Schizotypy: A Multi-Country Study of Psychometrics, Socio-Cultural Influences, Cognitive Processes, and Electrophysiological Markers

Barron, D.

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David Stewart Barron

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Abstract

Schizotypy represents a latent personality organisation reflecting a putative liability for schizophrenia-spectrum disorders. Schizotypic traits include anomalies in cognition (e.g., hallucinations), socio-emotional function (e.g., constricted affect), and behaviour (e.g., odd behaviour and language) that do not meet the clinical threshold for psychotic disorders. This thesis presents a series of studies investigating schizotypal measurement across ethno-cultural settings, examining cognitive antecedents and outcomes of schizotypy, and a schizotypal-continuum exploration into electrophysiological function.

Studies 1-3 examined the Schizotypal Personality Questionnaire (SPQ) as a measurement tool for schizotypy. These studies re-evaluated the domain structure of the English SPQ and the German SPQ, and developed and evaluated a Malay translation of the SPQ. Further, through the evaluation and development of these measures, schizotypy was explored within the framework of ethnic and cultural identities. This included evaluations between African Caribbeans in the UK and Trinidad, with White British participants; Malay and Chinese participants in Malaysia, and; central European White participants from Austria and southern Germany, with a similar cultural (migrational) group in the UK.

Studies 4a and 4b concerned schizotypy, cognitive processes, and conspiracy ideation. From an initial pilot, associations were established with conspiracy ideation, included as a *prima facie* outcome of disordered thinking. A follow-up study showed that analytic thinking mediated the relationship between Odd Beliefs or Magical Thinking (but not Ideas of Reference) and belief in conspiracy theories. Study 5 investigated whether a combination of high schizotypal ratings and abnormal electrophysiological function could be established. Second, this study allowed for a unique comparison between culture and ethnicity, within the assessment of

electrophysiological function. Finally, this study allowed for an investigation into associations between the domains established in Study 1 (namely, *Cognitive-Perceptual, Paranoid, Disorganised,* and *Negative*) and electrophysiological function. Results indicated little evidence of association between the schizotypy and schizophrenia literature; that is, there was no apparent electrophysiological deficits for high schizotypal individuals and no ethno-cultural influence. Further, the results of the regression indicated no support for associations at the higher-order domain level and electrophysiological function.

Taken together, these studies informed the schizotypal literature through multiple routes. Indeed, this thesis addressed both the personality (cognitive outcomes) and clinical (electrophysiological) nature of schizotypy with the foundation of a thorough measurement examination.

Declaration

The work presented in this thesis is the work of the author.

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List of Abbreviations

Ag/AgCl	Silver Silver-Chloride
AIC	Akaike Information Criterion
AMOS	Analysis of Moment Structures
ANOVA	Analysis of Variance
BCIS	Beck Cognitive Insight Scale
BCTI	Belief in Conspiracy Theories
CA	Constricted affect
CAPE	Community Assessment of Psychic Experiences
CEST	Cognitive-Experiential Self-Theory
Cog P	Cognitive-Perceptual
CSTQ	Combined Schizotypal Traits Questionnaire
CFI	Comparative Fit Index
CFA	Confirmatory Factor Analysis
CNS	Central Nervous System
dB	Decibel
Dis	Disorganised
DSM	Diagnostic and Statistical Manual
EEG	Electroencephalogram
vEOG	Visual Electroculography
ERP	Event-Related Potential
ESA	Excessive Social Anxiety

EP	Evoked Potential
fMRI	functional Magnetic Resonance Imaging
HIT	Human Intelligence Task
Hz	Hertz
ICD-10	International Statistical Classification of Diseases and Related Health Problems tenth edition
Int P	Interpersonal
IoR	Ideas of reference
IRR	Incidence Rate Ratios
ISI	Interstimulus Intervals
MANCOVA	Multivariate Analysis of Covariance
MANOVA	Multivariate Analysis of Variance
MI	Modification Index
MINI	Mini International Neuropsychiatric Interview
MMN	Mismatch Negativity
Ms	Millisecond
MTurk	Mechanical Turk
NCF	No Close Friends
Neg	Negative
NRM	New Religious Movements
OBoMT	Odd Beliefs or Magical Thinking
O-LIFE	Oxford-Liverpool Inventory of Feelings and Experiences
OoEB	Odd or Eccentric Behaviour

OS	Odd Speech
Per-Mag	Perceptual Aberration and Magical Ideation
PDI	Peters Delusional Inventory
Pn	Paranoia
RHS	Revised Hallucination Scale
RISC	Rust Inventory of Schizotypal Cognitions
RMSEA	Steiger-Lind Root Mean Square Error of Approximation
SCID-II	Structured Clinical Interview for DSM-IV Axis II Disorders
SIS	Structured Interview for Schizotypy
SIS-R	Structured Interview for Schizotypy Revised
SPD	Schizotypal Personality Disorder
SPQ	Schizotypal Personality Questionnaire
SPQ-B	Schizotypal Personality Questionnaire-Brief
SPQ-BR	Schizotypal Personality Questionnaire-Brief Revised
SPQ-G	Schizotypal Personality Questionnaire – German version
SRMR	Standardised Root Mean Square Residual
STA	Schizotypal Personality Scale
STB	Borderline Personality Scale
STQ	Schizotypy Traits Questionnaire
Sus	Suspiciousness
UK	United Kingdom
US	United States of America
UPE	Unusual Perceptual Experiences

μV	Microvolt
VIF	Variance Inflation Factor

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Notes

Publications from thesis

Barron, D., Swami, V., Towell, T., Hutchinson, G., & Morgan, K. D. (2015). Examination of the factor structure of the Schizotypal Personality Questionnaire among British and Trinidadian Adults. *BioMed Research International, 2015*, article ID 258275. doi:10.1155/2015/258275 — Study 1

Barron, D., Morgan, K. D., Towell, T, Jaafar, J. L., & Swami, V. (2017). Psychometric properties of Schizotypal Personality Questionnaire in Malaysia: Measurement invariance and latent mean comparisons of Malay and Chinese adults. *Asia-Pacific Psychiatry*. doi:10.1111/appy.12293 — Study 2

Barron, D., Voracek, M., Tran, U. S., Morgan, K. D., Towell, T., & Swami, V. (under review). Reassessment of the higher-order factor structure of the German Schizotypal Personality Questionnaire (SPQ-G) in German-speaking adults. *Journal of Abnormal Psychology* — Study 3

Fonseca-Pedrero, E., Ortuño-Sierra, J. O., Molina, B. L., Debbané, M., Chan, R. C. K., ... Voracek, M. (2017). Brief Assessment of Schizotypal Traits: A multinational study. *Schizophrenia Research.* doi:10.1016/j.schres.2017.10.043 — Study 3[1]

Barron, D., Morgan, K. D., Towell, T., Altemeyer, B. A., & Swami, V. (2014). Associations between schizotypy and belief in conspiracist ideation. *Personality and Individual Differences*, 70, 156-159. doi:10.1016/j.paid.2014.06.040 — Study 4a

Barron, D., Furnham, A., Weis, L., Morgan, K. D., Towell, T., & Swami, V. (2018). The relationship between schizotypal facets and conspiracist beliefs via cognitive processes. *Psychiatry Research, 259,* 15-20. doi:10.1016/j.psychres.2017.10.001 — Study 4b

[1] A sample of the German data (n = 1000) from Study 3 in this thesis was included in a multi-site study investigating the assessment of schizotypy across 14 countries. The author of this thesis is named as a co-author of this article.

Dissemination at International meetings

Barron, D. S., Smyth, N., Morgan, K. D., Towell, A., & Clow, A. (2012). Exploring the relationship between schizotypy and well-being in a student sample. 3rd Biennial Schizophrenia International Research Society Conference, Florence, Italy, 14th to 18th April. — Study 1

Barron, D., Morgan, K. D., Swami, V., Hutchinson, G., & Towell, T. (2016). Cultural influences on schizotypy among British and Trinidadian adults: An event-related potential and latent mean comparison study. 4rd Biennial Schizophrenia International Research Society Conference, Florence, Italy, 2nd to 5th April. — Study 5

1 Introduction

The concept of personality and its disorders have become increasingly central to the understanding of mental illness. This is particularly the case as dimensional and continuum models have begun to dominate the conceptual explorations of mental illness (Baumeister, Sedgwick, Howes, & Peters, 2017; Elahi, Algorta, Varese, McIntyre, & Bentall, in press; Subramaniam et al., 2017; Wright & Simms, 2015). As an indicator of the value of this continuum concept, the need for screening and early intervention as means of reducing the burden of psychosis have identified schizotypy as a vital bridge to an understanding of the onset of psychosis in general and schizophrenia in particular (Kwapil & Barrantes-Vidal, 2015; Zarogianni, Storkey, Johnstone, Owens, & Lawrie, 2017).

Schizotypy represents a constellation of personality factors thought to reflect the liability and subclinical quintessence of schizophrenia in the general population (Claridge, 1997; Ettinger et al., 2015; Lenzenweger, 2011). Observed in both clinical and non-clinical populations, schizotypy is characterised by thought processes and psychological experiences that are associated with psychosis and the paranormal, such as paranoia, magical thinking, and cognitive disorganisation (e.g., Raine, 2006). The broad schizotypic phenotype is heterogeneous, with two explanatory theoretical underpinnings: the categorical (taxonic) and continuous (dimensional) structures. This chapter will present these theoretical conceptions of schizotypy, with a review of theory-specific schizotypal measurement and an introduction to the multidimensionality of schizotypy. Following this, an overview of schizotypy and associated traits and deficits, with a focus on cognitive functioning, will be discussed. Finally, mirroring electrophysiological dysfunction found in the schizophrenia literature, early processing deficits of schizotypy will be presented.

1.1 Theoretical Conceptions of Schizotypy

In the absence of full-blown psychosis, mild forms of schizophrenia – where individuals initially express traits qualitatively similar to schizophrenic symptoms – often appear in non-psychotic relatives of patients and may precede the onset of clinical psychosis (Chapman, 1966; Gillies, 1958; Heston, 1970; Planansky, 1966). Early scholars, such as Kraepelin (1909-1913/1971) and Bleuler (1911/1950), described schizophrenia-like traits in relatives of patients and in patients prior to illness. Kraepelin described mild and subclinical symptoms as precursors to dementia praecox, while Bleuler described patients performing "crazy acts in the midst of normal behaviour" (p. 252) preceding onset of schizophrenia. Kraepelin and Bleuler were the first to collate these symptoms and establish the term 'latent schizophrenia', used to describe individuals who expressed schizophrenic-like symptoms. These individuals were most often biological relatives of those suffering from schizophrenia, providing a theoretical foundation for a possible schizophrenia liability model (Kendler, 1985). Indeed, the Danish Adoption Study (Kety, Rosenthal, Wender, & Schulsinger, 1968) advanced the understanding of the role that genetic factors play in 'latent schizophrenia' by highlighting that the schizophrenia-like symptoms were more prevalent in reared-apart biological relatives of adoptees with schizophrenia in comparison to biological relatives of controls (Kety et al., 1968; Kety et al., 1994; Tarbox & Pogue-Geile, 2011). This suggested that the syndrome was genetically associated with schizophrenia. Kety and colleagues labelled this syndrome 'borderline schizophrenia' and identified five symptom categories: interpersonal, atypical speech, cognitive perceptual, neurotic traits, and affective deficits (Kety et al., 1968; Kety, Rosenthal, Wender, & Schulsinger, 1971). Spitzer et al. (1979) subsequently modified these criteria and it was incorporated as Schizotypal Personality Disorder (SPD) in the third editions of the *Diagnostic and*

Statistical Manual (*DSM-III* and *DSM-III-R*).

Rado (1953) introduced the term 'schizotype' to characterise those expressing an alternate manifestation of such genetic liability. Rado suggested that the interaction between certain environmental factors with an inherited predisposition to schizophrenia resulted in a schizophrenic phenotype. These schizotypic individuals were proposed to have a neurochemically-based diminished capacity to experience pleasure (pleasure deficiency), stemming from an inherited pleasure potential coded in the infant's genes (Lenzenweger, 2011; Rado, 1960). A further suggested aspect in schizotype personality organisation was a proprioceptive diathesis that resulted in an aberrant awareness of the body, which gives rise to schizotypic body image distortions (Lenzenweger, 2011; Rado, 1960). An important aspect of Rado's (1960, p. 416) model focused on what he termed "developmental stages of schizotypal behaviour"; these developmental stages were essentially a continuum view of clinical compensation (Lenzenweger, 2011). Rado's continuum model implied that, depending on the manifestation of schizotypal behaviour, outcomes could range from 'stable compensated' schizotypy to 'deteriorated schizophrenia'.

Rado's (1960) observations of the schizotype were subsequently developed through Meehl's (1962, 1990) model of schizotypy encompassing genetic factors, social learning, and clinical symptomology. Meehl proposed that an aberration (termed 'hypokrisa') in a single dominant gene (the 'schizogene') during brain development results in a widespread defect in the synaptic control system of the central nervous system (CNS) at a neuronal level, resulting in schizotaxia (i.e., a predisposition to schizophrenia; Meehl, 1989). If, for example, there is an interplay of adverse environmental influences and social learning history, the schizotaxic individual may develop a schizotypal personality. Thus, Meehl viewed schizotypy as the personality organisation resulting from schizotaxia and that represents the underlying vulnerability

for developing schizophrenia. Meehl described something that was genetically influenced and would predispose to schizophrenia, clinical schizotypic disorders, or apparent normalcy depending on the amount of interaction between schizotaxia and polygenic potentiators (see Figure 1). These potentiators include: social introversion, hypohedonia, low energy, hypoarousal, passivity, and anxiety (Meehl, 1990; Lenzenweger, 2011).

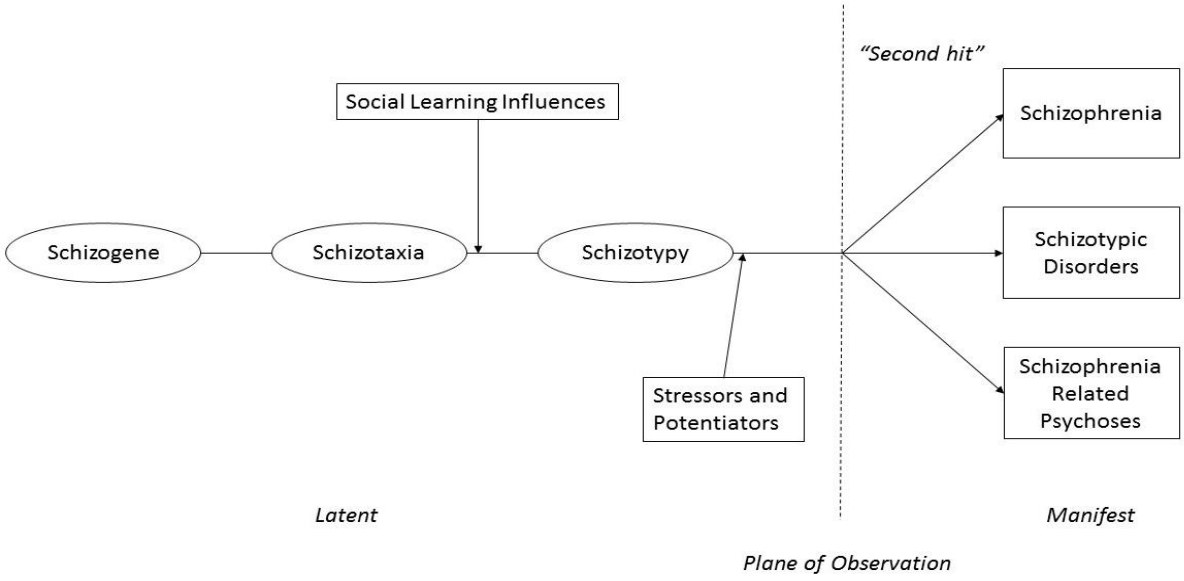


Figure 1. The taxonic model of schizophrenia, schizotaxia, and schizotypy (inspired by Meehl, 1962, 1990; with modifications by Lenzenweger, 2011). The plane of observation represents the divide between non-clinical and clinical manifestations of schizotypy, with factors to left of the plane representation the non-clinical, latent, and therefore unobservable, and factors to right of the plane indicating the manifest, and therefore observable, outcomes. A DNA-based liability (schizogene) produces an impaired central nervous system based neural circuity (schizotaxia) that results in the personality organisation of schizotypy. Further, social learning influences may interact with schizotaxia to produce schizotypy. Psychosocial stressors and polygenic potentiators interact with schizotypy to manifest into certain clinical outcomes. Possible clinical outcomes are reflected through schizophrenia, schizotypic psychopathology (primarily, schizotypal or paranoid personality disorder), or schizophrenia related psychoses (e.g., delusional disorder). The manifested outcome may be influenced by a "second hit" by an external agent (e.g., maternal influenza), which may trigger an outcome. Adapted from Lenzenweger (2011, p. 166).

Meehl (1962, 1990) defined schizotypy as taxonic in nature and estimated that schizotaxia leads to non-psychotic schizotypy in 10% of the general population, with a similar estimate of this subgroup developing schizophrenia (Lenzenweger, 2006). Evidence from studies with taxometric analyses have found this estimate to be fairly consistent, with findings suggesting a taxon of 8.5-10.5% in undergraduate and general population samples (e.g., Korfine & Lenzenweger, 1995; Linscott, Lenzenweger, & van Os, 2010). However, this taxonic model of schizotypy was based on the central component of the single gene model of schizotaxia, schizotypy, and schizophrenia, which has not received support throughout the schizophrenia literature (e.g., Gottesman & Shields, 1976). Instead, current literature in this field describes schizophrenia as a complex, heterogeneous, and polygenic disorder (Insel, 2010; Nivard et al., in press; Purcell et al., 2014; Purcell et al., 2009). Although Meehl suggested that polygenetic potentiators may increase or decrease the likelihood of transition to schizophrenia, the basis of the model was a single gene that was necessary for schizophrenia to develop (Kwapil & Barrantes-Vidal, 2015). Another aspect of Meehl's hypothesising concerned the taxonomic relationship between primary and secondary hypohedonia and schizotaxia/schizotypy (Meehl, 2001). While this relationship has not been conclusively demonstrated – that is, hypohedonia as a core feature of this phenotype (Linscott, 2007) – the presence of schizotypy does seem to distinguish itself in those with schizophrenia through impaired attention and memory, more negative symptoms, and therefore poorer global functioning (Everett & Linscott, 2015). This has implications for considering schizotypy as either categorical or dimensional. Mason (2014) suggested that the positive schizotypal traits (hallucination proneness, paranoia and delusional thought) are more dimensional than the negative traits (anhedonia/social impairment), which are more taxonomic and discontinuous. Gene-environment interactions and epigenetic

mechanisms may also make positive schizotypy appear to be discontinuous. However, Widiger (2001) raised concerns regarding taxonic models of psychopathology, with mental disorders resulting from multifactorial genetic and environmental influences that are inconsistent with taxonic models.

Combined, Rado's (1953) and Meehl's (1962, 1990) models represent a quasi-dimensional view of schizotypy as an attenuated form of schizophrenia. The main component of this understanding is that schizotypy is seen as a primary clinical progression, which can develop depending on the degree of expression of the underlying cause. Schizotypy also has a basis in the field of personality and individual differences. This alternative interpretation accounts for the prevalence of psychotic-like experiences (e.g., hallucinations) that may occur within the general population. Developed by Claridge and colleagues (e.g., Claridge, 1997; Claridge & Beech, 1995), this model of schizotypy was built on dimensional models of personality and psychopathology, and suggests that schizotypy is fully dimensional in nature and includes adaptive manifestations. This model proposes that schizotypy results from an interaction of genetic, environmental, and personality differences that are normally distributed in the general population (Claridge & Beech, 1995), distinguishing itself from the quasi-dimensional approach that only applies to a subset of the population. As well as encompassing the quasi-dimensional model, Claridge also argued for continuity of schizotypic traits as part of a healthy personality make-up and as a predisposition to schizophrenia (see Figure 2). In this view, it has been suggested that schizotypy can be thought of as a similar trait to anxiety that can be seen in the general population, but in its extreme forms may result in clinical disorders (Claridge & Beech, 1995).

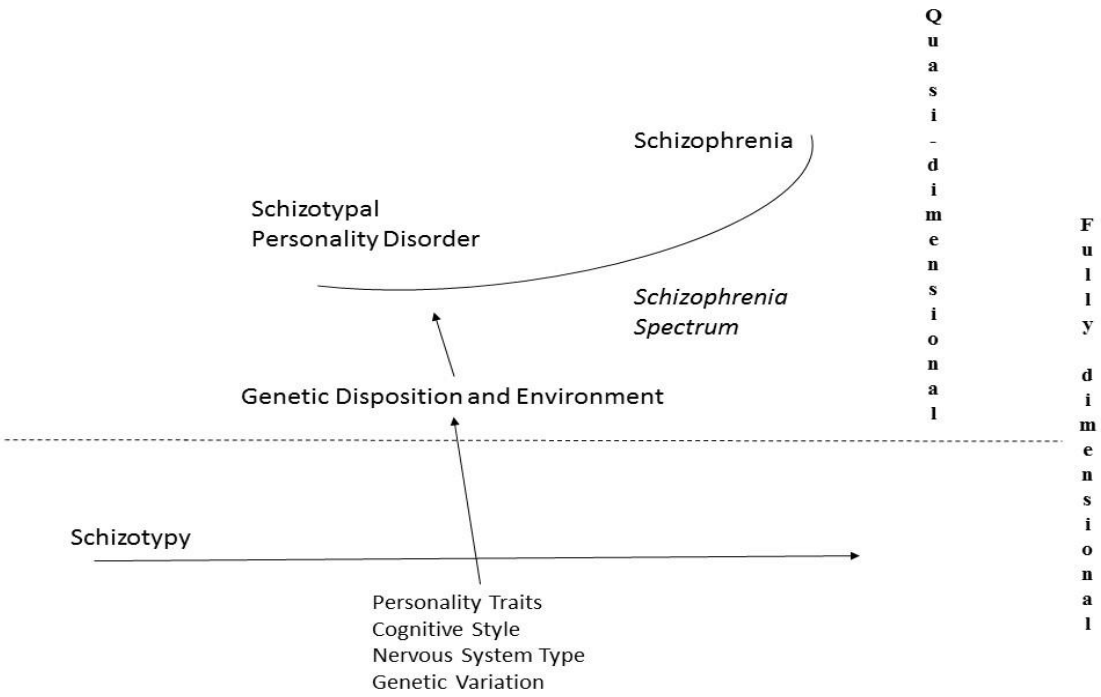


Figure 2. Comparison of the quasi-dimensional and fully dimensional models of schizotypy as defined by Claridge (1997). The quasi-dimensional model corresponds to the *forme furste*, or psychopathology-based view, where continuity exists but only as far as reflecting a variation in the underlying disease process. This contrasts with the fully dimensional model which includes the quasi-dimensional component but is more personality-based. The dotted line represents non-clinical and clinical manifestations of schizotypal traits and the arrow represents the schizotypal spectrum, with the curved line representing the schizophrenia spectrum. Adapted from Claridge (1997, p. 12).

Although high ratings of schizotypy may be aligned with several symptoms associated with psychosis (e.g., cognitive and behavioural aberrations), Claridge and colleagues (Rawlings, Williams, Haslam, & Claridge, 2008, p. 1670) postulated that "psychotic traits constitute an essentially healthy dimension of personality". However, advocates of healthy schizotypy do not disregard the association between schizotypy and anomalous experiences (McCreery & Claridge, 2002). Rather, they portray the schizotypal temperament in a more neutral fashion, predisposing all variants of abnormal experiences, including both adaptive and conflicted transformations with

varying levels of intensity. Therefore, this approach suggests that there may be conceptual issues with schizotypal traits viewed simply as predisposition to pathogenic anomalous experiences (e.g., schizophrenia), and therefore with operationalising schizotypal traits as the attenuated expression of psychotic disorder phenomenology (McCreery & Claridge, 2002). One adaptive effect that those with high schizotypy may possess is enhanced creativity (Nelson & Rawlings, 2010). It is thought that atypical lateralisation and consequent hemispheric asymmetry prompts a cognitive processing style that unites creativity with schizotypy (Lindell, 2014). This idea was first explored by Leonhard and Brugger (1998), who suggested that reduced left hemispheric language dominance fosters an unfocused semantic processing, which is useful in creativity and seen in schizotypy. Indeed, Batey and Furnham (2008) highlighted the positive association between creativity and unusual experiences and impulsive nonconformity, with a negative association for creativity and cognitive disorganised schizotypal traits. Further, Claridge and Blakey (2009) found associations between the schizotypal trait of unusual experiences (i.e., positive schizotypy) and creativity. Despite this evidence, "healthy" psychosis, as well as Claridge's theoretical position in general, has been suggested to be ungrounded in the clinical realities of schizotypy (Lenzenweger, 2010). Nevertheless, there is substantial evidence to support its relevance both in the clinical (psychosis-proneness and personality disorder) domain, as well as in the pure psychological personality domain with confirmation of a clear factor structure of its constituent traits (Mason, 2015).

1.2 Multidimensionality of Schizotypy

Both schizotypy and schizophrenia are heterogeneous (Kwapil & Barrantes-Vidal, 2015). This can be seen at the phenotypic level, with deficits ranging from slight abnormalities (e.g., asocial behaviour) to more substantial excesses (e.g., hallucinations)

and disorganised thinking (e.g., thought disorders). Moreover, this can be seen at the aetiological and developmental levels, with schizotypy and schizophrenia appearing to be characterised by a similar multidimensional structure (Kwapil & Barrantes-Vidal, 2015). That is, factor analytic studies of schizophrenia suggest that there are at least three dimensions – namely positive, negative, and disorganised (e.g., Lenzenweger & Dworkin, 1996) – that have been replicated in non-clinical schizotypal samples (e.g., Vollema & van den Bosch, 1995).

The positive, or psychotic-like, dimension is characterised by disruptions in the content of thought (from odd beliefs and magical ideation to delusions), odd perceptions (from illusions to hallucinations), and suspiciousness. Regarding content of thought, this may include grandiose insight, intense religious dependence, or belief in phantasia, specifically telepathy, clairvoyance, and extrasensory perception (Chequers, Joseph, & Diduca, 1997; Hardy, 1979; Maxwell & Tschudin, 1990). Odd perceptions are not limited to hallucinatory-like experiences, but also include distortions and hypersensitivities to sounds and smells, which may potentially lead to hallucinations (Bell, Halligan, & Ellis, 2006). Both thought and perceptual aberrations may also include confusion with reality, personalisation, and the feeling of *presque vu* or *déjà vu* (Eckblad & Chapman, 1983). While extreme forms of these symptoms may be problematic, such as being accepted within in a society, a large number of individuals do not find the symptoms distressing and instead successfully integrate the characteristics into their lives (Jackson, 1997). Despite the positive factor being the most consistent factor emerging from factor analytic studies (Vollema & van den Bosch, 1995), there has been much debate as to whether it is indeed two factors, distinguishing unusual perceptual experiences from paranoid-like beliefs (Compton, Goulding, Bakeman, & McClure-Tone, 2009; Stefanis et al., 2004b).

Negative schizotypy refers to deficit-like symptoms, such as anhedonia, social anxiety, lack of close friends, and general disinterest (Dinn, Harris, Aycicegi, Greene, & Andover, 2002; Sarkin, Dionisio, Hillix, & Granholm, 1998). It could be argued that these symptoms are primarily related to the idea of reduced ability or expectation of psychotic individuals to experience pleasure from social and physical stimulation. However, other studies suggest that, in schizotypy, this factor has more specific social-anxiety and social-impairment connotations rather than referring to physical anhedonia (Gruzelier, 1996; Venables & Rector, 2000). Torgersen (1985) suggested that a diagnostic criterion for schizotypy that focuses on negative (interpersonal and affective disability) symptoms might be more specific to the disorder and might advance research in the early-detection of psychotic disorders.

Dimensions relating to disorganisation include disruptions in the ability to organise and express thoughts and behaviour, which may range from mild disturbances in thinking and behaviour progressing to formal thought disorder (Kwapil & Barrantes-Vidal, 2015; Mason, Claridge, & Jackson, 1995; Raine, 2006). Schizotypal symptoms associated with this factor include odd or eccentric behaviour and odd speech (Raine et al., 1994). Some scholars have argued for the existence of an asocial component to be included in, or to replace, the disorganised factor of schizotypy (Bentall, Claridge, & Slade, 1989). Asocial schizotypy is believed to reflect impulsive non-conformity and the likelihood of engaging in hostile interactions, including irritation and anger (Shean & Wais, 2000). Indeed, there is some evidence to suggest that high schizotypal scores are associated with measures of conflict disorder comprising of physical and verbal aggression (Raine, Venables, Mednick, & Mellingen, 2002).

These dimensions have been found to be reasonably invariant across age, gender, culture, and religious affiliation, and therefore reflect stable factors of the schizotypy construct (Fossati, Raine, Carretta, Leonardi, & Maffei, 2003; Reynolds,

Raine, Mellingen, Venables, & Mednick, 2000). While these factors remain fairly consistent, there has been evidence of additional factors or a sub-division of factors dependent on the measurement tool employed. The following section will unpack these additional factors with the discussion of various schizotypal assessment measures.

1.3 Schizotypal Assessment

The varying theoretical approaches have been operationalised through different self-report measures and interview schedules. Where the emphasis is on a more personality-based approach to measurement (i.e., Claridge), schizotypy is framed as a personality construct similar to other personality dimensions, such as neuroticism with various subdimensions. On the other hand, the more clinical approach to schizotypy measurement (i.e., Meehl) takes a symptomatic or diagnostic approach to assessment (Bentall et al., 1989; Mason, 2015; Vollema & van den Bosch, 1995). This section will outline the main measures derived from both the personality and clinical theoretical approaches to schizotypy[2], with a focus on one of the main schizotypal measurement tools; this will include cross-cultural considerations specific to each measure and in general.

1.3.1 Personality Measures of Schizotypy

The Eysenckian approach of broad personality dimensions initially influenced the personality-based measures of schizotypy with both the original and revised

[2] The measures included in this section refer to those designed to directly assess schizotypy. For example, there are a plethora of paranoid ideation scales that measure components of schizotypy (e.g., the Paranoid Thoughts Scale measures the schizotypal feature of Ideas of Reference; Green et al., 2008), but these are not included here as they do not directly measure schizotypy as a construct itself.

Psychoticism Scales (see Table 1; Eysenck & Eysenck, 1975; Eysenck, Eysenck, & Barrett, 1985). The original scale had content directly relevant to psychosis, but suffered from poor internal consistencies and low endorsement rates – the very antithesis of the intention of normally distributed personality traits (Claridge, 1997; Mason, 2015). Eysenck et al.'s (1985) revision aimed to amend the weaknesses of the original scale, but instead moved the focus of the scale towards items addressing antisocial, impulsive, and nonconformist traits. This shift of focus led researchers to label the scale as more of a measure of psychopathy as opposed to psychosis proneness (Zuckerman, 1993). Irrespective of the label, the Psychoticism Scales have been criticised on the grounds of their specificity and criterion validity (Claridge, 1983), as well as issues with predictive validity (Chapman, Chapman, & Kwapil, 1994). For example, in factor analytic studies, instead of loading on to psychotic-like factors, scores on the Psychoticism Scales have tended to load on to factors reflecting impulsive non-conformity. This has brought into question the scale's relevance for use in psychosis research (Bentall et al., 1989; Claridge et al., 1996; Raine & Allbutt, 1989). However, from this, successive authors have sought to construct improvements to broaden the trait content and issues with validity (Claridge, 1997).

Nielsen and Petersen (1976) developed a scale of 'schizophrenism', a subschizophrenic trait characterised by withdrawal and cognitive abnormalities. The authors reported inter-scale correlations that were troublesome (*r*s = .53-.78), as they were indicative of potential multicollinearity. Rust (1988) later developed the Rust Inventory of Schizotypal Cognitions (RISC), a scale designed to tap different aspects of 'psychoticism' compared to the Psychoticism Scale. The RISC measures mild schizotypal cognitions from the positive spectrum of traits and focuses on avoidance of clear pathological items present in other scales (e.g., the Chapman scales; see Section 1.3.2).

Table 1. Personality-Based Measures of Schizotypy

Measure	Formulation	Internal Consistency	Content
Psychoticism Scales			
Original scale Eysenck and Eysenck (1975)	Single scale; 25 items	.68-.74	Description of features including aggressiveness, egocentrism, impulsivity, creative, lack of empathy, and impulsiveness.
Revised scale Eysenck et al. (1985)	Single scale; 32 items	.76-.78	Similar content to original scale but with greater focus on antisocial, impulsive, and nonconformist traits.
Schizophrenism Scale Nielsen and Petersen (1976)	Single scale; 14 items	Not Reported	Description of features associated with attentional difficulties and social anxiety
Rust Inventory of Schizotypal Cognitions Rust (1988)	2 subscales; 26 items	.67-.77	Cognitive schemata of suspicion, magical ideation, ritual, subjectivity, thought isolation, and self-delusion, which are not uncommon in the normal population.

Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE)			
O-LIFE Mason et al. (1995)	4 subscales; 104 items	.77-.89	Unusual experiences relating to magical thinking and hallucinations; cognitive disorganisation such as social anxiety, poor attention, and moodiness; introvertive anhedonia characteristics including social and physical anhedonia, and avoidance of intimacy. Impulsive non-conformity traits relating to eccentric behaviour and self-control.
O-LIFE Short Mason et al. (2005)	4 subscales; 43 items	.62-.80	Similar content to original scale with reduced item set.
Community Assessment of Psychic Experiences Stefanis et al. (2002)	3 subscales; 40 items	.62-.64	Positive psychotic-like experiences; negative symptoms including emotional deficits, lack of motivation, and social disinterest; and cognitive symptoms of depression.

Indeed, Miller, Lawrie, Byrne, Cosway, and Johnstone (2002) suggested that high scores on the RISC represent the existence of psychotic symptoms. However, Chapman, Chapman, and Kwapil (1995) suggested that the main reason for investigating schizotypal cognitions was to diagnose SPD and suggested that there was little evidence of the RISC detecting SPD in a non-psychotic population.

One of the most widely-used personality measurements of schizotypy is the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason et al., 1995), which was developed from the Combined Schizotypal Traits Questionnaire (CSTQ; Bentall et al., 1989), a combination of 15 scales that measures different aspects of schizotypy. Although comprehensive, the CSTQ is not especially practical for use in experimental research, as administration of its 410 items is time-consuming and highly repetitive. The O-LIFE consists of four scales derived from four factors through factor analysis of the scales in the CSTQ (Claridge et al., 1996): *Unusual Experiences, Cognitive Disorganisation, Introvertive Anhedonia, Impulsive Non-conformity,* with three other scales of Eysenck's Extraversion Scale, a lie scale, and Claridge's Schizotypal Traits Questionnaire (STA; based on diagnostic criteria for schizotypal personality disorder; see Section 1.3.2). The latter three scales were included as a foundation of known validity and reliability (Burch, Steel, & Hemsley, 1998). The four new scales set out to measure different aspects of the schizotype, with *Cognitive Disorganisation* and *Unusual Experiences* reflecting positive symptomatology, *Introvertive Anhedonia* reflecting negative symptoms, and *Impulsive Nonconformity* having high positive loading with Eysenck's Psychoticism Scale (Claridge et al., 1996). Rather than serving quasi-clinical aims, the primary use of the O-LIFE has been to explore relationships with a range of preferences, behaviours, and task performances including creativity, laterality, mentalising, and neurocognition (Mason, 2015).

The Community Assessment of Psychic Experiences (CAPE; Stefanis et al., 2002) was developed to measure the lifetime prevalence of psychotic-like experiences in the general population (Konings, Bak, Hanssen, van Os, & Krabbendam, 2006; Stefanis et al., 2002), and findings with this scale indicated self-reported psychotic-like experiences to be stable, reliable, and valid (Konings et al., 2006). The CAPE is based in part on the more clinical Peters Delusional Inventory (Peters et al., 1991), with two additional hallucination items and 14 negative items. The CAPE reflects positive and negative psychotic symptoms, yet is limited as an overall measure of schizotypy because of the lack of a disorganised factor.

1.3.2 Clinical Measures of Schizotypy

Meehl and colleagues (Meehl, 1964; Golden & Meehl, 1979) developed the 7-item checklist of schizotypic traits that could be used to identify those with the schizoid taxon prior to schizophrenia decompensation (see Table 2). This Schizoidia Scale measured symptoms of acute ambivalence, countertransference strain, parental hatred, magical ideation, societal fear, and touch aversion. However, this scale was not internally consistent, with a later study reporting coefficient alpha values of .16-.27 (Chapman, Chapman, & Miller, 1982); as a result, the checklist was rarely used in formal study. Nevertheless, the content of the Schizodia Scale provided the basis for Chapman and colleagues to develop a series of self-report scales to separately address each feature of schizotypy. These scales took an individual attenuated form of psychotic symptom (e.g., magical ideation) and formed a questionnaire with acceptable reliability and power to identify the schizotype. The items were designed more for clinical samples; as such, they are quite limited for use in the general population (Mason, 2015). The most widely-used of the measures are the Physical Anhedonia Scale (Chapman et al., 1976) and the Revised Social Anhedonia Scale (Eckland et al., 1982), with

substantial evidence that anhedonia is a risk marker for psychosis (Mason, 2015). As an indicator of positive schizotypy, the Perceptual Aberration and Magical Ideation scales have been widely used and are often combined to form a single scale (e.g., the "Per-Mag" Scale; Gooding, Shea, & Matts, 2005). Extensive cross-sectional research has indicated that higher ratings on these measures reflect physiological and psychological deficits associated with psychosis (Gross, Silvia, Barrantes-Vidal, & Kwapil, 2012).

As such, Gooding et al. (2006) reported that those with high ratings on either the Perceptual Aberration Scale, Magical Ideation Scale, or Revised Social Anhedonia Scale exhibited impaired sustained attention. Indeed, longitudinal studies have indicated that high scorers on these scales are at a greater risk for psychosis (Chapman et al., 1994; Gross et al., 2012; Kwapil et al., 1997; Kwapil, 1998; Gooding et al., 2005). However, particularly due to the substantial length when combining these measures and the inclusion of poorly discriminating items, Winterstein et al. (2011) developed a brief version. They retained items from the original scales with high item difficulty, high discrimination, and low differential functioning. The four resulting shortened scales, of 15 items each, had coefficient alpha values (.62-.83) lower than the original (.78-.94), highlighting internal consistency problems (Mason, 2015).

Other scales that have been specifically designed to assess components of Meehl's schizotypy model include the Referential Thinking Scale (Lenzenweger, Bennett, & Lilenfeld, 1997), the Social Fear Scale (Raulin & Wee, 1984), and the Schizotypal Ambivalence Scale (Raulin, 1986).

Table 2. Schizotypal Scales Based on Clinical Concepts

Measure	Formulation	Internal Consistency	Content
Schizoidia Scale			
Meehl (1964) Golden and Meehl (1979)	Single scale; 7 Items	Not Reported	Intense ambivalence; countertransference; Strain; hatred of mother; magical ideation; social fear; and touch aversion.
Wisconsin Schizotypy Scales			
Physical Anhedonia Scale Chapman et al. (1976)	Single scale; 40 items	.78-.84	Deficit of sensory and aesthetic pleasure, including, touch and sight.
Perceptual Aberration Scale Chapman et al. (1978)	Single scale; 35 items	.88-.94	Perceptual and bodily distortions.
Revised Social Anhedonia Scale Eckblad et al. (1982)	Single scale; 40 items	.84-.88	Asociality and indifference to other people.
Magical Ideation Scale Eckblad and Chapman (1983)	Single scale; 30 items	.83-.85	Belief in implausible or invalid constructs, including psychokinesis, precognition, and secret messages.

Wisconsin Schizotypy Scales Short Forms Winterstein et al. (2011)	4 subscales; 60 items	.62-.83	Short forms of the four Wisconsin Schizotypy Scales, with reduced item set.
Schizotypy Traits Questionnaire Claridge and Broks (1984)	9 lower order domains; Single scale (1–4 higher order domains*); 37 items	.82	*DSM-III* SPD criteria: Ideas of reference; excessive; social anxiety; odd beliefs or magical thinking; unusual perceptual experiences; odd or eccentric behaviour; no close friends; odd speech; constricted affect; suspiciousness
Social Fear Scale Raulin and Wee (1984)	Single scale; 36 items	.85-.88	Detailed description of social fear based on Meehl's elaboration of the symptom.
Schizotypal Ambivalence Scale Raulin (1986)	Single scale; 35 items	.88-.92	Based on Meehl's cognitive slippage traits consisting of speech deficits and confused thinking.
Schizophrenism and Anhedonia Scale Venables et al. (1990)	2 subscales; 30 items	.76-.82	Cognitive-perceptual aspects of schizotypy and anhedonia.

Schizotypal Personality Questionnaire (SPQ)			
SPQ Raine (1991)	9 lower order; Single scale; (2-7 higher order domains*); 74 items	.91	*DSM-III* SPD criteria: Ideas of reference; excessive; social anxiety; odd beliefs or magical thinking; unusual perceptual experiences; odd or eccentric behaviour; no close friends; odd speech; constricted affect; suspiciousness.
SPQ - Brief Raine and Benishay (1995)	3 subscales; 22 items	.72-.78	Similar content to original scale with reduced item set. Screen for *DSM-IV* SPD criteria: Ideas of reference; excessive; social anxiety; odd beliefs or magical thinking; unusual perceptual experiences; odd or eccentric behaviour; no close friends; odd speech; constricted affect; suspiciousness.
SPQ - Brief Revised Cohen et al. (2010)	7 subscales 32 items	.70-.86	*DSM-IV* SPD criteria: Ideas of reference; excessive; social anxiety; odd beliefs or magical thinking; unusual perceptual experiences; odd or eccentric behaviour; no close friends; odd speech; constricted affect; suspiciousness.
Referential Thinking Scale Lenzenweger et al (1997)	2 subscales 34 items	.83-.85	Referential experiences including guilty referential interpretation of an inter/intrapersonal nature.

Peters Delusional Inventory (PDI)			
PDI – 40 Peters et al. (1999b)	10 domains of delusional belief; 40 items	.88	A range of delusional ideas are rated for presence and appraisals of distress, preoccupation, and conviction.
PDI – 21 Peters et al. (2004)	11 domains of delusional belief; 21 items	.82-.93	Similar content to original scale with reduced item set.
Revised Hallucination Scale Morrison et al. (2000)	2 subscales; 13 items	.64-.75	Predisposition to auditory and visual hallucinations.

* Subsequent factor analytical studies have revealed further division of higher order subscales.

The Schizophrenism and Anhedonia Scale (Venables et al., 1990) is another measure created by combining items from existing self-report schizotypy assessment tools (e.g., the Schizophrenism Scale). Developed with a non-clinical sample, this measure was intended to assess both positive (i.e., *Schizophrenism*, highlighted by perceptual, cognitive, and attentional abnormalities) and negative factors (i.e., *Anhedonia*, indicated through withdrawal and anhedonia). The validation of this scale has involved correlations of high scorers with performance and biological markers on a variety of experimental tasks theoretically relevant to psychosis, such as reaction time and electrodermal activity (e.g., Hazlett, Dawson, Filion, Schell, & Nuechterlein, 1997). With findings indicating that the high scorers on the scale demonstrated similar cognitive and physiological associations as clinical schizophrenia samples, the validity of the scale appears to be supported (Venables et al., 1990). Further, Raine (1987) found strong support for the *Schizophrenism* factor through significant correlations with SPD symptoms, although this did not extend to the *Anhedonia* factor. Despite this, the Schizophrenism and Anhedonia Scales focuses on social anhedonia, but do not directly address items relating to social anxiety. This is problematic considering the increasing evidence for the role of social anxiety in the psychoses literature (Birchwood, 2003).

Reflecting syndrome-based measurement, several assessments of schizotypy have been based on the various versions of the *DSM*. One of the first to utilise such a method was the Schizotypy Traits Questionnaire (STQ; Claridge & Broks, 1984). While Claridge and colleagues were advocates, and indeed pioneers, of Eysenck's view of psychosis being the extreme point of a normal personality dimension, this did not necessarily extend to psychoticism and the Psychoticism Scales. Instead, they suggested that the personality dimension relevant to psychoticism might be measured by items based on the clinical symptoms of schizophrenia (Chapman et al., 1995). Using the *DSM-III* diagnostic criteria for SPD and borderline personality disorder, two scales were

established with the STQ: the Schizotypal Personality Scale (STA) and the Borderline Personality Scale (STB). The STA, unlike the Psychoticism Scale, yields higher scores for partially-recovered schizophrenics than for control participants (Jackson & Claridge, 1991). However, ratings for family members of schizophrenia patients have been found to be significantly lower than controls or the relatives of neurotic participants (Claridge, Robinson, & Birchall, 1983). While the authors attributed this finding to extreme defensiveness of relatives who may recognise many of the symptoms and therefore wish to avoid the perception of having similar thoughts to their relative, this does highlight some potential validity issues with the STA. The STB scale has been found to have a high loading on the disorganisation factor of schizotypy, but was designed to measure characteristics more akin to borderline personality disorder than SPD, and as such Claridge et al. (1996, p. 112) suggested that this is "closer to affective than to schizophrenic psychoses".

One well-established measure that assesses schizotypal personality as defined in the *DSM* is the Schizotypal Personality Questionnaire (SPQ; Raine, 1991). In both its original 74-item form (Raine, 1991) and its brief 22-item form (SPQ-B; Raine & Benishay, 1995), these measures assess the nine features described in *DSM-III-R/IV/V* (see section below for full details of the SPQ). The extensive use of the original form of this questionnaire has made the SPQ an important measurement tool for schizotypy research (Mason, 2015). However, the SPQ-B has had issues with internal consistency within factors ($\alpha s < .70$) due to the number, and depth of content, of items being heavily reduced. This seems to have resulted in a high level of inter-correlation between items from different subscales and a less robust factorial structure (Axelrod, Grilo, Sanislow, & McGlashan, 2001; Compton, Chien, & Bollini, 2007). This led Cohen et al. (2010) to develop a revised brief scale (SPQ-BR), with alternative items and a change from dichotomous scoring to a rating scale. The *DSM* criteria for SPD as a measure of

schizotypy has also taken the form of the most prominent semi-structured interview measure for schizotypal traits: the Structured Interview for Schizotypy (SIS; Kendler, Lieberman, & Walsh, 1989) and the shortened revised version (SIS-R; Vollema & Ormel, 2000). The symptoms are rated for frequency, duration, and level of conviction. The SIS-R remains the most detailed interview measure entirely focused on schizotypy in use today (Mason, 2015).

In addition, several individual scales have been designed to measure a single feature, such as the Revised Hallucination Scale (RHS: Morrison et al, 2010), which is a useful addition to the broader trait scales aforementioned. Another single-trait measure is the Peters Delusions Inventory (PDI; Peters et al., 1999b), which is theoretically based on the Beckian cognitive tradition, where delusional ideas are also rated for conviction, preoccupation, and distress (Mason, 2015). The scale has been shown by the authors to have good internal consistency and concurrent validity. Furthermore, it has been widely used in a range of studies assessing the psychosis continuum (e.g., Peters, Day, McKenna, & Orbach, 1999a).

1.3.3 The Schizotypal Personality Questionnaire

Instead of being designed to measure dimensional factor structures, the SPQ was designed have one subscale for each of the nine symptoms of SPD (Raine, 1991). These nine schizotypal aspects reflect: no close friends, constricted affect, ideas of reference, odd beliefs and magical thinking, unusual perceptual experiences, odd or eccentric behaviour, odd speech, suspiciousness, and excessive social anxiety. As the SPQ was constructed to reflect schizotypal symptomatology, rather than latent factorial domains, the higher-order domain structure was initially not clear (Cicero, 2015). Raine et al. (1994) grouped the nine subscales into three higher-order domains: *Cognitive-Perceptual*, *Interpersonal*, and *Disorganised*. Indeed, subsequent exploratory and

confirmatory factor analyses, with English and non-English versions of the SPQ, have confirmed this latent structure to have adequate fit (Chen, Hsiao, & Lin, 1997; Claridge et al., 1996; Reynolds et al., 2000; Rossi & Daneluzzo, 2002).

SPQ findings with the 3-factor model suggest measurement invariance across some cultures, religious affiliation, family adversity, psychopathy, and sex (Reynolds et al., 2000). In general, women score significantly higher on the *Cognitive-Perceptual* dimension and men score significantly higher on the *Negative* and *Disorganised* dimensions (Bora & Baysan Arabaci, 2009; Fossati et al., 2003; Raine, 2006). However, fit indices reported in some studies have generally been below accepted levels (Chmielewski & Watson, 2008; Kerns, 2006; Wuthrich & Bates, 2006). Further, consistency through exploratory (Miller & Tal, 2007), principal (Chmielewski & Watson, 2008), and confirmatory factor analysis (CFA; Bora & Arabaci, 2009; Compton et al., 2009; Stefanis et al., 2004b; Wuthrich & Bates, 2006) has been problematic. Alternative 3-factor models have also emerged, with Venables and Rector (2000) suggesting a model in which *Positive Schizotypy*, *Social Avoidance*, and *Negative Schizotypy* are independent domains. Yet others have suggested that the SPQ may be best suited to a 4-factor structure. For example, Stefanis et al. (2004b) proposed a 4-factor model comprising of *Cognitive-Perceptual*, *Paranoid*, *Negative*, and *Disorganised* dimensions. Confirmation of this structure over alternative solutions, including the 3-factor structure, has since been obtained in multiple populations Bora & (Baysan Arabaci, 2009; Cicero, 2015; Compton et al., 2009; Fonseca-Pedrero et al., 2014).

In addition, the SPQ had been translated into several languages including Chinese (Chen et al., 1997), Turkish (Şener, Bora, Tekin, & Özaşkınlı, 2006), Spanish (Fumero, Santamaría, & Navarrete, 2009), and Greek (Stefanis et al., 2004b). Despite structural investigations of the SPQ, there has been limited work in samples varying in

culture and/or ethnicity. Establishing cross-cultural and cross-ethnic measurement invariance is important because variability in the dimensionality of the SPQ may limit between-group comparisons. Obtaining measurement invariance indicates that change in the latent mean score reflects the latent variable, and is not an artefact of the tool. Reynolds et al. (2000) found evidence of invariance across ethnicity with a Mauritian sample (an Indian sub-sample and a sub-sample with participants consisting primarily of African origin) for the 3-factor structure of the SPQ. Further, there has been evidence of cross-cultural measurement invariance on the SPQ-B with Swiss and Spanish adolescents (Ortuño-Sierra et al., 2013). Recent measurement invariance evidence for a 4-factor structure has also been found with multi-ethnic Greek (Tsaousis, Zouraraki, Karamaouna, Karagiannopoulou, & Giakoumaki, 2015) and Pacific Islander (Cicero, 2015) samples.

1.4 Culture, Ethnicity, Migration and Cross-Cultural factors

Ödegaard (1932), an early contributor to migration and ethnicity influences in the psychosis literature, reported that rates of first-admission for schizophrenia in Norwegian migrants to the United States was twice that of American-born individuals and Norwegians based in Norway. Since then, studies have investigated mental health in different cultural and ethnicity groups within and between countries (Cantor-Graae & Selten, 2005; Morgan, McKenzie, & Fearon, 2008). Indeed, meta-analyses have reported that the risk of developing schizophrenia and other psychoses for first- and second-generation migrant groups varies between 2 and 4.5 times compared to that of the majority ethnic group in the host country (Bourque, van der Ven, & Malla, 2011; Cantor-Graae & Selten, 2005; Tortelli et al., 2015). Ödegaard (1932) suggested this increase in prevalence was mainly due to selection; that is, those who migrate tend to have a predisposition to schizophrenia and psychoses. However, this explanation has

since been challenged (Cantor-Graae, Pedersen, McNeil, & Mortensen, 2003; Selten, Cantor-Graae, Slaets, & Kahn, 2002). Instead of an inherited biological explanation, scholars have suggested that social experience, particularly social disadvantage, may explain far more of the variance in prevalence rates in migrants (Morgan et al., 2008; Sharpley, Hutchinson, Murray, & McKenzie, 2001). This section will introduce ethnicity and cultural effects in the psychosis literature and, by extension, provide insight into schizotypal considerations[3], with particular reference to the African Caribbean population resident in the United Kingdom (UK).

While reflecting related and interconnected concepts, culture and ethnicity are distinct (McKenzie, Fearon, & Hutchinson, 2008). Despite many definitions and interpretations of what culture represents, a common definition is "that culture provides a set of socially shared guidelines or rules that shape and constrain beliefs, attitudes and behaviours" (McKenzie et al., 2008, p.146). This suggests that at its foundation, culture is shaped by behavioural and attitudinal rules of social groups, which consist of norms, values, and beliefs of a particular group of people, reflective of non-biological and social facets of social interactions. That is, culture generally describes the non-biological and social aspects of human life, which are essentially everything that humans learn within a society. Indeed, as these behavioural and attitudinal expressions can be greatly influenced by upbringing and decision-making as an adult, and are thus malleable in nature, culture is a somewhat difficult concept to define and measure (Fernando, 1991; McKenzie et al., 2008). Further, defining 'culture' may be especially

[3] Although this thesis is in the area of non-clinical schizotypy, with the limiting amount of ethnicity and cultural research in the schizotypy literature, a window into the psychosis literature is essential for the presentation of ethnicity and cultural considerations.

challenging with regards to cultural mixing that is apparent from the experiences through migration (Hickling, 2012).

Varying definitions of ethnicity highlight the association between this particular concept and culture (Betancourt & López, 1993; Hickling, 2012). Ethnic groups are generally characterised by the identity of a group that one feels a sense of belonging to; that is, ethnic self-membership tends to be with a group in which an individual asserts heritage (Phinney, 1996). Like culture, these characteristics are not static; instead, ethnicity is dynamic and malleable, being influenced by social and psychological pressures (Jenkins, Rex, & Mason, 1986; McKenzie et al., 2008). One North American study highlighted the dynamic and changeable aspect of ethnicity, where participants were asked to identify their ethnicity at two time-points a year apart (Leech, 1989). Findings indicated that one-third of respondents chose a different ethnicity at the second time-point. Group identity by way of a sense of belonging may be based on common ancestral and national roots, while being influenced by social and psychological experiences. The interrelatedness of ethnicity and culture has led scholars to suggest that ethnicity may provide a gateway to culture (Hickling, 2012), while other scholars suggest elements of culture may provide a common identity, therefore reinforcing one's ethnic identity (Fernando, 1991).

Indeed, Fernando suggests that a sense of belonging may emerge from a societal group that has suffered discrimination and oppression. An example of this can be seen in the UK with a common 'Caribbean' identity for Caribbeans, where a sense of belonging is one aspect that has been accredited to a common identity among migrants from culturally diverse Caribbean islands (McKenzie et al., 2008). As suggested by Fernando, cultural heritage may form a significant component of ethnic identity, but it does not define it, and those who perceive themselves as belonging to an ethnic group may well differ markedly in terms of the cultural reference points that inform their

beliefs and actions (McKenzie et al., 2008). Therefore, scholars should not merge culture and ethnicity in terms of terminology and application in research, and should instead take into consideration both concepts in research design.

As mentioned, meta-analyses have reported that the risk of developing schizophrenia and other psychoses for migrant groups is between 2 and 4.5 times higher than that of the majority ethnic group in the host country (e.g., Cantor-Graae & Selten, 2005). However, individual studies often report far higher incidence rate ratios (IRRs) for certain ethnic groups. In one example, Fearon et al. (2006) found high IRRs for African Caribbeans resident in the UK for both schizophrenia (9.1) and manic psychosis (8.0). However, in Jamaica (Hickling & Rodgers-Johnson, 1995), Trinidad (Bhugra et al., 1996), and Barbados (Mahy, Mallett, Leff, & Bhugra, 1999) the prevalence of schizophrenia is similar to that of the White British population in England, which contrasts with the elevated incidence of schizophrenia in African Caribbean populations in the UK (Fernando, 1998). It has been suggested that the higher prevalence of schizophrenia in African Caribbeans in the UK is due to misdiagnosis. Hickling and colleagues (1999) re-assessed groups of patients with schizophrenia, diagnosed by British psychiatrists in the UK (Hickling was a Jamaican psychiatrist). While the British psychiatrists and the Jamaican psychiatrist diagnosed a similar number of all Black patients[4] (55% and 52%, respectively), with less agreement for the White patients (54% and 42%, respectively), this was not the case for African Caribbean patients. Instead, there were only 55% of African Caribbean cases for which the Jamaican psychiatrist agreed a diagnosis of schizophrenia was appropriate with the British psychiatrists. It has been argued that these instances emanate from emotional distress as a result of difficult

[4] The all-Black patient group consisted of 29 African Caribbean, 9 African, 2 European, 1 Indian, and 1 mixed-parentage participants (Hickling et al., 1999).

life circumstances in Black populations, which is misinterpreted and diagnosed as psychosis by White psychiatrists influenced by cultural stereotypes of the Black population (Fernando, 1991; Morgan & Hutchinson, 2009). However, it has been suggested that schizophrenia has not been over-diagnosed due to ethnicity of the patient, with some scholars highlighting the lack of statistical evidence identified through the diagnostic attitudes between and British and non-British graduates (Lewis, Croft-Jeffreys, & David, 1990; Sharpley et al., 2001).

Aside from potential misdiagnosis and Ödegaard's biological selection in migration, social experience – and acculturation specifically – has been highlighted as an explanation of this phenomenon. Acculturation refers to the multidimensional processes of adapting to the host's majority culture (Kety et al., 1994). Within the acculturation process, a member of one cultural group changes their behaviours, thoughts, beliefs, and attitudes to become more in-line with the norms of another culture (Tarbox & Pogue-Geile, 2011). Szapocznik and Kurtines (1980) suggested that, for members of a migrant group, acculturation is apparent through two dimensions: cultural accommodation to the host country and an interplay of retaining and disregarding the characteristics of the country or culture that preceded the host country. Issues from acculturation arise when migrants over/under-acculturate (Szapocznik, Kurtines, & Fernandez, 1980). This can be seen in migrants becoming under-acculturated, with a refusal to integrate and/or adjust to the host culture, or becoming over-acculturated, with a complete rejection of the country of origin (e.g., family and language; Furnham & Bochner, 1986; Swami, Arteche, Chamorro-Premuzic, & Furnham, 2010a; Szapocznik & Herrera, 1978; Szapocznik et al., 1980; Ward, Bochner, & Furnham, 2005). From this, to achieve successful adjustment, the migrant is required to have a balance, and an acceptance, of both country of origin and host country in terms of culture as well as the

"skills to live amongst and interact with both… cultural groups" (Szapocznik et al., 1980, p.13).

The research on schizotypy with ethnicity and cultural considerations is rather limited. In a Pacific Islander sample, Cicero (2015) reported on SPQ dimensions with White, Pacific Islander, Asian, and multi-ethnic participants. *Vis-à-vis* higher-order dimensions, findings indicated that the White group had significantly lower *Cognitive-Perceptual* scores than the Pacific Islander group, and significantly lower *Disorganisation* scores than the Asian group, with Asian and Pacific Islander scores being similar across both. For lower-order factors, White participants scored significantly lower on Unusual Perceptual Experiences than the Pacific Islander group. The Asian and Pacific Islander groups had significantly higher Odd Speech scores than the White, and the Pacific Islanders had significantly higher scores than the multi-ethnic group. The White participants had significantly lower Excessive Social Anxiety, No Close Friends, and Constricted Affect scores than the other three groups, while the multi-ethnic group had significantly lower Excessive Social Anxiety scores than both the Asian and Pacific Islander participants. These findings were consistent with the theoretical framework of differences in schizotypal constructs and ethnic minorities; that is, ethnic minorities scoring significantly higher on schizotypal personality dimensions than White participants (Sharpley & Peters, 1999).

Using the SPQ-B, Ortuño-Sierra et al. (2013) reported that there were only significant higher-order differences for the *Interpersonal* dimension, with Swiss teenagers scoring lower in comparison to Spanish teenagers. In a European assessment of schizotypy using the O-LIFE, Fonseca-Pedrero et al. (2015) reported latent mean comparisons of scores between non-clinical adolescents and young adults from four countries (UK, Switzerland, Italy, and Spain). For *Positive Schizotypy*, Spanish participants scored significantly lower than participants from the UK, Switzerland, and

Italy (η_p^2 = .05). On the *Cognitive Disorganisation* dimension, participants from the UK scored significantly higher than Italian and Spanish participants, with Swiss participants scoring significantly higher than Italian and Spanish, and the Spanish group scoring significantly higher than the Italian group (η_p^2 = .06). For *Introverted Anhedonia*, UK participants scored significantly lower than Italian and Swiss groups, and the Swiss sample had significantly higher scores than the Spanish group (η_p^2 = .04). Finally, for *Impulsive Nonconformity*, the UK group scored significantly highest and Spanish lowest than the other groups, with the Italian participants having significantly higher scores than the Swiss (η_p^2 = .04). These findings highlight the need for ethnicity and cultural consideration on schizotypal measurement.

However, it is important to note that these previous studies have conflated ethnicity and culture, with investigations into ethnicity from within a single cultural setting (e.g., Cicero, 2015), both culture and ethnicity as independent constructs (e.g., Ortuño-Sierra et al., 2013), and a focus on culture only (e.g., Fonseca-Pedrero et al., 2015). Indeed, ethnicity and cultural investigations are typically an afterthought in the analysis perfromed in these studies, as the primary aim is generally measurement invariance and factorial work. Further, these studies have used different and non-comparable measures. As such, there is an urgent need to investigate across both culture and ethnicity in a more systematic manner. This is particularly important as the social and psychological importance of ethnicity and culture, and the impact on individual functioning particularly in culturally-mixed or foreign societies, is essential for practitioners and researchers to be competent (Hickling, 2012).

1.5 The Schizotype's Associated Traits and Deficits

A previous analysis of research findings has indicated that knowledge on schizotypy is growing at an exponential rate, with more work in the first five years of

the 21st century than in the last 25 years of the preceding century (Raine, 2006; see Figure 3 for visual representation of published clinical and non-clinical schizotypal studies per year).

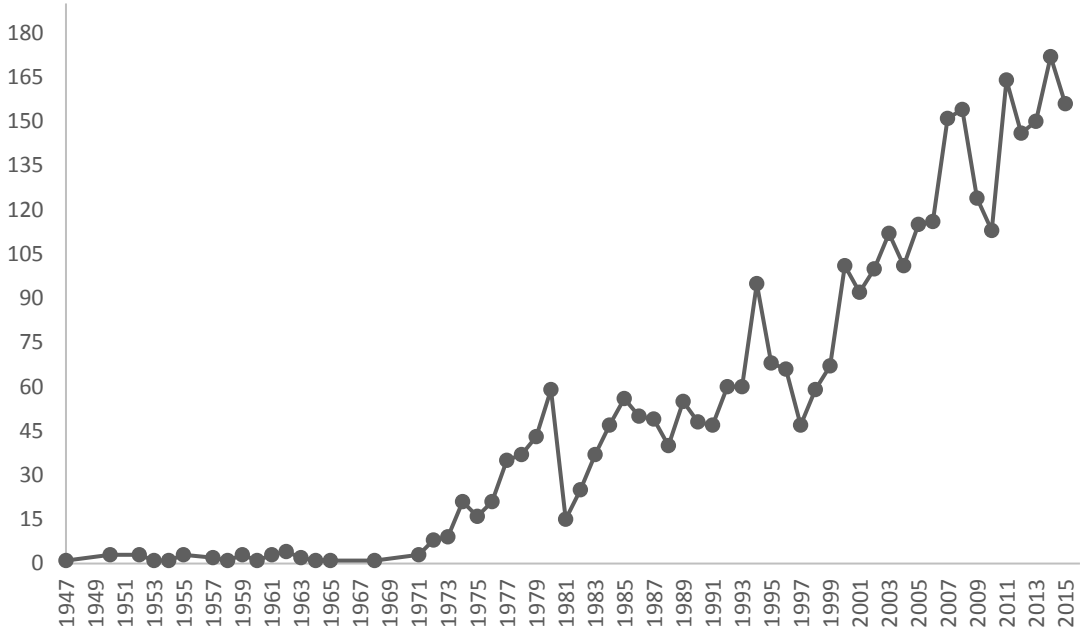


Figure 3. Number of schizotypal studies by year (1947-2015). Source: PubMed (Search term: 'Schizotypy or Schizotypal'; Search date: 15.10.16).

These advancements in schizotypal knowledge have led to specific insights into the mental health and well-being of people diagnosed with SPD and those high non-clinical schizotypes. For example, from the neurocognitive literature, there is evidence of associations between increased schizotypy levels and executive function (Trestman et al., 1995), latent inhibition (Wuthrich & Bates, 2001), negative priming (Claridge & Beech, 1996), hemisphere asymmetry (Voglmaier et al., 2000), verbal IQ (Noguchi, Hori, & Kunugi, 2008), spatial memory (Park, Holzman, & Lenzenweger, 1995), working memory (Park & McTigue, 1997; Schmidt-Hansen & Honey, 2009), and attention (Chen et al., 1997).

These cognitive deficits mirror psychosis symptomatology, particularly with attention and working memory, and are thought to contribute to symptom formation (Joyce, Hutton, Mutsatsa, & Barnes, 2005). Cognitive models of psychosis have become increasingly popular, with the intention of explaining the causation of symptoms (Kwapil, Ros-Morente, Silvia, & Barrantes-Vidal, 2012). Therefore, establishing cognitive models of schizotypy may allow for insight into tracking the underlying cognitive deficits along the continuum. This section will first highlight some of the health and well-being traits associated with schizotypy in previous research. Next, this section will introduce cognitive correlates of schizotypy, with a focus on conspiracist ideation and thinking styles.

1.5.1 Health and Schizotypy

Several studies have focused on associations between health and well-being on the one hand and schizophrenia and schizotypy on the other (Mohr & Claridge, 2015). For instance, one established finding in the schizophrenia literature is that patients compared to controls have a lower life satisfaction (e.g., Koivumaa-Honkanen, Honkanen, Antikainen, Hintikka, & Viinamäki, 1999), quality of life (e.g., Browne et al., 1996; Pinikahana, Happell, Hope, & Keks, 2002), and suicide (Ponizovsky, Grinshpoon, Levav, & Ritsner, 2003). In non-clinical samples, higher schizotypal scores have been found to be accompanied by lower life satisfaction and higher negative affect (Mohr & Claridge, 2015). This remains constant when negative affect is accounted for, with lower life satisfaction being associated with negative and disorganised schizotypy, but not with positive schizotypy (Abbott & Byrne, 2012; Abbott, Do, & Byrne, 2012). Horan, Brown, and Blanchard (2007) separated scorers on schizotypal dimensions, with their findings suggesting that those with high negative schizotypy, compared to high positive schizotypy and low in both dimensions, had significantly higher perceived

stress and avoidant coping. Further, Cochrane, Petch, and Pickering (2012) found that higher scores on the *Interpersonal* factor of the SPQ was significantly related with reduced verbal fluency. In a clinical setting, Soloff, Feske, and Fabio (2008) reported that interpersonal aspects of SPD may lead to poor social adjustment, which in turn, may lead to suicidal ideation and attempts. These studies indicate that negative schizotypy may be linked with lowered life quality, functioning, well-being, and higher suicidal ideation.

Regarding positive schizotypy, studies have linked this dimension with such factors as enhanced adaptive functioning, creativity, pleasant and enriching mental experiences, and mating success (Burch, Pavelis, Hemsley, & Corr, 2006; McCreery & Claridge, 2002; Mohr & Claridge, 2015; Nettle, 2006; Nettle & Clegg, 2006). Indeed, those scoring high on this dimension as compared with low report significantly higher, and greater intensity of, altered perceptual experiences and visual imagery (Rock, Abbott, Childargushi, & Kiehne, 2008). As mentioned, this dimension may include intense religious dependence or belief in phantasia, specifically telepathy, clairvoyance, and extrasensory perception (Chequers et al., 1997; Hardy, 1979; Maxwell & Tschudin, 1990). However, there is evidence that those individuals who hold these beliefs with a high degree of importance consider said beliefs to have a positive impact on their lives, enhancing their understanding of the world and of themselves (Boden & Berenbaum, 2004). With this, the more the perception of importance is observed, the less individuals experience psychological distress.

Further, significant relationships have been found between new religious movements (NRMs) and magical thinking and delusion ideation (Peters et al., 1999a), although this does not hold with paranoid ideation and perceptual ideation (Day & Peters, 1999; Farias, Claridge, & Lalljee, 2005). Individuals involved with NRMs (e.g., Hare Krishnas, Druids) reported a sense of connectedness and holistic experiences, and

showed an associative thinking style and emotional hypersensitivity (Mohr & Claridge, 2015). Farias et al. (2005) suggested that such features offer a healthy way to cognitively organise thoughts and experiences; that is, to reflect on a cognitive framework within which magical ideation and unusual experiences are given meaning. Being able to cognitively organise thought and experiences might indeed reflect a crucial factor in how schizotypal features impact on mental health. Positive schizotypal features themselves, especially when accompanied by low negative schizotypy with or without low cognitive disorganisation, may represent a healthy schizotype who can profit from positive schizotypal experiences by integrating positive schizotypal experiences into a coherent cognitive framework (Goulding, 2004; McCreery & Claridge, 2002; Mohr & Claridge, 2015; Nettle & Clegg, 2006; Schofield & Claridge, 2007). Whereas high positive schizotypy and low cognitive disorganisation is associated with the subjective evaluation of paranormal experiences being pleasant, high negative schizotypy and high cognitive disorganisation is associated with distressing experiences (Mohr & Claridge, 2015; Schofield & Claridge, 2007).

In short, these studies suggest that negative schizotypy might be associated with lower overall well-being and mental health, while high positive schizotypy in itself might reflect healthy schizotypy, which in the relative absence of negative schizotypy and cognitive disorganisation is associated with constructive integration of positive schizotypal beliefs and experiences into a meaningful and coherent cognitive belief framework. Indeed, this cognitive capacity is important to previous research, which suggests that schizotypy (in particular, positive schizotypy) is associated with enhanced fantasy-proneness, Openness to Experience, creativity, and cognitive ability (Batey & Furnham, 2008; Mohr & Claridge, 2015; Raine, 2006).

Individual differences in the degree to which people rely on different thinking styles may be of use in understanding psychopathologies for clinical psychologists or

scholars researching personality dimensions (Epstein, Pacini, Denes-Raj, & Heier, 1996). People commonly experience differences, and potential strain, between what they think and feel; that is, conflict between the head and the heart. From the perspective of cognitive-experiential self-theory (CEST; Epstein, 1994), this experience represents the outcomes of two different information-processing systems: rational and experiential. The rational, or analytical, system is an inferential system that is based on one's understanding of culturally-transmitted rules of reasoning. This system is conscious, slow, primarily verbal, and relatively affect-free. The experiential, or intuitive, system is a learning system that is preconscious, fast, automatic, holistic, primarily nonverbal, and intimately associated with affect (Epstein et al., 1996). Although there is growing evidence to suggest that specific cognitive biases pose as risk factors for the transition from subclinical psychotic experiences to clinically significant psychotic disorders, few cognitive biases have been examined across the psychosis spectrum (Beck, Rector, Stolar, & Grant, 2009; Sacks, de Mamani, & Garcia, 2012). Additionally, studies that have explored cognitive mechanisms in schizotypy rarely consider whether sub-domains of schizotypy are associated with each bias (e.g., self-certainty).

Williams and Irwin (1991) compared the thinking styles of paranormal believers and people rated as schizotypes. They reported that paranormal believers expressed a cognitive style reliant on beliefs of personal responsibility, whereas schizotypes emphasised the role of chance in various areas of life. It was, therefore, suggested that schizotypes are unable to use paranormal constructs to interpret and cope with anomalous experiences. Wolfradt, Oubaid, Straube, Bischoff, and Mischo (1999) reported on associations between the SPQ and four types of thinking style: rational (high rational and low intuitive), intuitive (high intuitive and low rational), complementary (high rational and high intuitive), and poor (low rational and low

intuitive). The participants with a complementary thinking style expressed significantly higher scores on the *Cognitive-Perceptual* aspects of schizotypy and self-efficacy than those belonging to the other groups. Intuitive thinkers scored highest on *Interpersonal* domain of schizotypy and interpersonal intolerance of ambiguity. In the growing schizotypal literature, cognitive models of psychosis have been becoming increasingly popular, with the intention of explaining the causation of symptoms (Kwapil et al., 2012). Therefore, establishing cognitive models and insight regarding cognitive associations of schizotypy may allow for insight into tracking the underlying cognitive deficits along the continuum. One such association of paranoid ideation and schizotypy, which is beginning to have an emerging body of research, is that of belief in conspiracy ideation (Darwin, Neave, & Holmes, 2011).

Swami and colleagues (2014) investigated analytical thinking and conspiracy ideation. The authors reported that a stronger belief in conspiracy theories was significantly associated with lower analytic thinking, open-mindedness, and greater intuitive thinking. However, of importance to schizotypal research, their experimental findings highlighted the potential utility of supporting attempts to promote analytic thinking as a means of reducing belief in conspiracy theories. Further, Darwin et al. (2011) suggested that belief in conspiracy theories is strongly associated with paranoid ideation and schizotypy. Indeed, Holm (2009) explained this association as shared and overlapping characteristics, contending that key components of conspiracist ideation are important aspects of paranoia (e.g., suspicion and fear of external agents; Dagnall, Drinkwater, Parker, Denovan, & Parton, 2015). Darwin et al. (2011) also suggest that those aspects of schizotypy that mirror disorganised thought processes and a rejection of analytic information generation are significantly associated with belief in conspiracy theories. Therefore, in a similar vein to the aforementioned health outcomes of

schizotypy, belief in conspiracy theories may represent a consequence of schizotypy expression.

1.5.2 Conspiracy Ideation and Schizotypy

Conspiracy theories tend to reflect a subset of false narratives where the ultimate outcome is believed to be due to a malevolent plot by multiple persons working together (Swami & Furnham, 2014). For example, conspiracy theorists have expressed belief that Lee Harvey Oswald did not act alone in the assassination of President John F. Kennedy (e.g., Goertzel, 1994) or that officials of the US government had previous knowledge of the September 11, 2001, terrorist attack, but failed to act (Sunstein & Vermeule, 2009; Swami, Chamorro-Premuzic, & Furnham, 2010b). Previous research has suggested that belief in conspiracy theories is widespread (Goertzel, 1994; Oliver & Wood, 2014). For instance, in a sample of 1,935 Americans, 25% of respondents endorsed a regarding financial crisis conspiracy theory[5], while this was rejected by 37% of respondents (Oliver & Wood, 2014). Conspiratorial beliefs are normally unsupported, and viewed as not being particularly detrimental (for review, see Swami & Coles, 2010). However, a growing body of work has shown significant associations between belief in conspiracy theories and various negative outcomes (Douglas & Sutton, 2015; Douglas, Sutton, Jolley, & Wood, 2015). This includes conspiracist beliefs about the treatment of HIV/AIDS leading to negative attitudes toward protective measures and treatment (Bogart, Wagner, Galvan, & Banks, 2010), conspiracist beliefs about childhood vaccinations resulting in decreasing rates of vaccination (Kata, 2010),

[5] Namely, "The current financial crisis was secretly orchestrated by a small group of Wall Street bankers to extend the power of the Federal Reserve and further their control of the world's economy" (Oliver & Wood, 2014, p.956).

as well as studies documenting associations between conspiracist ideation and negative social and political engagement (Butler, Koopman, & Zimbardo, 1995), increased political extremism and terrorism (Bartlett and Miller, 2010), and the increased risk of societal mistrust (Swami et al., 2011a).

As a result, the new field of conspiracy theories is in continual development, relating multiple perspectives from socio-cognitive psychology to personality and individual differences (for a review, see Swami & Furnham, 2014). From this, conspiracist ideation has been contextualised through the framework of the fundamental attribution bias. The fundamental attribution error (Ross, 1977) refers to the tendency to attribute the causes of events to internal forces, such as dispositions or traits of individuals or groups, rather than to situational factors. In this view, conspiracy theorists are more likely to blame conspiratorial agents even when there are adequate situational explanations of an event (Clarke, 2002). On the other hand, the sociological perspective has been supported by the individual differences literature (Swami et al., 2011a). For example, Swami et al. (2010) identified significant associations between conspiracist ideation and the Big Five personality factors: a negative association with Agreeableness, justified through the relationship between disagreeableness and suspicion with antagonism towards others; a positive relationship with Openness to Experience, highlighted through the association between openness and inquisitiveness, the tendency for novel ideas, and an active imagination.

A central component of the development of conspiracy theories literature has been to expand beyond the traditional stance that conspiracist ideation is the sole product of individual or collective psychopathology. Indeed, conspiracy theories are now interpreted as a subset of false beliefs that help individuals make sense of phenomena that are incomprehensible (Swami & Furnham, 2014); that is, they represent rational attempts to help cope with adverse psychological feelings triggered by complex

phenomena. However, this perspective does not rule out the possibility that conspiracist ideation, when endorsed as a differential trait, will be associated with psychopathological measures, particularly those that point to underlying paranoia or delusional thinking, such as schizotypy (Swami et al., 2011a).

In support of this perspective, researchers have recently begun examining associations between conspiracist ideation and traits such as paranoid ideation, superstitious beliefs, magical ideation, and belief in the paranormal (Brotherton, French, & Pickering, 2013; Bruder, Haffke, Neave, Nouripanah, & Imhoff, 2013; Darwin et al., 2011; Stieger, Gumhalter, Tran, Voracek, & Swami, 2013; Swami et al., 2011a). In addition, three studies have reported significant associations between conspiracist ideation and schizotypal personality disposition (Bruder et al., 2013; Darwin et al., 2011; Swami et al., 2013). In explanation, it has been suggested that the relationship is a function of schizotypal individuals being more open to arguments in support of conspiracy theories as a result of their suspiciousness of others (Darwin et al., 2011).

A potential constraint on this explanation, however, has been the limited way in which schizotypy has been measured in earlier studies. Thus, Swami and colleagues (2013) reported that scores on the *Unusual Experiences* subscale of the O-LIFE were significantly and positively associated with conspiracist ideation. Conversely, two other studies (Bruder et al., 2013; Darwin et al., 2011) have reported significant associations between conspiracist ideation and the three domains of schizotypy measured on the SPQ-B. However, as mentioned in Section 1.3, there remain questions concerning the reliability of this brief measure of schizotypy, as well as the factorial validity of the 3-factor model of schizotypy (Axelrod et al., 2001; Compton et al., 2007).

1.6 Electroencephalography and Early Processing Deficits

In the study of schizophrenia and psychoses, much research has been devoted to the examination of electrophysiological function in an effort to identify potential causes and vulnerability factors. Evidence of a premorbid decline in electrophysiological function has, for example, been shown in patients who subsequently developed a psychotic illness (Kravariti et al., 2009). It has also been shown that electrophysiological function is not only abnormal in patients with schizophrenia (Hermens et al., 2010), but also in people considered to be at risk of developing a psychotic illness. This section will introduce early processing deficits, with measurement techniques, observed in both the schizotypal and psychoses literature. This will be extended by reference to specific components of electrophysiological function and their relevance to schizotypy and schizophrenia.

Electrophysiological function is measured through the use of electroencephalogram (EEG) and is based on the measurement of electrical fields produced by neuronal activity. From the columnular organisation of the cortex, electrical potentials circulate the scalp where their differences can be examined (Kaiser, 2005). EEG measurement provides excellent temporal resolution in the order of milliseconds, is inexpensive to use in comparison to other measures of brain activity (e.g., functional Magnetic Resonance Imaging; fMRI), and is completely non-invasive. One of the main advantages of the use of EEG for research purposes is that it can be time-locked with external or internal events (e.g., muscle movement or perception of auditory stimuli), which allows the study of cortical processing to such events (Luck, 2005). The resulting recording of this time-locked event is known an event-related potential (ERP), or an evoked potential (EP), and is based on averaging tens to hundreds of time-windows (epochs) related to the onset of the event or signal (Luck, 2005). The use of ERPs are of particular relevance when investigating schizophrenia and psychoses

due to its high temporal resolution and ability to highlight the stages of cognitive processing. The ERP signal recorded reflects activity in the neuronal networks of the brain and is thought to be the spatial and temporal summation of a large number of cortical excitatory and inhibitory post-synaptic (dendritic) potentials (Allison, Wood, & McCarthy, 1986; Fabiani, Gratton, & Coles, 2000).

The voltage of the time-locked ERPs change in the response to specific stimuli. These signals are particularly small in amplitude (3-25μV), in comparison to the ongoing cortical activity in which they are embedded, the latter varying between -100 and +100μV (Luck, 2005). To measure cortical response to stimulation, ERPs can be separated from the continuous EEG by means of averaging and digital filtering. The voltage deflections of the ERP reflect the reception and processing of sensory information as well as higher level processing that involves selective attention, memory updating, comprehension, and various cognitive activity (Duncan et al., 2009). The components of the ERP are defined by the polarity of their positive or negative deflection, scalp distribution, latency, and relationship to experimental variables. The time course of cognitive processing is reflected in the order and latency of ERP components, which can be recorded with millisecond temporal resolution and from multiple locations (Duncan et al., 2009).

1.6.1 P300

A consistent finding in ERP research is that of the P300 (also known as P3 or P3b), which is a large, broad, positive component in the ERP that typically occurs 280 to 400ms after onset of a rare, active task-relevant stimulus (Polich, 2007). The P300 has a centro-parietal scalp distribution that is best observed over midline scalp sites (Duncan et al., 2009). A rare event that is not task-relevant may also elicit a positive-going ERP component, P3a. P3a can be distinguished from P300 on the basis of an

earlier peak latency of 250 to 300ms and a scalp distribution with a midline fronto-central maximum (Duncan et al., 2009; Squires, Squires, & Hillyard, 1975). P3a is generated from frontal attention mechanisms to task novelty and/or distractors, whereas P3b originates in the temporal/parietal regions and is associated with context updating and memory storage operations (Polich, 2007). The P3a is normally evoked in experiments associated with novelty and is believed to represent a reorienting mechanism. On the other hand, the P3b can be evoked in experiments where the participant is required to attend actively to a target stimulus (Polich, 2007).

The P300 was first reported by Sutton et al. (1965) and is perhaps the most studied ERP component (Duncan et al., 2009). It is predominantly elicited through the oddball paradigm, in which a random sequence of stimuli is presented; the stimuli can be classified into one of two categories, with the task being to classify the stimuli, either by counting or by pressing a button to members of one category (Duncan et al., 2009). If stimuli in one of the categories occur infrequently (the oddball), this will elicit a P300. Indeed, it is well established that the lower the probability of an attended stimulus, the larger the amplitude of P300 (e.g., Duncan-Johnson & Donchin, 1977).

Extensive research has shown that patients with schizophrenia have P300 amplitude reductions and latency prolongations compared to healthy controls (Frangou et al., 1997; Özgürdal et al., 2008; Wynn, Jahshan, Altshuler, Glahn, & Green, 2013). This is interpreted as impairment of stimulus discrimination because of sustained attention to both frequent and infrequent stimuli (e.g., Ogura et al., 1991). However, a frequent caveat affecting many studies is that the majority of electrophysiological experiments conducted have been with chronic patients treated with a range of medication (i.e., antimanic, antipsychotic, and other psychotropic medications). These types of drugs are known to cross the blood brain barrier and influence the recording and therefore act as potential confounders of the proposed electrophysiological

impairments (Ford, White, Lim, & Pfefferbaum, 1994; Mathalon, Ford, Rosenbloom, & Pfefferbaum, 2000). Therefore, research investigating endophenotypes associated with SPD and non-clinical schizotypal traits have been viewed as a promising approach to understand schizophrenia, as well as being beneficial for the schizotypal literature (Siever & Davis, 2004).

P300 and Schizotypy

Groom et al. (2008) showed with an at-risk group of adolescent siblings of patients with schizophrenia, significantly reduced auditory P300 amplitude when compared to healthy control participants. Further, Bramon et al. (2008) reported that the amplitude of the P300 was significantly reduced in at-risk individuals compared to controls, suggesting that P300 is a marker associated with increased vulnerability to progress to psychosis. Similar findings have been supportive of reduced P300 in at-risk groups (e.g., relatives of schizophrenic patients; Roxborough, Muir, Blackwood, Walker, & Blackburn, 1993; Saitoh et al., 1984). In relation to non-clinical schizotypy, Sumich et al. (2008) reported on associations between ERPs and paranormal ideation/unusual experiences, where paranormal ideation was found to be inversely correlated with P300 amplitude. However, in general, auditory deficits in schizotypy tend to be subtle. For example, increased schizotypy is associated with reduced P300 (Kimble et al., 2000; Klein, Berg, Rockstroh, & Andresen, 1999; Nuchpongsai, Arakaki, Langman, & Ogura, 1999) and N2 (Nuchpongsai et al., 1999) amplitudes, but not with other ERPs such as N1, P2, and P3a (Klein et al., 1999). Indeed, this subtlety can be extended with P300, where reduced amplitudes have not been evident with anhedonic participants (Miller, Simons, & Lang, 1984). Further, Condray and Steinhauer (1992) found normal P300 in schizotypal participants with and without a family history of schizophrenia.

1.6.2 Mismatch Negativity

The component of an ERP that is thought to represent a detection of change mechanism or a violation of regularity is known as the mismatch negativity (MMN; Näätänen, Gaillard, & Mantysalo, 1978). This component is thought to reflect an automatic process that detects a difference between an incoming stimulus and the sensory memory trace of preceding stimuli (Duncan et al., 2009; Näätänen, 2007). The standard procedure for MMN studies involves the presentation of a series of identical stimuli ('standard') with occasional mismatching stimuli ('deviant'). In auditory MMN, the mismatching stimuli can differ on a number of varying dimensions (i.e., pitch, gap[6], duration, intensity, or location). Hence, the standard stimuli occur frequently (p = ~.80), where the deviant stimuli occur infrequently (p = ~.20; Duncan et al., 2009). The stimuli throughout the paradigm are usually presented at relatively short interstimulus intervals (ISIs), such as 500ms to 1s (Näätänen, Pakarinen, Rinne, & Takegata, 2004). This is of particular importance as auditory MMN is not elicited by deviant stimuli when they are presented without the intervening standards or when ISIs are long (Sams, Paavilainen, Alho, & Näätänen, 1985). Further, it is not evoked by the first stimulus in a sequence (Cowan, Winkler, Teder, & Näätänen, 1993). This indicates that the auditory MMN represents a sensory memory trace, rather than a response generated by refractoriness of neural populations – a finding confirmed by a number of studies (Näätänen, Jacobsen, & Winkler, 2005). MMN is typically seen as a fronto-central negativity of approximately 0.5-5μV in amplitude, occurring in the latency range of 100 to 250ms (Näätänen et al., 2004).

[6] 'Gap' refers to the stimulus being broken; that is, a break in the middle (see Näätänen, Pakarinen, Rinne, & Takegata, 2004).

The contribution of the auditory MMN for exploring brain function relating to auditory discrimination processes and its value for investigating central auditory processing has been widely reported on (for reviews, see Duncan et al., 2009; Näätänen, 2003). An important feature of the auditory MMN is that it can be elicited in the absence of focused attention; indeed, when attention is sustained, this leads to overlap of other attention related ERP components (Duncan et al., 2009).

Mismatch Negative and Schizotypy

A decrease in the amplitude of MMN in patients with schizophrenia is a robust and consistent finding in biological psychiatry (for a review, see Michie, 2001). However, despite the plethora of research investigating MMN in patients with schizophrenia, very few studies have investigated associations between MMN and non-clinical schizotypy (Broyd et al., 2016; Evans, Gray, & Snowden, 2007). There has been research conducted with SPD features (Hong, Moran, Du, O'Donnell, & Summerfelt, 2012; Liu et al., 2007; Niznikiewicz et al., 2009) and at-risk children (e.g., Bruggemann, Stockill, Lenroot, & Laurens, 2013), with profiles similar to that of a schizophrenia sample. Broyd et al. (2016) reported on associations with the SPQ and a multi-feature MMN paradigm, where there were three deviant variations of standard tones (duration, frequency, and intensity), in 35 healthy participants. Few associations were identified between schizotypal traits and MMN amplitudes. However, with the lower-order subscales, higher suspiciousness ratings were significantly correlated with larger frequency MMN amplitudes. Further, a median-split comparison of the sample on suspiciousness scores showed larger MMN (irrespective of deviant condition) in the high compared to the low suspiciousness group (Broyd et al., 2016). In a non-clinical sample, Fernandes et al. (1999) found no significant effect on frequency MMN

amplitude of schizotypal symptoms, family history of psychosis, or group classification when associations were made with the Chapman scales.

1.7 Aims and Scope of Thesis

1.7.1 The Importance of Schizotypal Research

The literature presented in the previous sections provides support – through a number of different methods, functions, and structural domains – for deficits in cognition, perception, and electrophysiology in schizotypy. Indeed, many of these studies report on aspects that are qualitatively similar to the impairments observed in schizophrenia, supporting the notion of similarities between schizotypy and schizophrenia. However, also presented was evidence of discontinuity in theoretical approaches and consistently reported impairments in schizotypy (e.g., in the limited MMN and schizotypy literature). Research into such a continuum provides important knowledge into the aetiology of schizophrenia (David, 2010). Further, as highly schizotypal individuals may be undetected carriers of schizophrenia risk alleles, insight into schizotypy may provide one answer to questions from evolutionary biology concerning the frequency of schizophrenia in the population (Brüne, 2004; Ettinger, Meyhöfer, Steffens, Wagner, & Koutsouleris, 2014; Nettle & Clegg, 2006). Given the complexities of investigations into schizophrenia, including medication history, lifestyle factors such as substance use and smoking, and disease chronicity, research exploring schizotypy in the general population may provide important information for scholars and practitioners (Nelson, Seal, Pantelis, & Phillips, 2013).

In addition to providing clues regarding the aetiology of schizophrenia, schizotypy is an important topic for investigations in its own right, not only because of the documented neurocognitive impairments but also because of its associations with a number of maladaptive behaviours and psychiatric symptoms. Therefore, a thorough

characterisation of the cognitive and neural correlates of schizotypy can lead to an improved understanding of these disturbances and development of appropriate interventions. Further, some scholars have suggested that the development of the continuum, in which schizophrenia is formed as a spectrum disorder, may lead to increases in psychoeducational and psychotherapeutic treatment success (Ettinger et al., 2014). As such, David (2010) and Johns and van Os (2001) have suggested that dimensional conceptions of schizophrenia symptoms are less stigmatising than categorical diagnoses – a factor that could contribute to a successful treatment outcome.

1.7.2 The Current Research: Aims and Studies

The aims of this research are (see Figure 4 for highlights):

- To examine the Schizotypal Personality Questionnaire (SPQ) as a measurement tool for schizotypy. This will include a re-evaluation of the domain structure of the English SPQ and the German SPQ, and create and evaluate a Malaysian translation. Within the evaluation and development of these measures, it will also be possible to explore schizotypy within ethnic and cultural frameworks. This will include evaluations between African Caribbeans in the UK and Trinidad, with White British participants; Malays, Chinese, and Indians in Malaysia; and central European White participants from Austria and southern Germany, with a similar cultural (migrational) group in the UK. Establishing whether rates of schizotypy vary across different ethno-cultural groups will increase knowledge about psychosis risk and provide valuable information regarding the as-yet-unexplained inflated incidence rates of psychosis in people from ethnic minorities.
- A second aim from this thesis concerns schizotypal and cognitive processes, which has been infrequently investigated as an outcome of schizotypy. An initial

pilot will investigate the association between schizotypy and conspiracy ideation, which is included as a *prima facie* outcome of disordered thinking. A follow-up study will build a functioning path analysis model for cognitive traits (e.g., analytical thinking).

- Finally, an investigation of associations between subscales of schizotypy derived throughout the preceding studies in this thesis with electrophysiological measures (P300 and MMN) will be carried out. This will allow for clarity on under-investigated ERP components, such as the MMN, as well as investigating the schizotypal profile of ratings through dimensions on the SPQ. Further, this will allow for examination into the extent to which variations in cultural background and ethnicity impact on associations between ERP components and SPQ ratings.

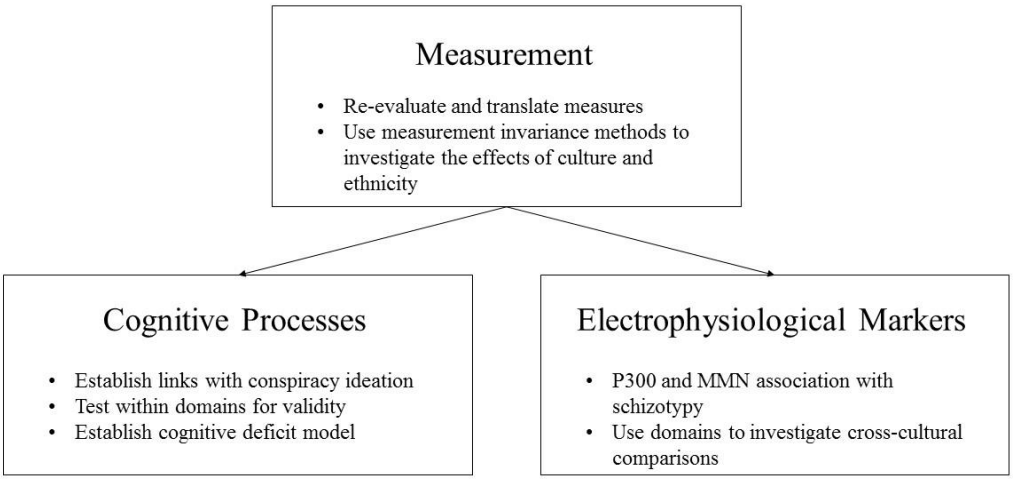


Figure 4. Highlights of aims within thesis

Study 1: Cultural Influences on Schizotypal Measurement in the UK and Trinidad

As mentioned, there are many conflicting measurement approaches within and between measurement instruments, such as with the factorial structure of the SPQ and between personality and clinically based instruments. Indeed, work with measurement

tools is essential for all schizotypal research so that scholars can be sure that any associations with, or measurement of, schizotypy reflects the latent variable (e.g., *Disorganisation*) and is not an artefact of the instrument itself. In addition, with the SPQ as an example, research with regard to translation and psychometric domain evaluation has primarily been established in Western samples. For example, the SPQ had been translated into several languages including, Turkish (Şener et al., 2006), Spanish (Fumero et al., 2009), and Greek (Stefanis et al., 2004b), but there has been limited work in samples varying in culture and/or ethnicity. Establishing appropriate cultural and ethnic instruments, and measurement structure, is important because variability in the instrument may limit between-group comparisons, thus limiting the scope of schizotypal research.

As mentioned, in terms of social and cultural factors, many studies have shown a significant variation in the prevalence and incidence of schizophrenia in different ethnic groups (Cantor-Graae & Selten, 2005). For example, it has been consistently shown that people from the African Caribbean community living in the UK have between a 2 and 14 times higher risk of developing psychosis compared to British White participants (Fearon & Morgan, 2006). There is, and perhaps as a result of measurement issues, a lack of any systematic study into cross-cultural and cross-ethnic differences in the prevalence and manifestation of schizotypy across different cultural and ethnic groups. Further, measurement invariance will be sought; whereby any predominant factor structure must also be consistent between groups. Therefore, an investigation addressing these issues would allow for an appraisal of how paranormal thinking and magical ideation in healthy participants, with no history of psychiatric illness, varies across different ethnic and cultural groups. The sample here will involve a mixed design of culture and ethnicity for comparison: a White British sample in the UK, an African

Caribbean sample based in the UK, and an African Caribbean group based in Trinidad, West Indies.

Study 2: Schizotypal Measurement in Malaysia

The findings from Study 1 will lead to a further investigation into ethnicity and cultural influences on schizotypy. The first, and primary, extension of Study 1 is to investigate the issue of ethnicity; where previously both cultural-site and ethnicity were independent, Study 2 will investigate the construct of schizotypy in different ethnic groups within the same cultural context. Second, previous research has suggested that environmental factors in urban areas are associated with a higher risk of developing schizophrenia (Pedersen & Mortensen, 2001), suggesting that urbanicity plays an important part in the aetiology of schizophrenia. Research has also suggested that around one-third of all diagnoses of schizophrenia may be associated with environmental factors related to the urban environment (Krabbendam & van Os, 2005). In one of the few schizotypal studies in this area, Stefanis et al. (2004a) found that men from urban areas have less interpersonal deficits but have higher positive psychotic experiences. Thus, Study 2 plans to compare ethnicity with a sample of Malays, Chinese, and Indians in Kuala Lumpur, Malaysia, with the first Malaysian version of the SPQ and urbanicity. Further, the higher-order factorial structure will be examined based on the findings from Study 1.

Study 3: The Psychometric and Cultural Evaluation of the SPQ-G

To compliment Study 2, Study 3 will investigate culture, but control for ethnicity with schizotypy. Two previous studies in the UK (Hutchinson et al., 1996; Sugarman & Craufurd, 1994) have observed a higher risk for schizophrenia in siblings of second-generation Black immigrants compared to their white counterparts.

Therefore, Study 3 will investigate a central European White subsample from Austria and southern Germany with a similar cultural group in London. The German schizotypy personality questionnaire (SPQ-G; Klein, Andresen, & Jahn, 1997) has been found to utilise a 2-factor solution, but this has not been re-evaluated since inception.

Study 4a and 4b: Conspiracist Ideation, Cognitive Process and Schizotypy

First, from the domain structure established with the SPQ in Study 1, schizotypal domain associations with conspiracy ideation ratings will be examined. If associations with conspiracy ideation hold when/if domains change in structure from Study 1, this would reinforce the content of the underlying structure. Second, being able to cognitively organise thought and experiences might reflect a crucial factor in how schizotypal features impact on mental health (Mohr & Claridge, 2015). As mentioned, individual schizotypal dimensions have varying effect on cognition traits, therefore, the follow-up study will include significant higher-order and lower-order schizotypal predictors of conspiracy ideation. This study will have a path-analysis underpinning, allowing for a potential theoretical mediating structure, investigating these schizotypal dimensions that predict conspiracy ideation. Also included in this investigation will be factors relating to a need for cognition, self-certainty, and analytical thinking. There is evidence that those aspects of schizotypy that mirror disorganised thought processes and a rejection of analytic information generation are significantly associated with belief in conspiracy theories (Darwin et al., 2011). However, of potential importance to schizotypal research, findings highlighted the potential utility of supporting attempts to promote analytic thinking as a means of countering the widespread acceptance of conspiracy theories.

Study 5: Electrophysiological function and Schizotypy

Building from the sample and latent means from Study 1, this study with compare the three previous samples with the aforementioned ERP components (P300 and MMN). As high scores of schizotypy may constitute a risk factor for schizophrenia, it would be of great interest, and potentially great clinical benefit, to examine whether high schizotypes show similar patterns of electrophysiological dysfunction as seen in schizophrenia; particularly to allow for clarity on under-investigated ERP components (e.g., MMN). If a combination of high schizotypal ratings and abnormal electrophysiological function can be established, this may constitute a more reliable measure of vulnerability for psychosis. Identifying persons at risk of psychosis is integral to developing preventative interventions for psychotic disorders. Since most ERP studies typically investigate one paradigm only (e.g., P300), this study will provide a wider scope of investigation. Further, this study allows for a unique comparison between culture and ethnicity.

Taken together, these studies are of importance as the research has the potential inform the schizotypal literature through multiple routes. First, the studies in this thesis will present an examination of the SPQ as a measurement tool for schizotypy, through ethno-cultural influences on this scale. Second, these studies will provide further insight into the relationship between schizotypy and one form of outcome; namely, conspiracy ideation, with promotion of cognitive inferences to reduce the outcome, when faced with anomalous phenomena. Finally, this thesis will investigate whether the electrophysiological dysfunction seen in schizophrenia is held through high schizotypes, potentially emphasising the clinical approach to schizotypy. In summary, this thesis will address both the personality (conspiracist ideational outcome) and clinical (electrophysiological) nature of schizotypy with the basis of a measurement examination.

2 Psychometric Factors and Socio-Cultural Influences

2.1 Study 1: Cultural Influences on Schizotypal Measurement in the UK and Trinidad

2.1.1 Introduction for Chapter 2 and Overview of Study 1

As discussed in section 1.2, despite debate over the latent structure of schizotypy, studies have revealed a multidimensional structure consisting of at least two factors of positive and negative schizotypy (Kwapil, Barrantes-Vidal, & Silvia, 2008). In parallel with multidimensional schizophrenia models, other suggested schizotypy factors include avoidant symptoms, cognitive disorganisation, social dysfunction, paranoia, and nonconformity (Claridge et al., 1996; Kendler & Hewitt, 1992; Kendler, McGuire, Gruenberg, & Walsh, 1995; Kwapil et al., 2008; Raine et al., 1994; Stefanis et al., 2004b).

Sections 1.3.2 and 1.3.3 highlighted one well-established measure that assesses all nine aspects of schizotypal personality in relation to the guidelines of the *DSM*: the Schizotypal Personality Questionnaire (SPQ; Raine, 1991). These nine schizotypal aspects reflect: No Close Friends, Constricted Affect, Ideas of Reference, Odd Beliefs and Magical Thinking, Unusual Perceptual Experiences, Odd or Eccentric Behaviour, Odd Speech, Suspiciousness, and Excessive Social Anxiety. First reported by Raine et al. (1994) and through subsequent factor analytic studies, these nine subscales can be grouped into three higher-order domains, namely *Cognitive-Perceptual*, *Interpersonal*, and *Disorganised* (Badcock & Dragović, 2006; Chen et al., 1997; Claridge et al., 1996; Reynolds et al., 2000; Rossi & Daneluzzo, 2002).

In terms of factorial structure, Raine et al.'s (1994) 3-factor model has been supported, with findings suggesting invariance across age and sex (Raine, 2006; Reynolds et al., 2000) and, in comparison to schizophrenic symptomatology, significant differences in schizotypal traits between sexes (Bora & Baysan Arabaci, 2009; Fonseca-Pedrero, Paino, Lemos-Giráldez, Sierra-Baigrie, & Muñiz, 2011; Fossati et al., 2003; Kwapil et al., 2008; Miettunen & Jääskeläinen, 2010; Raine, 2006). In general, and irrespective of higher-order factorial structure, women score significantly higher on the

positive dimension and men score significantly higher on the negative and disorganised dimensions (Bora & Baysan Arabaci, 2009; Fonseca-Pedrero et al., 2011; Fossati et al., 2003; Kwapil et al., 2008; Raine, 2006).

However, fit indices for the 3-factor model reported in some studies have been below accepted levels of adequate fit (Chmielewski & Watson, 2008; Kerns, 2006; Wuthrich & Bates, 2006). Further, consistency has been problematic through exploratory (Miller & Tal, 2007), principal (Chmielewski & Watson, 2008), and confirmatory factor analysis reports (CFA; Bora & Arabaci, 2009; Compton et al., 2009; Stefanis et al., 2004b; Wuthrich & Bates, 2006). Alternative 3-factor models have also emerged, with Venables and Rector (2000) suggesting a model in which *Positive Schizotypy*, *Social Avoidance*, and *Negative Schizotypy* are independent domains.

Section 1.3.3 indicated that the SPQ may be best suited to a 4-factor structure (Stefanis et al., 2004b), with researchers utilising this solution over the 3-factor structural model when investigating associations at the domain level (e.g., Compton et al., 2009). For this 4-factor structure, Stefanis et al. (2004b) proposed a model comprising of *Cognitive-Perceptual*, *Paranoid*, *Negative*, and *Disorganised* dimensions. Confirmation of this structure over alternative solutions has since been obtained in various populations (for details, see Section 1.3.3; Bora & Arabaci, 2009; Compton et al., 2009; Fonseca-Pedrero et al., 2014). Zhang and Brenner (2016) examined the factor structure of the SPQ between Canadian undergraduate and community samples, and found a distinct three-factor solution with the community sample, whereas a rather ambiguous four-factor solution was identified in the undergraduate sample. These findings highlight the ongoing debate as to the appropriate structure and, with only a handful of studies only explicitly testing the increased fit in one model compared with an alternative (Kerns, 2006), the SPQ factor structure requires further research to clarify its higher-order domains (Compton et al., 2009).

In addition, despite this research into the SPQ's structure, there has been less work on the dimensions of schizotypy between samples varying in culture and ethnicity, which is important because variability in the dimensionality of the SPQ may limit cross-cultural comparisons. However, within the same national setting, Reynolds et al. (2000) found evidence of 3-factor SPQ invariance between an Indian sample and participants of substantially African origin in Mauritius. Further, there is evidence of cross-cultural measurement invariance on the SPQ-B in Swiss and Spanish adolescents (Ortuño-Sierra et al., 2013). Although still in its infancy, research has also started to investigate cultural measurement invariance in alternative schizotypal scales. For example, using the Chapman psychosis-proneness scales, Chan et al. (2015) suggested schizotypy to be structurally invariant in a Chinese sample. That is, the authors replicated previous findings reported in US (Kwapil et al., 2008; Kwapil et al., 2012), Spanish (Kwapil et al., 2012), and German samples (Meyer & Keller, 2001), with Chinese students. This study also found that the measurement invariance held across time, with evidence of test-retest reliability over 6 months.

Despite the translation and wide use of the SPQ and other measures of schizotypal traits, there remains a lack of systematic study into the prevalence and manifestation of schizotypy across different cultural and ethnic groups. Using the SPQ, Gassab et al. (2006) found evidence that French students display higher mean scores on positive schizotypal traits and lower on negative traits relative to Tunisian students. However, this study was limited insofar as it only investigated the lower-order subscales and not higher-order factorial structure. Cross-cultural research into schizotypy at domain level suggests that African Caribbean populations express greater delusional ideation when compared to White British populations in the UK, but not more general schizotypal traits (Sharpley & Peters, 1999). Chavira et al. (2003) examined the

relationship between ethnicity and SPD, with findings suggesting that African-Americans had disproportionally greater SPD diagnoses than Whites and Hispanics.

Research on schizophrenia and ethnicity is more exhaustive, with relevant research comparing incidence rates in the Caribbean and the UK. As mentioned in Section 1.4, the incidence of schizophrenia in Jamaica (Hickling & Rodgers-Johnson, 1995), Trinidad (Bhugra et al., 1996), and Barbados (Mahy et al., 1999) has been found to be similar to the rate for the White population in England, which contrasts with the elevated incidence of schizophrenia in African Caribbean populations in the UK (Fernando, 1998). As healthy individuals who express schizotypal traits have a higher risk of developing schizophrenia-spectrum disorders (Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994; Gooding, Shea, & Matts, 2005; Kwapil, Gross, Silvia, & Barrantes-Vidal, 2013; Werbeloff et al., 2012), an investigation of schizotypy in African Caribbean and White British samples could not only illuminate further the nature of schizotypy as a personality dimension but also its link to variations of schizophrenia risk in different ethnic and cultural groups.

This study, therefore, aimed to identify the model of best fit between the 3-factor (Raine et al., 1994) and 4-factor structures[7] (Stefanis et al., 2004b). While this is not an exhaustive account of all possible structures, these represent the two most common and widely-supported solutions in the literature (Compton et al., 2009). Second, examination of measurement equivalence was conducted on the best-fitting model of the SPQ across White British and African Caribbean participants in London, UK, and African Caribbean participants in Port of Spain, Trinidad and Tobago. Finally, higher order domain-level scores were compared across cultural groups and sex.

[7] Following a similar procedure as Compton et al. (2009), three hierarchically-related models were also investigated based on Stefanis et al.'s (2004b) 4-factor structure.

2.1.2 Method

2.1.2.1 Participants

There were 762 participants: 362 (47.5%) White British and 116 (15.2%) African Caribbean residents in London, UK, and 284 (37.3%) African Caribbean residents in Port of Spain, Trinidad. The three sub-samples comprised participants from the general public and undergraduates. Recruitment from the general public was primarily through recruitment agencies in Trinidad and social and religious groups in London and Trinidad. The mean age of participants was 26.15 years (*SD* = 9.79) for the British sub-sample with 228 (63%) women and 134 (37%) men; 24.70 years (*SD* = 8.89) for the UK based African Caribbean sub-sample with 83 (71.6%) women and 33 (28.4%) men; and 28.79 years (*SD* = 7.70) for the Trinidadian African Caribbean sub-sample with 204 (71.8%) women and 80 (28.2%) men. There was a significant difference in age between the sub-samples, $F(1, 758) = 11.136$, $p < .001$, $\eta_p^2 = .03$. Follow-up multiple comparisons with Bonferroni correction indicated that the Trinidadian African Caribbean sub-sample was significantly older than the UK based African Caribbean ($p < .001$), and the British sub-sample ($p = .001$), with no significant difference between the British sub-sample and the UK based African Caribbean group ($p = .380$). All participants self-reported as not having a history of mental health problems relating to psychosis.

2.1.2.2 Measures

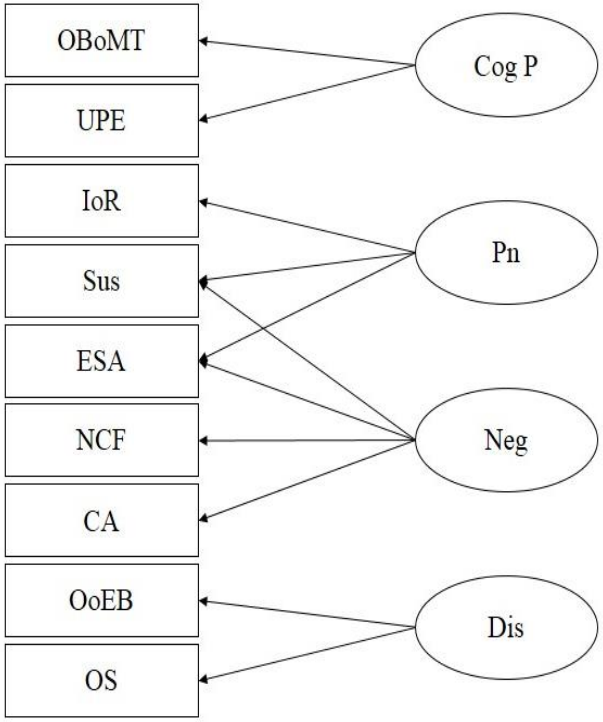
Schizotypy. Participants completed the 74-item SPQ (Raine, 1991). Each 'yes' response counts as one point and 9 subscale scores were computed as the total score for all items associated with each subscale (sample item: "Do you sometimes feel that other people are watching you?"). Internal consistency for each of the nine subscales was assessed using Cronbach's alpha. A Cronbach's alpha coefficient of between .65-.70 is

considered as minimally acceptable, .70-.80 as respectable, and > .80 as reflecting very good internal reliability (DeVellis, 2012). Table 3 shows Cronbach's alpha coefficients for the 9 subscales in the present sample (range = .71-.84, mean = .77), which is in-line previous findings (e.g., Compton et al., 2009).

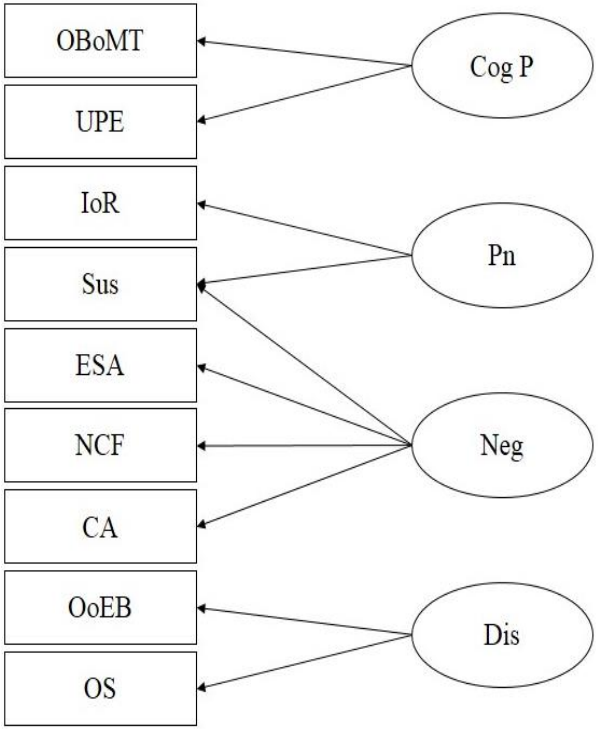
Table 3. Internal Consistency for SPQ subscales in Study 1

SPQ subscale	**α**
Ideas of reference (IoR)	.79
Excessive social anxiety (ESA)	.83
Odd beliefs or magical thinking (OBoMT)	.73
Unusual perceptual experiences (UPE)	.74
Odd or eccentric behaviour (OoEB)	.84
No close friends (NCF)	.79
Odd speech (OS)	.75
Constricted affect (CA)	.71
Suspiciousness (Sus)	.78

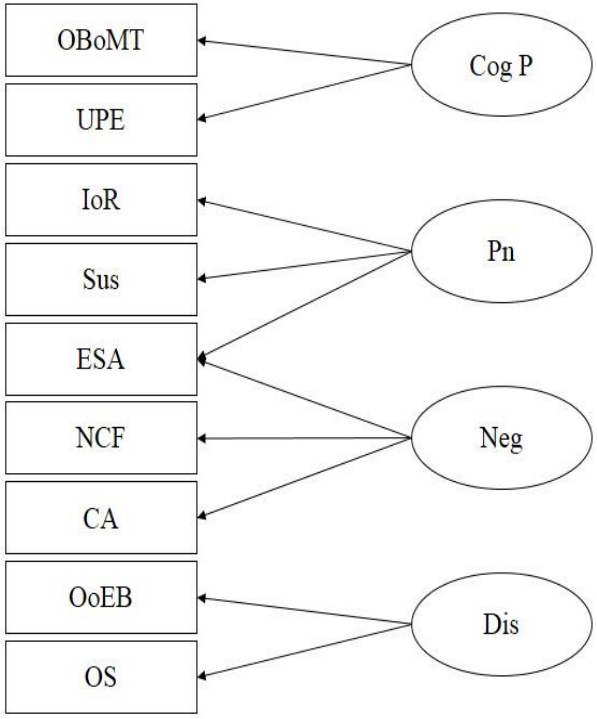
Higher order domain scores were then derived by summing of relevant subscale scores. The higher-order domains were comprised of the 3-factor structure (Raine et al., 1994) and varying 4-factor structures (for details of path structures, see Figure 5; Stefanis et al., 2004b).



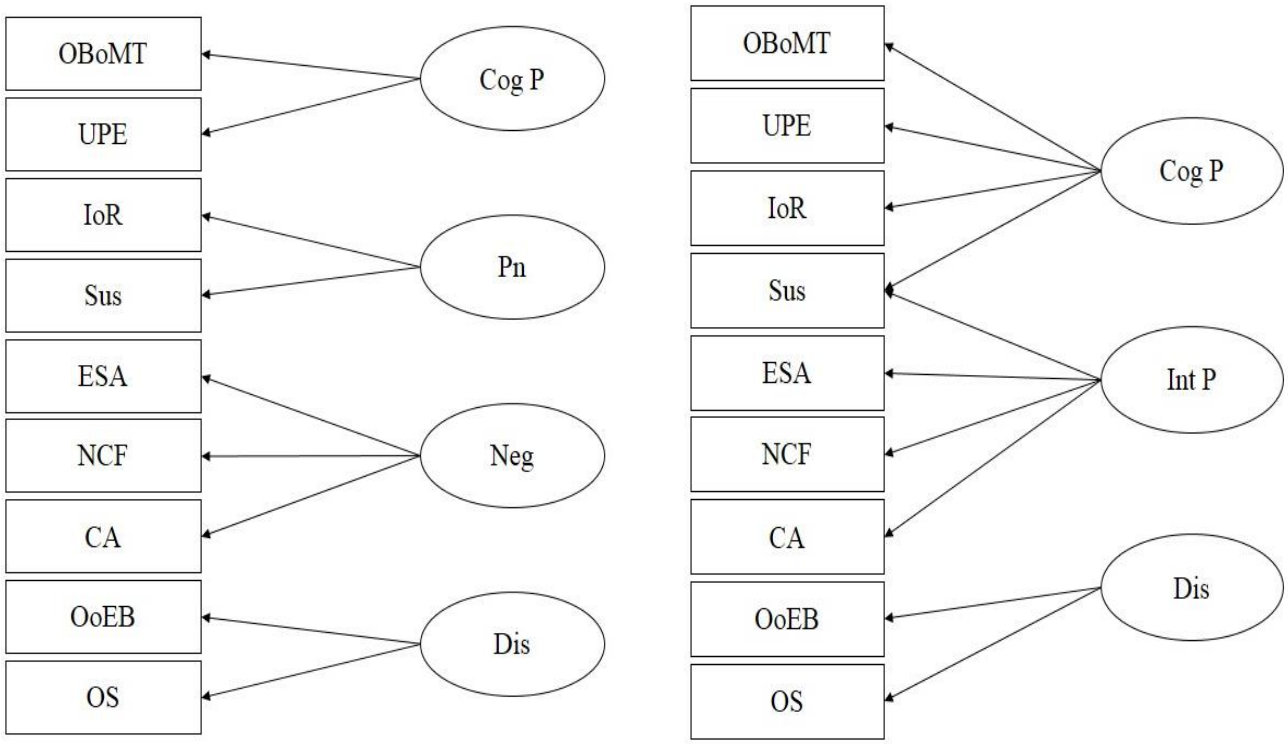
A: The 4-factor model (Stefanis et al., 2004b).



B: Modification of A. (Compton et al., 2009). Only Sus loads on both the paranoid and negative factors.



C: Modification of A. (Compton et al., 2009). Only ESA loads on both the paranoid and negative factors.



D: Unidimensional modification of A. (Compton et al., 2009).

E: The 3-factor model (Raine et al., 1994).

Figure 5. The measurement models under examination in Study 1. High-order factors: Cog P = Cognitive-Perceptual, Pn = Paranoid, Neg = Negative, Dis = Disorganised, Int P = Interpersonal. Lower-order subscales: OboMT = odd beliefs or magical thinking, UPE = unusual perceptual experiences, IoR = ideas of reference, Sus = suspiciousness, ESA = excessive social anxiety, NCF = no close friends, CA = constricted affect, OoEB = odd or eccentric behaviour, OS = odd speech.

2.1.2.4 Data Analysis

CFAs were conducted using Analysis of Moment Structures (AMOS 21; Arbuckle, 2012) to examine the factorial structure of the SPQ. CFA was deemed appropriate for use as the total sample size was above the accepted 200 (Boomsma & Hoogland, 2001) and there were at least 5 participants per model parameter for the models under examination (Bentler & Chou, 1987). Further, measurement invariance was conducted to ensure that latent mean comparisons at domain level are appropriate, i.e., difference in means reflects true deviation in score and not an error in measurement tool. The sample size for this was deemed acceptable as there were over the recommended 100 observations for each sub-sample (Kline, 2015).

Standard goodness-of-fit indices were selected *a priori* to assess the measurement models. The normed model chi-square (χ^2_{normed}) is reported with lower values of the overall model chi-square indicating goodness-of-fit. Good fit cut-off metric recommendations for χ^2_{normed} range from 5.0 (Wheaton, Muthen, Alwin, & Summers, 1977) to 2.0 (Tabachnick & Fidell, 2013). The Steiger-Lind root mean square error of approximation (RMSEA) and its 90% confidence interval provide a correction for model complexity. RMSEA values close to .06 indicate good fit, with values ranging to .10 representing mediocre fit (Hu & Bentler, 1999). The standardised root mean square residual (SRMR) assesses the mean absolute correlation residual and is a badness-of-fit index: the smaller the SRMR, the better the model fit. A cut-off value for SRMR is recommended to be "close to" or < .09 (Hu & Bentler, 1999, p. 27). The comparative fit index (CFI) measures the proportionate improvement in fit by comparing a target model with a more restricted, nested baseline model. The CFI reflects a goodness-of-fit index and is recommended to "close to" or > .95 for adequate fit (Hu & Bentler, 1999, p. 27). The Akaike information criterion (AIC) provides a measure to compare non-hierarchical factor structures, with the lowest AIC value being

preferred. Even so, these recommended cut-off values should be considered subjective guidelines (Heene, Hilbert, Draxler, Ziegler, & Bühner, 2011; Marsh et al., 2011).

As structural models are based *a priori*, fit statistics for the hypothesised models are not always ideal. While this may suggest a poor fit, the model may still be appropriate for the sample, with the inflated fit statistics reflecting idiosyncratic sample variation. Indeed, these poor fitting indices can be seen as forms of specification error within the model, which would indicate a marginal difference between the theoretical model and the true model in the sample (Whittaker, 2012). It is therefore possible to use respecification strategies to minimally adjust the model to the sample, of which there are two methods: an *a priori* simplification of the model; or, empirical testing, through the use of modification indices and standardised residuals, to respecify the model (Kenny, 1998). The latter, modification index (MI; or Lagrangian multiplier), is the most common method; providing an estimated value in which the chi-square (χ^2) statistic would decrease when a fixed parameter is added to the manifest variables' error terms, i.e., the model's observed and measurable components (in the present case these are the SPQ lower-order factors), and becoming freely estimated or relaxed in comparison to the remaining constrained parameters (Sörbom, 1989; Whittaker, 2012). In order to assess whether poor indices are the result of specification error; first, using the MI, a specification search is undertaken by examining whether the addition of fixed parameters throughout the model would significantly reduce the model's χ^2 value. Despite MI values greater than 3.84 have a statistically significant effect on the model's χ^2 value ($\alpha < .05$), following a more conservative convention used in previous research (e.g., Byrne, Shavelson, & Muthén, 1989), MIs in this thesis were judged only to be significant, and parameters relaxed, when greater than 5.00. Although the MI may be significant, any modification to the model must be theoretically plausible, if this is the case then it can be implemented in to improve model fit (Whittaker, 2012). However,

the number of modifications in any model should be kept to a minimum. Primarily this is to ensure that the fit of the model to population is not due to chance alone, as well as maximising cross-validity of model by not moulding the model to that specific sample (MacCallum, Roznowski, & Necowitz, 1992; Steenkamp & Baumgartner, 1998). Indeed, by name, CFA is confirmatory by nature, therefore it is important that the models under investigation are not data driven by the particular sample, but rather theoretically guided.

To determine if the best-fitting model was invariant across ethnicity, measurement invariance was tested at the configural (i.e., whether similar factors are measured), metric (i.e., whether the magnitude of factor loadings is the same), and scalar (i.e., whether the intercept of the regression relating each item to its factor is the same) levels (Chen, 2007). Finally, a multivariate analysis of covariance (MANCOVA) was used to examine sex and ethnicity differences with the domains for the model of best fit, with age has the covariate due to aforementioned discrepancies within the sample. Follow-up analyses for multiple comparisons used the Bonferroni correction to reduce the risk of obtaining Type I error.

2.1.2.3 Procedure

Ethics approval for this study was obtained from the University of Westminster, UK, and the University of the West Indies, Trinidad and Tobago. Survey dissemination was undertaken via multiple routes. First, an internal online research participation scheme was utilised. This scheme gives course credit to students eligible for this incentive. Second, where the course credit scheme did not apply, undergraduate students were invited to participate from adverts on campus via a paper-and-pencil and online format. Further, study information was distributed to the general public through recruitment agencies and social and religious groups in both London and Trinidad. In both the offline and online versions, participants completed a consent form before

proceeding to the survey. The consent form had the option for the participant to voluntarily register their email address for a follow-up study (Study 5). No monetary incentives were offered to the participants for completion of the survey. All participants received written debrief information at the end of the study.

2.1.3 Results

2.1.3.1 Confirmatory Factor Analysis

The goodness-of-fit indices of the five models proposed are shown in Table 4. As depicted, the first model (A) is the multidimensional 4-factor model of Stefanis et al. (2004b), which fits the data well. Previous research (Compton et al., 2009) has investigated two multidimensional modifications of this well-fitting model: one (B) where suspiciousness, but not expressions of social anxiety, loads on the *Paranoid* and *Negative* dimensions; another (C) in which expressions of social anxiety, but not suspiciousness, loads on the *Paranoid* and *Negative* dimensions; and one unidimensional modification (D) in which indicators do not load onto more than one dimension. With the exception of (B), previous research into these modifications has indicated a relatively poor fit (Compton et al., 2009). Similarly, the first modification (B) had good fit with alternative modifications having poor fit. The final model (E) is Raine et al.'s (1994) the multidimensional 3-factor model, with this model fitting the data well. For optimal fit, modification indices were consulted, which led to Expressions of Social Anxiety and Constricted Affect error terms being covaried in models A-D; and for model E, Ideas of Reference and Suspiciousness were covaried and, therefore, freely estimated within the model. Each model was limited to one adjustment for covariance of errors; that is, the highest pathways were covaried, with all covariances in this study having MIs > 10.000, i.e., covarying the pathways would cause the χ^2_M to be reduced by > 10.000. As previously mentioned in Section 2.1.2.4, the

number of modifications in any model should be kept to a minimum.

Table 4. Indices for Each Proposed Model in Study 1

Model		χ^2_M	df_M	χ^2_{normed}	RMSEA (90% CI)	SRMR	CFI	AIC
A.	The 4-factor model (Stefanis et al., 2004b)	47.042	18	2.613	.046 (.030, .062)	.021	.991	101.042
B.	Modification of A. (Compton et al., 2009) *Only Sus loads on both the paranoid and negative factors.*	52.405	19	2.758	.048 (.033, .064)	.025	.990	104.405
C.	Modification of A. (Compton et al., 2009) *Only ESA loads on both the paranoid and negative factors.*	107.794	19	5.673	.078 (.064, .093)	.034	.973	159.794
D.	Unidimensional modification of A. (Compton et al., 2009)	111.251	20	5.563	.077 (.064, .092)	.036	.973	161.251
E.	The 3-factor model (Raine et al., 1994)	76.658	22	3.484	.057 (.044, .071)	.034	.984	122.658

Overall, three of the models examined fit the data adequately, with all indices within acceptable ranges. The modified 4-factor structure (B) had a better fit than the 3-factor Raine et al. (1994) model, but poorer fit than the Stefanis et al. (2004b) model.

Further, using the AIC of the models as a comparative measure of fit, the Stefanis et al. (2004b) model had the best fit. Therefore, from the three well-fitting models, the present data were best suited to the Stefanis et al. (2004b) 4-factor model.

To test for invariance of the models across ethnicity, multiple-group analysis was performed with the best fitting model. As the unconstrained model had a good fit for the three ethnic sub-samples individually (see Table 5 for all invariance sub-sample metrics), this suggests configural invariance between the subsamples. Differences between the unconstrained and fully constrained model were not significant, indicating that the structure of the model achieved metric invariance across ethnicity, $\Delta\chi^2(20) = 29.742$, $p = .07$. Finally, scalar invariance was evaluated, where all item-factor intercepts were constrained equally across ethnicity and evaluated against the factor loading invariance model. Significant $\Delta\chi^2$ values ($p < .008$) and model fit changes (accounting for the uneven sample sizes: $\Delta CFI \geq -.005$ and $\Delta RMSEA \geq .010$ or $\Delta SRMR \geq .025$) would indicate intercept non-invariance (Chen, 2007). However, according to the changes to the fit indices and significant $\Delta\chi^2$ [(18) = 341.695, $p < .001$]. To identify which intercepts were not invariant, modification indices were assessed.

Table 5. Sub-sample Measurement Invariance Metrics in Study 1

Model	χ^2_M	df_M	χ^2_{normed}	RMSEA (90% CI)	SRMR	CFI
UK White British (n = 362)	28.429	18	1.579	.040 (.000, .067)	.051	.993
UK African Caribbean (n = 116)	44.017	18	2.445	.071 (.045, .099)	.041	.976
Trinidad African Caribbean (n = 284)	25.708	18	1.428	.061 (.000, .111)	.029	.986

Configural invariance	217.530	63	3.453	.057 (.049, .065)	.054	.952
Metric invariance	247.272	83	2.979	.051 (.044, .058)	.063	.949
Scalar invariance	588.967	101	5.831	.080 (.074, .086)	.058	.847

Examination of the modification indices revealed that the significant increase in χ^2 value and fit indices was due to a lack of scalar invariance of two indicators: Odd Beliefs or Magical Thinking and No Close Friends. While relaxing these two constraints yielded a substantial improvement in fit as compared to the full scalar invariance model, $\chi^2_M(88) = 419.126$, $\Delta\chi^2_{normed} = 4.763$, SRMR = .045, CFI = .896, RMSEA = .070 (low = .064, high = .077), in comparison to the configural model, findings suggest non-invariance at the scalar level. Further, modification indices indicated that there was no particular sub-sample that was responsible for this suggested scalar non-invariance; rather deviation was spread across sub-samples fairly evenly. It has been argued that full scalar invariance is not necessary for further tests of invariance and substantive analysis (e.g., latent factor comparisons) to be meaningful (Byrne, Shavelson, & Muthén, 1989; Hong, Malik, & Lee, 2003; Steenkamp & Baumgartner, 1998). While this does not reflect partial scalar invariance, and aside from the CFI index, the fit statistics were acceptable for the scalar model when not compared to the metric indices; therefore, it was deemed acceptable to continue with the analyses. However, any further inferences made between the sub-samples were cautionary.

2.1.3.2 Between-Group Differences

Sex and ethnicity differences in scoring with the four higher-order domains of the best fitting model. A 2-way MANCOVA was conducted, with the four dimension scores as dependent variables and age entered as a covariate term. Despite the unequal sub-sample sizes, multivariate analysis of variance (MANOVA), and by extension MANCOVA, is robust and adjusts for sample size differences (Morrison, 1990). A statistically significant main effect was obtained for ethnicity, $F(8, 1502) = 22.46$, $p < .001$, Wilk's $\Lambda = .80$, $\eta_p^2 = .11$. A series of follow up one-way analyses of variance (ANOVAs) indicated significant main effects of ethnicity on the *Disorganised*, *Cognitive-Perceptual*, and *Negative*, but not the *Paranoid* domains (see Table 6).

Table 6. Follow-Up ANOVAs of Ethnicity Main Effects for Each Domain in Study 1

Domain	*F*	*p*	η_p^2
Disorganised	58.14	< .001	.13
Cognitive-Perceptual	12.36	< .001	.03
Paranoid	2.93	.054	.01
Negative	15.53	< .001	.04

While the follow-up ANOVAs from the MANOVA/MANCOVA are said to be protected against inflated Type 1 error rates (Bock, 1985), the further inspection of the means used a Bonferroni-corrected ($\alpha = .05/3 = .017$) independent samples *t*-tests (see Table 7). Findings suggest that the Trinidadian based African Caribbean sub-sample scored significantly lower than both the UK sub-samples on all three domains, while there was no difference between UK based participants.

Table 7. Ethnicity Ratings Within the Best Fitting Model in Study 1

Domains	Group Comparison Mean (*SD*)		*t*	*p*	*d*
Disorganised	UK White British 5.59 (4.15)	UK African Caribbean 4.95 (4.57)	1.40	.162	0.15
	UK White British 5.59 (4.15)	Trinidad African Caribbean 2.14 (2.83)	11.96	< .001*	0.97
	Trinidad African Caribbean 2.14 (2.83)	UK African Caribbean 4.95 (4.57)	7.44	< .001*	0.74
Cognitive-Perceptual	UK White British 3.18 (3.27)	UK African Caribbean 3.16 (3.33)	0.07	.945	0.01
	UK White British 3.18 (3.27)	Trinidad African Caribbean 1.87 (2.36)	5.71	< .001*	0.46
	Trinidad African Caribbean 1.87 (2.36)	UK African Caribbean 3.16 (3.33)	4.37	< .001*	0.46
Negative	UK White British 10.22 (7.47)	UK African Caribbean 10.41 (7.44)	0.24	.812	0.03
	UK White British 10.22 (7.47)	Trinidad African Caribbean 7.12 (5.88)	5.74	< .001*	0.46
	Trinidad African Caribbean 7.12 (5.88)	UK African Caribbean 10.41 (7.44)	4.69	< .001*	0.49

* Bonferroni-corrected $p = .017$

There was a significant main effect of sex, $F(4, 751) = 2.77$, $p = .027$, Wilk's $\Lambda = .99$, $\eta_p^2 = .02$. However, the effect size of the main effect was small and inspection of

the one-way ANOVAs indicated that none of the effects reached significance on any of the four domains (see Table 8).

Table 8. Intra-Population Univariate ANOVAs of Domains for Sex in Study 1

Domains	Men Mean (*SD*)	Women Mean (*SD*)	*F*	*p*	η_p^2
Cognitive-Perceptual	2.52 (2.99)	2.77 (3.06)	1.33	.250	< .01
Negative	9.22 (7.72)	9.02 (6.75)	< .001	.982	< .01
Disorganised	4.76 (4.18)	3.94 (4.06)	0.37	.848	< .01
Paranoid	7.53 (6.04)	8.21 (5.61)	2.73	.099	< .01

Finally, there was a significant sex x ethnicity interaction, $F(8, 1502) = 3.63$, $p < .001$, Wilk's $\Lambda = .96$, $\eta_p^2 = .02$. One-way ANOVAs indicated a significant difference in the *Disorganised* domain only, $F(2, 754) = 5.221$, $p = .006$, $\eta_p^2 = .01$. Further inspection of the means used a Bonferroni-corrected ($\alpha = .05/15 = .003$) independent samples *t*-tests, and revealed within this domain, there were no significant differences that reached this adjusted significance level.

2.1.4 Discussion

The present findings revealed that the original 3-factor structure (Raine et al., 1994), the 4-factor (Stefanis et al., 2004b), and a hierarchically related 4-factor structure (Compton et al., 2009) had fit indices within an acceptable range. Of these well-fitting models, the 4-factor model proposed by Stefanis et al. (2004b) had the best fit. Raine et al.'s (1994) 3-factor model fitted well, which is consistent with some previous investigations into the SPQ's structure (Reynolds et al., 2000). However, the 3-factor

solution did not fit as well as the two 4-factor structures, indicating that the presence of a *Paranoid* factor may improve fit. Further, the modification whereby suspiciousness, but not excessive social anxiety, loaded on both the *Paranoid* and *Negative* factors had the second best fit, which is consistent with previous findings (Compton et al., 2009).

In addition, measurement invariance was found for this best fitting model at the configural and metric level, however the model fell short of full scalar invariance. Although the indices (with exception of CFI) fell within acceptable ranges, in comparison to the less constrained metric model. These findings suggest a reasonable level of confidence in the factorial structure and robustness between the divergent samples. However, as measurement invariance was not completely obtained, inferences made with the factorial structure has to be made with caution. This supports previous evidence of measurement invariance for the 3-factor model (Reynolds et al., 2000) and 3- and 4-factor models of the SPQ-B (Fonseca-Pedrero et al., 2011), with the addition of support for the 4-factor structure of the SPQ. However, full scalar invariance has been problematic with similar previous research; for example, Cicero (2015) found only partial scalar invariance with a Pacific Islander sample. While yielding constrains on the Odd Beliefs or Magical Thinking and No Close Friends parameters, marginally improved the indices, partial scalar invariance could not be obtained. Thus, to investigate this further, research at item level of the SPQ is necessary. While outside the scope of the present thesis, and limiting the *DSM* association with the SPQ, this is required for confidence in the scale between ethnic groups and in different cultural settings.

Subsequent analyses for each domain, derived from the best-fitting four-factor model, revealed no significant sex differences. Previous research has found that men score higher on the *Negative* factor and women score higher on the *Cognitive-Perceptual* factor (Bora & Baysan Arabaci, 2009; Fossati et al., 2003; Kwapil et al.,

2008; Wuthrich & Bates, 2006), which were not established in the present study. The *Cognitive-Perceptual* and *Negative* domains may be influenced by the inclusion of the *Paranoid* domain in the 4-factor solution, in terms of the lower-order to higher-order structure. While not in the scope of the present research, it would be of interest to further investigate this effect related to respondent sex. With regards to the *Cognitive-Perceptual* factor, reducing the four lower-order factors in the 3-factor solution to two lower-order factors in the 4-factor model may have diminished the effect of sex with this domain and should be further examined.

Between-group analysis of the ethnicity subgroups indicated that the African Caribbean based in Trinidad scored significantly lower than the White British and the African Caribbean group based in the UK on the four higher-order domains, while there was no difference in domain scores for the UK based groups. When considering the schizophrenia literature, similar incidence rates between White British and African Caribbeans have been found when the sample has been recruited from the UK and Trinidad, respectively (Bhugra et al., 1996). While the difference between the subgroups may reveal the profile of schizotypy to be dissimilar to that of schizophrenia, it could possibly be explained by confounding variables, such as urbanicity. Research suggests that around one-third of all diagnoses of schizophrenia may be associated with environmental factors related to the urban environment (Krabbendam & van Os, 2005). With the diverse sociodemographic variables of the sub-samples particularly in relation to population density and socioeconomic status, the urban environment and culture, rather than ethnicity, may account for variation in domain scores. This reasoning is emphasised by the similar scores between the two London based groups and gives possible support towards cultural, rather than biological, considerations. Finally, there was a significant sex x ethnicity interaction, with a significant difference in the *Disorganised* domain only. However, follow-up analyses controlling for a Type I error,

revealed no significant differences. As it is a fairly consistent finding that men score higher on this dimension than women (Bora & Baysan Arabaci, 2009; Fonseca-Pedrero et al., 2011; Fossati et al., 2003; Kwapil et al., 2008; Raine, 2006) and with the small effect size of the interaction, this possibly reflects a gender trend in the aforementioned direction, reduced by the effect of ethnicity.

Further, methodological problems may account for some of the difference in schizotypal scores. This study adopted both paper-and-pencil and electronic versions of the SPQ. While the majority of the UK sub-sample completed the SPQ online, the Trinidadian sub-sample required a paper-and-pencil approach. Buchanan et al. (2005) reported nonequivalence between online and paper-and-pencil approaches, suggesting caution with the measurement of psychological properties online. However, with a lack of internet access for many in Trinidad, this sub-sample was restricted primarily to a paper-and-pencil format of the SPQ. With online personality measurement, there is a lack of control in testing and the possibility of extraneous (e.g., environmental cues) or temporary (e.g., fatigue) factors influencing respondents (Buchanan, 2002). Further, in the present research, factors such as language and cultural differences may also be important, as well as interactions between the measured constructs and the characteristics of the testing method (Buchanan, 2002). With a lack of literature relating to the testing medium of the SPQ, it is unclear whether respondents would be influenced by either method. As the sample locations primarily adopted the differing methods, it is not possible with these data to investigate if there was measurement invariance with the mode of responding.

Thus, future research should investigate the best-suited testing medium for the SPQ as well as continue to investigate the SPQ's structure and measurement invariance across ethnicity and culture. Further refinement of the structure and knowledge regarding the SPQ will advance this assessment tool, allowing it to be used in

community studies and in parallel with endophenotypes for the early detection of schizophrenia.

2.2 Study 2: Schizotypal Measurement in Malaysia

2.2.1 Overview of Study 2

Similar to Study 1, psychometric evaluation of the SPQ was investigated, but utilising a different sample (see Section 2.1 for details of the SPQ). Specifically, the examination was of the higher-order factorial structure of the SPQ in an ethnically-diverse Malaysian sample. There are a number of reasons why doing so is important and meaningful. First, despite recent advances in mental health research in Malaysia, there are still a relatively low number of good quality studies reporting on schizophrenia research in this national and cultural context, in comparison with the number of universities and hospitals (Chee & Salina, 2014). By extension, clinical schizotypal research is extremely limited, with an absence of non-clinical personality dimensional research. Therefore, translation of the SPQ into Bahasa Malaysia (Malay) will help stimulate schizotypal research in a previously neglected national context. As high ratings of schizotypy may constitute a risk factor for schizophrenia and other psychotic illnesses, this would not only add to the limited psychosis literature in this population but, through the identification of people at risk for psychosis, potentially be of substantial clinical benefit and contribute to real improvements in quality of life (cf. Razali & Yahya, 1995; Salleh, 1994).

Second, Malaysia is ethnically heterogeneous, with a Malay majority and large ethnic minority populations of Chinese, Indians, and other indigenous ethnic groups (Department of Statistics Malaysia, 2010). This provides an opportunity to examine the factor structure of the SPQ in different ethnic groups within the same national context (as opposed to different ethnic groups in different national contexts; e.g., Study 1). Furthermore, by examining latent mean comparisons between ethnic groups, this study was able to examine the extent to which the phenomenology of schizotypy may be influenced by ethno-cultural factors. For example, Malays are more likely than Chinese in Malaysia to believe in supernatural agents (e.g., ghosts, demons, and possession by

spirits) as precursors of mental illness (Razali, Khan, & Hasanah, 1996; Swami, Furnham, Kannan, & Sinniah, 2008a). Indeed, as an extension to Study 1, the present study further investigates the possible influence of urbanicity on schizotypal ratings. While this is an under investigated facet of schizotypal research, Stefanis et al. (2004a) found that young adult men from urban areas are less effected by interpersonal deficits than females, but have higher levels of positive features. The findings of Stefanis et al. (2004a) are surprising, as generally women score higher on the positive dimension and men score higher on the negative and disorganised dimensions (Bora & Baysan Arabaci, 2009; Fonseca-Pedrero et al., 2011; Fossati et al., 2003; Kwapil et al., 2008; Raine, 2006). Some scholars have suggested that the environmental risk of urbanicity may move a moderate proportion, conditional on a predisposed generic risk, of the young adult population along a continuum of psychosis towards a diagnosis of schizophrenia (Spauwen, Krabbendam, Lieb, Wittchen, & van Os, 2004). Thus, the effect of urbanicity is of particular interest in Study 2 with regard to previous findings, and further as there was no gender effect established through Study 1.

Following the findings from Study 1, it was hypothesised that the structure of the Malay SPQ will endorse the 4-factor solution (Stefanis et al., 2004b). It was further hypothesised that Malays will have higher SPQ ratings than Chinese, emphasised particularly in the positive domains. Similar to previous investigations, it is expected that women will score significantly higher on the *Cognitive-Perceptual* dimension and men to score significantly higher on the *Negative* and *Disorganised* dimensions. Although there is less known regarding urbanicity and schizotypy, it is expected that urban participants will have significantly higher scores than rural participants on all dimensions.

2.2.2 Method

2.2.2.1 Participants

There were 382 undergraduate participants; 195 (51%) Malay and 187 (49%) Chinese individuals recruited from a national university in Kuala Lumpur, the capital and largest city in Malaysia. Kuala Lumpur is ethnically heterogeneous, with large groups of Malays and Chinese making up just under 90% of the estimated 7 million residents of the metropolitan population. The mean age of participants was 20.47 years (*SD* = 1.46) for the Malay sub-sample with 124 (63.6%) women and 71 (36.4%) men, and 20.69 years (*SD* = 1.40) for the Chinese sub-sample with 108 (57.8%) women and 79 (42.2%) men. There was no significant difference in age between sub-samples, $t(380) = 1.60$, $p = .111$, $d = 0.16$. All participants self-reported as not having a history of mental health problems relating to psychosis.

2.2.2.2 Measures

Schizotypy. See Section 2.1.2.2 for details of the Schizotypal Personality Questionnaire (SPQ; Raine, 1991). As Study 1 indicated support for three solutions: the original 4-factor structure (Model A in Study 1; Stefanis et al., 2004b), modified 4-factor variation (Model B in Study 1; Compton et al. 2009), and the 3-factor model (Model E in Study 1; Raine et al., 1994), these three were evaluated. For the factorial make-up of these structures, see Figure 5 in Section 2.1.2.2. Internal consistency for each of the nine subscales was assessed using Cronbach's alpha, see Section 2.2.2.4 below.

Urbanicity. In the schizophrenia literature, urbanicity has been operationalised in a variety of ways. Some studies have defined and measured urbanicity as the number of people in an area surface (e.g., Allardyce et al., 2001), while others have categorised levels of urbanicity based on the number of addresses relative to area surface (e.g.,

Marcelis, Navarro-Mateu, Murray, Selten, & van Os, 1998). Yet others have used the absolute population count to measure area size, such as a main city compared to municipalities in rural areas (e.g., Harrison et al., 2003). Urbanicity can also be defined with regard to place of birth, upbringing, or residence, with most studies examining urban birth or urban upbringing, although as these are strongly associated with residence, this is not of particular importance (Krabbendam & van Os, 2005; Marcelis, Takei, & van Os, 1999). Therefore, in the present study, participants self-reported their place of birth using five categories following previous investigations into urbanicity and schizophrenia (Mortensen et al., 1999; van Os, Pedersen, & Mortensen, 2004): *capital, capital suburb, provincial city with more than 100,000 inhabitants, provincial town with more than 10,000 inhabitants, and rural area*. However, as Malaysia is comprised of 13 states and one federal territory (which is also considered a state), with each state having a capital, *state capital* was added to the list of options. For the demographical self-ascribed urbanicity data, see Table 9.

Table 9. Urban Birth Demographics for the Sample in Study 2

Place of Birth	Number of Participants (% of sample)	Urban Grouping	Number of Participants (% of sample)
Capital city	71 (18.6)		
Capital city suburbs	3 (.8)	Urban	142 (37.2)
State capital	68 (17.8)		
Provincial city > 100,000 inhabitants	104 (27.2)		
Provincial town > 10,000 inhabitants	58 (15.2)	Rural	240 (62.8)
Rural areas	78 (20.4)		

As the sample size was relatively low for 6 categories of urbanicity, the initial self-ascribed ethnicity was grouped into a dichotomy of urban (37.2% of sample) and rural (62.8% of sample) for further analyses.

2.2.2.3 Procedure

Ethics approval for this study was obtained from the University of Westminster, UK, and the University of Malaya, Malaysia. Survey package dissemination was undertaken via a paper-and-pencil format in classroom settings. All participants were invited to complete the anonymous survey material voluntarily and, to minimise risk of coercion, participants were told that they were free not to participate with no risk to their grades. All participants took part on a voluntary basis with no monetary incentives offered to the participants for completion of the survey. Participants were verbally debriefed once they had returned their questionnaires.

The original SPQ was translated from English into Bahasa Malaysia (Malay) using a modified back-translation technique (Brislin, 1970). Specifically, the SPQ was initially translated into Malay by the two academic psychologists, both of whom are fluent speakers of the language. A synthesis version based on the two translations was then drawn up by the translators and a neutral judge. Next, from the synthesis, a back-translation was created by a translator unaffiliated with the study and with no prior knowledge of the original instrument. Finally, the original translators discussed the syntheses and back-translations to ensure clear final versions, equivalent to the originals in terms of semantics and concept.

2.2.2.4 Data Analysis

Initial data quality analysis for internal consistency of the new translation of the SPQ was conducted with item deletion if required. Following this, CFAs were

conducted on these data using the same indices as Study 1 (see Section 2.1.2.4 for details of metrics) and the best fitting models from Study 1 (Models A, B, and E; see Section 2.1.2.2). Finally, a MANOVA was used to examine sex, urbanicity, and ethnicity differences with the domains for the model of best fit, with follow-up analyses for multiple comparisons using the Bonferroni correction.

2.2.3 Results

2.2.3.1 Data Quality Analysis

Internal consistency for each of the nine subscales was assessed using Cronbach's alpha. A Cronbach's alpha coefficient of between .65-.70 is considered as minimally acceptable, .70-.80 as respectable, and > .80 as reflecting very good internal reliability (DeVellis, 2012). As one subscale (Odd Beliefs or Magical Thinking) fell below .65 and two subscales (Ideas of Reference and Unusual Perceptual Experiences) had questionable reliability, item-deletion was implemented to improve alpha. Table 10 shows item-rest correlations (internal item convergence), which should be above .30 (Field, 2005), and the change in alpha if items are deleted. Five items were deleted in total from the SPQ (Ideas of Reference, item #19; Odd Beliefs or Magical Thinking, items #3, 39, 47; Unusual Perceptual Experiences, item #40).

Table 10. Correlations Between Items and the Rest of Items in Its Own Scale and Cronbach's Alpha of Domains If item Is Deleted in Study 2

	Item-rest[1]	α if deleted[2]	α
Ideas of Reference			.66
1	.264	.638	
10	.223	.646	
19	.179	.659	
28	.408	.605	

37	.350	.619	
45	.279	.635	
53	.349	.619	
60	.459	.592	
63	.442	.596	
Odd Beliefs or Magical Thinking			.64
3	.161	.648	
12	.485	.545	
21	.554	.517	
30	.260	.623	
39	.251	.626	
47	.197	.636	
55	.490	.544	
Unusual Perceptual Experiences			.68
4	.453	.627	
13	.426	.634	
22	.339	.654	
31	.339	.654	
40	.031	.697	
48	.326	.656	
56	.381	.645	
61	.477	.623	
64	.322	.657	

[1] Item-rest = Item-rest correlation between item and sum of the other items in its own domain.
[2] α If Deleted = The values of the overall alpha if item is not in the calculation.

Table 11 shows the revised metrics following item-deletion and Cronbach's alpha for the remaining subscales. All item-rest correlations were above .30 except item #10, but as deleting this item had minimal improvement in overall reliability for this subscale, it was not removed. Further, while deleting item #30 marginally improves reliability for the Odd Beliefs or Magical Thinking subscale, it was not removed as (Tabachnick & Fidell, 2013) recommends no subscale should have fewer than three items.

Table 11. Modified Subscales, Reflecting; Inter-Rest Correlations, Cronbach's Alpha of Domains If Item Is Deleted, and Cronbach's Alpha of All Domains in Study 2

	Item-rest[1]	α if deleted[2]	α
Ideas of Reference			.66
1	.320	.641	
10	.236	.659	
28	.395	.622	
37	.351	.633	
45	.308	.643	
53	.339	.636	
60	.470	.601	
63	.404	.619	
Odd Beliefs or Magical Thinking			.68
12	.501	.583	
21	.542	.553	
30	.316	.691	
55	.485	.594	
Unusual Perceptual Experiences			.69
4	.453	.648	
13	.427	.655	
22	.335	.675	
31	.351	.673	
48	.301	.683	
56	.372	.668	
61	.508	.636	
64	.323	.678	
Excessive Social Anxiety	-	-	.83
Odd or Eccentric Behaviour	-	-	.82
No Close Friends	-	-	.76
Odd Speech	-	-	.75
Constricted Affect	-	-	.76
Suspiciousness	-	-	.79

[1] Item-rest = Item-rest correlation between item and sum of the other items in its own domain.
[2] α If Deleted = The values of the overall alpha if item is not in the calculation.

2.2.3.2 Confirmatory Factor Analysis

First, CFA was conducted where all lower-order domains loaded onto the multidimensional 4-factor model (Model A in Study 1) proposed by Stefanis et al. (2004b). Fit indices were found to be: $\chi^2(19, N = 382) = 73.619$, $\chi^2_{normed} = 3.875$, CFI = .961, RMSEA = .087 with 90% *CI* = .066-.108, SRMR = .058, AIC = 125.619. This model was deemed to have a moderate-to-good fit for these data. Then, CFA was conducted on the best fitting modification of this 4-factor structure (Model B in Study 1), as proposed by Compton et al. (2009). Fit indices were found to be: $\chi^2(20, N = 382) = 88.616$, $\chi^2_{normed} = 4.431$, CFI = .951, RMSEA = .095 with 90% *CI* = .075-.115, SRMR = .062, AIC = 138.616. This model was deemed to have a poorer fit for these data than the previous 4-factor solution.

Next, CFA was conducted on Raine et al.'s (1994) proposed multidimensional 3-factor model (Model E in Study 1). Fit indices were found to be: $\chi^2(23, N = 382) = 96.000$, $\chi^2_{normed} = 4.174$, CFI = .948, RMSEA = .091 with 90% *CI* = .073-.111, SRMR = .064, AIC = 140.000. This model fits the data adequately well, but to a lesser degree than that of either 4-factor solutions across all metrics. There was no modification of the pathways in any of the models to improve fit, i.e., modification indices were not used to covary any of the error terms of the manifest lower-order subscales. Importantly, using the AIC of the models as a comparative measure of fit, the Stefanis et al. (2004b) model had the best fit. Therefore, for the models, the present data were better suited to the Stefanis et al. (2004b) 4-factor model.

As there were over the recommended 100 observations per ethnic sub-sample (Kline, 2015) to test for measurement invariance across ethnicity, multiple-group analyses with the best-fitting model was performed. The unconstrained model had adequate fit for both ethnic sub-samples individually, $\chi^2(38, N = 382) = 105.550$, χ^2_{normed}

= 2.778, CFI = .953, RMSEA = .068 with 90% *CI* = .053-.084, SRMR = .051 (see Table 12 for all sub-sample metrics), suggesting configural invariance between the subsamples.

Differences between the unconstrained and fully constrained model were not significant, indicating that the structure of the model achieved metric invariance across ethnicity, $\Delta\chi^2(2) = 11.240$, $p = .339$. Finally, scalar invariance was evaluated, where all item-factor intercepts were constrained equally across ethnicity and evaluated against the factor loading invariance model. Significant $\Delta\chi^2$ values ($p < .008$) and model fit changes (as sub-sample sizes are even, ΔCFI $\geq .010$ and ΔRMSEA $\geq .015$ or ΔSRMR $\geq .010$) indicate intercept non-invariance (Chen, 2007). However, according to the changes to the fit indices and $\Delta\chi^2$, intercept invariance was not supported, $\Delta\chi^2(9) = 32.528$, $p < .001$. To identify which intercepts were not invariant, modification indices were assessed.

Table 12. Indices for the Best Fitting 4-factor Structure in Study 2

Model	χ^2_M	df $_M$	χ^2_{normed}	RMSEA (90% CI)	SRMR	CFI
Malay (*n* = 195)	37.228	19	1.959	.070 (.036, .104)	.051	.967
Chinese (*n* = 187)	68.318	19	3.596	.118 (.089, .149)	.072	.943
Configural invariance	105.550	38	2.778	.068 (.053, .084)	.051	.953
Metric invariance	117.813	48	2.454	.062 (.048, .076)	.070	.952
Scalar invariance	150.341	57	2.638	.066 (.053, .079)	.068	.935
Partial scalar invariance	129.826	55	2.360	.060 (.047, .073)	.069	.948

Examination of the modification indices revealed that the significant increase in χ^2 value and fit indices was due to a lack of scalar invariance of two indicators: Unusual Perceptual Experiences and Suspiciousness. Relaxing these two constraints yielded substantial and statistically significant improvement in fit as compared to the full scalar invariance model, $\Delta\chi^2(2) = 20.515$, $p < .001$. This partial scalar invariance model was then evaluated against the full metric invariance model. With the changes to the fit indices and $\Delta\chi^2$, partial intercept invariance was evident, $\Delta\chi^2$ (7) = 12.013, $p = .100$. As mentioned in Section 2.1.3, it has been argued that full metric/scalar invariance is not necessary for further tests of invariance and substantive analysis (e.g., latent factor comparisons) to be meaningful, provided that at least one item (other than the one fixed at unity to define the scale of each latent construct) is invariant (Byrne, Shavelson, & Muthén, 1989; Hong, Malik, & Lee, 2003; Steenkamp & Baumgartner, 1998). Thus, analyses with between-group differences can be continued on the basis of partial scalar invariance.

2.2.3.3 Between-Group Differences

Next, sex, urbanicity, and ethnicity differences in scoring with the four domains of the best-fitting model were investigated. A three-way MANOVA was conducted, with the four dimension scores as dependent variables and sex, urbanicity, and ethnicity, respectively, as independent variables. As the design of the observations was not balanced, particularly with urbanicity, Box's *M* test for equality of covariance was assessed. As Box's *M* test was significant ($p < .001$), Pillai's trace criterion was used for interpretation of the MANOVA, rather than the less conservative Wilk's Λ (Tabachnick & Fidell, 2013). There were statistically significant main effects found for sex, $F(4, 371) = 18.85$, $p < .001$, Pillai's trace = .17, $\eta_p^2 = .17$, ethnicity, $F(4, 371) = 2.59$, $p = .037$, Pillai's trace = .03, $\eta_p^2 = .03$, and urbanicity, $F(4, 371) = 11.17$, $p < .001$, Pillai's

trace = .11, η_p^2 = .11. Further, there were statistically significant interactions found for urbanicity x sex, $F(4, 371) = 18.69$, $p < .001$, Pillai's trace = .17, η_p^2 = .17, sex x ethnicity, $F(4, 371) = 3.17$, $p = .014$, Pillai's trace = .03, η_p^2 = .03, and sex x urbanicity x ethnicity, $F(4, 371) = 2.93$, $p = .021$, Pillai's trace = .03, η_p^2 = .03. However, there was no ethnicity x urbanicity interaction with these data, $F(4, 371) = 1.93$, $p = .105$, Pillai's trace = .02, η_p^2 = .02. Descriptive statistics and a summary of the follow-up ANOVAs can be found in Table 13 for ethnicity, sex, and urbanicity.

Table 13. Summary of Descriptives Statistics and Follow-up ANOVAs for Each Domain in Study 2

Source	Group Comparison	Domain	*F*	Effect Size (η_p^2)
Ethnicity	Malay (*M* = 5.72, *SD* = 3.86) Chinese (*M* = 5.91, *SD* = 4.12)	*Disorganised*	.14	< .01
	Malay (*M* = 4.94, *SD* = 3.23) Chinese (*M* = 4.21, *SD* = 2.97)	*Cognitive-Perceptual*	2.04	.01
	Malay (*M* = 13.78, *SD* = 5.22) Chinese (*M* = 12.13, *SD* = 6.19)	*Paranoid*	5.50*	.02
	Malay (*M* = 15.10, *SD* = 6.95) Chinese (*M* = 14.30, *SD* = 8.72)	*Negative*	1.49	< .01
Sex	Men (*M* = 6.87, *SD* = 4.70) Women (*M* = 5.14, *SD* = 3.28)	*Disorganised*	38.90***	.09
	Men (*M* = 4.04, *SD* = 3.34) Women (*M* = 4.94, *SD* = 2.94)	*Cognitive-Perceptual*	4.74*	.01
	Men (*M* = 13.40, *SD* = 6.88) Women (*M* = 12.69, *SD* = 4.91)	*Paranoid*	5.89*	.02
	Men (*M* = 16.81, *SD* = 9.35) Women (*M* = 13.35, SD = 6.40)	*Negative*	23.41***	.06
Urbanicity	Urban (*M* = 6.19, *SD* = 4.49) Rural (*M* = 5.60, *SD* = 3.65)	*Disorganised*	8.85**	.02
	Urban (*M* = 4.40, *SD* = 2.50) Rural (*M* = 4.69, *SD* = 3.44)	*Cognitive-Perceptual*	.05	< .01
	Urban (*M* = 13.35, *SD* = 5.22) Rural (*M* = 12.75, *SD* = 6.07)	*Paranoid*	5.06*	.01
	Urban (*M* = 14.31, *SD* = 7.65) Rural (*M* = 14.95, *SD* = 7.99)	*Negative*	< .01	< .01

*$p < .05$; **$p < .01$ ***$p < .001$

For the main effect of ethnicity, there was a significant difference in the *Paranoid* domain only, with Malay participants scoring significantly higher scores than Chinese participants. There were no further statistically significant comparisons within this domain (all *p*s > .05). Further, there was a main effect of sex, with men scoring significantly higher than women on the *Disorganised*, *Paranoid*, and *Negative* dimensions, while women scored significantly higher than men on the *Cognitive-Perceptual* factor. With regard to urbanicity, there was a main effect with those participants born in an urban setting scoring significantly higher on the *Disorganised* and *Paranoid* dimensions than those born in rural setting. There were no further statistically significant comparisons within this domain (all *p*s > .05). See Table 14 for a summary of the significant interactions of sex, ethnicity, and urbanicity through the four dimensions.

Table 14. Significant Interaction Effects of Sex, Ethnicity, and Urbanicity in Study 2

Source	Domain	*F*	Effect Size (η_p^2)
Urbanicity x Sex	*Disorganised*	49.92***	.12
	Cognitive-Perceptual	1.91	.01
	Paranoid	19.21***	.05
	Negative	9.13**	.02
Sex x Ethnicity	*Disorganised*	1.97	< .01
	Cognitive-Perceptual	4.00*	.01
	Paranoid	1.03	< .01
	Negative	.12	< .01
Urbanicity x Sex	*Disorganised*	5.14*	.01
x Ethnicity	*Cognitive-Perceptual*	.65	< .01
	Paranoid	.34	< .01
	Negative	.55	< .01

*$p < .05$ **$p < .01$ ***$p < .001$

Further analysis of the means used Bonferroni-corrected ($\alpha = .05/6 = .008$) independent samples *t*-tests for the urbanicity x sex interaction. Table 15 indicates the possible significant pathways within this interaction for the significant domains (*Disorganised*, *Paranoid*, and *Negative*).

Table 15. Urbanicity x Sex Interaction Through the SPQ Domains in Study 2

Domains	Group Comparison Mean (*SD*)		*t*	*p*	*d*
Disorganised	Urban Men 9.38 (4.42)	Rural Men 5.41 (4.24)	5.45	< .001*	0.92
	Urban Men 9.38 (4.42)	Urban Women 4.17 (3.17)	8.17	< .001*	1.35
	Urban Men 9.38 (4.42)	Rural Women 5.72 (3.22)	6.45	< .001*	0.95
	Rural Men 5.41 (4.24)	Urban Women 4.17 (3.17)	2.22	.028	0.33
	Rural Men 5.41 (4.24)	Rural Women 5.72 (3.22)	0.64	.526	0.08
	Urban Women 4.17 (3.17)	Rural Women 5.72 (3.22)	3.56	< .001*	0.49
Paranoid	Urban Men 15.98 (4.74)	Rural Men 11.91 (7.49)	3.64	< .001*	0.65
	Urban Men 15.98 (4.74)	Urban Women 11.69 (4.83)	5.20	< .001*	0.90
	Urban Men 15.98 (4.74)	Rural Women 13.30 (4.88)	3.50	.001*	0.56
	Rural Men 11.91 (7.49)	Urban Women 11.69 (4.83)	0.23	.819	0.03
	Rural Men 11.91 (7.49)	Rural Women 13.30 (4.88)	1.74	.082	0.22

	Urban Women	Rural Women	2.44	.015	0.26
	11.69 (4.83)	13.30 (4.88)			
Negative	Urban Men	Rural Men	1.62	.110	0.28
	18.42 (7.41)	15.88 (10.23)			
	Urban Men	Urban Women	5.61	< .001*	0.95
	18.42 (7.41)	11.71 (6.63)			
	Urban Men	Rural Women	3.99	< .001*	0.60
	18.42 (7.41)	14.34 (6.06)			
	Rural Men	Urban Women	3.23	.001*	0.48
	15.88 (10.23)	11.71 (6.63)			
	Rural Men	Rural Women	1.47	.143	0.18
	15.88 (10.23)	14.34 (6.06)			
	Urban Women	Rural Women	3.08	.002*	0.36
	11.71 (6.63)	14.34 (6.06)			

* $p < .008$

Table 15 indicates that urban men scored significantly higher than rural men, urban women, and rural women across all three significant pathways, with the exception of the *Negative* domain for rural men. Further, urban women scored higher on the *Disorganised* and *Negative* domains than rural women. Further inspection of the means for the sex x ethnicity on the *Cognitive-Perceptual* domain also used Bonferroni-corrected ($\alpha = .05/6 = .008$) independent samples *t*-tests. For this domain, there was a significant difference with Malay women ($M = 5.53$, $SD = 3.10$) scoring significantly higher than Malay men ($M = 3.90$, $SD = 3.22$), $t(193) = 3.48$, $p = .001$, $d = 0.51$; Chinese men ($M = 4.16$, $SD = 3.45$), $t(201) = 2.93$, $p = .004$, $d = 0.42$; and Chinese women ($M = 4.25$, $SD = 2.58$), $t(230) = 3.39$, $p = .001$, $d = 0.41$. There were no other significant differences that reached the adjusted significance level ($ps > .008$). Regarding the urbanicity x sex x ethnicity interaction, with further inspection of the *Disorganised* domain, the Bonferroni-corrected ($\alpha = .05/15 = .003$) independent

samples *t*-tests indicated no significant differences that reached this adjusted significance level. This interaction had a small effect size (η_p^2 = .01) and a limited number of participants in each factor; therefore, any inferences from this interaction should be made with caution.

2.2.4 Discussion

The results from these data showed that the SPQ is suited to pre-existing factor structures for use with a multi-ethnic Malay-speaking sample. Mirroring the findings in Study 1, the 3-factor solution (Raine et al., 1994) had adequate fit for the present data, with an improvement in fit for Compton et al.'s (2009) modification of a 4-factor structure, but Stefanis et al.'s (2004b) 4-factor structure had superior fit. The latter retained all latent domains (*Disorganised, Cognitive-Perceptual*, *Paranoid*, and *Negative*) as reported by Stefanis et al. (2004b), but a number of lower-order items were removed to improve internal consistency. Support for a 4-factor structure is consistent with findings from Study 1 and also in other Western sites (e.g., in US samples; Compton et al., 2009), but non-Western evaluations have been limited to primarily evaluating single or 3-factor solutions (e.g., Yu, Bernardo, & Zaroff, 2015). Importantly, measurement invariance for the model of best-fit was achieved in the Malaysian sample for Malay and Chinese adults, at least in university students. The practical importance of this finding should not be underestimated. An essential precondition for between-group comparisons is that measurement tools should be cross-culturally equivalent, providing confidence that change in the latent means are accurate and not an artefact of the measure. Therefore, these findings indicate that, while the 3-factor solution has an adequate latent structure for this population, a 4-factor solution for the SPQ is better suited for use in Malay-speaking populations and allows for the possibility of future multi-site comparisons. Indeed, while these findings further SPQ

structural knowledge in general, importantly our findings investigated a non-English variation of the SPQ and contributes to schizotypal research in Malay-speaking populations.

Regarding group differences at the latent mean level, there was a significant ethnicity by sex interaction, with Malay women having significantly higher scores than Chinese men, Chinese women, and male Malay participants on the *Cognitive-Perceptual* domain. One possible explanation for this finding is that there are basic differences in personality that put Malay women at higher risk of schizotypy along the *Cognitive-Perceptual* domain. For example, there is some evidence that, in the Malaysian context, Malay women in particular have very high scores on dimensions of self-effacement (Abdullah, 1993), self-consciousness (McCrae & Terracciano, 2005), indecisiveness (Swami et al., 2008b), and possibly lower scores on self-esteem (Swami, 2012). Differences in such endogenous traits that emerge within culturally-circumscribed environments may account for the present findings, but it is important to highlight that as schizotypal research within this population is underdeveloped, and coupled with the small effect sizes presented here, further research into this interaction is necessary as any conjecture here would be speculative.

Regarding ethno-cultural influences, it was hypothesised that Malay participants would have significantly higher scores than Chinese participants, particularly in the positive domains. Indeed, this was reflected in the *Paranoid* but not the *Cognitive-Perceptual* domain. The former finding may reflect the extent to which the phenomenology of schizotypy is influenced by Malays' greater tendency to believe in supernatural agents (e.g., ghosts, demons, and possession by spirits) as precursors of mental illness (Razali et al., 1996; Swami et al., 2008a). Further, sex differences within the domains reflected previous findings with women scoring significantly higher on the *Cognitive-Perceptual* domain and men scoring significantly higher on the *Negative* and

Disorganised domains (Bora & Baysan Arabaci, 2009; Fossati et al., 2003; Raine, 2006).

There was also a main effect for urbanicity, with urban participants scoring higher on the *Paranoid* and *Disorganised* dimensions; indeed, similarly to Stefanis et al. (2004a), there was an interaction with sex and urbanicity where urban males scored significantly higher on these dimensions and the *Negative* domain. This urban effect is common in the schizophrenia literature (e.g., Vassos, Pedersen, Murray, Collier, & Lewis, 2012) with environmental stressors and harmful lifestyle behaviours suggested to be in influence, such as stress, poverty, over-crowding, and the use of illegal drugs (Weiser et al., 2007). Interestingly, rural females scored higher than urban females on the *Disorganised* and *Negative* domains. As an explanation for this finding, it has been suggested (Stefanis et al., 2004a) that being raised in an urban environment, and therefore being exposed to further peer interaction, may allow for denser social networks that act as a protective factor against social anxiety.

However, limitations of this work should be recognised. First, while this sample contained the two largest ethnic groups in Malaysia, findings here may not be representative of other ethnic groups in Malaysia, such as Malaysian Indians and indigenous Malaysians. Further, this sample consisted of undergraduate students, thus potentially limiting generalisability to the general Malaysian population. For example, Zhang and Brenner (2016) highlighted the importance of using both community and undergraduate samples when examining the factor structure of the SPQ; with the former favouring a 3-factor solution and the latter a 4-factor. Therefore, future work in developing the SPQ, and by extension schizotypal research, in Malaysia should aim to include more heterogeneous sampling. Research has shown that Malaysian culture influences symptomatology of mental illness, particularly with regards to religiosity (Azhar, Varma, & Hakim, 1995). Azhar et al. (1995) highlighted that higher religiosity

was associated with greater schizophrenic symptoms in Malay and Chinese patients. Therefore, future research may wish to investigate religiosity as a mediator of schizotypal ratings.

Further, through the data quality analysis, a number of the items had poor internal consistency within the lower-order factors and had to be removed. While this removal procedure strengthened the reliability of the subscales, cross-sample comparisons are weakened with item-removal. Future work with a larger sample would allow the exploration of items further with an exploratory-then-confirmatory approach at item level. While this could potentially move the SPQ away from an SPD symptomatology basis, the benefit would be a reliable measurement tool in Malaysia.

2.3 Study 3: The Psychometric and Cultural Evaluation of the SPQ-G

2.3.1 Overview of Study 3

Similar to the previous two studies, this study is concerned with the structural make-up of the SPQ. In contrast to Study 2, however, the SPQ has been previously translated into the language of interest, German (SPQ-G; Klein et al., 1997). Unlike the English version of the SPQ, this version has only had one study devoted to validation in terms of structure of the higher order domains (see Klein, Andresen, & Jahn, 2001). This previous investigation did not take into account a 4-factor formation of these higher order domains, only investigating Raine's 3-factor structure (Raine et al., 1994) and the original 2-factor solution (Klein et al, 1997). Since formulation of the scale, the SPQ-G has primarily used a 2-factor structure (*Cognitive-Perceptual* and *Interpersonal* [or *Positive* and *Negative*]) or the aforementioned 3-factor solution. This measure, and structure, has been used in many previous studies, including studies on creativity (Fink et al., 2014), EEG (Klein et al., 1999), implicit memory (Nenadic et al., 2015), and visual encoding and working memory (Kopp, Wolff, Hruska, & Reischies, 2002). However, the 2-factor structure in the English version of the SPQ, and indeed other translations, does not have the same support as the 3- or 4-factor structures (e.g., Compton et al., 2009), and therefore has not been used in the previous studies in this thesis.

While this 2-factor structure may indeed be the optimal solution to this version of the SPQ, there is the need to confirm this with an investigation including the well-fitting models of Study 1 and 2. Whereas Study 1 had both cultural and ethnic groups independent and dependent of each other, and Study 2's ethnic groups were within the one cultural setting, this study will investigate one ethnic group in two cultural settings. It was thought that this method of sampling would give a proxy measure of the migration effect of central white Europeans, which has had little focus in the literature. The sample for the factorial investigation was from Southern Germany and Austria,

with an ethnicity-matched comparison group from the UK. It was hypothesised that, based on prior research and the previous studies in this thesis, that the sample will best suit the 4-factor solution by Stefanis et al. (2004b; the same optimal structure as Study 1 and 2) and mean comparisons indicating higher scores from the British sub-sample based on migration trends in the schizophrenia literature highlighted in Section 1.4.

2.3.2 Method

2.3.2.1 Participants

For the CFAs in this study, there were 2,428 participants, who were grouped into two main sub-samples. The first comprised of 2,318 native German-speaking White central European participants: 1,406 (60.7% of Austrian sample) Austrians and 912 (39.3% of Austrian sample) Germans. As this sample was mainly comprised of the former, this sample will be referred to as *Austrian*[8]. The second, a UK-based sample, consisted of 110 (4.5% of total sample) native German-speakers: 96 (87.3% of UK sample) Germans and 14 (12.7% of UK sample) Austrians. Both sub-samples were comprised of participants from the general public and undergraduates. The mean age of participants was 33.23 years (*SD* = 13.09) for the Austrian sub-sample with 1,234 (53.3% of Austrian sample) women and 1,083 (46.7% of Austrian sample) men, with one participant who did not provide an answer; 35.95 years (*SD* = 10.94) for the UK based sub-sample with 82 (74.5% of UK sample) women and 28 (24.5% of UK sample) men.

[8] The German participants were from Southern German, which is culturally similar to Austria, and in previous research, these groups have been collectively referred to as *Austrian* (e.g., Swami et al., 2011a)

With consideration of the difference in size of the two sub-samples, an age-matched, random selection of participants from the Austrian sample (n = 110; women = 57, men = 53) was selected by a computer programme to contrast migration effects with the UK sample (n = 110; N = 220). The mean age of participants for the Austrian sub-sample comparison group was 34.12 years (SD = 13.18). There was no significant difference in age between comparison sub-samples, $t(218) = 1.12$, $p = .262$, $d = 0.15$. All participants self-reported as not having a history of mental health problems relating to psychosis. Further, as additional analyses on these data are at the latent factor level, rather than the sum of schizotypal score, participants from the Austrian comparison sample were matched on total schizotypy (M = 15.37, SD = 11.96) with the UK German sub-sample (M = 13.11, SD = 8.36), $t(218) = 1.63$, $p = .105$, $d = 0.22$. This allowed for comparisons between cultural sites at the domain level.

2.3.2.2 Measures

Schizotypy. See Section 2.1.2.2 for details of the SPQ-G (Klein et al., 1997), which has the same underlying structure as the SPQ. Table 16 illustrates Cronbach's alpha coefficients for the 9 subscales in the present sample (range = .69-.80, mean = .74), which is in-line previous findings (e.g., Compton et al., 2009).

Table 16. Internal Consistency (Cronbach's Alpha) for SPQ subscales in Study 3

SPQ subscale	**α**
Ideas of reference (IoR)	.72
Excessive social anxiety (ESA)	.76
Odd beliefs or magical thinking (OBoMT)	.79
Unusual perceptual experiences (UPE)	.71
Odd or eccentric behaviour (OoEB)	.80
No close friends (NCF)	.74
Odd speech (OS)	.78
Constricted affect (CA)	.69
Suspiciousness (Sus)	.71

As Study 1 and 2 indicated at least partial support for three solutions of the original 4-factor structure (Model A; Stefanis et al., 2004b), the modified 4-factor variation (Model B; Compton et al. 2009), and the 3-factor model (Model E; Raine et al., 1994), these three were evaluated along with the original 2-factor (see Figure 6 for Model F; Klein et al., 1997).

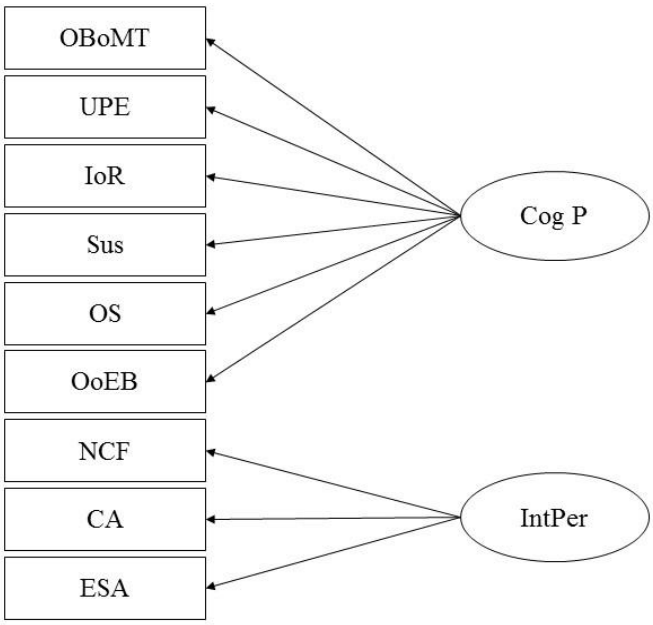


Figure 6. The additional measurement model under examination in Study 3. Higher-order factors: Cog P = *Cognitive-Perceptual*, IntPer = *Interpersonal*

2.3.2.3 Procedure

This study was conducted in accordance with institutional guidelines of the School of Psychology, University of Vienna. According to national laws (Austrian Universities Act 2002), effective at the time when this study was carried out, only medical universities were required to operate research ethics committees for evaluating and approving basic, clinical, and applied medical research proposals. As this was not applicable, this study was exempt from formal ethical approval in Austria. However, ethical approval for this study was obtained from the University of Westminster for data collection in the UK and Austria. Survey dissemination was undertaken via multiple routes. First, an internal online research participation scheme was utilised. This scheme gives course credit to students eligible for this incentive. Second, where the course credit scheme did not apply, the general public were invited to participate via social media. Third, both students and the general public were invited to participate through and paper-and-pencil offline approach. In both the offline and online versions,

participants completed a consent form before proceeding to the survey. The UK-based sample were recruited primarily online, while the Austrian sample were recruited via an offline method. No monetary incentives were offered to the participants for completion of the survey. All participants received written debrief information at the end of the study.

2.3.2.4 Data Analysis

CFAs were conducted on these data using the same indices as Study 1 and 2 (see Section 2.1.2.4 for details of metrics) for the aforementioned factorial solutions of the SPQ. The CFAs were performed on the complete sample. Following this, multiple group analyses were performed with the UK and Austrian samples to test for measurement invariance. Finally, a MANOVA was used to examine sex and cultural differences with the domains for the model of best fit CFA conducted on the full UK sample with aforementioned matched Austrian dataset.

2.3.3 Results

2.3.3.2 Confirmatory Factor Analysis

First, CFA was conducted where all lower-order domains loaded onto the multidimensional 4-factor model (Model A) proposed by Stefanis et al. (2004b). Fit indices were found to be: $\chi^2(19, N = 2428) = 152.575$, $\chi^2_{normed} = 8.030$, CFI = .984, RMSEA = .054 with 90% *CI* = .046-.062, SRMR = .022, AIC = 204.575. With exception of the χ^2_{normed}, this model was deemed to have a good fit for these data. Then, CFA was conducted on the well-fitting modification of this 4-factor structure from the previous studies (Model B), as proposed by Compton et al. (2009). Fit indices were found to be: $\chi^2(20, N = 2428) = 287.019$, $\chi^2_{normed} = 14.351$, CFI = .969, RMSEA = .074 with 90% *CI* = .067-.082, SRMR = .038, AIC = 337.019. This model was deemed to

have a moderate fit for these data than the previous 4-factor solution, however, poorer than Model A, with limiting issues with the χ^2_{normed}.

Next, CFA was conducted on Model E, the multidimensional 3-factor model (Raine, 1994). Fit indices were found to be: $\chi^2(23, N = 2428) = 702.200$, $\chi^2_{normed} = 30.530$, CFI = .920, RMSEA = .110 with 90% *CI* = .103-.117, SRMR = .053, AIC = 746.200. This model was deemed to have a poor fit for these data. Finally, CFA was conducted on Model F, the 2-factor structure (Klein et al., 1997). Fit indices were found to be: $\chi^2(25, N = 2428) = 1081.016$, $\chi^2_{normed} = 43.241$, CFI = .876, RMSEA = .132 with 90% *CI* = .125-.392, SRMR = .069, AIC = 1121.016. This model was deemed to have the poorest fit of the models proposed for these data. As all models under investigation had problems with at least one metric, modification indices were assessed to improve fit.

Following the assessment of modification indices, the goodness-of-fit indices of the four models proposed were improved and are illustrated in Table 17. Each model was limited to two adjustments for covariance of errors; that is, the two highest pathways were covaried, with all covariances in this study having MIs > 15.000, i.e., covarying the pathways would cause the χ^2_M to be reduced by > 15.000. Modifications indices were consulted for the covariance of one pathway per model in Study 1, however, due to the poor χ^2 in the present study, an additional pathway was freely estimated. This led to the following covariances of error terms through the models: Model A, Suspiciousness ↔ No Close Friends, and Excessive Social Anxiety ↔ No Close Friends; Model B, Suspiciousness ↔ No Close Friends, and Excessive Social Anxiety ↔ Constricted Affect; Model E, Excessive Social Anxiety ↔ Constricted Affect, and Odd Beliefs or Magical Thinking ↔ Unusual Perceptual Experiences; and Model F, Odd Beliefs or Magical Thinking ↔ Unusual Perceptual Experiences, and Odd or Eccentric Behaviour ↔ Odd Speech.

Table 17. Indices for Each Proposed Model, After Modification Indices, in Study 3

Model		χ^2_M	df_M	χ^2_{normed}	RMSEA (90% CI)	SRMR	CFI	AIC
A.	The 4-factor model (Stefanis et al., 2004b)	105.850	17	6.226	.046 (.038, .055)	.018	.990	161.850
B.	Modification of A. (Compton et al., 2009)	201.595	18	11.200	.065 (.057, .0.73)	.029	.978	255.595
E.	The 3-factor model (Raine et al., 1994)	295.605	21	14.076	.073 (.066, .081)	.034	.968	343.605
F.	The 2-factor model (Klein et al., 1997)	461.089	23	20.047	.089 (.082, .0.96)	.052	.948	505.089

As depicted, Model A has superior fit compared to the other models under evaluation, with the multidimensional modification (Model B) of this well-fitting model having the next best fit. Finally, Model E had a better fit than that of the original SPQ-G structure of Model F, the 2-factor solution (Klein et al., 1997). After modification of covaried error terms, the χ^2 statistic was still inflated. However, this statistic is sensitive to small and, in the present case, large sample sizes, and therefore it is not relied upon as a basis for absolute acceptance or rejection of the fit of a model (Schermelleh-Engel, Moosbrugger, & Müller, 2003). Indeed, it has been suggested that the χ^2 statistic should be used as a descriptive goodness-of-fit index, rather than an absolute criterion (Jöreskog & Sörbom, 1993; Schermelleh-Engel et al., 2003). Further, when testing individual sub-samples for measurement invariance evaluation (see below), and thus reducing the number of participants in Model A per iteration, the χ^2 statistic is reduced and falls within an acceptable range, providing additional support of model fit for this structural solution. Therefore, as the metrics prior to and following adjustment through

modification indices were deemed acceptable for the 4-factor structure of the SPQ-G, and the comparative AIC indicates support for this structure over the other models under evaluation, this was deemed the most acceptable to be used with these data.

To test for invariance of the models across culture, multiple-group analysis was performed with the best-fitting model. As the unconstrained model had a good fit for the two main ethnic sub-samples individually, and also through further analysis of the Austrian sample (see Table 18 for all invariance sub-sample metrics), this suggests configural invariance between the subsamples, with the exception of SRMR. However, on further inspection of the regression weights for each sample, the UK sample had non-significant pathways for each of the *Negative* lower-order factors: Suspiciousness (Estimate = .031, *SE* = .093, C.R. = .330, p = .742); Expressions of Social Anxiety (Estimate = .051, *SE* = .155, C.R. = .328, p = .743); No Close Friends (Estimate = .087, *SE* = .279, C.R. = .313, p = .754); Constricted Affect (Estimate = .135, *SE* = .429, C.R. = .315, p = .753). Therefore, it was deemed that the data from this sub-sample does not achieve configural invariance through the *Negative* domain. This is also highlighted through the poor SRMR, the badness-of-fit index of the metrics included in these analyses. Therefore, comparative measurement checks were completed as these data failed at the configural level of tests.

Table 18. Indices for the Best Fitting 4-Factor Structure in Study 3

Model	χ^2_M	df_M	χ^2_{normed}	RMSEA (90% CI)	SRMR	CFI
Austrian (*n* = 2318)	103.282	17	6.075	.047 (.038, .056)	.018	.989
UK (*n* = 110)	23.106	17	1.359	.057 (< .001, .111)	.051	.978

Configural invariance	126.540	34	3.722	.033 (.027, .040)	.152	.989
Metric invariance	185.690	44	4.220	.036 (.031, .042)	.152	.983
Scalar invariance	233.466	52	4.490	.038 (.033, .043)	.155	.979

While these metrics do not reflect at least the partial scalar invariance level achieved in Study 2, and aside from the SRMR index, the fit statistics were acceptable to the scalar level when not compared to the previous invariance level; that is, the comparative fit between scalar to metric, and metric to configural. Therefore, it was deemed acceptable to continue with the analyses. However, any further inferences made between the sub-samples were made with caution; indeed, subsequent analyses do not consider inferences on the *Negative* domain.

2.3.3.3 Between-Group Differences

Sex and cultural differences in scoring with the three higher-order domains of the 4-factor model, excluding infers on the *Negative* domain. A 2-way MANOVA was conducted, with the three dimension scores as dependent variables. As the design of the observations were not balanced – that is, with regard to the gender imbalance of the UK sub-sample – Box's *M* test for equality of covariance was assessed. As Box's *M* test was significant ($p < .001$), Pillai's trace criterion was used for interpretation of the MANOVA, rather than the less conservative Wilk's Λ (Tabachnick & Fidell, 2013). There were statistically significant main effects found for sex, $F(3, 214) = 6.40$, $p < .001$, Pillai's trace = .08, $\eta_p^2 = .08$, and culture, $F(3, 214) = 4.39$, $p = .005$, Pillai's trace = .06, $\eta_p^2 = .06$. Descriptive statistics and a summary of the follow-up ANOVAs can be found in Table 19 for sex and culture effects through the three domains.

Table 19. Summary of Descriptive Statistics and Follow-Up ANOVAs of Main Effects for each Domain in Study 3

Domains	Group Comparison		*F*	*p*	η_p^2
	Mean (*SD*)				
Disorganised	UK	Austrian	1.57	.212	.01
	3.23 (3.05)	3.63 (3.88)			
	Male	Female	0.32	.573	< .01
	3.37 (3.50)	3.46 (3.49)			
Cognitive-Perceptual	UK	Austrian	13.17	< .001	.06
	1.74 (2.40)	2.88 (3.20)			
	Male	Female	13.00	< .001	.06
	1.62 (2.52)	2.71 (3.01)			
Paranoid	UK	Austrian	2.54	.112	.01
	5.26 (3.93)	5.76 (4.85)			
	Male	Female	8.52	.004	.04
	4.52 (3.61)	6.09 (4.73)			

For sex, there were significant differences in the *Paranoid* and *Cognitive-Perceptual* domains, with female participants scoring significantly higher scores on both dimensions. There was no main effect for sex on the *Disorganised* domain ($p > .05$). With regard to culture, there was a main effect with participants from Austria scoring higher on the *Cognitive-Perceptual* dimension than those from the UK; however, there were no further statistically significant comparisons for this factor on the other domains (both *p*s > .05).

2.3.4 Discussion

The present findings revealed that the original 3-factor structure (Raine et al., 1994), the 4-factor (Stefanis et al., 2004b), and a hierarchically related 4-factor structure

(Compton et al., 2009) had fit indices within an acceptable range. Of these well-fitting models, the 4-factor model proposed by Stefanis et al. (2004b) had the best fit. Raine et al.'s (1994) 3-factor model fitted well, which is consistent with some previous investigations into the SPQ's structure (Reynolds et al., 2000). However, the 3-factor solution did not fit as well as the two 4-factor structures, suggesting that the presence of a *Paranoid* factor may improve fit. Further, the modification of the 4-factor structure whereby suspiciousness, but not excessive social anxiety, loaded on both the *Paranoid* and *Negative* factors had the second best fit, which is consistent with previous findings (Compton et al., 2009). The original factorial structure of the SPQ-G, the 2-factor solution (Klein et al., 1997), had the poorest of fit for the models under investigation. This further suggests that the inclusion the *Paranoid* domain is appropriate when considering the factorial structure of the SPQ.

However, when investigating measurement invariance of this version of the SPQ, with a UK German speaking comparison group, and despite values falling with acceptable ranges (with exception of the SRMR), the comparison of invariance levels was not appropriate. This was particularly highlighted in the *Negative* domain, where the UK group did not score in the hypothesised manner for this domain. Therefore, any between group differences should be interpreted with caution and did not include any effect on the *Negative* domain. Regarding sex differences within the domains, results reflected previous findings with females scoring significantly higher on the *Cognitive-Perceptual* domain but not with males scoring higher on the *Disorganised* domain (for review, see Raine, 2006). Further, in Study 2, male participants scored higher on the *Paranoid* domain, however, for these data, females scored higher on this domain. Further, there were main effects for culture on the *Cognitive-Perceptual* domain, with Austrian participants scoring significantly higher than the UK comparison group.

One limitation of this study concerns the methodology of the data collection. This study adopted both paper-and-pencil and electronic versions of the SPQ. While the majority of the UK sub-sample completed the SPQ online, the Austrian sub-sample endorsed a paper-and-pencil approach. As mentioned in Study 1, Buchanan et al. (2005) reported nonequivalence between online and paper-and-pencil approaches, suggesting caution with the measurement of psychological properties online. Therefore, this may account for the noninvariance through the measure, particularly the *Negative* domain, and by extension, could account for mean differences between groups reflecting data collection issues, rather than true latent mean change.

However, the practical importance of these findings should not be underestimated. As mentioned, the SPQ-G has previously been operationalised through a 2-factor structure in many previous studies (e.g., Fink et al., 2014; Klein et al., 1999; Kopp et al., 2002; Nenadic et al., 2015). Therefore, as this structure has shown to be the poorest fit of the models under investigation, caution has to be advised in the use of this structure. This is of concern when considering the robustness of previous factorial associations of the SPQ-G in many previous investigations. In one example, Kopp et al. (2002) examined brain structural changes in the medial and lateral prefrontal cortex, and other relevant areas, with degree of schizotypy measured through the SPQ-G. Kopp and colleagues found significant positive associations between bilateral inferior and right superior frontal cortices and positive schizotypy. Therefore, in general, without the prior investigation of the factorial structure, associations may be due error in the classification of factors, rather than reflect true associations.

The findings from the present study suggest that the inclusion of the *Paranoid* domain to the 3-factor solution, as suggested by Stefanis et al. (2004b), should be endorsed in future applications of this measure in German. By extension, and as found

within all three factorial studies, the SPQ is suited to a 4-factor solution with the additional *Paranoid* domain included. While future work needs to consider a larger comparison group, with more detailed analyses for the SPQ-G with particular regard to the measurement invariance component of analyses, these findings highlight the consistency of this measure throughout samples of investigation. Therefore, all forthcoming analyses of the SPQ shall reflect this factorial solution.

3 Cognitive Correlates of Schizotypy

3.1 Study 4a: Schizotypy and Conspiracy Ideation

3.1.1 Introduction for Chapter 3 and Overview of Study 4a

The growing literature on schizotypy has led to specific insight into the mental health and well-being of people diagnosed with schizotypal personality disorder and high non-clinical schizotypes. In particular, cognitive models of psychosis have become increasingly popular, with the intention of explaining the causation of symptoms (Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001; Hemsley, 2005; Howes & Murray, 2014; Kwapil et al., 2012; Luther et al., 2016). Indeed, cognitive deficits have been identified since Meehl's assertion that cognitive slippage represents the "diagnostic bell ringer" of indicators of high schizotypy or schizophrenia (Meehl, 1962, p. 828). Therefore, considering cognitive associations, and outcomes of, schizotypy may allow for insight into tracking the underlying cognitive deficits along the continuum. Previous research has reported significant outcomes of high schizotypy with a general belief in the paranormal, such as spiritualism (Hergovich & Arendasy, 2007; Schermelleh-Engel et al., 2003; Swami, Pietschnig, Stieger, & Voracek, 2011b; Tanaka, 1987). By extension, an examination of paranormal beliefs has identified a significant shared basis with that of conspiracist expression (Bogart et al., 2010; Kata, 2010).

As discussed in Section 1.5.2, a conspiracy theory usually refers to a subset of false narratives in which the ultimate cause of an event is believed to be due to a malevolent plot by multiple actors working together (Swami & Furnham, 2014). Researchers have recently begun examining associations between conspiracist ideation and traits such as paranoid ideation, superstitious beliefs, magical ideation, and belief in the paranormal (Brotherton et al., 2013; Bruder et al., 2013; Darwin et al., 2011; Stieger et al., 2013; Swami et al., 2011a). As mentioned in Section 1.5.2, three studies have reported significant associations between conspiracist ideation and schizotypal personality disposition (Bruder et al., 2013; Darwin et al., 2011; Jöreskog & Sörbom, 1993). Tanaka (1987) explained this association between paranoia and conspiracist

ideation as shared and overlapping characteristics, contending that key components of conspiracist ideation are important aspects of paranoia (e.g., suspicion and fear of external agents; Dagnall et al., 2015). Darwin et al. (2011) also suggest that those aspects of schizotypy which mirror disorganised thought processes and a rejection of analytic information generation are significantly associated with belief in conspiracy theories. In explanation, it has been suggested that the relationship is a function of schizotypal individuals being more open to arguments in support of conspiracy theories as a result of their suspiciousness of others (Darwin et al., 2011).

A potential constraint on this explanation, however, has been the limited way in which schizotypy has been measured in earlier studies. While scholars have reported that scores on the *Unusual Experiences* subscale of the O-LIFE positively predicted conspiracist ideation (Swami et al., 2011b). Conversely, two other studies (Bruder et al., 2013; Darwin et al., 2011) have reported significant associations between conspiracist ideation and the three domains of schizotypy measured on the SPQ-B. As mentioned, however, questions concerning the reliability of this brief measure of schizotypy, as well as the factorial validity of the 3-factor model of schizotypy (Axelrod et al., 2001; Compton et al., 2007). This study will seek to build upon the previous research linking conspiracy ideation and schizotypy (e.g., Darwin et al., 2011). This initial associative study will primarily act as a pilot to investigate thinking styles and cognitive biases (see Section 1.5.1), forming a more complete model of cognitive deficits in Study 4b (see Section 3.2.1 for theoretical reasoning). That is, significant schizotypal predictors of conspiracy ideation will be included into a measurement model using structural equation modeling in Study 4b. As measurement models in this fashion are theoretically driven rather than data driven, this is essential since the underlying structure of the SPQ shall be the 4-factor model based on Study 1. Since, previous studies have reported significant associations between conspiracist ideation and the three domains of

schizotypy measured on the SPQ-B (Bruder et al., 2013; Darwin et al., 2011), this step is important for the structure and version of the SPQ. Further, as a standalone study out-with Study 4b, findings from this investigation will develop the schizotypal literature, overcoming previous measurement issues with the associations between schizotypy and conspiracy ideation.

3.1.2 Method

3.1.2.1 Participants

The participants of this study were an online, international sample of 346 women and 101 men, who ranged in age from 18 to 68 (M = 23.17, SD = 7.87). Most participants were from the United States of America (49.1%) and the United Kingdom (36.4%), with the remainder of the sample consisting of various nations (14.5%). Seventy-two percent of the sample had completed at least some college education, with 98.4% completing high school.

3.1.2.2 Measures

Schizotypy. See Section 2.1.2.2 for details of the Schizotypal Personality Questionnaire (SPQ; Raine, 1991). As Study 1 indicated support for original 4-factor higher order structure (Model A in Study 1; Stefanis et al., 2004b) for the English version of the SPQ this was used initially in the analyses. For the factorial make-up of this structure, see Model A in Figure 5, Section 2.1.2.2. The internal consistency, assessed using Cronbach's alpha, for each of the nine subscales are presented in Table 19, which is in line with previous findings (e.g., Compton et al. (2009).

Table 20. Internal Consistency of the SPQ Subscales in Study 4a

Subscale	Items	α
Odd Beliefs or Magical Thinking	7	.77
Unusual Perceptual Experiences	9	.74
Ideas of Reference	9	.80
Suspiciousness	8	.80
Excessive Social Anxiety	8	.81
No Close Friends	9	.80
Constricted Affect	8	.76
Odd or Eccentric Behaviour	7	.86
Odd Speech	9	.80

Conspiracist ideation. The Belief in Conspiracy Theories Inventory (BCTI; Swami et al. 2010, 2011) was used to measure general conspiracist ideation. The BCTI is a 15-item measure that describes a range of internationally-recognisable conspiracy theories (sample item: "US agencies intentionally created the AIDS epidemic and administered it to Black and gay men in the 1970s"). All items are rated for agreement on a 9-point scale (1 = *Completely false*, 9 = *Completely true*). The BCTI is unidimensional and an overall score is computed as the mean of all items and higher scores on this scale reflect greater conspiracist ideation. Previous work has shown that the scale has good internal consistency (Swami et al., 2017; Swami et al., 2010b), and correlates very strongly with a non-event-based, generic measure of conspiracist

ideation (Brotherton et al., 2013). In the present study, Cronbach's alpha for this scale was .92.

3.1.2.3 Procedure

Ethics approval for this study was obtained from the University of Westminster. Survey dissemination was undertaken via multiple routes. First, an internal online research participation scheme was utilised. This scheme gives course credit to students eligible for this incentive. On the other hand, the survey was advertised at university-associated online platforms via online networks Psychological Research on the Net (http://psych.hanover.edu/Research/exponnet.html) and Social Psychology Network (https://www.socialpsychology.org/). These online platforms are primarily for institutions in the USA and UK, and while no course credit was offered for participation in the present study, it cannot be ruled out that other institutions require students to complete open-access surveys on these platforms to earn credit. All participants gave a dual-consent prior and post survey. No monetary incentives were offered to the participants for completion of the survey. All participants received written debrief information at the end of the study.

3.1.3 Results

3.1.3.1 Bivariate Correlates

Descriptive statistics for all variables included in the present study are reported in Table 20. An independent-samples *t*-test showed that there was no significant difference in conspiracist ideation between women (M = 3.82, SD = 1.60) and men (M = 3.83, SD = 1.73), $t(444) = 0.05$, $p = .963$, $d < .01$, so the sample was combined for all further analyses. Inter-scale correlations between conspiracist ideation and the SPQ domains and subscales, respectively, are reported in Table 16. As can be seen, greater

conspiracist ideation was significantly associated with higher scores on three SPQ domains (Cognitive-Perceptual, Paranoid, and Negative). In addition, greater conspiracist ideation was significantly associated with higher scores on six of the nine SPQ subscales.

Table 21. Inter-Scale Correlations Between Conspiracist Ideation and SPQ in Study 4a

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Conspiracist ideation		.22**	.32**	.23**	.14*	.09	.32**	.25**	.28**	.24**	.03	.10*	.10*	.08	.08
(2) Total SPQ			.79**	.91**	.91**	.84**	.58**	.79**	.77**	.81**	.65**	.74**	.76**	.72**	.78**
(3) *Cog P* domain				.66**	.55**	.60**	.86**	.90**	.67**	.60**	.35**	.41**	.42**	.54**	.55**
(4) *Pn* domain					.87**	.62**	.46**	.67**	.86**	.87**	.74**	.60**	.61**	.50**	.62**
(5) *Neg* domain						.65**	.37**	.57**	.59**	.78**	.78**	.86**	.85**	.53**	.63**
(6) *Dis* domain							.39**	.65**	.55**	.57**	.43**	.53**	.60**	.89**	.91**
(7) OBoMT								.53**	.51**	.41**	.21**	.29**	.29**	.37**	.34**
(8) UPE									.65**	.62**	.39**	.42**	.44**	.56**	.60**
(9) IoR										.72**	.39**	.39**	.42**	.45**	.53**
(10) Sus											.43**	.55**	.57**	.48**	.53**
(11) ESA												.54**	.52**	.32**	.45**
(12) NCF													.73**	.46**	.48**
(13) CA														.49**	.58**
(14) OoEB															.62**
(15) OS															
M	3.81	24.09	3.99	9.68	11.24	5.72	1.53	2.46	3.13	2.68	3.87	2.60	2.09	2.30	3.42
SD	1.63	15.48	3.54	6.20	7.67	4.43	1.87	2.18	2.65	2.36	2.54	2.47	2.04	2.35	2.56

Note. SPQ = Schizotypal Personality Questionnaire, *Cog P = Cognitive-Perceptual*, *Pn = Paranoid*, *Neg = Negative*, *Dis = Disorganised*, OBoMT = Odd Beliefs or Magical Thinking, UPE = Unusual Perceptual Experiences, IoR = Ideas of Reference, Sus = Suspiciousness, ESA = Excessive Social Anxiety, NCF = No Close Friends, CA = Constricted Affect, OoEB = Odd or Eccentric Beliefs, OS = Odd Speech. * $p < .01$, ** $p < .001$.

3.1.3.2 Regression

To examine the predictive power of schizotypy, two separate multiple linear regressions using the Enter method. In the first regression, conspiracist ideation was entered as the criterion variable and all SPQ domains as predictor variables. Results showed that the regression was significant, $F(4, 446) = 16.24$, $p < .001$, Adj. $R^2 = .12$. As can be seen in Table 17, *Cognitive-Perceptual* and *Disorganised* emerged as significant predictors of conspiracist ideation, although multicollinearity was a limiting issue. Multicollinearity was determined by the tolerance statistic and variance inflation factor (VIF). For the tolerance statistic, values below .20 are an indication of multicollinearity (Menard, 2002); whereas, there is a general rule of thumb that values greater than 4.00 for VIF indicate problems with multicollinearity (van Vuuren, de Jong, & Seydel, 2007).

Table 22. Regression Coefficients for the Regression Predicting Conspiracist Ideation with SPQ Domains Entered as Predictors in Study 4a

	B	SE	ß	*t*	*p*	Tolerance	VIF
Cognitive-Perceptual	.17	.03	.36	5.74	< .001	.50	2.02
Paranoid	.05	.03	.19	.189	.060	.20	4.91
Negative	-.02	.02	-.10	-1.02	.307	.23	4.40
Disorganised	-.07	.02	-.18	-2.90	.004	.49	2.03

In the second regression, conspiracist ideation was entered as the criterion variable and all SPQ lower-order subscales as predictor variables. The regression was again significant, $F(9, 446) = 8.75$, $p < .001$, Adj. $R^2 = .14$. Regression coefficients are reported in Table 18 and, as can be seen, the only significant predictors of conspiracist

ideation were Odd Beliefs or Magical Thinking and Ideas of Reference. Multicollinearity was not a limiting issue in this regression.

Table 23. Regression Coefficients for the Regression Predicting Conspiracist Ideation with SPQ Subscales Entered as predictors in Study 4a

	B	SE	ß	*t*	*p*	Tolerance	VIF
IoR	.09	.04	.15	2.03	.043	.68	1.63
ESA	-.06	.04	-.10	-1.77	.077	.63	1.58
OBoMT	.21	.05	.24	4.37	< .001	.66	1.51
UPE	.08	.05	.10	1.46	.14	.68	1.47
OoEB	-.07	.04	-.10	-1.67	.097	.63	1.60
NCF	-.01	.05	-.01	-0.16	.872	.70	1.44
OS	-.07	.04	-.11	-1.60	.110	.75	1.31
CA	.03	.06	.04	0.57	.571	.68	1.65
Sus	.08	.05	.11	1.52	.129	.60	1.74

Note. OBoMT = Odd Beliefs or Magical Thinking, UPE = Unusual Perceptual Experiences, IoR = Ideas of Reference, Sus = Suspiciousness, ESA = Excessive Social Anxiety, NCF = No Close Friends, CA = Constricted Affect, OoEB = Odd or Eccentric Beliefs, OS = Odd Speech.

3.1.4 Discussion

The results support previous work (Bruder et al., 2013; Darwin et al., 2011; Swami et al., 2013) showing a robust association between conspiracist ideation and schizotypy. However, previous findings need to be interpreted with caution: previous studies have not considered multicollinearity between SPQ domains as a limiting factor. In this study, although the results indicated that two SPQ domains significantly predicted conspiracist ideation, multicollinearity meant that conclusions about

individual predictors should be treated with caution. Nevertheless, the general conclusion that schizotypy is associated with conspiracist ideation was supported in the present work.

When examining SPQ subscales, Odd Beliefs or Magical Thinking emerged as the strongest predictor of conspiracist ideation. This subscale, and its parent domain, have been shown to be associated with paranormal beliefs (Schermelleh-Engel et al., 2003; Tanaka, 1987), which in turn are associated with conspiracist ideation (Bruder et al., 2013; Darwin et al., 2011; Stieger et al., 2013; Swami et al., 2011a). Swami and colleagues (2011) proposed that the latter association may reflect the fact that both conspiracist ideation and paranormal beliefs require a rejection of official mechanisms of information generation and expert opinion. That is, and consistent with the present results, it would seem that differential traits that lead an individual to hold unusual beliefs may also lead them to assimilate conspiracy theories.

What is to some extent unclear, however, is whether Odd Beliefs or Magical Thinking and paranormal beliefs are different concepts. Hergovich et al. (2008) showed that some aspects of paranormal beliefs (e.g., belief in precognition, psi, witchcraft, and spiritualism) were predicted very well by schizotypy, but other facts such as superstition were not. This would seem consistent with the finding that conspiracist ideation is associated with paranormal, but not superstitious, beliefs (Swami et al., 2011). It is possible that individuals who score highly on Odd Beliefs or Magical Thinking and/or paranormal beliefs subscribe to larger delusional systems (Schermelleh-Engel et al., 2003) that make it more likely that they will adopt conspiracy theories. Conversely, and as argued by Swami et al. (2011), it is possible that conspiracy theories fill a need for control that individuals who score highly on paranormal beliefs or Odd Beliefs or Magical Thinking might seek.

These results also showed that Ideas of Reference emerged as a significant, albeit relatively weak, predictor of conspiracist ideation. In general, this finding is consistent with previous work reporting significant associations between conspiracist ideation and paranoia (Clarke, 2002; Darwin et al., 2011). Even so, this finding is important because Paranoid Ideation/Suspiciousness did not significantly predict conspiracist ideation in the present sample. That is, it seems that it is the specific concept of Ideas of Reference, rather than suspiciousness of others, that may build up into a complex conspiracy theory related to the self. Given the finding that conspiracy theories are monological (Goertzel, 1994; Swami et al., 2010b), it is plausible that those theories in relation to the self-assist in the assimilation of conspiracy theories related to much larger events.

However, there are a number of limitations with this study. First, because there were no inclusion of measures other than the BCTI and SPQ, there was no examination of any possible measurement overlap with constructs omitted from the present work. For example, it would be useful to concurrently examine the predictive power of variables such as Odd Beliefs or Magical Thinking and cognitive style in relation to conspiracist ideation. Indeed, Study 4b sought to overcome this by assessing components of cognitive processing to try and unpack the relationship between schizotypal facets and conspiracist ideation. Second, although the reliance on an online recruitment strategy ensured a relatively large sample, the participants are unlikely to be representative of any one nation or community.

3.2 Study 4b: Cognitive Processes and Schizotypy

3.2.1 Overview

Findings from Study 4a indicated an association between lower-order components of schizotypy and belief in conspiracy theories. That is, the SPQ subscales of Odd Beliefs or Magical Thinking and, to a lesser extent, Ideas of Reference emerged as significant predictors of belief in conspiracy theories. However, one limitation of study 4a was the underlying conceptual assumption that schizotypal facets would be directly associated with belief in conspiracy theories. While the findings of Study 4a certainly provided preliminary support for this assumption, it is also possible that the links between schizotypal components and belief in conspiracy theories are mediated by additional factors that were not measured in Study 4a. Investigating the mediating utility of additional variables, which was the aim of Study 4b, would therefore provide for a fuller and more robust picture of the ways in which schizotypy may be related to outcomes in terms of beliefs in conspiracy theories.

Such a mediating perspective is not misplaced. For example, previous research has focused on paranoid ideation as a mediating variable between schizotypy and belief in conspiracy theories (Dagnall et al., 2015; Darwin et al., 2011); that is, it has been suggested that the continual fear of external agents and deficits of perception typified by paranoid ideation may mediate the relationship between schizotypy and belief conspiracy theories (see also Holm, 2009). Beyond paranoid ideation, another set of potentially useful mediating variables can be broadly grouped under the category of "cognitive processes". In this view, schizotypal facets may be associated with a number of cognitive processes, which in turn are related to belief in conspiracy theories. Such a focus is not misplaced: previous research has applied a similar conceptual perspective in seeking to understand associations between schizotypy and paranormal beliefs; that is, studies have suggested that cognitive processes may mediate the link between

schizotypy and paranormal beliefs (Baumeister et al., 2017; Bogart et al., 2010; Dagnall et al., 2015; Kata, 2010; Williams & Irwin, 1991).

A number of facets of cognitive processes may be of relevance when considering the associations between schizotypy and belief in conspiracy theories reported in Study 4a. One such facet is an analytic (or rational) cognitive style, which is believed to be one of two distinct branches of reasoning processing (Epstein et al., 1996; Evans, 2010; Evans & Stanovich, 2013; Kahneman, 2011; Ross et al., 2016; Stanovich, 2011). The analytic branch, also referred to as Type 2 thinking style, represents a cognitive processing style that has a low capacity, is measured and slow, and is dependent on cognitive ability (Ross et al., 2016). A second branch, also referred to as Type 1, represents an intuitive processing style that has a high capacity, operates quickly, and is independent of cognitive ability (Ross et al., 2016). Although there is little research investigating cognitive style and schizotypy, greater intuitive cognitive style has previously been associated with negative factors of schizotypy, including interpersonal aspects (Wolfradt et al., 1999). Conversely, analytic thinking is a core component of rationality (Nivard et al., in press; Pennycook et al., 2015; Stanovich, 2011) and has important consequences for diverse domains of psychological functioning (Pennycook et al., 2015). Importantly, Swami et al. (2014) have reported significant negative associations between analytic thinking and belief in conspiracy theories (see also van Prooijen, 2017); these authors also found that priming analytic thinking was successful at reducing belief in conspiracy theories. Thus, it might be suggested that greater analytic thinking may mediate the relationships between schizotypal facets and belief in conspiracy theories.

However, analytic thinking style represents one of several cognitive processes that may have an influence over atypical beliefs (Gray & Mill, 1990). A need for cognition has been suggested to be another potential antecedent of belief in conspiracy

theories (Swami et al., 2014). Need for cognition can be defined as dispositional thinking differences in cognitive motivation and this reflects the motivation to engage in and enjoy effortful cognitive actions (Cacioppo & Petty, 1982; Cacioppo et al., 1996). Those with a high need for cognition are more likely to attend to, elaborate, evaluate, and recall information (e.g., Peltier and Schibrowsky, 1994), are less assertive (Cacioppo & Petty, 1982), and may be less likely to believe in conspiracy theories (Swami et al., 2014). While there has been no previous evaluation of the association between need for cognition and schizotypy, these constructs share similar negative associations with other personality dimensions. For example, high schizotypy has been shown to be negatively associated with Conscientiousness and Openness to Experience (Gurrera et al., 2005), with these factors having similar associations with a need for cognition (Sadowski & Cogburn, 1997). Thus, examining the mediating utility of need for cognition between schizotypal facets and belief in conspiracy theories may be useful.

In addition to analytic-rational thinking and need for cognition, metacognitive factors (i.e., the ability to think about thinking) may be another cognitive processing aspect that mediates the relationship between schizotypy and conspiracist ideation. One particular facet of meta-cognition that may be important *vis-à-vis* schizotypy and belief in conspiracy theories is cognitive insight, which can be conceptualised as the mental processes involved in self re-evaluation of anomalous experiences and misunderstandings (Beck, Baruch, Balter, Steer, & Warman, 2004; Sumiyoshi et al., 2016). One prominent measure of cognitive insight is the Beck Cognitive Insight Scale (BCIS; Beck et al., 2004), which has two subscales: Self-Reflectiveness and Self-Certainty. Those with psychotic disorders have been shown to be less self-reflective (e.g., unwilling to acknowledge the possibility that they are wrong) and more assertive in their own judgments in comparison to psychiatric patients who did not have

psychosis (Beck et al., 2004; Warman, Lysaker, & Martin, 2007; Warman & Martin, 2006). However, researchers have postulated that Self-Reflectiveness reflects a state characteristic, while Self-Certainty reflects a trait characteristic (Bora, Erkan, Kayahan, & Veznedaroglu, 2007; Sacks et al., 2012; Warman et al., 2007), suggesting that Self-Certainty may be more relevant to schizotypal research than Self-Reflectiveness. In accordance with this view, previous studies have suggested that higher self-certainty may be associated with positive factors of schizotypy (Sacks et al., 2012; Stirling, Barkus, & Lewis, 2007; Warman & Martin, 2006), although associations with belief in conspiracy theories has not been previously examined. Thus, self-certainty was included in Study 4b as a third potential mediating factor between schizotypal facets and belief in conspiracy theories.

In short, Study 4b examined the mediating power of three cognitive processes – analytic thinking, need for cognition, and self-certainty – in the relationship between schizotypy and belief in conspiracy theories. Doing so is important as it provides a more nuanced conceptual view of the link between schizotypy and belief in conspiracy theories, and would also help to further explicate the findings reported in Study 4a. More specifically, a hypothesised model of relationships was developed in Study 4b, in which lower-order schizotypy facets from Study 4a (i.e., Odd Beliefs or Magical Thinking and Ideas of Reference, respectively) were included as distal factors in a path analysis framework. Both schizotypal components were predicted to be directly associated with belief in conspiracy theories (as per the findings of Study 4a), as well as indirectly via the variables of analytic thinking, need for cognition, and self-certainty. A

hypothesised model of these relationships is presented in Figure 7.

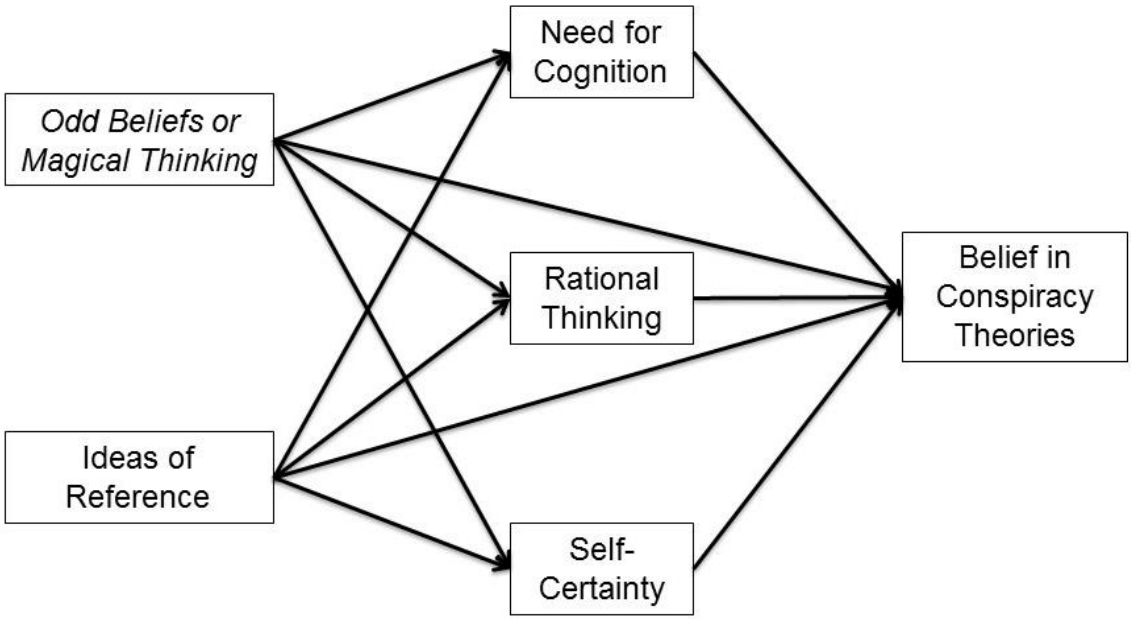


Figure 7. The hypothesised path model from schizotypal traits to belief in conspiracy theories via cognitive mediators

3.2.2 Method

3.2.2.1 Participants

The participants of this study were from an online, international sample of 252 women and 159 men, who ranged in age from 18 to 69 (M = 35.41, SD = 13.06). Most participants were from the United States (65.1%), India (18.7%), and the United Kingdom (10.7%), with the remainder of the sample consisting of various nations (5.5%).

3.2.2.2 Measures

Schizotypy. The Schizotypal Personality Questionnaire (SPQ; Raine, 1991) was used to assess schizotypal traits, see Section 2.1.2.2 for details of the SPQ. As Study 4a indicated support for associations between the lower-order domains of Odd Beliefs or

Magical Thinking and Ideas of Reference, respectively, without the multicollinearity concerns observed with the higher-order domains, only these subscales were included from this measure. Internal consistency, assessed using Cronbach's alpha, for Odd Beliefs or Magical Thinking was .78, and .83 for Ideas of Reference, which is in line with in data reported earlier in this thesis and previous research (e.g., Compton et al., 2009).

Conspiracist ideation. The Belief in Conspiracy Theories Inventory (BCTI; Swami et al. 2010, 2011a) was used to measure general conspiracist ideation (see Section 3.1.2.2 for details of this measure). As mentioned, scores on this measure have been shown to be one-dimensional (Swami et al., 2017; Swami et al., 2011a), and overall score was computed as the mean of all items, with higher scores on this scale reflect greater conspiracist ideation. Reliability analysis indicated that Cronbach's alpha for this scale was .95.

Need for cognition. Need for cognition was measured using the 18-item Need for Cognition Scale (Cacioppo et al., 1996). This scale measures dispositional differences in the motivation to endorse and enjoy cognitive behaviours (sample item: "I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought"). Items are rated for agreement on a 5-point scale (1 = *Extremely uncharacteristic*, 5= *Extremely characteristic*) and an overall score was computed as the mean of all items. Higher scores on this scale reflect greater need for cognition. Previous research has indicated that this scale measures one underlying dimension (Sadowski, 1993), with good internal consistency (West et al., 2008). Here, Cronbach's alpha for this scale was .92.

Analytic-rational cognitive style. Participants completed the 12 items of the Rational Thinking subscale of the Rational/Experiential Multimodal Inventory (Norris & Epstein, 2011), a revision of the Rational Experiential Inventory (Epstein et al.,

1996). These items measure an analytic thinking style (i.e., the ability and enjoyment of problem solving through logical processes of the evaluation of evidence; sample item: "I enjoy intellectual challenges"). All items are rated on a 5-point scale (1 = *Strongly disagree*, 5= *Strongly agree*) and the subscale score was computed as the mean of the items. Norris and Epstein (2011) reported that the Rational Thinking subscale has good discriminant validity and internal consistency coefficients. The Cronbach's alpha coefficient for this scale was .89.

Beck Cognitive Insight Scale. Participants completed the 6 items of the Self-Certainty subscale from the Beck Cognitive Insight Scale (BCIS; Beck et al., 2004). All items are rated on a 4-point scale (0 = *Do not agree at all*, 3= *Agree completely*), with the total score reflecting the degree of self-certainty. Higher scores on this subscale indicate more self-certainty, and in turn, poorer cognitive insight (sample item: "When people disagree with me, they are generally wrong"). The factor structure of the BCIS has also been confirmed for use in non-clinical populations and shows adequate psychometric properties (Warman, Dunahue, Martin, & Beck, 2004). The Cronbach's alpha coefficient for the Self-Certainty subscale in the present study was .77.

3.2.2.3 Procedure

Ethics approval for this study was obtained from the University of Westminster. All data collection was conducted online via Amazon's Mechanical Turk (MTurk) website (www.mturk.com), a crowdsourcing Internet marketplace. In general, samples generated through MTurk are more demographically diverse than alternative online samples, with data considered to be of a high quality (Buhrmester, Kwang, & Gosling, 2011). An advert on the site was placed, and data collection completed, in September 2015. All participants had previously achieved at least a 98% approval rate and completed at least 1000 Human Intelligence Tasks (HITs). After providing informed

consent, participants were directed to the measures described in Section 3.2.2.2, which were presented in an anonymous form in Qualtrics and in ramdomised order. In exchange for completing the survey, participants were awarded $0.30. All participants received written debrief information at the end of the study.

3.2.3 Results

3.2.3.1 Bivariate Correlates

Descriptive statistics for all variables included in the present study are reported in Table 23. An independent-samples *t*-test showed that there was no significant difference in the outcome measure of belief in conspiracy theories between women (M = 3.73, SD = 2.01) and men (M = 4.12, SD = 1.97), $t(399) = 1.90$, $p = .058$, $d = .02$, so the sample was combined for all further analyses. Inter-scale correlations between belief in conspiracy theories, the SPQ lower-order subscales, and potential mediators are reported in Table 24. As can be seen, greater conspiracist ideation was significantly associated with higher scores on both schizotypal traits (Odd Beliefs or Magical Thinking and Ideas of Reference) and Self-Certainty, and lower scores on Need for Cognition and Rational Thinking. In addition, Odd Beliefs or Magical and Ideas of Reference were significantly and positively associated with Self-Certainty and negatively associated with Rational Thinking. However, although there was a significant, negative association between Odd Beliefs or Magical Thinking and Need for Cognition, there was no significant association between need for cognition and Ideas of Reference; therefore, the latter pathway was deleted from the hypothesised model.

Table 24. Inter-Scale Correlations Between Conspiracist Ideation, SPQ Subscales, and Cognitive Factors in Study 4b

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Conspiracist ideation		.53**	.54**	-.14*	-.19**	.36**
(2) OBoMT			.53**	-.11*	-.17**	.29**
(3) IoR				-.09	-.13*	.30**
(4) Need for Cognition					.84**	-.19**
(5) Rational Thinking						-.14*
(6) Self-Certainty						
M	3.89	1.67	2.98	3.38	3.65	15.03
SD	2.00	1.94	2.74	0.72	0.68	3.41

Note. OBoMT = Odd Beliefs or Magical Thinking, IoR = Ideas of Reference. *$p < .05$, **$p \leq .001$

3.2.3.2 Path Analysis

After deletion of the aforementioned pathway (i.e., the pathway of Ideas of Reference → Need for Cognition), path analysis was used to test the hypothesised model using AMOS 21 statistical software with maximum likelihood estimation using the covariance matrix (Arbuckle, 2012). Standard goodness-of-fit indices were selected *a priori u*sing the same indices as used in Studies 1-3 (see Section 2.1.2.4 for details of metrics), with the exception of the Akaike information criterion (AIC), as no nested-model comparison was required for path analysis.

The hypothesised model did not fit these data well, $\chi^2(5, N = 401) = 641.122$, $\chi^2_{normed} = 128.224$, CFI = .292, RMSEA = .564 with 90% *CI* = .528-.601, SRMR = .232. Accordingly, modification indices (see Section 2.1.2.4 for details on this method) were assessed to suggest covarying terms that would improve the overall fit of the

hypothesised model after non-significant paths were removed. Inspection of maximum likelihood scalar estimates indicated that there were non-significant paths. Specifically, this included the pathway leading to Analytical Thinking from Ideas of Reference (estimate = -0.012, SE = .012, CR = -0.996, p = .319), and the pathway leading to Belief in Conspiracy Theories from Need for Cognition (estimate = 0.236, SE = .200, CR = 1.177, p = .239). Following a specification search, by examining whether the addition of fixed parameters throughout the model would significantly reduce the model's χ^2 value, this led to the following covariances of error terms through the model: Odd Beliefs or Magical Thinking ↔ Ideas of Reference, and Need for Cognition ↔ Analytical Thinking. Modification index (MI) values for these covariances were large (MI > 100) and there was high correlation between the variables (see Table 24). The respecified model is displayed in Figure 8 and provided good fit to these data, $\chi^2(5, N = 401) = 15.665$, $\chi^2_{normed} = 3.133$, CFI = .988, RMSEA = .073 with 90% *CI* = .006-.066, SRMR = .042.

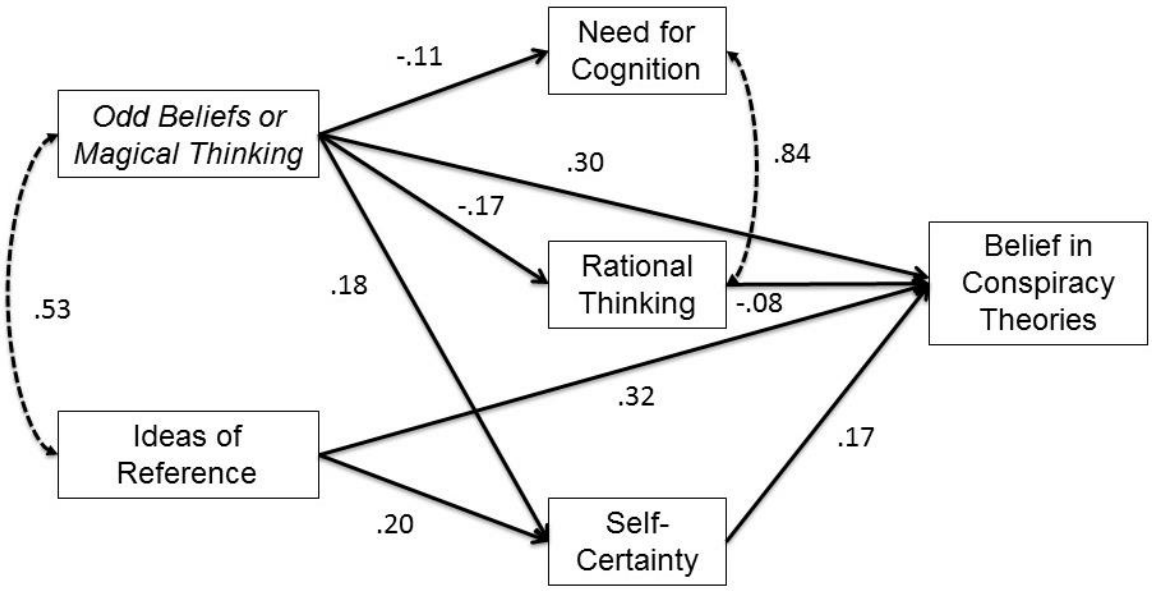


Figure 8. Path diagram model with estimated standardised coefficients

Bootstrapping procedures were used to obtain the direct, indirect, and total effects for Odd Beliefs or Magical Thinking and Ideas of Reference to belief in conspiracy theories, via the significant paths in the fitted model, drawing on 5,000 bootstrap samples from the dataset (see Table 25). The results showed that there were significant direct and indirect effects from all pathways within the fitted model (Odd Beliefs or Magical Thinking → Rational Thinking → BCTI; Odd Beliefs or Magical Thinking → Self-Certainty → BCTI; Ideas of Reference → Self-Certainty → BCTI). For the Odd Beliefs or Magical Thinking → Rational Thinking → BCTI pathway, the significant unstandardised direct effect of Odd Beliefs or Magical Thinking to belief in conspiracy theories was .525 ($p < .001$); however, the significant indirect effect (mediated) effect of Odd Beliefs or Magical Thinking on belief in conspiracy theories was .019 ($p = .016$). That is, due to the indirect (mediated) effect, through the Rational Thinking pathway, of Odd Beliefs or Magical Thinking on belief in conspiracy theories, there was a reduction in effect to that of the direct effect; this is in addition to any direct (unmediated) effect. The significant total (direct and indirect) effect of Odd Beliefs or Magical Thinking on belief in conspiracy theories was .544 ($p < .001$). This represents the total effect due to both direct (unmediated) and indirect (mediated) effects on belief in conspiracy theories. There was a similar effect in the Odd Beliefs or Magical Thinking → Self-Certainty → BCTI pathway, whereby the significant direct effect (.477, $p < .001$) was reduced through the significant indirect effect (.067, $p < .001$); and the Ideas of Reference → Self-Certainty → BCTI pathway, whereby the significant direct effect (.345, $p < .001$) was reduced through the significant indirect effect (.047, $p < .001$).

Table 25. Decomposition of Unstandardised and Standardised Direct, Indirect, and Total Effects from Schizotypal Traits Within the Model, With Bootstrapped Standard Errors in Parentheses in Study 4b

Pathway	Direct Effect		Indirect Effect		Total Effect	
	Unstd.	Std.	Unstd.	Std.	Unstd.	Std.
OBoMT → Rational Thinking	-.059 (.016)	-.170 (.048)	-	-	-	-
Rational Thinking → BCTI	-.311 (.142)*	-.106 (.047)*	-	-	-	-
OBoMT → Rational Thinking → BCTI	.525 (.044)	.510 (.039)	.019 (.010)*	.018 (.009)*	.544 (.044)	.528 (.039)
OBoMT → Self-Certainty	.505 (.090)	.288 (.049)	-	-	-	-
Self-Certainty → BCTI	.132 (.027)	.225 (.046)	-	-	-	-
OBoMT → Self-Certainty → BCTI	.477 (.044)	.463 (.040)	.067 (.018)	.065 (.017)	.544 (.044)	.528 (.039)
IoR → Self-Certainty	.367 (.066)	.295 (.051)	-	-	-	-
Self-Certainty → BCTI	.129 (.028)	.219 (.046)	-	-	-	-
IoR → Self-Certainty → BCTI	.345 (.029)	.472 (.040)	.047 (.013)	.065 (.017)	.392 (.029)	.537 (.039)

Note. OBoMT = Odd Beliefs or Magical Thinking, IoR = Ideas of Reference, BCTI = Belief in Conspiracy Theories Inventory, Unstd. = Unstandardised, Std. = Standardised. *$p < .05$, all other ps $\leq .001$.

3.2.4 Discussion

The aim of this study was to build on Study 4a by further exploring the nature of the association between schizotypy and belief in conspiracy theories, via a number of postulated cognitive processes that were derived from the available literature. The results of Study 4b are important in two ways. First, the results confirmed through path analysis the direct and positive relationships between two lower-order facets of schizotypy (Odd Beliefs and Magical Thinking and Ideas of Reference) and belief in conspiracy theories. This is important as it suggests that the findings reported in Study 4a are relatively robust and remain stable across different samples. In other words, there appears to be a significant and positive association between lower-order facets of schizotypy and belief in conspiracy theories, which cannot be attributed to artefactual explanations. Second, the results of the present study add to those of Study 4a by showing that cognitive processes mediated the relationships between schizotypal components and belief in conspiracy theories.

First, the results of this study showed that analytic thinking mediated the relationship between Odd Beliefs or Magical Thinking (but not Ideas of Reference) and belief in conspiracy theories. This finding builds on previous work (Swami et al., 2014; van der Tempel & Alcock, 2015; van Prooijen, 2017) by suggesting that schizotypal tendencies may be a latent factor that results in lower analytic thinking, which in turn as an impact on belief in conspiracy theories. That is, the cognitive disorganisation and possible delusional ideation that is typified by high scores on Odd Beliefs and Magical Thinking (Dagnall et al., 2015) may result in lower tendencies to process information analytically, which in turn influences tendencies to believe in conspiracy theories. More precisely, the present findings highlight a potential cognitive route through which schizotypal facets exert an influence on belief in conspiracy theories.

Swami and colleagues (2011b) proposed that the latter association may reflect the fact that both conspiracist ideation and paranormal beliefs require a rejection of official mechanisms of information generation and expert opinion. That is, and consistent with the present results, it would seem that differential traits that lead an individual to hold unusual beliefs may also lead them to assimilate conspiracy theories.

What is to some extent unclear, however, is whether Odd Beliefs or Magical Thinking and paranormal beliefs are different concepts. Hergovich et al. (2008) showed that some aspects of paranormal beliefs (e.g., belief in precognition, psi, witchcraft, and spiritualism) were predicted very well by schizotypy, but other facts such as superstition were not. This would seem consistent with the finding that conspiracist ideation is associated with paranormal, but not superstitious, beliefs (Swami et al., 2011b). It is possible that individuals who score highly on Odd Beliefs or Magical Thinking and/or paranormal beliefs subscribe to larger delusional systems (Darwin, 2015) that make it more likely that they will adopt conspiracy theories. Conversely, and as argued by Swami et al. (2011b), it is possible that conspiracy theories fill a need for control that individuals who score highly on paranormal beliefs or Odd Beliefs or Magical Thinking might seek.

In addition, the results of Study 4b indicated that greater schizotypal tendencies on both Odd Beliefs or Magical Thinking and Ideas of References were associated with greater self-certainty. This aspect of the study was consistent with previous work (e.g., Sacks et al., 2012; Warman & Martin, 2006); however, it extends previous work by showing that self-certainty mediated the relationships between these schizotypal traits and belief in conspiracy theories. That is, greater schizotypy scores on the two facets included here were associated with greater unwillingness to acknowledge the possibility that one may be wrong about an issue and greater assertiveness in one's own judgments.

In turn, such greater self-certainty appears to have been associated with greater belief in conspiracy theories. These findings are important, both because they have highlight self-certainty as a mediating factor and also because it supports previous findings suggesting a link between self-certainty and conspiracist beliefs (van Prooijen, 2016).

One final aspect of Study 4b is worth commenting on. Although this study found that Odd Beliefs or Magical Thinking was significantly and negatively associated with need for cognition, the latter was not directly associated with belief in conspiracy theories nor did it mediate the link between schizotypal facets and belief in conspiracy theories. Although need for cognition has been suggested as an antecedent of belief in conspiracy theories, previous studies have likewise reported null effects once the variance accounted for by other cognitive processing factors have been accounted for (Swami et al., 2014). One broad conclusion that might be drawn on the basis of these results is that, once other cognitive factors (e.g., analytic thinking) have been accounted for, need for cognition no longer exerts any significant effect on belief in conspiracy theories.

Taken together, the results of this study support the findings from Study 4a by suggesting that schizotypal traits are directly associated with belief in conspiracy theories. However, they also extend the findings of the previous study by suggesting that cognitive processes – namely, analytic thinking and self-certainty – may mediate the link between schizotypy and belief in conspiracy theories. This helps to provide a more nuanced perspective of previously reported results (e.g., Darwin et al., 2015; Swami et al., 2011b) suggesting a link between schizotypy and belief in conspiracy theories. That is, although a direct link between these variables may be tenable, it is also important to consider the possible ways in which schizotypy shapes cognitive processes, which in turn influence belief in conspiracy theories. This is important as it may highlight possible intervention routes for reducing belief in conspiracy theories.

However, there are a number of limitations with this study. First, there were only two subscales of schizotypy included in this study; these were selected on the basis of findings reported in Study 4a and helped reduced limitations associated with multicollinearity. However, it could also be suggested that these particular facets of schizotypy represent analogous constructs to cognitive processes, or at least subsume latent cognitive processes. The cognitive measures included in the present study may, therefore, represent overlapping constructs with schizotypal facets, rather than independent variables. Second, similar to Study 4a, the online recruitment strategy ensured a sufficient sample for the analyses, but participants were unlikely to be representative of any one nation or community. Third, it is important to highlight that the data in Study 4b were cross-sectional and, while these results were interpreted in line with contemporary theorising of conspiracy ideation (e.g., Swami & Furnham, 2014), some caution should be exercised when interpreting causational effects.

4 Early Processing Deficits

Study 5: Electrophysiological Markers and Schizotypy

4.1 Overview

Much research has been devoted to the examination of electrophysiological function in an effort to identify potential causes and vulnerability factors for schizophrenia. For example, there has been evidence of a premorbid decline in electrophysiological function in patients who subsequently developed a psychotic illness (Kravariti et al., 2009) and electrophysiological function is not only abnormal in patients with schizophrenia (Hermens et al., 2010), but also in people considered to be at risk of developing a psychotic illness.

Indeed, Groom et al. (2008) showed with an at-risk group of adolescent siblings of patients with schizophrenia, significantly reduced auditory P300 amplitude (see Section 1.6.1 for details on this component) when compared to healthy control participants. Further, Bramon et al. (2008) reported that the amplitude of the P300 was significantly reduced in at-risk individuals compared to controls, suggesting that P300 is a marker associated with increased vulnerability to progress to psychosis. Similar findings have been supportive of reduced P300 in at-risk groups (e.g., relatives of schizophrenic patients; Roxborough et al., 1993; Saitoh et al., 1984). In relation to non-clinical schizotypy, Sumich et al. (2008) reported on associations between ERPs and paranormal ideation/unusual experiences, where paranormal ideation was found to be inversely correlated with P300 amplitude. However, in general, auditory deficits in schizotypy tend to be subtle. For example, increased schizotypy is associated with reduced P300 (Kimble et al., 2000; Klein et al., 1999; Nuchpongsai et al., 1999) and N2 amplitudes (Nuchpongsai et al., 1999), but not with other ERPs such as N1, P2, and P3a (Klein et al., 1999). Indeed, this subtlety can be extended to P300, where reduced amplitudes have not been evident with anhedonic participants (Miller et al., 1984). Further, Condray and Steinhauer (1992) found normal P300 in schizotypal participants with and without a family history of schizophrenia.

The component of an ERP that is thought to represent a detection of change mechanism or a violation of regularity is mismatch negativity (MMN; Näätänen et al., 1978). This component is thought to reflect an automatic process that detects a difference between an incoming stimulus and the sensory memory trace of preceding stimuli (see Section 1.6.2 for details of this component; Duncan et al., 2009; Näätänen, 2007). A decrease in the amplitude of MMN in patients with schizophrenia is a robust and consistent finding in biological psychiatry (for a review, see Michie, 2001). However, despite a plethora of research investigating MMN in patients with schizophrenia, very few studies have investigated associations between MMN and non-clinical schizotypy (Broyd et al., 2016). There has been research conducted with SPD features (Hong et al., 2012; Liu et al., 2007; Niznikiewicz et al., 2009) and at-risk children (e.g., Bruggemann et al., 2013), with profiles similar to that of a schizophrenia sample. Broyd et al. (2016) reported on associations with the SPQ and a multi-feature MMN paradigm, where there were three deviant variations of standard tones (duration, frequency, and intensity), in 35 healthy participants. Few associations were identified between schizotypal traits and MMN amplitudes. However, with the lower-order subscales, higher Suspiciousness ratings were significantly correlated with larger frequency MMN amplitudes. Further, a median-split comparison of the sample on suspiciousness scores showed larger MMN (irrespective of deviant condition) in the high compared to the low suspiciousness group (Broyd et al., 2016). In a non-clinical sample, Fernandes et al. (1999) found no significant effect on frequency MMN amplitude of schizotypal symptoms, family history of psychosis, or group classification when measurements were made with the Chapman scales.

Building from the sample and latent means from Study 1, this study will compare UK White British, UK African Caribbean, and African Caribbean participants resident in Trinidad on the aforementioned ERP components (P300 and MMN). As high

scores of schizotypy may constitute a risk factor for schizophrenia, it would be of great interest, and potentially of clinical benefit, to examine whether high schizotypes show similar patterns of electrophysiological dysfunction as seen in schizophrenia and to shed further light on under-investigated ERP components (e.g., MMN). If a combination of high schizotypal ratings and abnormal electrophysiological function can be established, this may constitute a more reliable measure of vulnerability for psychosis. Identifying persons at risk of psychosis is integral to developing preventative interventions for psychotic disorders. Since most ERP studies typically investigate only one paradigm (e.g., P300 alone), this study will provide a wider scope of investigation. It is hypothesised that high schizotypes will have an attenuated P300 and MMN profile similar to the schizophrenia profile. Further, this study allows for a unique comparison between culture and ethnicity, although this element of the study was more exploratory given the lack of relevant literature on which to draw in formulating hypotheses. Finally, this study allows for an investigation into associations between the domains established in Study 1 and electrophysiological function.

4.2 Method

4.2.1 Participants

Participants for this study were selected from the total score of Schizotypal Personality Questionnaire (SPQ; Raine, 1991) in Study 1. Previous research has typically used the upper and lower 10% of SPQ distributions as cut-offs for schizotypal comparison groups (e.g., Hall & Habbits, 1996). However, previous electrophysiological studies with schizotypy have used the upper and lower 1/3 of SPQ scores as groupings of high and low schizotypy, respectively (e.g., Wan et al., 2008). From the distribution of total SPQ score from Study 1 (M = 18.50, SD = 13.68), the upper cut-off of SPQ score was 22 (66.6%) and the lower cut-off was 10 (33.3%).

Although one African Caribbean in the low schizotypy group scored 13, this participant was included in analyses due to low recruitment numbers in the African Caribbean sub-sample.

From these cut-offs, there was an initial recruitment of 38 participants for this study from the initial sample in Study 1. The sample included 19 White British participants in the UK (12 men and 7 women), 15 African Caribbean participants in Trinidad (4 men and 11 women), and 4 African Caribbean participants in the UK (3 men and 1 woman). Due to the low numbers in the latter group, this sub-sample was removed from analyses. For the UK group (SPQ *M* = 19.21., *SD* = 17.05), there were 10 low schizotypal participants[9] (SPQ *M* = 4.60, *SD* = 2.91) and 9 high schizotypes (SPQ *M* = 35.44, *SD* = 9.00). For the African Caribbean group (SPQ *M* = 26.60, *SD* = 16.98), there were 7 low schizotypal participants (SPQ *M* = 9.71, *SD* = 1.98) and 8 high schizotypes (SPQ *M* = 41.38, *SD* = 6.23). The mean age of participants for the UK sub-sample group was 26.16 years (*SD* = 7.60) and 27.73 years (*SD* = 10.19) for the African Caribbean sub-sample. There was no significant difference in age between sub-samples, $t(32) = 0.52$, $p = .609$, $d = 0.17$.

4.2.2 Measures

Screening methods. As this study required the inclusion of non-clinical high schizotypes only, screening measures were used prior to testing. The Mini International Neuropsychiatric Interview (MINI; Lecrubier et al., 1997) was used for initial screening. The MINI has good-to-very good validity, reliability (inter-rater and test-retest), and sensitivity and specificity indices (Boudrot, D'uva, Sheehan, Lecrubier, & Even, 2009; Sheehan et al., 1998; Sheehan et al., 2010). The MINI includes both Axis I

[9] One participant in this group did not complete the P300 oddball task, therefore for that paradigm, the group consisted of 9 participants.

and Axis II disorders for *the International Statistical Classification of Diseases and Related Health Problems* tenth edition (*ICD-10*) and the *DSM-IV* (Sheehan et al., 1998), with 16 modules (e.g., Post-Traumatic Stress Disorder). For this study, all participants completed the Psychotic Disorders and Mood Disorders with Psychotic Features module. Further, participants completed the Schizotypal Personality Disorder module in the Structured Clinical Interview for *DSM-IV* Axis II Disorders Personality Questionnaire (SCID-II; First et al., 1997). No participants reached the necessary diagnostic criteria for exclusion from this study.

Schizotypy. See Section 2.1.2.2 for details of the SPQ (Raine, 1991). As Study 1 indicated support for original 4-factor higher order structure (Model A in Study 1; Stefanis et al., 2004b) for the English version of the SPQ with UK White British participants and African Caribbean participants, this was used initially in the analyses. For the factorial make-up of this structure, see Model A in Figure 5, Section 2.1.2.2.

4.2.3 Procedure

Ethics approval for this study was obtained from the University of Westminster and the University of the West Indies. See Section 2.1.2.3 for recruitment strategy for the initial SPQ distribution. Participants who scored within the high and low bounds were contacted via email if there was a registration of interest from the consent form in Study 1. All participants gave a dual-consent prior and post experimental session. No monetary incentives were offered to the participants for completion of the study. All participants received written debrief information at the end of the study.

4.2.4 EEG data recording

Silver-silver chloride (Ag/AgCl) electrodes were used to record the EEG activity and were positioned at sites, in accordance with the International 10-20 system (Jasper,

1958). Electrophysiological recording was at F3, F4, Fz, C3, C4, Cz, Pz, and both mastoids. The reference was placed on the nose and the ground electrode was placed at AFz. A pair of electrodes were placed above and below the left eye (E1, E2) to record vertical eye movements (vEOG) to enable artefact rejection of eye blinks. Continuous EEG was collected using Grass Technology TWin Recording & Analysis Software, at a sampling rate of 1000 Hz, with a low pass of 100 Hz and a high pass of .10 Hz and stored on a computer for offline analysis.

4.2.5 Stimuli and Protocol

All stimuli and experimental paradigms were created by the author of this thesis. The stimuli were created using Audacity (http://www.audacityteam.org/) and the presentation software (E-Prime v2.0 Psychology Software Tools Inc., USA) provided markers to be used during averaging of the EEG to produce evoked potential waveforms. The paradigms were hosted using a Dell Latitude e6510 (Intel Core i5-2540M [2.60GHz, 3MB cache, Dual Core]). Markers were sent via a Quatech SPPXP-100 26 pin parallel express card to a Grass Technology portable AS40-PLUS EEG (Astro-Med USA, Ltd.). All equipment was used at both sites. Recommended recording conditions were followed for the construction of the paradigms (see Table 26; Duncan et al., 2009; Näätänen et al., 2004).

Participants were seated in a darkened room, at a comfortable distance from the laptop, and wore headphones to listen to the tones in both paradigms (Sennheiser HD 212 Pro). The paradigms were presented at a pseudo-randomised order. As the MMN is operationalised through a passive task, participants were requested to complete a simple paper and pencil task present throughout recording. For the P300 oddball task, participants actively selected whether it the tone was frequent (standard) or was infrequent (deviant), using a two-button press-pad. Within both paradigm, stimuli were

presented in a pseudo-random sequence ensuring deviant stimuli were interspersed with standard stimuli. The MMN recordings contained a minimum of 150 deviants, and the P300 recordings contained a minimum of 36 artefact-free trials.

Table 26. Paradigm Parameters Used for Eliciting and Recording MMN and P3 in Study 5

Stimulus factors	MMN ('Optimal paradigm'; Näätänen et al., 2004)	P300 Oddball Task
Description	Two categories of stimuli: One frequent standard, five deviant tones. Passive task	Two categories of stimuli: one standard, one target. Active task
Standard	1000Hz tone	500Hz tone
Duration	80ms	50-150ms duration
Intensity	60Db	70Db
ISI	500ms	1-2 seconds (variable)
Deviants		1000Hz tone
Duration	35ms	-
Intensity	50% intensity deviants 10dB higher; 50% 10dB lower	-
Frequency	50% frequency deviants 10% higher partials; 50% were 10% lower partials	-
Location	10% location deviants perceived as having a spatial location 90° to the right and 10% were 90° to the left	-
Gap	Silent gap of 7ms within 80ms stimulus	-
Probability	.50 (standard), .10 (each of the deviants); a minimum of one standard between each deviant	.10–.20 (target), .80–.90 (standard)

4.2.6 Data Analysis

Continuous EEG data were epoched offline at 500ms, with 50ms prestimulus baseline for MMN, and 1000ms, with a prestimulus baseline of 100ms for P300. The epochs were digitally filtered with a band pass of 1-30Hz and baseline corrected employing an average of a 100ms pre-stimulus baseline as zero. Epochs containing transients greater than ± 100μV were excluded from further analyses. For each participant, ERPs were averaged separately for standard and deviant stimuli and deviant minus standard subtraction waveforms generated. From the grand average waveforms, MMN- and P300-like differences were identified on the basis of known negative and positive polarity, respectively. For auditory MMN, greatest amplitudes are recorded over fronto centro electrode positions in a typical latency range of 100 to 250ms and typically P300 is recorded in the latency range of 250 and 500ms (e.g., Sumich et al., 2008), although the P300 may extend to 1000ms for more complex paradigms (Duncan et al., 2009).

For MMN, in both high and low schizotypal groups, the maximal difference between ERPs to standards and deviants was identified at 145ms and 185ms post-stimulus presentation at Fz. Therefore, a 40ms time window was centred at these latencies for electrodes Fz and Cz. When referenced to the nose, the MMN response is seen as a negative displacement in particular at the frontocentral and central scalp electrodes (Näätänen, Paavilainen, Rinne, & Alho, 2007); thus, these sites were used for analysis. For P300, the maximal difference between ERPs to standards and deviants was identified at 280ms and 360ms post-stimulus presentation at Fz for the high schizotypes, and 265 and 345ms for low schizotypes. Therefore, an 80ms time window was centred at these latencies for electrodes sites previously used in studies concerning schizotypy and schizophrenia (Fz, Cz, C3, and C4; Chun et al., 2013). The mean amplitude for these time windows was then calculated. Following this MANOVAs, were used to

investigate the effect of ethnicity and schizotypal grouping on the deviant stimuli at the electrodes of interest for each paradigm. Finally, multiple regression was used to investigate associations with the domain structure from Study 1.

4.3 Results

4.3.1 Grand Average Waveforms

Grand average and subtraction waveforms were constructed for the standard and deviant stimuli (for P300, see Figure 9 A-D; for MMN, see Figure 10 A-D) for waveforms at electrode Fz. For P300, the standard and deviant grand average waveforms for high and low schizotypy for the combined UK and Trinidad sample are presented in Figure 9A, with the subtraction of deviant minus standard in Figure 9B. From this, the time-window of interest was identified at 280ms and 360ms for high schizotypes and 265 and 345ms for low schizotypes. In Figure 9A and 9B, it can be seen that a P300 response was recorded in both high and low schizotypy groups but that the response appeared comparatively attenuated in the high schizotypy group. Further, Figures 9C and 9D show the grand average and subtraction waveforms, respectively, for Trinidad on the left and the UK on the right. The P300 response was larger for the Trinidad group than for those from the UK.

For MMN, the standard and deviant grand average waveforms for high and low schizotypy for the combined UK and Trinidad sample are presented in Figure 10A, with the subtraction of deviant minus standard in Figure 10B. From this, the time-window of interest was identified at 145ms and 185ms for both groups. Similar to P300, there was some evidence of a MMN, however, this appeared to be consistent across groups. For the MMN, the standard and deviant grand average waveforms for high and low schizotypy for the combined UK and Trinidad sample are presented in Figure 10A, with the subtraction of deviant minus standard in Figure 10B. It can be seen (10B) that the

morphology of the subtraction waveforms for the high and low schizotypy groups are similar and it is unclear whether MMN was elicited. Figures 10C and 10D show grand average and subtraction waveforms, respectively, for Trinidad on the left and the UK on the right and the responses are similar between the two population samples.

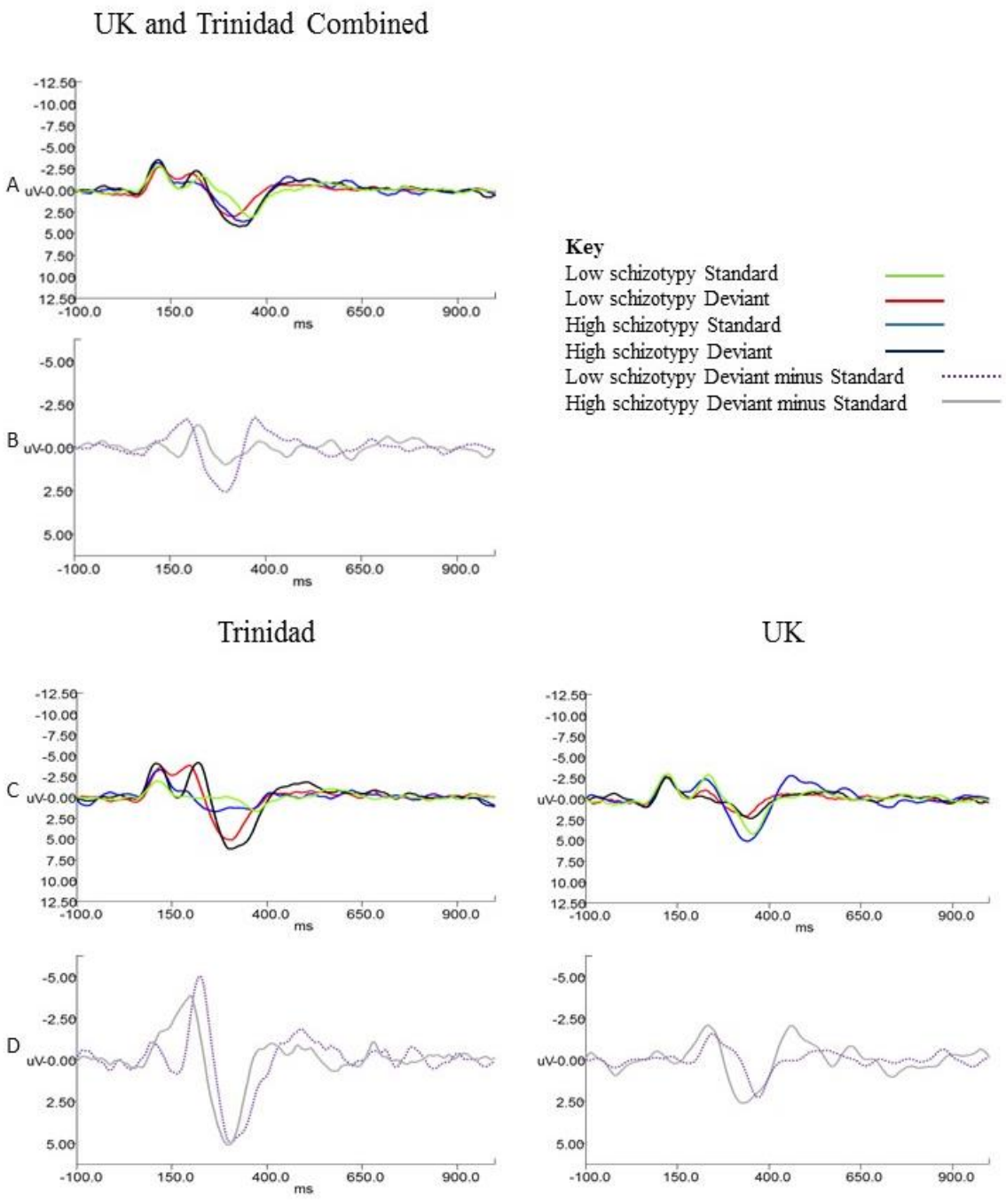


Figure 9. Grand average waveforms at electrode Fz. (A) Standard and deviant grand average waveforms for high and low schizotypy across groups. (B) Deviant minus standard subtraction waveforms for high and low schizotypy across groups. (C) Standard and deviant grand average waveforms for high and low schizotypy by country. (D) Deviant minus standard subtraction waveforms for high and low schizotypy by country

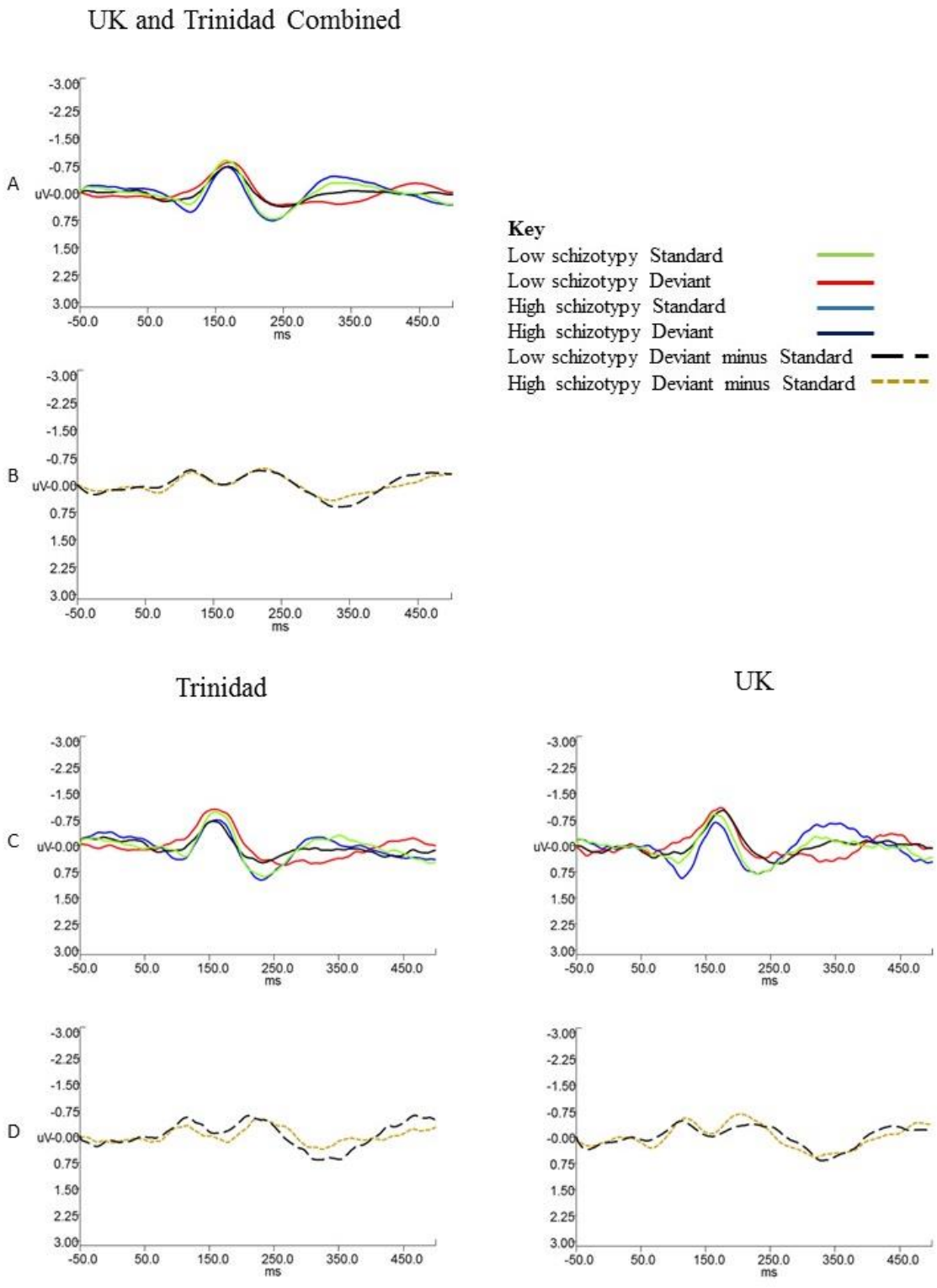


Figure 10. Grand average waveforms and MMN at electrode Fz. (A) Standard and deviant grand average waveforms for high and low schizotypy across groups. (B) Deviant minus standard subtraction waveforms for high and low schizotypy across groups. (C) Standard and deviant grand average waveforms for high and low schizotypy by country. (D) Deviant minus standard subtraction waveforms for high and low schizotypy by country

4.3.2 Between-Group Differences and Associations

MMN

Schizotypal group and ethnicity differences were investigated with the subtracted (deviant – standard) mean amplitudes at Fz and Cz. A 2-way MANOVA was conducted, with the two subtracted mean amplitudes as dependent variables. There were no statistically significant main effects found for schizotypal group, $F(2, 29) = 1.25$, $p = .301$, Wilk's $\Lambda = .92$, $\eta_p^2 = .08$, and ethnicity, $F(2, 29) = 0.66$, $p = .526$, Wilk's $\Lambda = .96$, $\eta_p^2 = .04$. Next, to investigate the associations between latent domain and mean amplitude, a regression was conducted with the 4 domains identified from Study 1 (*Cognitive-Perceptual, Paranoid, Negative,* and *Disorganised*) as predictor variables and the subtracted (deviant – standard) mean amplitudes at Fz and Cz in two separate regressions. The results showed that the regression was not significant for Fz, $F(4, 13) = 2.41$, $p = .103$, Adj. $R^2 = .25$. However, *Disorganised* was a significant coefficient (ß = -1.42, $t = -2.93$, $p = .012$). With similar findings at Cz, with the regression not significant, $F(4, 13) = 2.31$, $p = .190$, Adj. $R^2 = .16$. However, *Disorganised* was a significant coefficient (ß = -1.34, $t = -2.62$, $p = .021$).

P300

Schizotypal group and ethnicity differences were investigated with the subtracted (deviant – standard) mean amplitudes at Fz, Cz, C3, C4. A 2-way MANOVA was conducted, with the four subtracted mean amplitudes as dependent variables. There were no statistically significant main effects found for schizotypal group, $F(4, 26) = 0.14$, $p = .967$, Wilk's $\Lambda = .98$, $\eta_p^2 = .02$, and ethnicity, $F(4, 26) = 2.11$, $p = .109$, Wilk's $\Lambda = .76$, $\eta_p^2 = .25$. Again, a regression was conducted with the 4 domains identified from Study 1 (*Cognitive-Perceptual, Paranoid, Negative,* and *Disorganised*) as

predictor variables and the subtracted (deviant – standard) mean amplitudes and the four components of the P300 as criterion variables in different regressions. The results showed that there were no significant associations for Fz $F(4, 13) = 0.67$, $p = .622$, Adj. $R^2 = .17$, Cz $F(4, 13) = 0.52$, $p = .722$, Adj. $R^2 = .13$, C3 $F(4, 13) = 1.23$, $p = .345$, Adj. $R^2 = .05$, and C4 $F(4, 13) = 0.77$, $p = .563$, Adj. $R^2 = .06$.

4.4 Discussion

The aim of this study was to build on the measurement results from Study 1 by further exploring ethno-cultural factors, within the framework of electrophysiological function. First, this study sought to investigate if a combination of high schizotypal ratings and abnormal electrophysiological function could be established. Second, this study allowed for a unique comparison between culture and ethnicity, within the assessment of electrophysiological deficits. Finally, this study allowed for an investigation into associations between the domains established in Study 1 (*Cognitive-Perceptual, Paranoid, Disorganised*, and *Negative*) and electrophysiological function.

Despite previous research suggesting that increased schizotypy is associated with reduced P300 (Kimble et al., 2000; Klein et al., 1999; Nuchpongsai et al., 1999), this study failed to establish significantly reduced auditory P300 amplitude with a high schizotypal group in comparison to a low schizotype group in Trinidad and the UK. Further, although the P300 response was larger for the Trinidad group than for those from the UK, there were no significant differences in the subtraction (deviant – standard) at any electrode when assessed by ethnicity or schizotypal group. However, in general, auditory deficits in schizotypy tend to be subtle. For example, there has been evidence of normal P300 amplitude with anhedonic participants (Miller et al., 1984) and schizotypal participants with and without a family history of schizophrenia (Condray & Steinhauer, 1992).

With regard to MMN, there has been research conducted with SPD features (Hong et al., 2012; Liu et al., 2007; Niznikiewicz et al., 2009) and at-risk children (e.g., Bruggemann et al., 2013), with profiles similar to that of a schizophrenia sample. Despite a lack of previous research in comparison to the schizophrenia literature, Broyd et al. (2016) reported on associations with the SPQ and a multi-feature MMN paradigm. However, few associations were identified between schizotypal traits and MMN amplitudes, with the lower-order subscale of Suspiciousness being significantly correlated with larger frequency MMN amplitudes. While the present study similarly found little evidence of associations with the schizophrenia literature with high schizotypal electrophysiological deficits, the results of the regression indicated no support from associations at the higher-order subscale level.

This study had several limitations that may have influenced the aforementioned null results. First, while the cut-off levels endorsed by this study fall within the range used by previous studies (e.g., Wan et al., 2008), they are not typical from previous schizotypal research. For example, previous research has typically used the upper and lower 10% of SPQ distributions as cut-offs for schizotypal comparison groups (e.g., Hall & Habbits, 1996). Therefore, potential electrophysiological deficits that may have been observed with the participants at the higher-end of the spectrum may have been masked with scorers that are more typical. However, due to the limited sample size in general, it was not possible for a more stringent criterion for group cut-offs. Second, although the level of intensity was constant throughout all recordings, previous research has suggested that a threshold be first calibrated, to which a 60dB raise in intensity is then implemented (Duncan et al., 2009). Therefore, despite participants hearing the tones when presented the intensity was not thoroughly monitored.

5 General Discussion

Schizotypy represents a constellation of personality factors thought to reflect the liability and subclinical quintessence of schizophrenia in the general population (Claridge, 1997; Ettinger et al., 2015; Lenzenweger, 2011). Observed in both clinical and non-clinical populations, schizotypy is characterised by thought processes and psychological experiences that are associated with psychosis and the paranormal, such as paranoia, magical thinking, and cognitive disorganisation (e.g., Raine, 2006). Schizotypy has been widely studied, for example research have investigated associations between increased schizotypy levels and executive function (Trestman et al., 1995), latent inhibition (Wuthrich & Bates, 2001), negative priming (Claridge & Beech, 1996), hemisphere asymmetry (Voglmaier et al., 2000), verbal IQ (Noguchi, Hori, & Kunugi, 2008), spatial memory (Park, Holzman, & Lenzenweger, 1995), working memory (Schmidt-Hansen & Honey, 2009), and attention (Chen et al., 1997). However, there has been limited work conducted in a social identity framework. This is of concern as there has been evidence that joining social groups and incorporating those groups into one's social identity endorses better physical and mental health; in particular, with a reduction in risk of paranoia and depression (McIntyre, Wickham, Barr, & Bentall, 2017).

To rectify the aforementioned dearth in the literature, this thesis began by (re-)examining the Schizotypal Personality Questionnaire (SPQ; Raine, 1991) as a measurement tool for schizotypy. This included a re-evaluation of the domain structure of the English SPQ and the German SPQ, and the development and evaluation of a Malay translation of the SPQ. Within the evaluation and development of these measures, an exploration of schizotypy within the frameworks of ethno-cultural identities was conducted. This included evaluations between African Caribbeans in the

UK and Trinidad, with White British participants; Malays and Chinese participants in Malaysia, and; central European White participants from Austria and southern Germany, with a similar cultural group in the UK. Establishing whether rates of schizotypy vary across different ethno-cultural groups would increase knowledge about psychosis risk and provide valuable information regarding the as-yet-unexplained inflated incidence rates of psychosis in people from ethnic minorities.

A second aim from this thesis concerned schizotypal and cognitive processing, which has been infrequently investigated as an outcome of schizotypy. An initial pilot was to conducted to investigate the association between schizotypy and conspiracy ideation, which was included as a *prima facie* outcome of disordered thinking. A follow-up study was conducted to build a functioning path analysis model for cognitive traits (e.g., analytical thinking). The final aim was to investigate electrophysiological markers between subscales of schizotypy derived throughout the studies in this thesis with electrophysiological measures (P300 and MMN). The final study sought clarity on under-investigated ERP components, such as the MMN, as well as investigating the schizotypal profile of ratings through dimensions on the SPQ. Finally, this study investigated the extent to which variations in cultural background and ethnicity impact on associations between ERP components and SPQ ratings.

5.1 Overview of Findings

Study 1 aimed to identify the model of best fit between the most common and widely-supported solutions in the literature of the English version of the SPQ (see Compton et al., 2009). Second, examination of measurement equivalence was conducted on the best-fitting model of the SPQ across White British and African Caribbean participants in London, UK, and African Caribbean participants in Port of Spain, Trinidad and Tobago. Finally, higher order domain-level scores were compared

across cultural groups and sex. The findings revealed that the 4-factor model (Stefanis et al., 2004b) had the best fit, with the original 3-factor structure (Raine et al., 1994) and a hierarchically related 4-factor structure (Sefanis et al., 2004b) having fit indices within an acceptable range. In addition, measurement invariance was found for this best fitting model at the configural and metric level, although the model fell short of full scalar invariance. These findings suggest a reasonable level of confidence in the factorial structure and robustness between the divergent samples. However, as measurement invariance was not completely obtained, inferences made with the factorial structure should be made with caution. Previous research has found that men score higher on the *Negative* factor and women score higher on the *Cognitive-Perceptual* factor (Bora & Baysan Arabaci, 2009a; Fossati et al., 2003; Kwapil et al., 2008; Wuthrich & Bates, 2006), which were not established in this study. The *Cognitive-Perceptual* and *Negative* domains may have been influenced by the inclusion of the *Paranoid* domain in the 4-factor solution, in terms of the lower-order to higher-order structure. For example, for the *Cognitive-Perceptual* factor, reducing the four lower-order factors in the 3-factor solution to two lower-order factors in the 4-factor model may have diminished the effect of sex with this domain.

In Study 2, the SPQ was translated into Malay and was subjected to psychometric evaluation. Following the findings from Study 1, it was expected that the structure of the Malay SPQ would mirror the 4-factor solution (Stefanis et al., 2004b). It was further hypothesised that Malay participants would have have higher SPQ ratings than Chinese participants, emphasised particularly in the positive domains. It was expected that women would score significantly higher on the *Cognitive-Perceptual* dimension and men to score significantly higher on the *Negative* and *Disorganised* dimensions. Mirroring the findings from Study 1, the 3-factor solution (Raine et al., 1994) had adequate fit, with an improvement in fit for Compton et al.'s (2009)

modification of the primary 4-factor structure, with the standard 4-factor structure (Stefanis et al., 2004b) having the superior fit. While all latent domains, as reported by Stefanis et al. (2004b), were retained, a number of lower-order items were removed to improve internal consistency. Importantly, acceptable measurement invariance for the model of best-fit was achieved in the Malaysian sample for Malay and Chinese adults. Regarding group differences at the latent mean level, there was a significant ethnicity by sex interaction, with Malay women having significantly higher scores than Chinese men, Chinese women, and Malay men participants on the *Cognitive-Perceptual* domain. There was also a main effect for urbanicity, with urban participants scoring higher on the *Paranoid* and *Disorganised* dimensions; indeed, similarly to Stefanis et al. (2004a), there was an interaction with sex and urbanicity, where urban males scored significantly higher on these dimensions and the *Negative* domain

With little previous factorial evaluation of the German version of the SPQ (SPQ-G), Study 3 sought to investigate this and to compliment the ethno-cultural comparisons in Studies 1 and 2. That is, Study 1 had both cultural and ethnic groups independent and dependent of each other, whereas Study 2's ethnic groups were within the one cultural setting; in Study 3, by contrast, the investigation centred on one ethnic group in two cultural settings. It was thought that this method of sampling would give a proxy measure of the migration effect of central white Europeans, which has had little focus in the literature. Based on prior research, and the previous studies in this thesis, it was hypothesised that the data would best suit the 4-factor solution by Stefanis et al. (2004b). Findings from Study 3 revealed that the original 3-factor structure (Raine et al., 1994), the 4-factor (Stefanis et al., 2004b), and a hierarchically related 4-factor structure (Compton et al., 2009) had fit indices within an acceptable range. Of these well-fitting models, the 4-factor model proposed by Stefanis et al. (2004b) had the best fit. Regarding sex differences within domains, results reflected previous findings with

women scoring significantly higher on the *Cognitive-Perceptual* domain but not with men scoring higher on the *Disorganised* domain (for review, see Raine, 2006). Further, in Study 2, men scored higher on the *Paranoid* domain, but in Study 3, women scored higher on this domain. Further, there were main effects for culture on the *Cognitive-Perceptual* domain, with Austrian participants scoring significantly higher than the UK comparison group.

Study 4a sought to build upon the previous research linking conspiracy ideation and schizotypy (e.g., Darwin et al., 2011). This initial associative study served as a pilot to investigate thinking styles and cognitive biases, forming a more complete model of cognitive deficits in Study 4b (where significant schizotypal predictors of conspiracy ideation were included into a measurement model using structural equation modeling). That is, Study 4b examined the mediating power of three cognitive processes – analytic thinking, need for cognition, and self-certainty – in the relationship between schizotypy and belief in conspiracy theories. The results of this study showed that analytic thinking mediated the relationship between Odd Beliefs or Magical Thinking (but not Ideas of Reference) and belief in conspiracy theories. That is, the cognitive disorganisation and possible delusional ideation that is typified by high scores on Odd Beliefs and Magical Thinking (Dagnall et al., 2015) may result in lower tendencies to process information analytically, which in turn influences tendencies to believe in conspiracy theories. Further, the results of Study 4b indicated that greater schizotypal tendencies on both Odd Beliefs or Magical Thinking and Ideas of References were associated with greater self-certainty. This aspect of the study was consistent with previous work (e.g., Sacks et al., 2012; Warman & Martin, 2006); however, it extends previous work by showing that self-certainty mediated the relationships between these schizotypal traits and belief in conspiracy theories.

The aim of Study 5 was to further build on the measurement results from Study 1, by exploring electrophysiological function within the framework of ethno-cultural influence. First, this study sought to investigate if a combination of high schizotypal ratings and abnormal electrophysiological function could be established. Second, this study allowed for a unique comparison between culture and ethnicity, within the assessment of electrophysiological deficits. Finally, this study allowed for an investigation into associations between the domains established in Study 1 (namely, *Cognitive-Perceptual, Paranoid, Disorganised,* and *Negative*) and electrophysiological function. Results indicated little evidence of association between the schizotypy and schizophrenia literature; that is, there was no apparent electrophysiological deficits for high schizotypal individuals and no ethno-cultural influence. Further, the results of the regression indicated no support for associations at the higher-order subscale level.

5.2 Theoretical and Practical Implications

In addition to providing clues regarding the aetiology of schizophrenia, schizotypy is an important topic for investigations in its own right, not only because of the documented neurocognitive impairments, but also because of its associations with a number of maladaptive behaviours and psychiatric symptoms. Indeed, this thesis represents a biopsychosocial account of schizotypy, and adds to the literature in a number of ways. First, this thesis builds on the measurement literature of schizotypy and, specifically, the SPQ. Across Studies 1-3, the 4-factor structure was consistently endorsed; importantly, this was true across all cultural settings that were investigated. Establishing cross-cultural and cross-ethnic factorial invariance is important because variability in the dimensionality of the SPQ may limit between-group comparisons. Thus, the series of studies presented in this thesis has provided further support for the 4-factor structure in terms of general stability; that is, measurement invariance across

studies indicated that change in the latent mean score reflected the latent variable, and not an artefact of the measurement tool. Therefore, this work enables future research to investigate valid comparisons within each cultural setting with the measurement tool.

Further, with the development of the Malay SPQ, it is hoped that schizotypal research, as well as good research practice, will be generated in Malaysia from the work presented here. While scholars have acknowledged that advancements in psychological research have been made in Asia, they have also highlighted that Asian psychology faces challenges in identity and continuing their growth into the future (Leung, 2007). One limiting factor in research generated in Asia is that researchers often use novel measures without presenting any evidence, or protocols implemented, that such measures are reliable and valid (see Swami & Barron, in press). Without this evidence, scholars must assume that their measures are valid, but have no evidence that the construct is being measured by the tool, i.e., measurement *post hoc ergo propter hoc*. Establishing that the construct is accurately being measured by the tool improves the interestingness of a piece of research and advances the quality of the data that is generated. Therefore, Study 2 has implications for schizotypal research, but may also serve as a framework for psychological research in Malaysia in general. Further, development of the Malay version of this scale allows for future investigation into the prevalence of schizotypal traits from this setting in comparison to Western sites. In practical terms, this scale may be of use to practitioners in this setting, with a lack of culturally valid clinical measures for Malaysians (see Ng, Trusty, & Crawford, 2005). This is of particular concern to cultural competence in health care. Cultural competence refers to the ability to provide healthcare to patients with varied values, beliefs, and behaviours; including, creating a health care system to the demands of patients' social, cultural, and linguistic needs (Truong, Paradies, & Priest, 2014). Therefore, the

development and evaluation of psychological tools in Malaysian will help to improve cultural competence within this setting.

In terms of the German version of the SPQ (SPQ-G), the practical importance of the findings presented here should not be underestimated. The SPQ-G has previously been operationalised through a 2-factor structure in many previous studies (e.g., Fink et al., 2014; Klein et al., 1999; Kopp et al., 2002; Nenadic et al., 2015), while here, the 4-factor solution was again endorsed by these data. This is of concern when considering the robustness of previous factorial associations of the SPQ-G in many previous investigations. In one example, Kopp et al. (2002) examined brain structural changes in the medial and lateral prefrontal cortex, and other relevant areas, with degree of schizotypy measured through the SPQ-G. Kopp and colleagues found significant positive associations between bilateral inferior and right superior frontal cortices and positive schizotypy. Without the prior investigation of the factorial structure, however, associations may be due error in the classification of factors, rather than reflect true associations.

Further, the findings from this thesis have helped characterise some of the cognitive processing deficits of schizotypy, leading to an improved understanding of these disturbances. Indeed, findings here highlight the relationship, and the processes, between positive schizotypal facets and conspiracy ideation. The studies presented here are of importance as the research has the potential to inform the schizotypal literature through multiple routes. As scholars have previously noted (e.g., Kwapil & Barrantes-Vidal, 2015), schizotypy can be viewed as a window into schizophrenia and, as such, it is hoped that the findings from Studies 4a and 4b may be of clinical use in the schizophrenia literature. While false beliefs are commonly measured through the study of schizophrenia (for reviews, see Bora, Yucel, & Pantelis, 2009; Brüne, 2005; Harrington, Siegert, & McClure, 2005), belief in conspiracy theories has not been

investigated. Therefore, the studies presented here have the potential to provide a theoretical framework for investigation in the schizophrenia literature. This is emphasised by the associations represented here between positive schizotypy and conspiracy ideation via the metacognition facet of self-certainty. Indeed, metacognitive associations with schizophrenia are well reported (for review see Moritz, 2014). Deficits in metacognition with those of a diagnosis of schizophrenia are negatively associated with quality of life, neurocognition, and poorer awareness of illness (Lysaker et al., 2005). Similarly, as the findings from Study 4b supported literature (e.g., Swami et al., 2014) by finding that priming analytic thinking reduced belief in conspiracy, this may have clinical relevence. Indeed, in the schizophrenia literature, cognitive behavioural techniques through the use explanatory destigmatisation of schizophrenia has been associated with the reduction of psychotic symptoms (e.g., Kingdon & Turkington, 1991). As such, practitioners may wish to adopt promotion of rational thinking to reduce the prevalence of false beliefs for high schizotypes.

5.3 Limitations

There are some limitations to this thesis on a global level which need to be acknowledged, as well as some specific limitations through individual studies. First, as a measure of schizotypy in all studies, only the SPQ was implemented for the measurement of schizotypy. While this provides a thorough investigation of the SPQ across many research sites, it could be viewed as a rather narrow window into schizotypy. For example, as discussed in Section 1.3, the SPQ has its roots in the clinical measurement of schizotypy (see Raine, 1991, 1994); therefore, this limits comparison with some previous research. For example, rather than serving quasi-clinical aims, the primary use of the O-LIFE has been to explore relationships with a range of preferences, behaviours, and task performances including creativity, laterality,

mentalising, and neurocognition (Mason, 2015). While, there can be some comparisons on a global schizotypy level, the main facets of schizotypy are not comparable due to different formations in theoretical scale development. Despite the SPQ having good-to-excellent construct validity (Raine, 2006), it would have been beneficial to have additional measures of schizotypy to address both the personality-based and clinical-based theoretical and measurement conceptions of schizotypy. Indeed, this would have emphasised associations made, particularly with positive schizotypy and cognitive aspects in Studies 4a and 4b.

The theoretical and practice implications from Studies 1 and 5 in this thesis are limited due to the lack of recruitment of African Caribbean participants from the UK. As such, without the control of cultural setting, inferences made with ethnicity in these studies should be made with caution. That is, mean and electrophysiological differences observed between the UK White British and the African Caribbean group may be an effect of cultural setting, rather than the effect of ethnicity. Further, in Study 5, while the cut-off groups of high and low schizotypy fell within the range used by some previous studies (e.g., Wan et al., 2008), they are not typical from previous schizotypal research. Previous research has typically used the upper and lower 10% of SPQ distributions as cut-offs for schizotypal comparison groups (e.g., Hall & Habbits, 1996). Therefore, potential atypical electrophysiological deficits that may have been observed with the participants at the higher-end of the spectrum may have been masked with scorers that are more typical.

With regards to the participant sample in Study 2, while this included the two largest ethnic groups in Malaysia, findings here may not be representative of other ethnic groups in Malaysia, such as Malaysian Indians. Further, this sample consisted of undergraduate students, thus potentially limiting generalisability to the general Malaysian population. For example, Zhang and Brenner (2016) highlighted the

importance of using both community and undergraduate samples when examining the factor structure of the SPQ; with the former favouring a 3-factor solution and the latter a 4-factor. Indeed, while inferences were made with regards to urbanicity and schizotypal scores, these are limited due to the requirement of urban grouping in the analyses, due to low numbers of participants in rural settings. Thus, a more strategic method would be for a quota sampling approach for the suburbs and provincial towns, to allow for a more sensitive measure of urbanicity. Further, due to internal consistency problems, a number of items were removed from the SPQ in this study; as such, it was not possible to have a global comparison of schizotypal ratings and measurement invariance across settings included in this thesis (namely, UK, Austria, Malaysia, and Trinidad).

While Studies 4a and 4b investigated false beliefs as an outcome of schizotypy, via the measure of belief in conspiracy theories, it is unclear whether a similar cognitive model would be held through other false beliefs, such as delusional ideation. As such, these studies were limited to a rather narrow view of false beliefs. This also extends to the measure of cognitive reasoning. For example, previous research has indicated that delusion-prone individuals are associated with an increased 'jumping-to-conclusions' style of reasoning; this is, they required less evidence before reaching a decision and expressed higher levels of certainty, in comparison to healthy control groups (Broome et al., 2007; Linney et al., 1998). In turn, jumping-to-conclusions has been associated with an increased self-certainty (Schlier et al., 2016), with the latter being suggested to have a link with conspiracist beliefs (van Prooijen, 2016). Finally, while higher order cognitive function is the focus in Study 4b, it would be of benefit to review the role of lower order cognitive function within the model. The biopsychosocial approach to investigating schizotypy in this thesis has allowed for a broad examination, although the nuance of cognitive processes, as well as the measure of false beliefs, need to be further investigated.

5.4 Conclusion

This thesis represents a biopsychosocial examination of schizotypy. Overall, the studies reported in this thesis are of importance to both the schizotypal and schizophrenia literature. In particular, this research has the potential to inform the literature through multiple routes. First, the studies (1-3) in this thesis presented an examination of the main measure of schizotypy – the SPQ – as a measurement tool for schizotypy, through ethno-cultural influences on this scale. Findings were consistent and fairly robust, with the 4-factor organisation of latent traits endorsed throughout research sites and ethnic groups. Fairly robust measurement invariance within research site was obtained, and mean group comparisons were presented. Second, these studies (4a and 4b) provided further insight into the relationship between schizotypy and one form of false beliefs; namely, conspiracy ideation. Importantly, results indicated that promotion of cognitive inferences, such as analytical thinking and self-certainty, reduced the association between positive schizotypy and conspiracy ideation. Finally, this thesis investigated whether the electrophysiological dysfunction seen in schizophrenia was held through high schizotypes, potentially emphasising the clinical approach to schizotypy. However, there were no significant electrophysiological deficits observed between high and low schizotypes. Further, cultural setting did not have an effect in electrophysiological measurements between groups. In summary, this thesis addressed both the personality (conspiracist ideation) and clinical (electrophysiological) nature of schizotypy with the basis of a measurement examination.

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