female gender History of escape History of sexual offending Index crime characteristics Legal status Neurologic abnormality Previous offences Self-injurious/suicidal behaviour Young age at first arrest Young age at first psychiatric hospitalisation	Stepwise logistic regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
					Young age on admission	
Baxter et al., 1999 (Baxter et al., 1999)(Baxter et al., 1999)	n=63 patients discharged from medium security, 75% male UK	Reoffending	Young age at admission/discharge Substance use History of conduct disorder	Restriction order	Inpatient Violence Parental absence Previous offences Previous psychiatric admissions Psychosis Race Shorter length of stay Single	Poisson or negative binominal regression
Brown & Fahy, 2009	n=157 male patients discharged from medium security over a 4 year period. UK	Length of Stay	Legal status Restriction order	-	-	Mann-Whitney U
Buchanan & Leese, 2006 (Buchanan & Leese, 2006)(Buchanan & Leese, 2006)	All patients (n=425; n= 349 male) discharged from 3 special hospitals in the UK over a 2 year period, followed up for approx. 10.5 years UK	Reoffending	Previous offences Young age (at admission or discharge) Male gender Detained under psychopathic disorder	-	-	AUC, logistic regression, number needed to detain

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
Buchanan, 1998	n=425 inpatients discharged from high secure hospital, 82% male, convictions within first 10 years. UK	Reoffending	Previous offences Young age (at admission or discharge) Detained under psychopathic disorder	-	Male gender	Logistic Regression
Castro, Cockerton & Birke, 2002	n=116 patients admitted to medium secure unit over a three year period, 20% female UK	Length of Stay Reoffending	Length of Stay: Difficult behaviour while hospitalised Absconding Substance use history Number of therapy programmes attended Previous prison sentence Reoffending: History of sexual offending Known to institutions Poor compliance with medication	Length of Stay: - Reoffending: -	Length of Stay: Unclear which factors were considered. No systematic reporting of which demographic characteristics were collected. Reoffending: Previous offences	Correlations Chi-square
Cohen et al., 1988	n= 127 insanity acquittees USA	Reoffending	Early birth order Substance use	-	Childhood abuse/trauma Previous offences Race School maladjustment/expulsion Seclusion during admission Single	Stepwise discriminant analysis

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
					Young age (at admission or discharge) Young age at time of offence	
Coid et al., 2007 (Coid, Hickey, et al., 2007b)	n=1344 patients discharged from medium security, spent time at risk for a mean of 6.2 years UK	Reoffending	Male gender Personality disorder Previous offences Shorter length of stay Young age (at admission or discharge) Young age at time of offence	Restriction Order/Conditional Discharge	Delusional disorder Depression Organic/cognitive disorder Race Sexual deviation Single Substance use	Cox regression models. Hazard ratios Survival curves
Dietz & Rada, 1982	n= 61 assaultative patients compared with n=147 non-assaultative patients from a maximum security hospital. USA	Inpatient Violence	Race Transferred prisoner	-	Combat history Education Employment Index crime characteristics Religion Single Young age on admission	Chi-square
Duncan et al., 2002	n=123 male readmissions, compared with a published survey of the state hospital population. UK	Readmission to High Secure Hospital	Mood/affective disorder Previous prison sentence Shorter length of stay	Restriction order/conditional discharge	History of recidivism Male gender Previous offences Previous psychiatric admissions Previous secure psychiatric care Reason for readmission (violence/relapse etc.) Referral source	Group comparisons

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
					Young age (at admission or discharge)	
Edwards, Steed & Murray, 2002	n=225 first admissions to medium security followed up over a fixed 5 year period. UK	Length of Stay Reoffending	Length of Stay: Severity of Offence Race Reoffending: Previous Offences	Length of Stay: - Reoffending: -	Length of Stay: Admission source Diagnosis Legal status Male gender Previous offences Previous psychiatric contact Violent vs. sexual offence Young age at first hospitalisation/psychiatric contact Young age at time of offence/admission Reoffending: Detained under psychopathic disorder Diagnosis Male gender Offence characteristics Previous psychiatric treatment Race Referral source Severity of index offence Young age (at admission/discharge)	Logistic Regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
					Young age at onset of mental disorder Young age at time of offence	
Enticott et al., 2007	n=10 hospitalised offenders Australia	Inpatient Violence	Aggressive individuals (n=5) showed greater response inhibition than non-aggressive individuals (at a trend level, $p=0.07$).	-	Inhibitory reach task (assessing impulsivity)	Mann Whitney U
Foster, Hillbrand & Silverstein, 1993	n=23 male forensic patients USA	Inpatient Violence	Frequency of aggression could be reliably predicted by the scores from Judgement of Line Orientation errors, Stroop Colour Word Test and Emotion Perception Test anger errors.	-	Test of Non-Verbal Intelligence Wisconsin Card Sorting Test	Whole-set correlation analysis
Friendship et al., 1999	n=184 patients discharged from MSU over a 14 year period. UK	Reoffending	Previous offences Young age (at admission or discharge) Shorter length of stay	-	Male gender Race Previous violence Restriction order/conditional discharge Referral source Diagnosis Lived with parents until 16 Previous psychiatric treatment	Logistic Regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
Green & Baglioni, 1998	n=203 mentally disordered hospitalised offenders Australia	Length of Stay	Charges not proceeded with Organic/cognitive disorder Psychosis Severity of offence	-	Mood disorder Previous offences Readmission Sentenced Substance use history Young age at time of offence/admission	Regression Model
Hillbrand et al., 1998	n=164 male admissions to high secure hospital USA	Inpatient Violence	Creatine Kinase (CK) Those in high frequency of aggression had higher CK than the low frequency aggression group (p=0.048) Those who engaged in only verbal aggression had lower CK than those who engaged in physical aggression (p=0.012) Restraints in the past 7 days prior to CK sample being collected were also significantly associated with higher CK. CK >200U/l to predict aggression – 94% of cases correctly classified.	-	-	t-tests, factorial ANOVA

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
Hillbrand, 1995	n= 103 male patients from high-secure hospital, divided into self-injurious and non-self injurious. USA	Inpatient Violence	Self-injurious/suicidal behaviour	-	-	Chi-square
Hillbrand, Spitz & Foster, 1995	n=106 inpatients from maximum security hospital. Divided into low and high cholesterol groups. USA	Inpatient Violence	Low cholesterol group engaged in more frequent acts of aggression than the high cholesterol group. No difference in severity of type of aggression	-	-	Chi-square
Hoptman et al, 1999	n=183 males, newly admitted patients to high secure psychiatric hospital USA	Inpatient Violence	Dual diagnosis (schizophrenia and substance use disorder) Legal status Young age on admission	-	Ability to follow ward routine Family deviance e.g. parental alcohol/drug use Previous offences Race Schizophrenia Substance use	Chi-square, t-test
Howard & Lumsden, 1996	n=44 male inpatients in high secure hospital. UK	Reoffending	Classified as high or low risk based on Go/No Go Contingent Negative Variant, high risk if outside 1 SD from mean (control group of 19	-	-	Relative improvement over chance.

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
			student nurses), low risk if within 1 SD. At follow up 6 patients in high risk group and 1 patient from low risk group had been reconvicted. 6 from High Risk- manslaughter, burglary x 3, arson, NOS indictment. 1 from Low Risk- theft. Accuracy of predictor – 63.6%			
Howard et al., 2013	n=53 men who were treated at specialist forensic PD unit and spent time at risk of offending in the community. Only diagnostic data reported as other data is reliant on clinical judgement UK.	Reoffending	Personality disorder (specifically cluster B) Substance use	-	-	Kaplan–Meier survival analysis with the hazard ratios (HRs) calculated using Cox regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
Long & Dolley, 2012	n=70 women, MSU. Divided into short and long stay groups based on median split of 21.6 months. n=40, short stay, n= 28, long stay. UK	Length of Stay	Psychosis Severity of offence	Number of therapies attended	-	Chi square; Analysis of variance
Lussier et al., 2009	527 patients, forensic psychiatric hospital, 87.5% male. Variables extracted for most violent group (15 or more incidents). Canada	Inpatient Violence	Antisocial personality disorder Early onset mental health problems Female gender History of violence Legal status	Schizophrenia Substance use	Number of previous psychiatric admissions Number of previous forensic psychiatric admissions Personality disorder other than ASPD Previous offences Single Young age at index offence Young age on admission	Logistic regression controlling for length of stay.
Maden et al., 1999a	n=234 patients discharged from MSU, followed for average 6.6 years. UK	Reoffending/Readmission	Male gender Previous offences Previous psychiatric admissions Shorter length of stay Young age (at admission or discharge) Young age at onset of mental disorder	-	Race Previous violence Referral source Diagnosis Previous psychiatric treatment	Chi-square/t-test

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
Maden et al., 1999b	n=104 Black/African/Black-Caribbean patients and 125 White/Caucasian patients discharged from medium security. UK	Reoffending/Readmission	-	-	Race	Chi-square
Moran et al., 1999	n=101 maximum security forensic inpatients, (87 male). USA	Length of Stay	Young age at time of offence/admission	Employment Psychosis	Education Personality disorder Previous prison sentence Prior admission to general psychiatric hospital Previous not criminally responsible adjudications Prior transfer to medium security Race Severity of offence Single Substance use history	Linear regression
Murphy, 2007	n=30 male high security admissions with a diagnosis of schizophrenia. UK	Assessed risk and need.	Controlling for Full Scale IQ, working memory, processing speed, trails B and Colour/Word Stroop, Revised Eyes Test remains significant	-	-	Multiple regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
			predictor of Health of the Nation Outcome Scale total and social scores. Controlling for Full Scale IQ, working memory, processing speed, trails B and C/W Stroop, Revised Eyes Test remains partially correlated with Camberwell Assessment of Need (forensic version) scores. Revised Eyes Test only significant predictor. Revised Eyes Test only significant predictor variable for Risk Management total of HCR-20, when controlling for Full Scale IQ, working memory, trails B and 2nd order Modified Advance Test.			
Phillips et al., 2005	n=315 patients discharged from medium security – 276 men and 39 women.	Reoffending	Previous offences Young age (at admission or discharge) Shorter length of stay		Male gender Single Race Personality disorder Previous psychiatric admissions	Regression model

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
	UK				Young age at time of offence Young age at onset of mental disorder	
Phillipse et al., 2006	n=132 patients discharged from seven secure hospitals (92.4% male) Netherlands	Reoffending	Comorbid SUD and PD Number of times absent without leave Personality disorder (cluster B specific)	Psychosis	Previous offences Young age at time of offence Previous violence Employment Institutionalisation in childhood Victim characteristics	Regression model, Area under the curve
Quinn & Ward, 2000	n=23 patients from high security admitted to medium security, then either discharged or readmitted to high security, over a period of 10 years. UK	Success of Transfer from high secure hospital. Success of transfer discrete category, not included in any category variable count.	-	-	Age Diagnosis Index offence characteristics Legal status Length of stay Male gender Number of past hospitalisations Previous offences Race Substance use	Chi-square/Wilcoxon
Quinsey & Maguire, 1986	n=206 discharged patients from high secure psychiatric care, followed up for a minimum of 11 years.	Reoffending	Young age (at admission or discharge) Severity of index offence Previous conviction for property crime	Civilly committed	Education Employment Inpatient violence IQ Lived with parents until 16 Offence characteristics	Stepwise regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
	USA		More admissions to correctional facilities Criminally committed		Personality disorder Previous psychiatric admissions Psychosis Shorter length of stay Single Substance use	
Quinsey, Rice & Harris, 1995	n= 178 men at maximum security hospital who had (at the time of admission) sexually assaulted a female adult or child, and had an opportunity to reoffend. USA	Reoffending	Previous offences Single Personality disorder Previous violence Previous conviction for property crime History of sexual offending		Admitted for assessment Education Employment IQ Parental absence Previous psychiatric admissions Previous secure psychiatric care Shorter length of stay Victim characteristics Young age (at admission or discharge)	Multiple regression
Rasmussen & Levander, 1996	n=87 male, n=7 female patients admitted to maximum security psychiatric hospital over a 6 year period. Norway	Inpatient Violence	Borderline symptoms Positive psychotic symptoms Young age on admission Previous Violence	Depressive symptoms	History of violence	Multiple regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
Reiss, Grubin & Meux, 1996	n=49 young male patients in high secure hospital, detained under psychopathic disorder UK	Reoffending	Childhood bullying/fighting Childhood foster care history of sexual offending IQ Previous violence	Employment Relationship prior to admission	Inpatient violence Seclusion during admission Sexually inappropriate inpatient behaviour	
Repo-Tiihonen et al., 2002	n=397 male forensic patients Finland	Seclusion due to acute acts of violent or suicidal behaviour	Mean total cholesterol levels of those who had been secluded (voluntarily or involuntarily) were significantly lower than the controls. Subsample of those who had only been secluded involuntarily were also significantly lower than controls. 5.3 mmol/l was optimum level to differentiate those who would be secluded vs. those who wouldn't with 60.5% sensitivity and 55.9% specificity.	-	-	Mann-Whitney U Area under curve
Rice & Harris, 1996	n= 208 male fire setters admitted to	Reoffending	Previous offences Single	-	Bed wetting Childhood abuse/trauma Childhood firesetting	Multivariate logistic regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
	maximum security psychiatric facility. Average of 7.8 years follow-up. USA		Young age at time of offence Civily committed Institutionalisation in childhood Cruelty to animals in childhood Low socioeconomic status (childhood)		Education Employment Homosexuality IQ Lived with parents until 16 More admissions to correctional facilities Offence characteristics Parental crime/alcohol abuse Personality disorder Previous prison sentence Previous psychiatric admissions Previous violence Psychosis School maladjustment/expulsion Socioeconomic status Substance use	
Rice et al., 1990	n=253 insanity acquittees detained in maximum security institution. 7 year follow up of reoffending. USA	Reoffending	Parental absence More admissions to correctional facilities Offence characteristics Parental crime/alcohol abuse Personality disorder Previous conviction for property crime Previous offences Previous violence	Employment	Childhood bullying/fighting Childhood socioeconomic status Education IQ Victim characteristics Parental psychiatric history Previous psychiatric admissions	Chi-square/t-test.

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
			School maladjustment/expulsion Severity of index offence Single Teen alcohol abuse Young age at time of offence			
Rice, Harris & Quinsey, 1990	n=54 men who had been detained in maximum security hospital, who had sexually assaulted an adult female and had opportunity to reoffend. USA	Reoffending	Previous violence	-	Shorter length of stay Single Offence against children History of sexual offending	Multiple regression – step-wise.
Rice, Quinsey & Houghton, 1990	n=92 men, detained in high security forensic hospital. Approximately 6.6 years follow-up USA	Length of Stay Reoffending	Length of Stay: Psychosis Referral from psychiatric unit Severity of offence Reoffending: Young age (at admission or discharge) Referral source Longer time in institutions	Length of Stay: - Reoffending: Employment Psychosis Unfit to stand trial	Length of Stay: Charges leading to admission Legal Status Education Employment Single Young age at time of offence/admission Reoffending: Previous offences Single	Hierarchical multiple regression

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
					Severity of index offence Education Legal status	
Rogers et al., 2002	n=110 patients, medium security UK	Inpatient Violence	-	-	Command hallucinations Female gender History of violence Paranoid delusions Substance use	Negative binomial regression, controlling for length of stay
Ross et al., 2012	Two groups of forensic inpatients; n=67 short stay (less than 48 months), n=137 long stay (who had remained in treatment for at least 120 months). Germany	Length of Stay	Living situation at time of offence (institutional/parental care) Previous prison sentence Severity of offence Young age at time of offence/admission	Immigrant Employment	Absconding Inappropriate sexual behaviour (inpatient) Inpatient violence Male gender Previous offences Prior admission to general psychiatric hospital Substance use history Substance use whilst hospitalised Suicidal behaviour	Backward, stepwise logistic regression
Skipworth et al., 2006	n=135 patients, insanity acquittees, 83% male. New Zealand	Length of Stay Reoffending	Length of Stay: Severity of offence Reoffending: Previous offences Young age (at admission or discharge) Male gender Race	Length of Stay: - Reoffending: -	Length of Stay: Diagnosis Male Gender Previous Offences Race Reoffending: Shorter length of stay Previous violence	Kaplan-Meier survival analysis, compared using log-rank tests.

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
					Severity of index offence Diagnosis	
Spitz et al., 1997	n=164 male admissions to high secure hospital USA	Inpatient Violence	Creatine Kinase: African American participants showed greater severity of physical aggression, and also those with schizophrenia had higher levels of Creatine Kinase, than those African Americans without schizophrenia. This trend was not shown in Caucasians.	-	-	t-tests, factorial ANOVA
Steadman et al., 1983	n=225 'Not guilty by reason of insanity' acquittees, 196 male and 29 female. USA	Length of Stay	Male gender Severity of offence Single	-	Charges leading to admission Diagnosis Previous offences Young age at time of offence/admission	Linear regression
Tennent & Way, 1984	n=617 men discharged from English high secure hospitals UK	Reoffending	Institutionalisation in childhood Parental absence Previous offences Previous prison sentence Shorter length of stay	Psychosis Depression	Previous psychiatric admissions Employment IQ	Chi-square

Study	Sample and Location	Outcome	<u>Extracted Predictors</u>			Analysis Method
			Positive	Negative	No Association	
			Young age at time of offence			
Thomas et al., 2009	n=193 new admissions to forensic psychiatric services, 44% (n=85) were included in seclusion group, not secluded n=108. Australia	Inpatient Violence (assessed by seclusion episodes)	Number of previous psychiatric admissions Previous offences Substance use Young age on admission	-	Diagnosis Female gender History of violence Legal status Number of previous forensic psychiatric admissions Race Single	Multiple regression; area under the curve; receiver operant characteristic
Zonana et al., 1990	n=31 women 'Not guilty by reason of insanity' matched to n=31 'Not guilty by reason of insanity' men based on date of 'Not guilty by reason of insanity' ruling. USA	Reoffending	Race	-	Young age (at admission or discharge) Shorter length of stay Male gender Previous psychiatric admissions Substance use Education Previous conviction for property crime Parent	Regression Model controlling for prior arrests

Appendix 4 - Ethical Approval Confirmation Letter



NRES Committee London - Camberwell St Giles

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14 March 2014

Ms Otilie Sedgwick
Institute of Psychiatry
King's College London
London
SE5 8AF

Dear Ms Sedgwick

Study title: Characterisation of, and Prediction of Clinical Outcomes
in, Mentally Disordered Offenders
REC reference: 14/LO/0238
IRAS project ID: 98463

Thank you for your letter of 07 March 2014, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information was considered in correspondence by a sub-committee of the REC. A list of the sub-committee members is attached.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details, unless you expressly withhold permission to do so. Publication will be no earlier than three months from the date of this favourable opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to withhold permission to publish, please contact the REC Manager Mr Thomas Fairman, nrescommittee.london-camberwellstgiles@nhs.net.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

NHS sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management

permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at <http://www.rdforum.nhs.uk>.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non clinical trials this is not currently mandatory.

If a sponsor wishes to contest the need for registration they should contact Catherine Blewett (catherineblewett@nhs.net), the HRA does not, however, expect exceptions to be made. Guidance on where to register is provided within IRAS.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
Covering Letter		22 January 2014
Covering Letter		07 March 2014
Evidence of insurance or indemnity		09 August 2013
GP/Consultant Information Sheets	1	22 January 2014
Investigator CV	Ottile Sedgwick (CI/student)	22 January 2014
Investigator CV	Veena Kumari (supervisor)	22 January 2014
Investigator CV	Dr Aisling Parsons	22 January 2014
Investigator CV	Dr Emily Glomey	
Investigator CV	Dr Susan Young	
Investigator CV	Dr Mrigendra Das	
Letter from Sponsor		15 January 2014
Other: Letter from funder	CConfirmation of study letter	27 March 2013
Other: Feedback from service users report -FAST-R	1	13 December 2013
Other: Forensic Clinical Research Domain [FRED] approval for study to go ahead at Broadmoor		12 December 2013
Other: Clinical Status Tool - Used for structured file review by researchers	1	22 January 2014
Participant Consent Form: Patients	2	07 March 2014
Participant Consent Form: Controls	2	07 March 2014
Participant Information Sheet: Patients	2	07 March 2014
Participant Information Sheet: Controls	2	07 March 2014
Protocol	2	07 March 2014
Questionnaire: DBSP	validated	
Questionnaire: MVQ	validated	
Questionnaire: PPQ	validated	
Questionnaire: PMI	validated	
Questionnaire: SOAS-R	validated	
Questionnaire: EHI	validated	
REC application	1	22 January 2014
Response to Request for Further Information		07 March 2014

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document "*After ethical review – guidance for researchers*" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

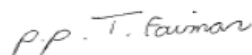
Further information is available at National Research Ethics Service website > After Review

14/LO/0238	Please quote this number on all correspondence

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at <http://www.hra.nhs.uk/hra-training/>

With the Committee's best wishes for the success of this project.

Yours sincerely



Mr John Richardson
Chair

Email: nrescommittee.london-camberwellstgiles@nhs.net

Enclosures: *List of names and professions of members who were present at the meeting and those who submitted written comments*
"After ethical review – guidance for researchers"

Copy to: *Mr Keith Brennan*
Ms Rubina Choudhry, West London Mental Health Trust

Appendix 5 - Trust Approval Confirmation Letter

West London Mental Health

NHS Trust

*We care
to make the
difference*

Ms Otilie Sedgwick
Institute of Psychiatry
King's College London
London
SE5 8AF

West London Mental Health R&D Office
Medway Lodge
K Block, 1st Floor
Uxbridge Road
Middlesex
UB1 3EU

Tel: 020 8354 8738
Fax: 020 8354 8733
Email: rd.office@wlmht.nhs.uk

01 April 2014

Dear Ms Sedgwick

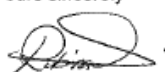
Re: Characterisation of, and Prediction of Clinical Outcomes in, Mentally Disordered Offenders
REC Ref: 14/LO/0238
R&D Reference Number: 98463/LNW

I am pleased to confirm that the above study has now received a full R&D approval, and you may continue your research in **West London Mental Health Trust**. May I take this opportunity to remind you that during the course of your research you will be expected to ensure the following:

- **Patient contact:** only trained or supervised researchers who hold the appropriate Trust/NHS contract (honorary or full) with each Trust are allowed contact with that Trust's patients. If any researcher on the study does not hold a contract please contact the R&D office as soon as possible.
- **Informed consent:** original signed consent forms must be kept on file. A copy of the consent form must also be placed in the patient's notes. Research projects are subject to random audit by a member of the R&D office who will ask to see all original signed consent forms.
- **Data protection:** measures must be taken to ensure that patient data is kept confidential in accordance with the Data Protection Act 1998
- **Health & safety:** all local health & safety regulations where the research is being conducted must be adhered to.
- **Serious Adverse events:** adverse events or suspected misconduct should be reported to the R&D office and the Research Ethics Committee.
- **Project update:** you will be sent a project update form at regular intervals. Please complete the form and return it to the R&D office.
- **Publications:** it is essential that you inform the R&D office about any publications which result from your research.
- **Ethics:** R&D approval is based on the conditions set out in the favourable opinion letter from the Research Ethics Committee. If during the lifetime of your research project, you wish to make a revision or amendment to your original submission, please contact both the Research Ethics Committee and R&D Office as soon as possible.
- **Monthly/Annual Progress report:** you are required to provide us and the Research Ethics Committee with a progress report and end of project report as part of the research governance guidance.
- **Recruitment data:** if your study is a portfolio study, you are required to upload the recruitment data on a monthly basis in the website:
http://www.crncc.nihr.ac.uk/about_us/processes/portfolio/p_recruitment/
- **Amendments:** if your study requires an amendment, you will need to contact the Research Ethics Committee. Once they have responded, and confirmed what kind of amendment it will be defined as, please contact the R&D office and we will arrange R&D approval for the amendment.
- **Audits:** each year, West London Mental Health Trust selects 10% of the studies from each service we have approved to be audited. You will be contacted by the R&D office if your study is selected

We would like to wish you every success with your project.

Yours sincerely



Rubina Choudhry
Research Governance Officer