

**TURNING THE CURSE INTO A BLESSING: USING  
MINDFULNESS TO REDUCE  
SUSPICIOUSNESS/PARANOIA IN INDIVIDUALS WITH  
HIGH POSITIVE SCHIZOTYPY**

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## Abstract

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Positive schizotypy, the aspects of which include magical thinking, unusual perceptual experiences, ideas of reference and suspiciousness/paranoia, has emerged as a significant predictor of schizophrenia-spectrum disorders, with suspiciousness/paranoia regarded a key risk factor. On the other side of the coin, positive schizotypy (predominantly magical thinking/unusual experiences) is positively linked to creativity; however, mixed findings have been previously reported, which may be due to suspiciousness/paranoia having an unfavourable effect upon the relationship. Previous research has also shown that experienced mindfulness meditators have lower suspiciousness/paranoia in the presence of higher magical thinking. In *Study 1*, a general population sample of 342 participants completed an online study to investigate the interrelationship among positive schizotypy, creative experience and dispositional mindfulness. Findings indicated a significant attenuating effect of suspiciousness upon the positive relationship of magical thinking and unusual perceptual experiences with positive-affect/pleasurable flow-type creative experience. Further, higher dispositional mindfulness was significantly associated with lower suspiciousness.

The mechanism(s) which may underlie the link between positive schizotypy and creativity is presently unclear; information processing theories of schizophrenia argue that it may in part result from reduced ability to filter sensory information. Yet, decreased sensory information filtering (a more open information processing style) has also been observed in highly creative individuals, pointing to a view that reduced sensory information filtering may present both psychosis risk and creative potential. Previous research has also shown that, alongside lower suspiciousness/paranoia and higher magical thinking, experienced mindfulness meditators show attenuated sensory information filtering. To investigate whether attenuated sensory information filtering, as indexed by auditory startle habituation, mediates the relationship between positive schizotypy and creativity, a subset of 101 individuals from *Study 1* participated in *Study 2*, split into high and low-to-moderate positive schizotypy groups. Additionally, *Study 2* assessed creativity using multiple measures - both self-report and objective (lab-based) tasks. Individuals with high positive schizotypy were found to have significantly elevated scores on all aspects of creative experience, and significantly wider associative thinking style compared with individuals who had low-to-moderate positive schizotypy. However, the groups did not differ on divergent thinking performance or a subjective measure of creative personality. Suspiciousness attenuated the relationship between magical thinking and some, but not

all, dimensions of creativity. However, there were no differences between two groups in the rate of habituation and it did not mediate the positive associations between positive schizotypy and creativity.

Last but not least, *Study 3* explored mindfulness training for reducing suspiciousness/paranoia in a sub-set of individuals from *Study 2* who were high in positive schizotypy with high suspiciousness/paranoia. A pilot randomised control trial with an active control examined the feasibility, acceptability and efficacy of a 40-day online mindfulness-based intervention on trait and state (using virtual reality methodology) paranoia as compared with reflective journaling ( $N = 12$  per group). Results indicated both feasibility and acceptability (100% retention rate), with a medium-to-large effect size observed for state - but not trait – paranoid ideation in favour of the mindfulness-based intervention.

The research highlights worth in considering the multidimensionality of both positive schizotypy and creativity in future examinations of the relationship between the two, with particular attention paid to the potential influence of suspiciousness/paranoia. Additional research, using paradigms which tap into different aspects (e.g. pre-attentive vs. attentive) of sensory information filtering, is recommended for further insight into the mechanisms underlining the link between positive schizotypy and creativity. The findings are consistent with the proposal for using mindfulness to mitigate risk of psychosis development in individuals high in positive schizotypy with high suspiciousness/paranoia and provide a stepping-stone towards developing low-cost and easily accessible mindfulness-based interventions to alleviate psychosis risk whilst preserving the aspects associated with creativity, aiding the flourishing of both the individuals and the society.

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## Abbreviations

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Abbreviation	Meaning
ASH	Acoustic Startle Habituation
AUT	Alternative Uses Task
BWAS	Baron-Welsh Art Scale
CAT	Consensual Assessment Technique
CAQ	Creative Achievement Questionnaire
CPS	Creative Personality Scale
D2BP	D2 Dopaminergic Binding Potential
DASS	Depression, Anxiety and Stress Scale
DMN	Default Mode Network
ECQ	Experience of Creativity Questionnaire
EMG	Electromyography
ERP	Event Related Potential
FAST-R	Feasibility and Acceptability Support Team for Researchers
FFMQ	Five Facet Mindfulness Questionnaire
FVPS	Fenigstein Variable Paranoia Scale
HPS	High Positive Schizotypy
ICC	Intraclass Correlation Coefficient
JS	Just Suppose
K-RWA	Kent-Rosanoff Word Associations
L-MPS	Low-to-Moderate Positive Schizotypy
MBI	Mindfulness-based Intervention
O-LIFE	Oxford-Liverpool Inventory of Feelings and Experiences
O-LIFE SF	Oxford-Liverpool Inventory of Feelings and Experiences Short-Form
PPI	Pre-pulse Inhibition
PS	Positive Schizotypy
RAT	Remote Associations Task
RISC	Rust Inventory of Schizotypal Cognitions
SPQ	Schizotypal Personality Questionnaire
SPQ-B	Schizotypal Personality Questionnaire-Brief
SPSS	Statistical Package for the Social Sciences
SRC	Self-Rated Creativity
SSPS	State Social Paranoia Scale
STA	Schizotypal Personality Scale
SUS	Slater-Usch-Steed Sense of Presence Questionnaire
TTCT	Torrance Test of Creative Thinking
VR	Virtual Reality

## Chapter 1 General Introduction

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This chapter will provide a general introduction to the concepts used throughout the thesis, along with an overview of the theoretical framework and rationale upon which the research reported in the thesis is based. Following an introduction to the construct of schizotypy, including a brief overview of different approaches to its conceptualisation, it will move focus towards positive schizotypy – the dimension of primary interest to the presented research. This will include an overview of how positive schizotypy can be viewed as a multidimensional construct, and the risk for psychosis associated with higher levels of its aspects, specifically suspiciousness/paranoia. It will then shift to the potential benefits of positive schizotypy – namely, of heightened creativity. A review of studies which have investigated the positive schizotypy-creativity link will be presented, including an overview of how positive schizotypy and creativity are typically assessed. Challenges regarding the conceptualisation and measurement of creativity will be highlighted, as well as the heterogeneity of methods used in previous research that may have contributed to the inconsistency of findings. The mechanisms that may underlie the link between positive schizotypy will then be discussed; specifically, the role of a more open sensory information processing style. This mechanism has been critically implicated in aetiology of psychosis and schizophrenia, but has also been linked with a heightened creative ability.

These discussions lead to a double-edged sword view of positive schizotypy, highlighting the importance of dissociating the risks and benefits of positive schizotypy. Emphasis is placed on the importance of taking its multidimensionality into consideration, and benefits for identifying strategies to target and alleviate risk factors of positive schizotypy, allowing the beneficial aspect of creativity to flourish. In this context, an introduction to mindfulness will be made, with evidence presented for how mindfulness may not only lend itself to helping dissociate aspects of positive schizotypy, but how it may offer potential for mitigating the risks of psychosis development associated with this set of traits whilst preserving creativity. Specifically, this pertains to the reduction of suspiciousness/paranoia, whilst preserving and supporting the aspects thought to underlie heightened creativity in individuals with increased positive schizotypal traits.

## 1.1 Schizotypy

Schizotypy was first coined by Rado (1953) and Meehl (1962), and refers to schizophrenia-like characteristics found in the general population. Historically, the concept of 'schizotypy' was used to describe the phenotypic expression of '*schizotaxia*' – an integrative neural deficit influenced by a heritable '*schizogene*' (Grant et al., 2018). Different approaches to schizotypy have since been proposed; following Meehl's original conceptualisation, the idea that schizotypy could be considered subclinical expression of schizophreniform symptoms is encapsulated within a quasi-dimensional approach. This approach posits that psychosis lies on a continuum (Claridge and Beech, 1995; Grant et al., 2018) with schizotypy existing on a spectrum of disorder severity (with schizophrenia at the extreme end of the scale; Grant et al., 2018). This approach considers schizotypy as schizophrenia-liability, rather than a healthy personality trait normally distributed in the general population.

An alternative, fully-dimensional model has since been developed; whilst encompassing the quasi-dimensional approach, this interpretation considers varying levels of schizotypy in the context of a normal and adaptive multidimensional set of personality traits, which can exist free of disorder and schizophrenia-liability (Claridge, 1997). However, it is argued that although high levels of schizotypal traits do not invariably lead an individual to develop schizophrenia-related disorders, schizotypy may still reflect a latent disposition to schizophrenia rather than a completely benign personality trait (Kwapil & Barrantes-Vidal, 2015; Lenzenweger, 2015). This ties in with the view posited by Claridge (1997), that schizotypy can describe both healthy variations in the population *and* a predisposition to psychosis.

Overall, most evidence points to a three-factor structure of schizotypy, corresponding to the symptom dimensions of schizophrenia: positive (hallucinations, ideas of reference, magical thinking, and paranoid ideation), negative (social anhedonia, blunted affect) and cognitive disorganisation (odd speech and behaviours; Mason et al., 1997; Mohr & Claridge, 2015; Nelson et al., 2013,).

## 1.2 Positive schizotypy

There is evidence that the dimension of positive schizotypy (reflecting the positive symptoms of schizophrenia and related to psychotic-like experiences), can uniquely predict later emergence of psychotic disorders in the general population (Chapman et al., 1994; Debbané, 2015; Kwapil et al., 2013). Like schizotypy, positive schizotypy itself has been identified as being multidimensional, and is generally agreed to consist of



several aspects (as conceptualised by Raine, 1991, following DSM-III-R Criteria; American Psychiatric Association, 1987):

- *Magical Thinking* - the tendency to believe in the supernatural; for instance, that unrelated events are causally connected without a clear evidence of a link between them.
- *Unusual Perceptual Experiences* - anomalous experiences, such as hallucinations.
- *Ideas of Reference* - the tendency to attribute personal significance upon unrelated, external events.
- *Suspiciousness/Paranoia* - an inclination to distrust others and their motives, a belief of malevolence of others.

In line with the fully-dimensional model and Claridge's view (1997), whilst positive and psychotic-like experiences demonstrate predictive validity for psychotic disorders, they are also found to be common in the general population and can be transient in nature, without leading to a 'full-blown' psychosis (van Os, 2009).

The aspect of suspiciousness/paranoia has surfaced as a key risk factor in the development of schizophrenia-spectrum disorders: not only is paranoia common in populations at high risk for psychosis (Salokangas et al., 2013), but prospective studies reported high levels of suspiciousness/paranoia to have significant predictive power for psychosis onset in high-risk individuals (Cannon et al., 2008; Wilcox et al., 2014). Indeed, a distinguishing feature of individuals experiencing psychotic-like symptoms with need for care is the tendency for paranoid or threatening appraisals toward anomalous experience (Lovatt et al., 2010; Peters et al., 2017; Ward et al., 2014). High levels of traits such as unusual beliefs or experiences may not be pathological *per se* (Lynn et al., 1996), but the addition of suspiciousness/paranoia may introduce the risk of distress and psychopathological outcomes for individuals high on such traits. This reflects the concept of 'benign' or 'healthy' schizotypy (Jackson, 1997), distinguished by high levels of positive schizotypy, such as unusual experiences and beliefs (for example, belief in the paranormal; Holt et al., 2008) when occurring within a healthy and adaptive cognitive framework (Mohr & Claridge, 2015), including lower negative (e.g., social anhedonia) and disorganised symptomology.

### **1.3 Positive schizotypy and creativity**

Another side of the coin is that positive schizotypal traits have been associated with enhanced creativity - a highly advantageous trait to both society and the individual.

The link between positive schizotypy and creativity has gained considerable interest over the years as a possible evolutionary explanation for the schizophrenia phenotype remaining in the population (O'Reilly, Dunbar & Bentall, 2001). Healthy relatives of individuals with schizophrenia and individuals with higher polygenic risk for schizophrenia are more likely to engage in creative professions and artistic society membership (Heston & Denney, 1968; Kyaga et al., 2011; Power et al., 2015), whilst showing higher levels of schizotypy compared to the general population (Kinney et al., 2001) including positive schizotypy (Kremen et al., 1998, Vollema et al., 2002; Yaralian et al., 2000). Positive schizotypy has also been found to distinguish artists from non-artists (Burch et al., 2006) and predict 'flow' state (conducive to creativity), art-making and positive affect during artistic engagement (Holt, 2019; Nelson & Rawlings, 2010).

In contrast to their healthy relatives, individuals with a diagnosis of schizophrenia are less likely to have professions in a creative field (Kyaga et al., 2011). This could be due to the severity of negative symptoms, introducing functional impairments (Jaracz et al., 2012). For example, Nettle (2006) found that both healthy artistic individuals and individuals with psychiatric disorders shared distinctive positive-symptom traits (such as unusual thinking and experiences), but the creative group was distinguished by an absence of negative symptomology. This reflects an inverted U-curve relationship between creativity and schizophrenia-like personality (Acar et al., 2018; Kinney et al., 2001), wherein higher than average levels of schizotypy associate with greater creative ability, but this relationship diminishes with more severe expressions of features in people with schizophrenia. In non-clinical populations, the apparent creative advantage is observed for positive schizotypy, with the negative and disorganised dimensions inversely relating to creativity (Acar & Sen, 2013).

#### **1.3.1 Assessing the link between positive schizotypy and creativity**

##### **1.3.1.1 Assessments of positive schizotypy**

Some of the most widely used measures to assess schizotypy in the general population are the Chapman scales (Perceptual Aberration Scale; Chapman et al., 1995; Magical Ideation Scale; Eckblad & Chapman, 1983), Schizotypal Personality Questionnaire (SPQ; Raine, 1991) and Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason et al., 1995; Mason & Claridge, 2006). Whilst these assessments typically

tap into the three factors of schizotypy (Raine, 2006) - with the exception of the O-LIFE, which encapsulates a fourth, impulsive nonconformity factor - they differ in their conceptualisation of positive schizotypy. A key difference between the measures is the inclusion of a suspiciousness/paranoia subscale included as an aspect of positive schizotypy. For example, the SPQ contains a distinct subscale for this aspect, whereas others do not and focus largely on magical ideation and perceptual aberrations/unusual experiences (e.g., O-LIFE, Chapman scales) as being indicative of positive schizotypy.

#### **1.3.1.2 Current conceptualisation and assessments of creativity**

Creativity is difficult to define and assess, and an agreement has not yet been made regarding its conceptualisation and measurement. It is generally accepted that creative ability should lead to the production of something novel, original, meaningful and/or useful (Batey & Furnham, 2008). The consensus at present is that creativity (or creative *potential*) is best measured through domains by which creativity is thought to be fostered (such as creative thinking processes, products and personal factors; Cropley, 2000). However, there are several domains of creativity and a large variety of assessments available to tap into them.

Beyond assessing schizotypy in creative populations (e.g., artists), objective creativity tasks have been designed to test aptitude in creative domains, such as divergent/flexible thinking, which often follow the view of creativity as the ability to think fluently (number of ideas), flexibly (across different categories), originally (uniqueness of ideas) and elaboratively (extension and development of ideas). Others use convergent thinking or insight problem solving tasks, which tap into creative aptitude as an ability to find 'correct' solutions to a given problem. These tasks assume that the correct solution can be more easily found by an individual able to generate and converge many different ideas in order to find a correct solution (Mednick, 1962). Similar but distinct processes of free associative thinking style (not requiring a narrowing of ideas to find a 'correct' solution to a problem) is indicative of a wider spread of semantic networks (enabling generation of divergent ideas; Kenett et al., 2014), and is also suggestive of creative thinking style. Self-report measures are also widely used for assessing creativity (e.g., creative achievement or personality scales).

Given the lack of a standard, agreed-upon assessment of creativity, and the expanse of possible combinations of measures and scales for assessing both creativity and positive schizotypy, the replicability and reliability of results of empirical studies can be problematic. Indeed, despite the overall evidence for positive schizotypy uniquely driving the schizotypy-creativity relationship in comparison to negative and disorganised

schizotypy (Acar & Sen, 2013), the findings of individual studies using formal creativity tasks are not uniform. To overcome limitations of investigating creativity in psychopathology, it has been recommended that studies should utilise the four 'P's of creativity (Thys et al., 2014): *Person* (e.g., creative personality traits), the cognitive *Process* involved in creative production (e.g., divergent thinking; flexible, open and wide associational thinking style), the *Product* (e.g., a new or original idea, or its quality), and the *Place/Press* (environment) conducive to creativity.

### **1.3.2 Review of studies assessing the creativity and positive schizotypy relationship**

For an evaluation of the assessment methods of creativity and positive schizotypy in psychopathology research, along with patterns of results across previous literature, a comprehensive search of literature was conducted. Using the electronic databases Emabase (OvidSP), PsychInfo (OvidSP), Web of Science and PubMed (NCBI), 45 peer-reviewed articles examining the relationship between positive schizotypy and creativity using formal measures were identified using the following criteria:

- i. provides data on the direct relationship between positive schizotypy and aspects of creativity;
- ii. uses a formal assessment of creativity (i.e., not just using a sample of creative individuals);
- iii. uses a formal, validated self-report measure of positive schizotypy;
- iv. is written in the English language;
- v. reveals behavioural data (i.e., not just mechanisms identified to be implicated in creative processes, as measured by neuropsychological methods);
- vi. uses adult sample (age >18), as the assessment of creativity can differ between adults and children (Thys et al., 2014).

*Exclusion criteria* were:

- i. essays, reviews, case studies, conference abstracts and PhD theses;
- ii. studies that only used clinical samples or sample of individuals with psychopathologies or mental disorder (e.g., individuals schizophrenia-spectrum disorders, bipolar) without providing data specific to healthy comparison groups;
- iii. studies that included a manipulation (e.g., drug administration) which do not additionally provide data on the positive schizotypy-creativity relationship at baseline;

- iv. peer-reviewed articles for which full text was not available.

The articles included in the final review are presented in Table 1.1. Following the methods of Thys et al (2014), the current review will use the four creative 'Ps' as a guideline for the reporting of the creative measures used throughout the studies.

### **Assessment of positive schizotypy**

The most widely used measure of positive schizotypy in the reviewed papers was the *Unusual Experiences* subscale of the Oxford-Liverpool Inventory of Feelings and Experiences (22 studies [49%]; or O-LIFE Short Form; Mason et al., 1995; Mason et al., 2005), followed by the positive schizotypy dimension (a total of four subscale scores including *Magical Thinking*, *Unusual Experiences*, *Suspiciousness*, and *Ideas of reference*) of the Schizotypal Personality Questionnaire (11 studies [24%]; or SPQ-Brief, German or Likert-Scale SPQ; Raine, 1991; Raine & Benishay, 1995; Klein et al., 1997; Wuthrich & Bates, 2005). One or both of the Chapman Scales for *Magical Ideation* (Eckblad & Chapman, 1983) and *Perceptual Aberration* (Chapman et al., 1995) were used in 9 studies (20%); two implemented the Schizotypal Personality Scale as a measure of positive schizotypy (STA; Claridge and Broks, 1984) and one study used the Rust Inventory of Schizotypal Cognitions (RISC; Rust, 1988).

**Table 1.1.** Details of the reviewed studies.

Schizotypy Measure	Measured Subjective/Objective	Author	Sample M/F	Creativity Measure(s)	Creativity Dimension	Creative 'P'	Task/Measure type	Analysis	Result
<b>Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE;</b> Mason, Claridge & Jackson 1995) Or <b>O-LIFE Short Form</b> (Mason, Linney & Claridge, 2005)  Positive Schizotypy subscale: Unusual Experiences (UnEx) Scale	Subjective Only	MacPherson & Kelly (2011)	Total $N = 415$ $n = 222$ Creative (scientists) $n = 193$ General Population	Creative Personality Scale (CPS; Gough, 1979)	Trait/Personality	PERSON	Adjective Selection	<b>Correlation</b> between O-LIFE-SF UnEx and CPS:	Scientists: + CPS ( $r = .55, p < .001$ )  General population: Ns CPS
		Nettle & Clegg (2006)	Total $N = 425$ (M 156/F 269) $n = 186$ Creative (visual artists, poets) $n = 239$ General Population	Creative Production/Activity Questionnaire (Authors own)	Behaviour	PERSON	Self-reported Activities	<b>Path Analysis</b> between O-LIFE UnEx and overall creative activity (Total Sample):	+ UnEx sig. effect on creative activity ( $\beta = .28, p < .05$ )
		Nelson & Rawlings (2010)	$N = 100$ Creative (musicians, visual artists, writers, theatre, photography, sculpture)	Experience of Creativity Questionnaire Part A (ECQ; Nelson & Rawlings, 2009)	Phenomenology	PROCESS	Ratings for 5 aspects of creative experience	<b>Correlation</b> between O-LIFE UnEx and ECQ Part A subscales:  <i>Note: Factor analysis of UnEx yielded a 2-factor structure (unusual beliefs, unusual perceptions). Correlations found for these factors with ECQ Part A were comparable to the results reported here.</i>  <b>Stepwise Regression</b> with UnEx and Personality factors to predict ECQ Part A subscales:	+ Distinct Experience ( $r = .48, p < .001$ ) + Anxiety ( $r = .37, p < .001$ ) + Absorption ( $r = .26, p < .01$ ) + Power/Pleasure ( $r = .39, p < .001$ ) Ns Clarity/Preparation  UnEx scores were predictive of: + Distinct Experience ( $\beta = .48, p < .001$ ) + Anxiety ( $\beta = .31, p < .01$ ) + Absorption ( $\beta = .29, p < .01$ )

							+ Power/Pleasure ( $\beta = .44, p < .001$ ) Ns Clarity/Preparation
Batey & Furnham (2008)	N = 140 General Population	1) Self-Rating of Creativity (SRC; Batey, 2007)  2) Creative Personality Scale (CPS; Gough, 1979)  3) Biographical Inventory of Creative Behaviours (BICB; Batey, 2007)	Trait/Personality   Behaviour	PERSON	Self-report ratings of creativity (Likert-Scale descriptive items)  Adjective Selection  Self-reported Activities	<b>Correlations between O-LIFE UnEx and total creativity score:</b>  <b>Correlations between O-LIFE UnEx and each creativity measure:</b>  <b>Hierarchical Regressions of O-LIFE UnEx on each creativity measure:</b>	+ Total Creativity ( $r = .29, p < .01$ )  + SRC ( $r = .26, p < .01$ ), + BICB ( $r = .26, p < .01$ ), Ns CPS  All overall models were sig., with:  UnEx sig. predicting: + SRC ( $\beta = .23, p < .05$ ) + BICB ( $\beta = .26, p < .01$ ) + Total creativity ( $\beta = .26, p < .01$ )
Kéri (2011)	N = 111 (M65/F46) General Population	Creative Achievement Questionnaire (CAQ; Carson, Peterson & Higgins, 2005)	Achievement	PLACE/PRESS	Self-reported Recognition/ Meaningful accomplishments	<b>Correlations between O-LIFE UnEx and CAQ total Score:</b>  <b>Multiple Regression between OLIFE and CAQ:</b>	+ CAQ ( $r = .22, p < .05$ )  Overall model = Ns, however:  + UnEx sig. predicted CAQ scores ( $\beta = .23, t = 2.31, p < .05$ )
Objective Only	Rawlings & Locarnini (2008)	N = 64 (M33/F31)  Creative (visual artists, musicians, biological scientists, physical scientists/math ematicians)	Associative Processing	PROCESS	Free word associations (no 'correct' solution)	<b>Correlations between O-LIFE-SF UnEx and word associations (Total sample):</b>  <b>ANCOVA Creative subgroups:</b> Group effects for UnEx (controlling for age and gender):	+ Common Responses ( $r = -.30^*, p < .05$ ) + Unusual Responses ( $r = .25, p < .05$ ) Opposites - ( $r = .28, p < .05$ )  Visual Artist & Musicians sig. higher on UnEx than all Scientists. ( $p < .01$ )

Claridge & McDonald (2009)	N = 77 (M33/F44) Creative (scientists) and General Population	1) Wallach-Kogan Divergent Thinking Battery (Wallach & Kogan, 1965) Sub-tests: i) Similarities ii) Pattern Meanings  2) Missionaries & Cannibals (Garnham & Oakhill 1994)  3) Tower of Hanoi (Garnham & Oakhill, 1994)	Divergent Thinking   Convergent Thinking	PROCESS	Identify similarities between objects, Interpret patterns   Problem Solving, find correct solution	<b>Correlations between</b> O-LIFE UnEx and composite originality score across divergent thinking tasks; and convergent thinking composite scores (number of legal, illegal, total moves and time take; Total sample):	Ns
Winston, Tarkas & Maher (2014)	N = 130 General Population	Wallach-Kogan Divergent Thinking Battery (DTB); Indian Adaption (Wallach & Kogan, 1965; Paramesh, 1971) Sub-tests: i) Instances ii) Alternate Uses iii) Similarities	Divergent Thinking	PROCESS, PRODUCT	Free Associational Generate alternative uses for objects Identify similarities between objects	<b>Correlations between</b> O-LIFE-SF UnEx and composite Fluency, Flexibility, Originality and Elaboration scores across tasks on the DTB:	+ Originality ( $r = .18, p = .047$ ) + Flexibility ( $r = .19, p = .028$ ) Ns Fluency Ns Elaboration



Rawlings & Georgiou (2004)	N = 170 General Population	1) Origence Scale (Welsh Figure Preference Test; Welsh, 1987)  2) Aesthetic Preference Test (APT; Author's own, based on Munsinger & Kessen, 1964)	Trait/Personality	PERSON	Figure preference (Like/Dislike)	<b>Correlations between O-LIFE-SF UnEx and Origence Scale factors:</b>  <b>Correlations between O-LIFE-SF UnEx and APT indices and factors:</b>	+ Geometric Figures ( $r = -.22, p = .006$ )*  + Preference for Complex ( $r = .25, p = .002$ ) + UnEx/Simple asymmetrical polygons ( $r = -.26, p < .01$ ) (Lower scores indicate higher creativity)
Rybakowski & Klonowska (2011)	Total N = 88 n = 48 General Population (n = 40 bipolar patients)	1) Barron-Welsh Revised Art Scale (BW-RAS; Barron & Welsh, 1952)  2) 'Inventiveness' test of the Berlin Intelligence Structure Test (BIS; Jager et al., 1997)	Trait/Personality	PERSON, PROCESS	Figure preference (Like/Dislike)	<b>Correlations between O-LIFE UnEx and BW-RAS (Like, Dislike, Total; Results for general population sample only):</b>  <b>Correlation between O-LIFE UnEx and BIS:</b>	Ns  Ns
Wang, Xu, Wang, Healey, Su & Pang, (2017)	N = 74 General Population	(Tasks adapted from TTCT; Torrance, 1968):  i) Alternate Uses Task (AUT) ii) Figure Completion Task iii) Tangram Construction; Story Generation (Domino, 1980)	Divergent Thinking  Combined divergent and convergent thinking	PROCESS, PRODUCT	Generate alternative uses for objects  Complete/Extend abstract lines into picture  Figure (tangram) Construction; Story generation using target words	<b>Correlations between O-LIFE UnEx and TTCT sub-tasks (High Schizotypy Group):</b>	AUT: Ns Fluency Ns Flexibility Ns Originality  Figure Completion: + Elaboration ( $r = .48, p = .003$ ); but Ns after Bonferroni correction; ( $p = .09$ )  Ns Tangram Construction

	Abu-Akel Webb, de Montpellier, Von Bentivegni, Luechinger, Ishii & Mohr (2020)	N = 142 General Population	1) Alternative Uses Task (from Wallach & Kogan, 1965)  2) Anagrams (Authors' own)	Divergent Thinking  Convergent Thinking	PROCESS, PRODUCT	Generate alternative uses for objects  Unscramble letters to find correct solution	<b>Correlations between O-LIFE UnEx and Creativity tasks:</b>      <b>Linear regressions: UnEx as a predictor for creative performance:</b>	Ns Story Generation AUT: + Fluency ( $r = .25, p < .01$ ) + Originality ( $r = .26, p < .01$ ) + Unique ( $r = .19, p < .05$ ) Ns Anagrams  AUT: + Fluency ( $\beta = 3.13, p < .05$ ) + Originality ( $\beta = 4.17, p < .01$ )  Ns Anagrams
Subjective and Objective	Michalica & Hunt (2013)	Total N = 72 n = 31 Creative (visual artists) n = 31 General Population	<u>Subjective:</u> Self-Rated Measure of Creativity (SRC; Author's own)  <u>Objective:</u> Barron-Welsh Art Scale (BWAS; Barron & Welsh, 1952)	Behaviour Trait/Personality  Figure Preference	PERSON	Self-rated Hobbies/ Beliefs  Figure preference (Like/Dislike)	<b>Correlation between O-LIFE UnEx, total SRC and BWAS (general population sample only):</b>  <b>Group effects on O-LIFE UnEx scores:</b>	+ SRC ( $r = .30, p < .01$ ) + BWAS ( $r = .20, p < .05$ )  + Artists sig. higher than general population ( $p = .045$ )
	O'Reilly, Dunbar & Bentall (2001)	Total N = 100 n = 50 Creative (M17/F33) (contemporary arts students) n = 50 general (M28/F22)	<u>Subjective:</u> The Lifestyle Questionnaire (LQ; Author's own).  <u>Objective:</u> TTCT Subtasks (Torrance 1974) i) 'Just Suppose' (JS) ii) Picture Construction (PC)	Behaviour  Divergent Thinking	PERSON, PROCESS, PRODUCT	Self-reported Activities  Consequences; Complete/Extend abstract lines into picture	<b>Correlations between O-LIFE UnEx and TTCT sub-tasks (Total Sample):</b>      <b>PC:</b>	JS: + Originality ( $r = .28, p < .005$ ) + Flexibility ( $r = .20, p < .05$ ) + Fluency ( $r = .20, p < .05$ )  PC: + Originality ( $r = .26, p < .01$ ) Ns Flexibility  <b>(All Ns after adjusting for group).</b>

**Multiple Regressions** for O-LIFE UnEx on each TTCT sub-task: Only UnEx subscales scores were predictive:  
+ JS Originality ( $\beta = 0.28$ ,  $p < .005$ )  
+ JS Flexibility ( $\beta = 0.20$ ,  $p < .05$ )  
+ JS Fluency ( $\beta = .20$ ,  $p < .05$ )  
+ PC Originality ( $\beta = 0.27$ ,  $p < .01$ )

**(All Ns after group entered regression)**

**Multiple Regressions** for O-LIFE UnEx on LQ scores: Only UnEx sig. predictive:  
+ Verbal Arts ( $\beta = .20$ ,  $p < .05$ )

**(Retained after group entered into regression)**

**Group effects** for O-LIFE UnEx: + Arts students sig. higher on UnEx than general population sample.  
( $F(1,96) = 8.92$ ,  $p < .001$ )

Polner, Nagy & Kéri,(2015)	N = 19 General Population	<u>Subjective:</u> Creative Achievement Questionnaire (CAQ; Carson, Peterson & Higgins, 2005)	Achievement	PLACE/ PRESS, PROCESS, PRODUCT	Recognition/ Meaningful accomplishment	<b>Correlations</b> between O-LIFE UnEx and CAQ:	Ns
		<u>Objective:</u> 1) TTCT subtask 'Just Suppose' (JS; Torrance, 1974) 2) Letter Fluency Task (F-A-S; Spreen & Benton, 1977)	Divergent Thinking		Consequences; fluency/number of correct responses	<b>Correlations</b> between O-LIFE UnEx and F-A-S (fluency):  <b>Correlations</b> between O-LIFE subscales and JS:	Ns  Ns Fluency Ns Flexibility Ns Originality
Claridge & Blakey, (2009)	Total N = 78 n = 47 Science students	<u>Subjective:</u> Creativity Styles Questionnaire-Revised (CSQ-R;	Behaviour Traits/ Personality	PERSON, PROCESS, PRODUCT	Self-report creative strategies and beliefs	<b>Correlations</b> between O-LIFE-SF UnEx subscales and CSQ-R	+ Global Creativity ( $r = .307$ , $p < .01$ ) + Belief in Unconscious Processes

	<i>n</i> = 8 Social science <i>n</i> = 23 Humanities students	Kumar, Kemmler & Riley-Holman, 1997)  <u>Objective:</u> Wallach-Kogan Test Battery (1965) subtasks: i) Pattern Meanings ii) Alternate Uses	Divergent Thinking		Interpret patterns; Generate alternative uses for objects	<i>subscales (Total sample):</i>  ( <i>r</i> = .547, <i>p</i> < .01) + <i>Use of Techniques</i> ( <i>r</i> = .356, <i>p</i> < .05) + <i>Environmental Control</i> ( <i>r</i> = .293, <i>p</i> < .01) + <i>Use of the Senses</i> ( <i>r</i> = .384, <i>p</i> < .01) Ns <i>Use of Other People</i> Ns <i>Final Product Orientation</i> Ns <i>Superstition</i>	
						<b>Correlations between O-LIFE UnEx and divergent thinking tasks:</b>  Pattern Meanings: Ns Fluency, Ns Originality  Alternate Uses: Ns Fluency, Ns Originality	
						<b>Group effects on O-LIFE UnEx</b>  Ns	
Burch, Hemsley, Corr & Pavelis (2006)	<i>N</i> = 100 General Population	<u>Subjective:</u> Creative Personality Scale (CPS; Gough, 1979)  <u>Objective:</u> Wallach-Kogan Test Battery (1965) subtasks i) Instances ii) Alternate Uses (AU)	Trait/Personality  Divergent Thinking	PERSON, PROCESS, PRODUCT	Adjective Selection  Instances of a concept Generate alternative uses for objects	<b>Correlations between O-LIFE UnEx and CPS:</b>  <b>Correlations between O-LIFE UnEx and divergent thinking tasks:</b>	Ns  Instances: - Fluency ( <i>r</i> = -.23, <i>p</i> < .05) Ns Originality  Alternate Uses: Ns Fluency Ns Originality
Meyersburg, Carson, Mathis & McNally (2014)	<i>N</i> = 106 General Population and Creative Professionals	<u>Subjective:</u> 1) Creative Achievement Questionnaire (Carson et al., 2005)  2) Creative Personality Scale (Gough, 1979)	Achievement  Trait/Personality	PLACE/ PRESS, PERSON, PROCESS, PRODUCT	Recognition/ meaningful accomplishment	<b>Correlations between O-LIFE UnEx and Total (composite) Creativity Score:</b>	+ ( <i>r</i> = .22, <i>p</i> = .03)

		<u>Objective:</u> TTCT: i) Alternative Uses ii) Consequences iii) Instances	Divergent Thinking		Instances/ consequences of a concept Generate alternative uses for objects		
Baas, Nijstad, Koen, Boot & De Dreu, (2020a)	N = 147 General Population	<u>Subjective:</u> Creative Achievement Questionnaire (CAQ; Carson et al., 2005)	Achievement	PLACE/ PRESS, PROCESS, PRODUCT	Recognition/ meaningful accomplishment	<b>Correlation between</b> O-LIFE UnEx and CAQ:	+ ( $r = .25, p < .01$ )
		<u>Objective:</u> Alternate Uses Task (Guilford, 1967)	Divergent Thinking		Generate alternative uses for objects	<b>Correlation between</b> O-LIFE UnEx and Total (composite) Creativity Score:	+ ( $r = .22, p < .01$ )
Baas, Nijstad, Koen, Boot & De Dreu, (2020b)	N = 339 General Population	<u>Subjective:</u> 1) Janssen Creativity Scale (Janssen, 2001)	Behaviour	PERSON, PLACE/ PRESS, PROCESS, PRODUCT	Self-report creative engagement; Recognition/ meaningful accomplishment	<b>Correlation between</b> O-LIFE UnEx and creative behaviour (Janssen Creativity Scale):	+ ( $r = .16, p < .05$ )
		2) CAQ (Carson et al., 2005)	Achievement			<b>Correlation between</b> O-LIFE UnEx and CAQ:	+ ( $r = .16, p < .05$ )
		<u>Objective:</u> Alternative Uses Task (Guilford, 1967)	Divergent Thinking		Generate alternative uses for objects	<b>Correlation between</b> O-LIFE UnEx and Total (composite) creative ideation:	Ns
Baas, Nijstad, Koen, Boot & De Dreu, (2020c)	N = 239 General Population	<u>Subjective:</u> 1) Janssen Creativity Scale (Janssen, 2001)	Behaviour	PERSON, PLACE/ PRESS, PROCESS, PRODUCT	Self-report creative engagement	<b>Correlation between</b> O-LIFE UnEx and creative behaviour (Janssen Creativity Scale):	Ns
		2) Creative Achievement Questionnaire (CAQ; Carson et al., 2005)	Achievement		Recognition/ meaningful accomplishment	<b>Correlation between</b> O-LIFE UnEx and CAQ:	Ns

				<u>Objective:</u> Alternative Uses Task (Guilford, 1967)	Divergent Thinking		Generate alternative uses for objects	<b>Correlation between</b> <i>O-LIFE UnEx and Total (composite) creative ideation:</i>	+ ( $r = .18, p < .01$ )
		Polner, Simor & Kéri, (2018)	N = 182 General Population	<u>Subjective:</u> Creative Achievement Questionnaire (CAQ; Carson et al., 2005)	Achievement	PLACE/ PRESS, PROCESS, PRODUCT	Recognition/ meaningful accomplishment	<b>Correlations between</b> <i>O-LIFE UnEx and CAQ</i>	Ns
				<u>Objective:</u> 1) 'Just Suppose' (TTCT, Torrance, 1974)	Divergent Thinking		Provide as many ideas as possible; Find the linking word which links target words (correct solution)	<b>Correlations between</b> <i>O-LIFE UnEx and 'Just Suppose' Task</i>	Ns Fluency Ns Originality Ns Judge-rated overall 'creativity'
				2) Compound Remote Associate problems (CRA; Bowden & Jung- Beeman, 2003)	Convergent Thinking			<b>Correlation between</b> <i>O-LIFE UnEx and Remote Associations task</i>	Ns
								<b>Linear Regression of</b> <i>O-LIFE UnEx as a predictor of Creativity</i>	+ CAQ ( $\beta = .03, p = .03$ ) Ns Just Suppose Ns Remote Associations
<b>Schizotypal Personality Questionnaire</b> (SPQ; Raine, 1991) or <b>SPQ- Brief</b> (Raine & Benishay, 1995), <b>SPQ- Brief Revised</b> (Cohen, Matthews, Najolia & Brown, 2010), <b>German Scale</b> (Klein et al., 1997), <b>Likert Scale</b> (Wuthrich & Bates, 2005)	Subjective Only	Beaussart, Kaufman & Kaufman (2012)	N = 708 (M 105/F 603)  General Population	Modified Adapted Creative Activities and Interests Checklist (Griffin & McDermott, 1998)	Behaviour/Intere sts	PERSON	Self-reported creative activities	<b>Multiple Regressions</b> <i>for SPQ-B PS on self- reported overall creative activity: (Visual arts; Literary arts; Performing arts; Scientific).</i>	Total Sample: + ( $\beta = 15, p < .001$ ) Males only: + ( $\beta = .24, p < .05$ ) Females only: + ( $\beta = 13, p < .001$ )  (Controlled for age, marital status and income)
	Objective Only	Fink, Weber, Koschutnig, Benedek, Reishofer, Ebner, Papousek & Weiss (2014)	N = 41 General Population	Alternate Uses Task (AUT; Guilford, 1967)	Divergent Thinking	PRODUCT	Generate alternative uses for objects	<b>Correlations between</b> <i>SPQ PS and AUT scores</i>	Ns Originality

Positive Schizotypy Subscale:  Magical Thinking; Unusual Perceptual Experiences; Ideas of Reference; Suspiciousness/ Paranoid Ideation.	Minor, Firmin, Bonfils, Chun, Buckner & Cohen (2014)	N = 148 General Population	Alternate Uses Task (AUT; Guilford, 1967)	Divergent Thinking	PROCESS, PRODUCT	Generate alternative uses for objects	<b>T-tests: Group effects of SPQ-BR PS vs Non-schizotypy on AUT:</b>	PS sig. higher scores than Non-Schizotypy: + Originality ( $t = 2.08$ , $p = .04$ ); + Fluency ( $t = 2.06$ , $p = .04$ ); + Flexibility ( $t = 2.75$ , $p = .01$ )
							<b>T-tests: Group effects of SPQ-BR Positive vs Negative schizotypy on AUT:</b>	PS sig. higher scores than Negative Schizotypy: + Originality ( $t = 2.34$ , $p = .02$ ); + Flexibility ( $t = 2.37$ , $p = .02$ ) Ns Fluency
							<b>Correlations between SPQ-BR PS and AUT:</b>	+ Originality ( $r = 0.24$ , $p < .01$ ) + Fluency ( $r = .19$ , $p = .03$ ) + Flexibility ( $r = .23$ , $p < .01$ ).
							<b>Regressions for SPQ-B PS on AUT: (Cannabis use also entered into model)</b>	+ Originality ( $\beta = .20$ , $p < .05$ ) + Flexibility ( $\beta = .21$ , $p < .05$ ) Ns Fluency (Cannabis did not account for any significant variance)
	Dinn, Harris, Aycicegi, Greene & Andover (2002)	N = 103 General Population	1) Alternate Uses Task (AUT; Guilford, 1967)	Divergent Thinking	PROCESS	Generate alternative uses for objects	<b>ANOVA comparing high, median and low SPQ-B PS on AUT:</b>	Ns differences between groups for fluency.
	Rominger, Papousek, Fink & Weiss (2014)	N = 40 General Population	Picture Completion Task (from TTCT; Torrance, 1966)	Divergent Thinking	PROCESS, PRODUCT	Complete/extend abstract lines to create image	<b>Correlations between SPQ PS and Composite Picture Completion Task score (baseline):</b>	Ns

Rominger, Weiss, Fink, Schuster & Papousek, (2011)	N = 106 General Population	Bridge-the-Associative-Gap (Gianotti et al., 2001)	Associative Processing	PROCESS	Bridge associative gap between two words (no 'correct' solution)	<b>Correlation</b> between SPQ PS and frequency of unique associations to unrelated word pairs:	+ ( $r = .21, p < .05$ )
Rominger, Fink, Weiss, Bosch & Papousek, (2017)	N = 46 General Population	1) Alternate Uses Task (Guilford, 1967)  2) Verbal Fluency (German Verbal Creativity Test; Schoppe, 1975)  3) Picture Completion Task (From TTCT; Torrance, 1966)  4) Bridge-the-associative-gap (Gionatti et al., 2001)  5) Inkblot test (Drey Fuchs, 1958)	Divergent Thinking    Associative processing	PROCESS, PRODUCT	Generate alternative uses for objects   Complete/Extend abstract lines into picture  Bridge associative gap between two words (no 'correct' solution)  Interpret abstract image	<b>Correlations</b> between SPQ PS and Composite Creativity Scores   <b>Correlations</b> between PS and associative thinking tasks:	+ ( $r = .34, p < .05$ )   Ns Bridge-the-associative-gap:  + Inkblot Test: Common associations ( $r = -.29, p = .05$ ; (fewer common associations indicative of creativity)  Number of associations: Ns Bridge-the-associative-gap  Ns Inkblot test
Stamatis & De Mamani, (2020)	N = 536 General Population	1) Unusual Uses Task (UUT, Torrance, 1966)  2) Remote Associates Test (RAT; Mednick, 1962)	Divergent Thinking  Convergent Thinking	PROCESS, PRODUCT	Generate alternative uses for objects  Find the linking word which links target words (correct solution)	<b>Preliminary Correlations</b> Between SPQ PS aspects and UUT	Magical Thinking: Ns (Fluency, Flexibility, Originality, Elaboration)  Unusual Experiences: Ns (Fluency, Flexibility, Originality, Elaboration)  Ideas Of Reference: + Elaboration ( $r = .14, p < .01$ ) + Originality ( $r = .14, p < .01$ ) + Fluency ( $r = .14, p < .01$ ) + Flexibility



								( $r = .11$ $p < .01$ )
								Suspiciousness: Ns (Fluency, Flexibility, Originality, Elaboration)
							<b>Preliminary Correlations</b> Between SPQ PS aspects and RAT	- Magical Thinking ( $r = -.13$ , $p < .05$ ) Ns Unusual Experiences Ns Ideas Of Reference Ns Suspiciousness
							<b>Linear Regressions:</b> SPQ PS (overall) as a predictor of divergent thinking (combined measures)	+ ( $\beta = .23$ , $p = .04$ )
							<b>Linear Regressions:</b> PS (overall) as a predictor of convergent thinking (RAT)	Ns
Subjective and Objective	Gibson Folley & Park (2009)	Total $N = 40$ $n = 20$ Creative (musicians) $n = 20$ General Population	<u>Subjective:</u> Creative Personality Questionnaire (CPS; Gough, 1979)  <u>Objective:</u> 1) Remote Associates Task (RAT; Mednick, 1962)  2) Divergent Thinking Task (DTT; Folley & Park, 2005)	Trait/Personality   Convergent Thinking  Divergent Thinking	PERSON, PROCESS	Adjective Selection   Find the linking word which links target words (correct solution)  Generate alternative uses for objects	<b>Correlations</b> between SPQ PS and creativity task scores (total sample):  <b>Group effects</b> on SPQ PS score (musicians vs non- musicians):	Ns CPS Ns RAT Ns DTT  + Musicians sig. higher on PS ( $F(1, 39) = 4.1$ , $p = .049$ )
	Miller and Tal (2007)	$N = 225$ General Population	<u>Subjective:</u> Self-reported creative capacity (SRC; Author's own)  <u>Objective:</u>	Trait/Personality	PERSON, PRODUCT	Adjective Selection	<b>Correlations</b> between SPQ PS and SRC:  <b>Correlations</b> between SPQ PS (based on author's factor	Ns  + Essays ( $r = .16$ , $p = .018$ ) + Drawing ( $r = .16$ ,

				1) 6 Short Essays (Author's own) 2) 8 Drawings (abstract and representative; Author's own)	Divergent Thinking		Provide consequences; creative writing; creative drawing	analysis) and composite scores for essays and drawing:  <b>Multiple Regression</b> for SPQ factors (based on author's FA*), IQ and personality factors on composite scores for essays and drawing tasks	p = .014)  Ns Essays Ns Drawing (Only Openness and Intelligence significantly predicted creativity. Similar results were found when using Raine's original 3-factors.)
		Carter, Haas, Charfadi & Dinzeo (2019)	N = 156 General Population	<u>Subjective:</u> Creative Achievement Questionnaire (CAQ; Carson et al., 2005)  <u>Objective:</u> Wallach-Kogan Creativity Tests (Wallach & Koganm 1965): i) Alternate Uses ii) Pattern Meaning iii) Line Meaning	Achievement	PLACE/ PRESS, PROCESS, PRODUCT	Self-report recognition/ meaningful accomplishment	<b>Correlations</b> between PS and CAQ  <b>Correlations</b> between PS and battery of creative thinking  <b>Linear Regressions:</b> PS as a predictor for CAQ scores  <b>Linear Regressions:</b> PS as a predictor for divergent thinking scores	+ (r = .22, p < .05)  Ns AU (originality) Ns Pattern Meaning Ns Line meaning  Ns  Ns
<b>Chapman Scales (for Positive schizotypy):</b>  Positive Schizotypy scales (used separately or combined):  <b>Perceptual Aberration Scale</b> (PA; Chapman, Chapman and Kwapil, 1995);	Subjective Only	Badzakova-Trajkov, Häberling & Corballis, (2011)	N = 132 General Population	Creativity Achievement Questionnaire (CAQ; Carson, Peterson & Higgins, 2005)	Achievement	PLACE/ PRESS	Self-report recognition/ meaningful accomplishment	<b>Correlations</b> between Total CAQ Score and Magical Ideation	+ (r = .21, p = .02)
		Thalbourne & Delin (1994)	N = 241 General Population	Creative Personality from Torrance Creative Motivation Inventory (Torrance, 1971) With additional author-specific items	Trait/Personality	PERSON	Endorsement of descriptions of creative motivation	<b>Correlation</b> between Magical Ideation and Creative Personality:	+ (r = .48, p < .001)
	Objective Only	Mohr, Graves, Gianotti, Pizzagalli &	N = 30 General Population	Study 1: Semantic Distance – Paired Words (Unspecified)	Associative Processing	PROCESS	Subjective degree of semantic distance between words	Study 1: <b>Correlation</b> between Magical Ideation (MI) and Semantic distance	+ (r = .44, p = .02)

Magical Ideation Scale (Eckblad and Chapman, 1983)	Brugger (2001)		Study 2: Bridge-the Associative-Gap (Gianotti et al., 2001)			Bridge associative gap between two words (no 'correct' solution)	Study 2: <b>Anova</b> for High vs. Low Magical Ideation (MI; median split) on semantic distance	High MI group + larger semantic distances than Low MI group ( $p = .001$ )
	Weinstein & Graves (2001)	N = 30 General Population	1) Revised Remote Associations task (RAT; Mednick, 1959)	Convergent Thinking	PROCESS, PRODUCT	Find the linking word which links target words (correct solution)	<b>Correlations</b> between PS (MI-PA) and creativity measures:	Ns RAT Ns UT (Originality + Fluency combined)
			2) Utility Test (UT; Wilson et al., 1969)	Divergent Thinking		Generate alternative uses for objects	Note: DFT Dropped from analysis due to not correlating with the other creativity tasks	Ns TWFT
			3) Thurstone Word Fluency Test (TWFT; Thurstone & Thurstone, 1962)			Generate words beginning with same letter		
	Weinstein & Graves (2002)	N = 60 General Population	4) Design Fluency Test (DFT; Jones-Gotman & Milner, 1977)			Produce abstract drawings		
			1) Remote Associations Task (RAT; Mednick, 1959)	Convergent Thinking	PROCESS	Find the linking word which links target words (correct solution)	<b>Correlations</b> between PS (MI-PA) and creativity tasks:	RAT: + ( $r = .30, p < .01$ )
			2) Thurstone written Fluency Test (TWFT; Thurstone & Thurstone, 1962)	Divergent Thinking		Generate words beginning with same letter		TWFT: + ( $r = .23, p < .05$ )
Subjective and Objective	Armstrong (2012)	N = 114 General Population	<u>Subjective:</u> Lifetime Creativity Scale (LCS; Richards, Kinney, Benet & Merzel, 1988)	Achievement	PLACE/ PRESS, PROCESS, PRODUCT	Self-reported activities ('Extent'); meaningful accomplishment ('Peak')	<b>Correlations</b> between MI/PA and LCS (Reported Peak, Reported Extent):	+ MI with Reported Extent ( $r = .19, p < .05$ ) only (Ns PA, Ns Reported Peak for MI or PA)
			<u>Objective:</u> 1) Product Improvement sub-test of the TTCT (Torrance & Ball, 1984)	Divergent Thinking		Generate Product Improvement ideas	<b>Correlations</b> between MI/PA and Product Improvement Task  <b>Correlations</b> between MI/PA and RAT:	Ns (Fluency, Originality):  Ns

		2) Remote Associates Test (RAT; Mednick, 1962)	Convergent Thinking		Find the linking word which links target words (correct solution)	<b>Correlations between MI/PA and CPrS (Total):</b>	Ns
		3) Deductive Reasoning (DR; Ansburg & Hill, 2003)	Combined Divergent/Convergent Thinking		Find correct solution to problems	<b>Correlations between MI/PA and DR:</b>	- PA ( $r = -.23, p < .05$ ) only (Ns MI)
		4) Creative Problem Solving (CPrS; adapted from Redmond, Mumford & Teach, 1993)				<b>Multiple Regressions for MI-PA predicting CrPS:</b>	Ns
Schuldborg (1990)	N = 625 General Population	<u>Subjective:</u> 1) How do You Think Test (HDYT; Davis & Subkoviak, 1975)	Traits/ Personality Behaviours	PERSON, PROCESS, PRODUCT	Self-report beliefs/motivation and activities	<b>Correlations between MI-PA and Creativity tasks:</b>	+ HDYT ( $r = .29, p < .001$ ) Ns CPS Ns BWAS Ns Alt Uses Ns Remote Associations
		2) Creative Personality Scale (CPS; Gough, 1979)			Adjectives Selection		
		<u>Objective:</u> 1) Barron-Welsh Art Scale Revised (BWAS; Welsh & Barron, 1963)	Figure Preference		Figure preference (Like/Dislike)		
		2) Alternate Uses (Guilford et al., 1978)	Divergent Thinking		Find the linking word which links target words (correct solution)		
		3) Remote Associates Task (Mednick, 1967)	Convergent Thinking		Find the linking word which links target words (correct solution)		
Schuldborg, French,	N = 117	<u>Subjective:</u>	Trait/Personality	PERSON, PROCESS,		<b>ANOVA for high PS vs low MI-PA on</b>	Ns CPS

		Stone & Heberle, (1988)	General Population	1) Creative Personality Scale (CPS; Gough, 1979)  2) Domino's (1970) Creativity Scale  <u>Objective:</u> 1) Modified Alternate Uses Task (Guilford et al., 1978)  2) Barron-Welsh Art Scale Revised (BWAS; Welsh & Barron, 1963)	Divergent Thinking   Trait/Personality	PRODUCT	Adjective Selection   Generate alternative uses for objects   Figure preference (Like/Dislike)	<i>Subjective Creativity Tasks:</i>  <b>ANOVA</b> for high PS vs. low PS on <i>Objective creativity tasks:</i>	Ns Domino's Creativity Scale  Ns AUT ( <i>Fluency/Worthwhileness</i> ) + BWAS (High PS score sig. higher than Low PS, $p < .01$ )
		Gross Araujo, Zedelius & Schooler (2019)	N = 88 General Population	<u>Subjective:</u> 1) Creative Behaviours Inventory (Dollinger, 2003)  2) Creative Personality Inventory (Kaufman & Baer, 2004)  <u>Objective:</u> Incomplete Figures Task (TTCT; Torrance, 1972)	Behaviours   Trait/Personality   Divergent Thinking	PERSON, PRODUCT	Self-report creative Behaviour   Forced-choice selection of creative characteristics  Complete/Extend abstract lines into picture	<b>Correlations</b> between <i>MI and Creative Behaviours Inventory</i>  <b>Correlations</b> between <i>MI and Creative Personality</i>  <b>Correlations</b> between <i>MI and Incomplete Figures Task</i>	Ns  Ns  Ns
Schizotypal Personality Scale (STA; Claridge & Broks, 1984)	Objective Only	Green & Williams (1999)	N = 72 General Population	Subtests of Wallach-Kogan Divergent Thinking Battery (Wallach & Kogan, 1965) i) Instances ii) Uses	Divergent Thinking	PROCESS, PRODUCT	Instances of a concept; Generate alternative uses for objects	<b>Correlation</b> between <i>PS and total (composite) scores across tasks</i>	Ns Fluency + Originality ( $r = .27$ , $p = < .01$ )
		Zanes, Ross, Hatfield, Houtler & Whitman (1998)	N = 115 General Population	Remote Associates Task (RAT; Mednick & Mednick, 1967)	Convergent Thinking	PROCESS	Find the linking word which links target words (correct solution)	<b>Correlations</b> between <i>PS and RAT:</i> <i>Factor 1: Per-Mag</i> <i>Factor 2: Suspiciousness</i>	Ns Factor 1 (Per-Mag) Ns Factor 2 (Suspiciousness)

								ANOVA for PS factors and RAT, by subgroups i) 'normal' scorers, ii) 'consistently high' scorers, ii) 'inconsistent high' scorers	Factor 1 (Per-Mag) Ns - Factor 2 (Suspiciousness) Consistently high scorers on Factor 2 (Suspiciousness) associated with lower RAT means ( $t = -2.02, p < 0.04$ )
								Factor 1: Per-Mag Factor 2: Suspiciousness	
Rust Inventory of Schizotypal Cognitions (RISC; Rust, 1988)	Objective Only	Rust, Golombok & Abram, 1989)	N = 80 General Population	Creativity scales of the Comprehensive Ability Battery (Hakstian & Cattell, 1976)	Divergent Thinking	PROCESS, PRODUCT	Cognitive ability tasks (e.g., Idea production)	Correlations between PS and Creativity Task Domains	+ Originality ( $r = .28, p = <.01$ ) + Fluency ( $r = .22, p <.05$ )  Ns spontaneous Flexibility  Ns Flexibility of closure (elaboration)

Key: + significant positive association; - significant negative association; Ns = no significant association

Abbreviations: APT = Aesthetic Preference Test; AU = Alternative Uses; AUT = Alternative Uses Task; BICB = Biographical Inventory of Creative Behaviours; BIS = Berlin Intelligence Structure Test; BWAS = Barron-Welsh Art Scale; CAQ = Creative Achievement Questionnaire; CPS = Creative Personality Scale; CSQ-R = Creativity Styles Questionnaire-Revised; DR = Deductive Reasoning; DTB = Divergent thinking battery; DTT = Divergent thinking task; ECQ = Experience of Creativity Questionnaire; HDYT = How Do you Think Test; JS = Just Suppose; LCS = Lifetime Creativity Scale; LQ = Lifestyle Questionnaire; M/F = Male/Female; MI = Magical Ideation; O-LIFE = Oxford-Liverpool Inventory of Feelings and Experiences; O-LIFE-SF = Oxford-Liverpool Inventory of Feelings and Experiences-Short Form; PA = Perceptual Aberration; PC = Picture Completion; Per-Mag = Perceptual Aberration-Magical Ideation; PS = Positive Schizotypy; RAT = Remote Associations Task; RISC = Rust Inventory of Schizotypal Cognitions; SPQ = Schizotypal Personality Questionnaire; SPQ-B = Schizotypal Personality Questionnaire-Brief; SRC = Self Rated Creativity; STA = Schizotypal Personality Scale; TTCT = Torrance Test of Creative Thinking; TWFT = Thurstone Written Fluency Test; UNEX = Unusual Experiences; UUT = Unusual Uses Task

### 1.3.2.1 Sampling

Ten (22%) studies included creative individuals in their sample (Claridge & Blakey, 2009; Claridge & McDonald, 2009; Gibson et al., 2009; MacPherson & Kelly, 2011; Meyersburg et al., 2014; Michalica & Hunt, 2013; Nelson & Rawlings, 2010; Nettle & Clegg, 2006; O'Reilly et al., 2001; Rawlings & Locarnini, 2008). All other studies used general population samples, either alone or as a comparison group (as compared with, for example, individuals with schizophrenia; Wang et al., 2017).

Most studies (93%) assessed the relationship between positive schizotypy and creativity by analysing the relationship between the range of positive schizotypy and creativity scores across a sample of randomly recruited participants. This was typically done using correlational analysis (and/or using regression models with positive schizotypy entered as a predictor for creativity). Only three studies used a categorical approach and compared groups (i.e. groups with high vs. low positive schizotypy scores) on creativity measures; two of these used pre-selection criteria (only recruiting participants who met specific score criteria for the positive schizotypy group; Minor et al., 2014; Schuldburg et al., 1998), and one split their sample into groups (based on median scores) after recruiting a range of scorers (Dinn et al., 2002). Notably, the latter study was the only one to report no significant association between positive schizotypy and creativity, suggesting that analysis methods may have some bearing on results. However, there were inconsistent results on the same divergent thinking task used by the studies using pre-selection criteria (AUT), with only Minor et al. (2014) finding a significant positive association between positive schizotypy score and the AUT performance. It should be noted, however, that the selection criteria for the positive schizotypy group in Schuldburg et al.'s study (1998) was based on scoring highly on *either* Chapman's *Magical Thinking or Perceptual Aberration* scale, whereas the positive schizotypy group in Minor et al.'s (2014) study were high scorers on the positive schizotypy dimension scale of the SPQ-brief version (SPQ-BR), which encapsulates both of these aspects.

### Assessments of creativity

Most studies used either subjective (8 [18%]) or objective (20 [44%]) creativity measures only, with 17 (38%) studies using a mix of subjective and objective measures (Table 1.2). A large proportion of studies (40%) tapped into only a single creative '*P*' dimension, with the remainder tapping into two or more '*P*'s of creativity.

**Table 1.2** Frequencies of studies using either subjective or objective (or both) creativity measures, with the number in each category reporting a significant positive association with positive schizotypy traits (arranged by positive schizotypy scale used).

Creativity measure type	Studies by positive schizotypy scale used				Total
	O-LIFE	SPQ	Chapman Scales	STA/RISC	
<b>Subjective only</b>	5	1	2	0	8
<i>N</i> reporting significant positive relationship	5	1	2	N/A	8
<b>Objective only</b>	7	7	3	3	20
<i>N</i> reporting significant positive relationship	4	4	2	2	12
<b>Both subjective and objective</b>	10	3	4	0	17
<i>N</i> reporting significant positive relationship	7	1	3	N/A	11
<i>N</i> per measure type (Subjective/Objective/Conglomerate)	3 Subjective only 1 Objective only 2 Subjective and Objective 1 Conglomerate scores	(Subjective only)	2 Subjective only 1 Objective only		6 Subjective only 3 Objective only 2 Subjective and objective 1 Conglomerate scores

Abbreviations: O-LIFE = *Oxford-Liverpool Inventory of Feeling and Experiences*; SPQ = *Schizotypal Personality Questionnaire*; RISC = *Rust Inventory of Schizotypal Cognitions*; STA = *Schizotypal Personality Scale*



### 1.3.2.2 Creative Person

Nineteen (42%) studies included a formal assessment of the creative *Person*.

#### Subjective measures

Fifteen studies used self-report assessment of the creative person, tapping into creative personality (E.g., Creative Personality Scale; Gough, 1979, Torrance Creative Motivation Inventory; Torrance, 1974; Creative Personality Inventory, Kaufman & Baer, 2004; Domino's Creativity Scale; Domino, 1970), and/or self-reported extent of creative activity or behaviour (e.g., Biographical Inventory of Creative Behaviours; Batey, 2007). These types of scales are considered to be ecologically valid, having found to be positively associated real-life creativity (Cropley, 2000) and are also positively associated with scores on other tests of creativity. However, some studies used author-specific measures which have not been formally validated (e.g., Nettle & Clegg, 2006; O'Reilly, Dunbar & Bentall, 2001). The findings using these subjective measures were generally consistent, with 10 studies reporting a significant positive relationship of positive schizotypy with one or more subjective measures of the creative *Person* (using O-LIFE [7]; using SPQ: [1]; using the Chapman Scales: [2]).

#### Objective measures

The most common objective assessments of the creative *Person* were aesthetic preference tests (5 studies; e.g., the Barron-Welsh Art Scale; BWAS; Barron & Welsh, 1952; Welsh Figure Preference Test; Welsh, 1987). These types of assessments assume that preference for complex images in comparison to simple ones is indicative of a creatively-minded individual (Eysenck, 1995), however Thys et al. (2014) noted that these scales may tap into aspects other than creative personality. One study implemented their own figure preference test (Rawlings & Georgiou, 2004) which, though not formally validated, did significantly and positively correlate with a different and previously validated assessment of figure preference used in the study. Three of the studies using this type of assessment reported a significant positive relationship with positive schizotypy (using O-LIFE: [2]; using the Chapman Scales: [1]).

Six of the ten studies which included creative individuals when assessing the creative *Person* directly assessed positive schizotypy in their samples as a part of their investigation (Gibson et al., 2009; Rawlings & Locarnini, 2008; O'Reilly et al., 2001; Michalica & Hunt, 2013; MacPherson & Kelly, 2011; Claridge & Blakey, 2009). Studies using creative samples comprised of artists/musicians found that such groups scored

significantly higher on positive schizotypy than non-creative samples (using O-LIFE: [3]: using SPQ: [1]). One study reported higher positive schizotypy in scientists than in the comparison samples (using O-LIFE; [1]). Four of the studies which reported increased positive schizotypy in creative groups also found significant relationships between positive schizotypy and creativity measures (Claridge & Blakey, 2009; MacPherson & Kelly, 2011; Michalica & Hunt, 2013; Rawlings & Locarnini, 2008), though in one case (Macpherson & Kelley, 2011) the relationship between positive schizotypy and self-reported creative personality was specific to the creative sample, with no such relationship observed for the general population sample. One study reported a negative finding, despite higher positive schizotypy scores in the creative group (Gibson et al., 2009).

The remaining three studies (all using O-LIFE) which included creative individuals as part of their investigation did not test the differences in positive schizotypy between the creative and general population groups, two of which found a significant positive association between positive schizotypy and their creative measures (Nettle & Clegg, 2006; Meyersburg et al., 2014), and one did not (Claridge & McDonald., 2009).

### **1.3.2.3 Creative Process**

The creative *Process* was the most widely measured aspect in relation to positive schizotypy, with 33 (73%) of all studies including one or more assessments of this type.

#### *Subjective measures*

Two studies used self-report measures of the creative *Process*; one of which was the Experience of Creativity Questionnaire (Nelson & Rawlings, 2009), which taps into experiences during engagement in creative activity, including depth of absorption and 'flow' during the creative process. Scale development was based on experiences as reported by creative individuals (artists) and higher scores were shown to significantly associate with higher positive schizotypy scores (as measured by O-LIFE; Nelson & Rawlings, 2010). The other – the Creativity Styles Questionnaire-Revised (Kumar et al., 1997) - has been shown to distinguish between high and low creativity groups, though is found to inconsistently correlate with measures of creative personality (Kumar et al., 1997). For the study using this measure (Claridge & Blakey, 2009), positive schizotypy (O-LIFE) was found to significantly positively correlate with several strategies to facilitate creative works (e.g., use of the senses).

### Objective measures

All other studies assessing the creative *Process* used objective measures – the most popular being divergent thinking tasks, with 29 studies including these tasks as a part of their investigation. Divergent thinking tasks are considered to be a valid indication of creative potential (Cropley, 2000). Measures included the Alternative Uses Task (AUT; Guilford, 1967), all or some of the Torrance Tests of Creative Thinking (TTCT; Torrance, 1970; 1979) or the similar Wallach-Kogan Divergent Thinking Battery (Wallach & Kogan, 1965). Convergent thinking tasks were also widely used (11 studies) – such as the Remote Associates Task (RAT; Mednick, 1969), or problem solving tasks (e.g., Creative Problem Solving; Redmond et al., 1993; Tower of Hanoi; Garnham & Oakhill, 1994). The least commonly used assessments were those which tap into free associative thinking processes (with no ‘correct’ solution; e.g., Kent-Rosanoff Word Association Task; Kent & Rosanoff, 1910; Bridge-the-Associative-Gap; Gianotti et al., 2001; Inkblot test; Drey Fuchs, 1958). These tasks typically assess the semantic distance or unconventionality of participants’ free associative responses in relation to given concepts or words - with the exception of the Inkblot test, which was used to assess the number of associations which participants give in response to ambiguous images.

Results for studies using divergent thinking measures to tap into the creative process were largely mixed. Most studies (62%) found no significant relationship between positive schizotypy and the measure(s) of divergent thinking (using O-LIFE: [7]; using SPQ: [6]; using Chapman scales: [5]). Three of these studies initially found a significant positive relationship, which disappeared after accounting for other factors, such as study subject (O-Reilly et al., 2001), statistical correction (Wang et al., 2017) or other personality factors (Miller & Tal, 2007). One study (Burch et al., 2006) found a significant *negative* relationship between positive schizotypy and divergent thinking (as measured by fluency).

The remaining ten studies reported a significant positive relationship between positive schizotypy and divergent thinking; however, such findings were usually specific to some – but not all - aspects of divergent thinking. All of these studies which reported the relationship of positive schizotypy with multiple, individual aspects of divergent thinking (e.g., fluency, flexibility, originality, elaboration) reported mixed findings (using O-LIFE: [2]; using SPQ: [2]; using Chapman Scales: [1]; using RISC: [1]). One study found a significant relationship between their only measure of divergent thinking (fluency) and positive schizotypy (using Chapman scales), and three studies which reported significant positive relationship between positive schizotypy and divergent thinking used only conglomerate scores across two or more indices of divergent thinking for analysis (using

O-LIFE), contributing to difficulties in inferring specific relationships of positive schizotypy with thinking styles measured by these tasks.

Only one study reported a significant positive relationship between convergent thinking and positive schizotypy (as measured by the Chapman *Magical Ideation* scale), with all other studies (11) reporting either no association (using O-LIFE: [5]; using SPQ: [1]; using Chapman Scales: [3]; using STA: [1]) or a significant negative association with positive schizotypy (SPQ *Magical Ideation*: Stamatis & De Mamani, 2020).

All four studies which assessed associative thinking processes reported that higher positive schizotypy related to wider associative thinking style as indicated by semantic distance or uncommon associations; however, Rominger et al. (2017) found no relationship between the number of associations generated during the Inkblot test and positive schizotypy.

#### **1.3.2.4 Creative Product**

Over half (58%) of studies included an assessment of the creative *Product*. This was assessed by objective tasks only, namely, the originality of responses to divergent thinking tasks (e.g., AUT) – an index based on a general conception that something creative should be something novel (Batey & Furnham, 2008; Runco & Acar, 2012). This was usually assessed via statistical rarity of the responses (e.g., Winston et al., 2014; Minor et al., 2001; Claridge & Blakey, 2009; Polner et al., 2015). Few studies used independent raters, such as the Consensual Assessment Technique (CAT; Amabile, 1982), to score originality or quality of responses (Miller & Tal, 2007; Armstrong et al., 2012; Baas et al., 2020; Rominger et al., 2017; Schuldborg et al., 1998). Scoring techniques which rely on independent judges to rate responses for creativity is thought to be particularly useful for studies using larger sample sizes, since statistically rare responses become less likely as the sample size increases (Silvia et al., 2009).

The findings were generally mixed, with five reports of a significant positive relationship between positive schizotypy and originality (using O-LIFE: [2]; using SPQ: [1]; using STA: [1]; using RISC: [1]). All but one (which did not specify how originality was calculated; Rust et al., 1989) of these studies used statistical frequency of answers. All other studies either reported no direct relationship between positive schizotypy and originality or combined originality scores with other indices of divergent thinking, making it difficult to interpret results in relation to creativity as indexed by uniqueness of products.

### 1.3.2.5 Creative Place/Press

Ten studies (22%) used an assessment tapping into creative *Place/Press*, using the widely used self-report scale of achievement; the Creative Achievement Questionnaire (CAQ; Carson, Peterson & Higgins, 2005), which has been found to positively relate to both ratings of creative products and measures of the creative person (Carson et al., 2005). The other scale used was the Lifetime Creativity Scale (Richards et al., 1988), shown to distinguish individuals with an interest in creativity and those who pursue creative activities. Both of these scales ask participants to report their real-life creative accomplishments (e.g., success or recognition in a particular field of creativity, or obtaining a paid creative profession). Seven (70%) of these studies reported a significant positive relationship between positive schizotypy and creative achievement (using O-LIFE: [2]; using SPQ: [1]; using Chapman scales: [3]), with two studies having reported negative findings.

Despite the mostly consistent findings, it has been noted by Thys et al. (2014) and Cropley (2000), a potential problem with this type of assessment is that creative achievement may be reliant on factors beyond creative potential or ability, such as opportunity or drive to engage in creative pursuits, or factors which could be affected by more severe psychopathology vulnerabilities.

### 1.3.2.6 Relationships between creativity measures

#### *Relationships between objective and subjective measures*

Seventeen (38%) of all studies used both subjective and objective creativity tasks. Of these studies, 12 reported the correlations between these tasks. Ten studies observed significant positive correlations between the subjective and objective measures (e.g., Burch et al., 2006; Baas et al., 2020<sup>b,c</sup>; Gross et al., 2019), though six of these studies found that this was the case for only some (but not all) of the measures. Two studies found no significant correlations between the subjective and objective creativity measures (Michalica & Hunt, 2013; Miller & Tal, 2007).

#### *Relationships between subjective with subjective, and objective with objective measures*

Seven studies included multiple subjective measures for their investigation, four of which reported significant positive correlations between them (Batey & Furnham, 2008; Baas et al., 2020<sup>b,c</sup>; Schulberg 1990; Gross et al., 2019). Of all studies using multiple objective measures of creativity (15), 11 (73%) reported the correlations between the tasks. Eight studies reported significant relationships between at least some of their objective

measures (Claridge & McDonald, 2009; Rawlings & Georgiou 2004; Miller & Tal, 2007; Rominger et al., 2017; Weinstien & Graves 2001, 2002; Armstrong, 2012; Schuldberg, 1990). Three studies reported no significant associations between any of their objective tasks (Abu-Akel, 2020; Polner et al., 2018; Gibson et al., 2009); however, it should be noted that these correlations were between the convergent and divergent thinking tasks which, though related, are known to be distinct types of creative thinking processes (Guilford, 1967). However, inconsistent correlations were also found between tasks thought to similarly tap into divergent thinking processes (e.g., Weinstein & Graves, 2001; Armstrong et al., 2012).

### **1.3.2.7 General patterns and discussion of findings**

There is a strong body of evidence supporting a positive link between positive schizotypy and creativity. However, some of the findings are inconsistent, both between as well as within studies (when assessing multiple aspects of creativity). The main reason for this is likely to be a heterogeneity in the combinations of measures for the assessment of both positive schizotypy and creativity. First, the conceptualisation and measurement of positive schizotypy varies between studies; notably, much of the evidence for a positive relationship between positive schizotypy and creativity comes from the studies using measures of positive schizotypy which primarily assess magical thinking and unusual perceptual experiences, but do not fully encapsulate a subscale for the aspect of suspiciousness/paranoia (e.g., O-LIFE and Chapman scales of magical ideation and perceptual aberrations). A more specific conclusion on the basis of these studies may, therefore, be that higher positive schizotypy – as conceptualised by high *magical thinking* and *unusual perceptual experiences* - could be beneficial to creativity.

In contrast, findings are less consistent for the studies using the SPQ, which includes a suspiciousness/paranoia subscale. However, nearly all studies assessed positive schizotypy as a whole. Only two studies (Stamatis & De Mamani, 2020; Zanes et al., 1998) looked at suspiciousness/paranoia separately (with the former study having used the separate subscales of the SPQ within a preliminary analysis, and the latter having identified a 'paranoid schizotypy' factor within the STA for their sample), with only one study (Zanes et al., 1998) finding a significant, but inverse, association with convergent thinking. Brod (1997) noted that paranoia may undermine creativity; indeed, 'paranoid' schizotypy has been previously associated with deficits in set-shifting and performance on tasks requiring frontotemporal connectivity (Karagiannopoulou et al., 2016), which have been implicated in creativity (de Souza, 2010; Zabelina et al., 2019). In light of previous indications of an overlap of suspiciousness/paranoia with the negative schizotypy domain (e.g., Raine et al., 1994) and evidence of an inverse association of

negative symptomology with creativity (Acar & Sen, 2013), the inclusion/exclusion of suspiciousness/paranoia in the assessment of positive schizotypy may have a role to play in defining the relationship between positive schizotypy and creativity.

Second, there is high heterogeneity in creativity measures used, with some measures having been used only once. More consistent reports of positive findings were seen amongst studies using subjective (self-report) creativity assessments, or categorical status of creative profession/hobby, with more inconsistent findings for studies objectively measuring creativity – particularly in the case of divergent thinking tasks. This could be due to differences in task administration and scoring methods used; however, the inconsistent findings also occur for the indices derived from the same tasks. Many studies reported that higher scores on positive schizotypy were positively related to higher scores on only some, but not all, indices as measured by a single divergent thinking task (e.g., originality and flexibility, but not fluency; Winston et al., [2014]). Convergent thinking processes appear largely unrelated to positive schizotypy, with >90% of studies which measured convergent thinking reporting non-significant - or negative - associations. On the other hand, wider associative thinking styles (in free-associational tasks), were consistently associated with higher positive schizotypy.

These patterns of findings indicate that positive schizotypy relates differently to the aspects of creativity, with the correlations (or the lack of such) between creativity measures adding to the consensus that various measures, particularly objective lab-based tasks, tap into distinct aspects of creativity. Furthermore, the use of conglomerate scores across different objective creativity tasks (e.g., Meyersburg et al., 2014), or even across divergent thinking indices measured within a single task (e.g., Baas et al., 2020) could obscure nuanced links between positive schizotypy and creativity. These findings also tie into problems with using assessments tapping into limited aspects of creativity; over half (58%) of studies used only subjective or objective creativity tasks, and many studies (40%) assessed only one 'P' of creativity. Thus, the use of multiple creativity tasks, both subjective and objective, measuring more than one P, with indices derived for the specific aspects of creative outputs – all utilised within the same sample - is necessary for a more comprehensive understanding of the positive schizotypy-creativity relationship.

Another common feature of the reviewed studies is that studies generally recruited a sample of participants with a range of scores on positive schizotypy, using correlational (or regression model) designs. Only two of the studies which were reviewed used selective sampling for their investigation – both of which reported significant positive

findings. This may also have a bearing on replicability, particularly in general, non-creative population samples, since the prevalence of positive schizotypy is around 8% in the general population (Linscott & Morton, 2018). Assessing creativity within a sample of low-to-average levels of positive schizotypy, as may be expected to be found in general population samples, might make the detection of a positive link of positive schizotypy with a heightened creative aptitude more challenging.

To conclude, the relationship between creativity and positive schizotypy may depend on the aspect of creativity being measured, and/or the scale used to assess positive schizotypy. The high heterogeneity of creativity tasks used within positive schizotypy research is presumably due to the current lack of clarity on the definition and conceptualisation of creativity; this leads back to the view that multiple measures (both subjective and objective), using the four ‘P’ dimensions of creativity, as recommended by Thys et al. (2014), is an advantageous approach to assessing the link between positive schizotypy and creativity. Furthermore, using pre-selective criteria for such investigations (e.g., recruiting high vs. low positive schizotypy scorers) is an underused sampling method and may be worth implementing in future studies, with the ‘composition’ of scores across different positive schizotypy subscales being taken into consideration as a possible influence on the results.

#### **1.4 A possible mechanism underlying positive schizotypy-creativity link: sensory information processing**

Evidence for heightened creativity in both relatives of schizophrenia and individuals with schizophrenia-like traits points to a genetic underlying link between positive schizotypy and creativity. This may manifest through specific phenotypic mechanisms; namely, the way sensory information is processed. The ability to filter out irrelevant and/or repetitive information is a useful mechanism for everyday function (synonymous with selective attention; Braff & Geyer, 1987); for example, attending to a conversation whilst filtering out background noise (such as other, irrelevant conversations between other people, or music) in a busy environment. This process implicates the thalamus – a ‘gatekeeper’ for multiple sensory inputs (Sherman & Guillery, 2002). This includes visual, auditory and tactile information, preventing extraneous (non-salient) information passing into the higher-level brain regions for further processing.

Information processing theories of schizophrenia (e.g. Braff, 1993; Carr & Wale, 1986) posits that schizophrenia may in part result from a reduced ability to filter information. Thus, drug-naïve schizophrenia patients show decreased levels of thalamic



dopaminergic binding potential (D2BP; Buchsbaum et al., 2006), which has been suggested to play an underlying role in positive symptoms of schizophrenia (Yasuno et al., 2004). Reduced D2BP is understood to lower thalamic gating threshold, leading to increased information flow (Yasuno et al., 2004; Young et al., 1995). It is theorised that an excessive flow of information may 'overload' cortical regions, resulting in distractibility and cognitive fragmentation (Braff et al., 1991), subsequently leading to symptoms of psychosis (Braff & Geyer 1990; Freedman et al., 1991; McGhie and Chapman 1961; Venables, 1964). Reduced D2BP binding potential has also been linked to higher paranoia/suspiciousness (Buchsbaum et al., 2006), and information inhibitory mechanisms have been implicated in schizotypal personality disorder (Cadenhead et al., 2002; 1993). As such, more open sensory information processing is thought to play a critical role in the development of schizophrenia and is regarded a possible endophenotype in schizophrenia-related populations.

However, the greater 'openness' to incoming sensory information has also been observed in healthy creative individuals (Martindale et al., 1996). This has been proposed as an underlying factor between creativity and psychopathology (Carson, 2011). The tendency to attend to a wider range of stimuli and screen out less information is thought to enable idea generation through an increased likelihood of making novel connections with the increased information load (Carson et al., 2003). Dopaminergic systems associated with processing increased salience of external stimuli are implicated in creativity as well as schizophrenia (Flaherty, 2005), with decreased thalamic D2BP found in healthy individuals exhibiting increased creative thinking (de Manzano et al., 2010), similarly to the drug-naïve schizophrenia patients. Furthermore, real life creative achievement in healthy individuals has been associated with more open sensory information processing (Zabelina et al., 2015).

These lines of research suggest that a more open information processing style, though implicated in psychosis development, is a feature that can be found in healthy and functioning individuals. Furthermore, since more open information processing is a feature seen to be associated with heightened creativity, this could be the underlying mechanism for the positive link between positive schizotypy and creativity. However, this link has not yet been investigated in a single sample of individuals with high positive schizotypy.

## **1.5 Preserving the benefits whilst mitigating the risks of positive schizotypy: the role of mindfulness**

Given the two-sided coin of positive schizotypy, dissociating the risks and benefits of this set of traits is of importance. Specifically, there is a need to identify and develop methods to reduce known risk-factors of psychosis development – namely, suspiciousness/paranoia - whilst preserving mechanisms which may support creativity (more open information processing). This is particularly relevant in the context of mitigating the risk of psychosis and a subsequent need for antipsychotic treatment in first episode psychosis, which work to dampen down more open sensory information processing (Geyer et al., 2001; Kumari et al., 2007; Kumari & Sharma, 2002; Oranje et al., 2002), thus alleviating positive symptoms (Zhang et al., 2020), but potentially negatively impacting heightened creativity. One such way could be by using mindfulness-based interventions.

### **1.5.1 Disassociating aspects of positive schizotypy with mindfulness**

Mindfulness promotes a present-moment, receptive awareness, with an open and non-judgemental attitude towards experience (Brown & Ryan, 2003; Deikman, 1982; Kabat-Zinn, 1990; Martin, 1997). Typically developed through meditation practice, mindfulness has been adopted as a method for bringing awareness and skilful response to mental processes which contribute to or maintain distress and maladaptive behaviour (Bishop et al., 2004). Increased mindful awareness has been shown to associate with improved mental health, including anxiety, depression, as well as overall wellbeing (Brown & Ryan, 2003).

Notably, experienced mindfulness practitioners have been found to have higher magical thinking, alongside significantly lower suspiciousness on a measure of positive schizotypy (the SPQ) compared with the general population (Antonova et al., 2016). This finding suggests that these two aspects of positive schizotypy dimension are dissociable with mindfulness practise. This gives impetus to the use of mindfulness-based approaches for mitigating psychosis risk by reducing suspiciousness/paranoia in individuals high in positive-schizotypal traits that are associated with creativity, namely magical thinking and unusual experiences (as reviewed in section 1.3).

## **1.5.2 Using mindfulness to target suspiciousness/paranoia**

### **1.5.2.1 Overview of suspiciousness/paranoia**

Paranoia lies atop a hierarchy of social evaluative concerns, interpersonal sensitivity, ideas of reference, and varying degrees of threat and persecutory belief (Bebbington et al., 2013; Freeman et al., 2005). Thought to lie on a continuum throughout the general population (Freeman, 2007), paranoia is not an experience confined to severe mental illness (Freeman et al., 2008). Paranoid thoughts can be distressing even when fleeting (Freeman, 2007) yet can be pre-occupying (Freeman & Garety, 2006), with rumination being implicated in the maintenance of paranoid beliefs (Martinelli et al., 2013; McKie et al., 2017), as well as delusion formation (Carse et al., 2013). Paranoia is associated with cognitive inflexibility, such as belief inflexibility (Freeman et al., 2008) and self-focussed attention – specifically, increased experience of the self as a target for others' thoughts and behaviours (Ellet & Chadwick, 2007). Finally, paranoia is shown to be preceded and maintained by socially evaluative concerns (Meisel et al., 2018) and is associated with problems in adapting to the social world (Collip et al., 2013). Mistrust and beliefs of negative judgment or malevolence between individuals can give rise to avoidant, suspicious or aggressive behaviours (Schaerer et al., 2021). This could lead to isolation, potentially causing a self-perpetuating cycle of being unable to socially integrate, thus strengthening paranoid beliefs.

### **1.5.2.2 How mindfulness can target suspiciousness/paranoia**

Mindfulness can potentially buffer against the above-mentioned factors. First, mindfulness meditation increases propensity to devote attention toward each passing moment and learning to respond to experience - including thoughts - in a non-habitual way, which is reflected in improved cognitive flexibility (Moore & Malinowski, 2009). Further, mindfulness fosters higher-order thinking skills, such as metacognitive insight (i.e., thinking about one's thinking) and decentred awareness (Chadwick et al., 2006; Teasdale et al., 2002). These types of skills are key to developing an improved ability to notice and understand unhelpful evaluations of experience and cognitions which can lead to adverse well-being outcomes - and recognise them as such. A central element of mindfulness is the ability to recognise thoughts as thoughts, without the automatic assumption that they reflect reality (Williams & Kuyken, 2012). Mindfulness has been shown to negatively associate with rumination (Burg & Michalak, 2011; Hawley et al., 2014); increasing awareness of and mindful responding to experience circumvents reactivity and fixation towards distressing thought content, thereby enabling an ability to

disengage from rumination and potentially intersecting the maintenance and progression of paranoid beliefs.

Finally, mindfulness promotes empathy, compassion and prosocial behaviour (Condon, 2017; Condon et al., 2013), as well as a world-view of 'shared human experience' (Neff & Dahm, 2015). These are all aspects which contrast characteristics of paranoia, which thus could improve social integration and relationship building, thereby increasing the likelihood of perceived social support - which in itself can buffer against paranoia (Freeman et al., 2011).

#### **1.5.2.3 Evidence for the use of mindfulness to reduce suspiciousness/paranoia**

Indeed, mindfulness has been shown to associate with reduced suspiciousness/paranoia. In addition to evidence for significantly lower suspiciousness in experienced mindfulness practitioners (Antonova et al., 2016), trait mindfulness is inversely associated with paranoid cognition, and can buffer against paranoia related to perceived discrimination (Thoroughgood et al., 2020). Further, mindfulness training in general population samples has been shown to lead to reductions in paranoia; Shore and colleagues (2018) recently demonstrated that a brief two-week mindfulness-based intervention (using guided mindfulness meditation developed by Chadwick et al., 2006) led to a significant reduction in paranoia in a non-clinical population, mediated by the mindfulness skills cultivated through the training. Similarly, Kingston and colleagues (2019) found that dispositional non-judgement of experience (integral to mindfulness) was inversely associated with paranoia, and that self-administered mindfulness training led to reduced state paranoia. Mindful self-focus, inducing mindful engagement (such as highlighting shared human experience) has also been shown to reduce paranoid thinking (McKie et al., 2017) and paranoia in daily life, increasing feelings of social acceptance (Collip et al., 2013). Mindfulness training has also been found to favourably change the relationship with distressing thoughts - including paranoid thoughts - in people with psychotic experiences (Ellett, 2013). This is particularly relevant to using mindfulness in the context of vulnerable populations, such as those high in positive schizotypy with high suspiciousness/paranoia, who have a tendency for experiencing unusual perceptual experiences and/or making causal attributions; increasing the ability to disengage from paranoid appraisals or thoughts associated them could lead to reductions in associated distress.

As pointed out in section 1.5.2.1, self-referencing and self-directed attention is implicated in paranoia (Bebbington et al., 2013; Ellet & Chadwick, 2007; Fenigstein & Venable, 1992). However, hyper self-referencing is also implicated in schizophrenia, and is

associated with an overactive default mode network, a group of brain regions shown to be active when individuals engage in internal processing (DMN; Cannon, 2015; Whitfield-Gabriel & Ford, 2012). There is evidence that mindfulness training is associated with reduced activation of the DMN and its connectivity (Farb et al., 2007), which in turn is associated with reduced self-referencing (Berkovich-Ohana et al., 2012) and spontaneous mentation (Pagnoni et al., 2008). These findings support the notion that mindfulness entails an experiential shift toward a non-judgemental, non-elaborative, moment-to-moment awareness, without self-referential interpretations or attributions toward events, and would thus be beneficial for individuals with an increased tendency for paranoid interpretations of experience as a special case of self-referential processing.

#### **1.5.2.4 More open information processing in mindful meditators**

Reduced sensory information filtering, indexed by the responsiveness to repetitive incoming auditory stimuli, has been observed in experienced mindfulness practitioners (Antonova et al., 2015), similarly to people with schizophrenia (Geyer & Braff, 1982), schizotypy (Cadenhead et al., 1993) and creative individuals (De Manzo et al., 2010; Zabelina, 2015). This is thought to be promoted by the 'beginner's mind' orientation towards experiences afforded by mindful awareness - a 'newness' of perception of every passing moment (Siegal, 2009), resulting in experiential freshness of even repetitive and familiar stimuli (Cahn & Polich, 2006). Together with the finding of higher magical thinking in experienced mindfulness practitioners (Antonova et al., 2016), this suggests that more open processing style *per se* does not necessitate information overload and cognitive fragmentation resulting in psychosis and schizophrenia. Aspects associated with mindfulness, such as increased cognitive flexibility and decentred awareness, promoting reduced fixation on self-referential thinking (paranoid ideations), may be a crucial protective factor in the presence of greater openness to incoming stimuli. Training an ability for mindful awareness in this context may, therefore, buffer against what otherwise might present a psychosis risk.

Overall, mindfulness training appears to be a promising approach for reducing suspiciousness/paranoia as a risk factor for psychosis in individuals with high positive schizotypy, whilst leaving intact magical thinking and more open information processing style associated with creativity. This is supported by the evidence suggesting that: i) magical thinking and suspiciousness, whilst both facets of positive schizotypy, seem to be dissociable with mindfulness practise; ii) reduced sensory information filtering and schizotypal traits such as magical thinking can co-exist, in isolation from suspiciousness/paranoia, without a functional detriment, and may even enhance creative ability.

## 1.6 Summary

As suggested by previous researchers (Carson, 2011; Mohr and Claridge, 2015), there is a need to move focus towards supporting healthy and beneficial expressions of psychotic-like traits, rather than focusing solely on pathological risk. Positive schizotypy presents a double-edged sword, having been implicated in both schizophrenia-spectrum disorder vulnerability and increased creative potential. In addition to a link between positive schizotypy and heightened creativity, separate lines of research provide evidence for more open information processing being both an endophenotype of schizophrenia-spectrum disorders and an information processing style underlying heightened creative ability. However, the link between positive schizotypy, creativity and attenuated sensory information filtering have not been empirically investigated in a single sample. Moreover, several limitations of previous research in relation to the conceptualisation and measurement of positive schizotypy and creativity, as reviewed in section 1.3, should be addressed in this type of investigation.

Furthermore, suspiciousness/paranoia remains a problematic feature of positive schizotypy, having been identified as a key risk factor for psychosis development, putting it at the forefront of early prevention research. It appears that the features which may underlie creativity – more open sensory information processing and magical thinking/unusual experiences - though both implicated in psychopathology, may not be harmful *per se*, in isolation from suspiciousness/paranoia. It is, therefore, of significant value to develop preventative strategies that would reduce the risks associated with suspiciousness/paranoia in psychosis-prone individuals, whilst supporting conditions thought to support creativity. Converging evidence for mindfulness practise being associated with higher magical thinking, lower suspiciousness/paranoia and attenuated sensory information processing provides promise for the use of mindfulness-based intervention as such a preventative strategy.

## Chapter 2 Overview of the Studies

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This chapter will provide a broad outline of the aims and objectives of the thesis, with an overview of the planned investigation and experimental studies.

### 2.1 Aims and objectives

Given the considerations laid out in Chapter 1, the main aims of the present investigation are threefold; first, the project aims to robustly examine the relationship between positive schizotypy and creativity. To do so, it will address the methodological issues as outlined in Chapter 1 (section 1.3.2.7) by using a schizotypy assessment which taps into all aspects of positive schizotypy in order to take the multidimensional nature of this set of traits into consideration. This will be with the specific aim to take into account the role of suspiciousness/paranoia in the relationship between positive schizotypy and creativity. It also aims to address the methodological issues of past research in assessing creativity (Chapter 1, section 1.3.2.7); specifically, in order to help robustly investigate the relationship between positive schizotypy and creativity, it will use multiple measures (subjective and objective) to tap into several domains of creativity, using the four creative 'P's, as has been previously recommended for psychopathology research (Thys et al., 2014).

Second, given the separate lines of research pointing to a link between a more open processing style with both positive schizotypy and creativity (Chapter 1, section 1.4), the project aims to empirically investigate the interrelationship between more open sensory information processing, creativity and high positive schizotypy within the same sample. Thirdly, given the risk of suspiciousness/paranoia associated with psychosis development for individuals with high positive schizotypy (Chapter 1, section 1.2), a central aim of the current project is to investigate the feasibility and acceptability of a mindfulness-based intervention in individuals with high positive schizotypy (with high suspiciousness/paranoia). A primary objective will be to reduce suspiciousness/paranoia in these individuals using the intervention. In addition, should more open sensory information processing underlie the relationship between positive schizotypy and creativity in Study 2, a further aim was to investigate whether these conditions were maintained following the intervention.

## **2.2 Plan of Investigation**

The current thesis comprises three novel studies to address the aims and objectives outlined in the above section; one of which was conducted online and two were lab-based experimental studies.

### **2.2.1 Study 1 (Chapter 3)**

Chapter 3 presents a published study (Study 1) of an online investigation into the interrelationship between the aspects of positive schizotypy, dispositional mindfulness and experience of the creative process. In a large sample of participants with a range of positive schizotypy scores, this study specifically focused on the moderating role of suspiciousness/paranoia upon the relationship between positive schizotypy and creativity. Given previous reports of a dissociation between aspects of positive schizotypy in mindfulness practitioners (Antonova et al., 2016), and that higher dispositional mindfulness (as opposed to cultivated mindfulness through practise) is associated with lower trait paranoia (Kingston et al., 2019), this study also employed an exploratory investigation into the interactive role of dispositional mindfulness within the positive schizotypy-creativity relationship.

### **2.2.2 Study 2 (Chapter 4):**

Chapter 4 presents a novel empirical investigation into the interrelationship between high positive schizotypy, creativity and sensory information processing (Study 2) within a single sample. This study used robust methodology with a large sample for the investigation; first, it directly compared scores on several creativity measures (tapping into multiple 'P's) between groups of participants pre-selected on the basis of scoring high or low-to-moderate on positive schizotypy (as opposed to correlational designs across a sample with a range of scores typically employed by previous studies, see section 1.3.2.1 of Chapter 1). Second, this study, for the first time, assessed whether the positive relationship(s) between positive schizotypy and creativity was mediated by more open information processing as assessed by a well-established index of information filtering - acoustic startle habituation - within the same sample.

### **2.2.3 Study 3 (Chapter 5):**

This chapter presents a pilot, randomised control trial for the use of an online mindfulness-based intervention in a sample of participants with high positive schizotypy and high suspiciousness/paranoia (Study 3). It focused on the feasibility and



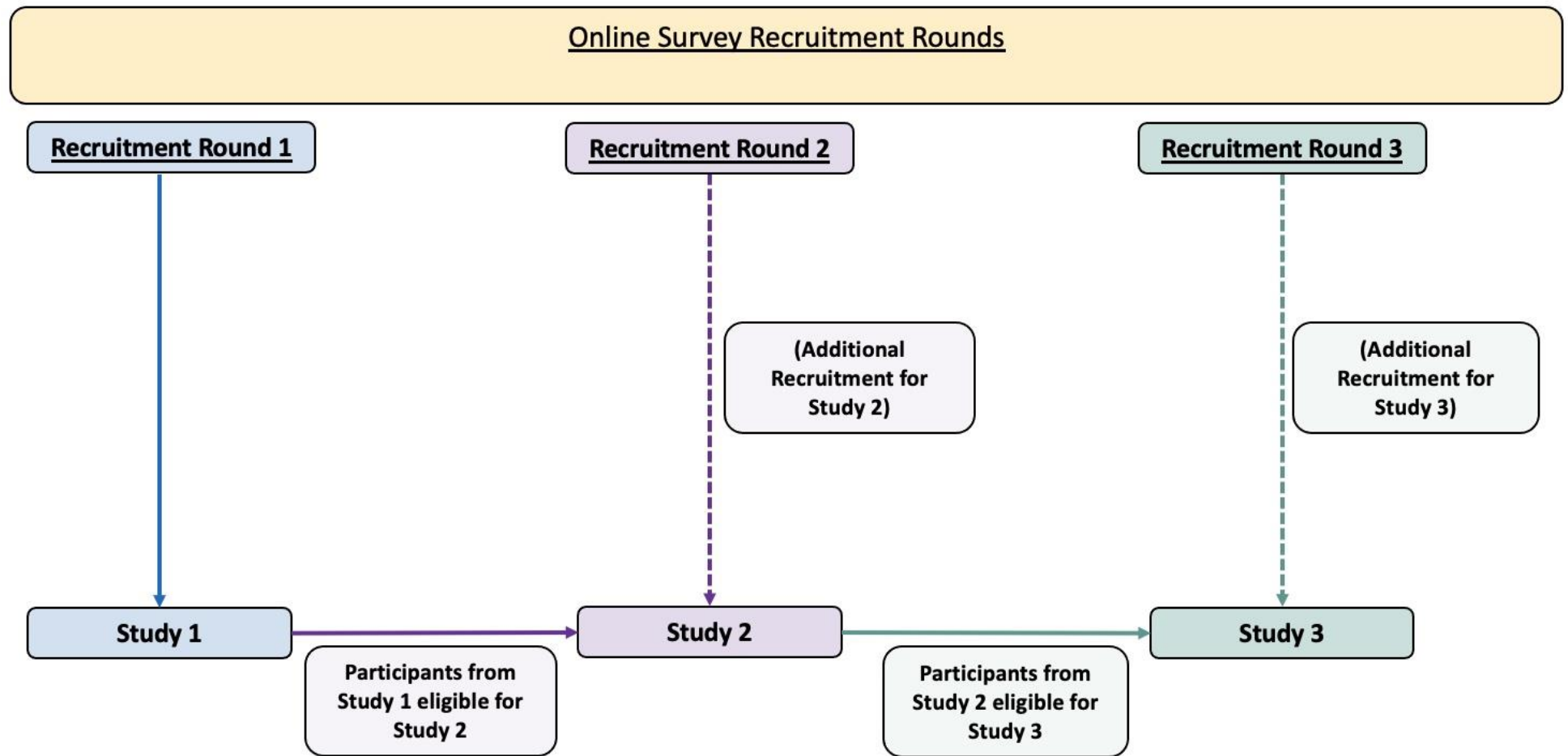
acceptability of this intervention within the sample, and looked to investigate whether a reduction of suspiciousness/paranoia in these individuals could be observed following the intervention compared to a closely matched active control condition. In addition to assessing trait paranoia, this study employed novel methodology – virtual reality – for an objective and experimentally controlled measure of state paranoia. This was the first study of its kind to assess change in state paranoia as induced by virtual reality social environment following a mindfulness-based intervention. Should the results of Study 2 provide confirmatory evidence for a mediation of sensory information processing upon the relationship between positive schizotypy and creativity, a further aim of Study 3 would be to additionally investigate whether this mechanism could be preserved following the mindfulness intervention.

#### **2.2.4 Population for sampling and flow of recruitment throughout studies**

Healthy participants from the general population were recruited from London-based sites (UK) including King's College London, local creative colleges, forums and social media pages to complete an online survey as part of Study 1. The primary inclusion criteria for all participants taking part in any of the three studies was as follows:

- Aged between 18-65 years
- No history or current diagnosis of a mental health illness, neurodevelopmental or neurological disorder (as diagnosed by a professional health practitioner, psychiatrist or psychologist)
- No history or current diagnosis of substance abuse
- Fluent in English

A further pre-requisite for taking part in the survey (and subsequent studies) was to be based in London UK to ensure they could attend to the lab upon invitation to Studies 2 and 3. Participants were informed as part of taking part in the survey (as used for Study 1) that they might be invited to take part in the second and third stages of the project. A subsample of these participants were then recruited for Study 2 on the basis of their responses on the online survey (including positive schizotypy scores) and additional inclusion criteria (as is outlined in Chapter 4). A further subsample of participants who took part in Study 2 was then recruited for Study 3 on the basis of additional study-specific criteria (as is outlined in Chapter 5). To reach target sample sizes for Studies 2 and 3, additional participants were recruited using the online survey as a screening tool to assess eligibility (See Fig. 2.1 for participant recruitment flow throughout the studies).



**Figure 2.1.** Outline of planned study flow throughout the project.

The term 'schizotypy' was omitted throughout advertisements and participant information materials for all studies to avoid stigma associated with terms related to psychopathology; instead, the term 'personality' was used. It has been noted that when schizotypy scales are framed as 'personality', rather than 'pathological' scales, responses are less defensive and therefore more reliable (Mohr et al., 2018).

## **2.3 Patient and Public Involvement and Ethical approval**

Prior to ethical approval, the project was presented to the Feasibility and Acceptability Support Team for Researchers (FAST-R), a free and confidential service in England provided by the Biomedical Research Centre Service User Advisory Group (National Institute for Health Research) via King's College London. This service offers a review of research projects by service users with experience of mental health problems (and their carers) who have been trained to provide advice for aspects such as aims, protocols and recruitment materials. A presentation of the planned research and methodology was given to the service, as well as all recruitment materials used for the planned series of studies. The project received very positive feedback and suggested changes were reflected in the final protocol and participant materials, including (but not limited to) the following suggestions for improvement:

- Include a creativity task which allow participants to create their own piece of creative work.
- Avoidance of the word 'schizotypy' and 'paranoia' to avoid unnecessary stigma attached to such terms for participants.
- Amendment of 'No history of or current diagnosis of a psychopathology' in the recruitment criteria detailed in the participant information sheet to 'serious mental health problem', as the term 'psychopathology' may be confusing.
- 'Electrodes' changed to 'Sensors' within the protocol section of the participant information sheet to sound less invasive (with regards to Study 2 methodology).
- Consider ways to ensure that participants were completing the intervention studies (with regards to Study 3 methodology).
- General amendments to language for concepts and terms throughout participant materials to improve lay-audience suitability.

All studies were regarded low-risk and were approved by the Psychiatry, Nursing and Midwifery Research Ethics Committee (ref: LRS-17/18-5604).

## **Chapter 3 (Study 1): Online Investigation of the relationship between positive schizotypy, experience of creativity and dispositional mindfulness**

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### **3.1 Introduction to published work**

This chapter will present the revised manuscript of a published article investigating the interrelationship between positive schizotypy, experience of creativity and dispositional mindfulness. A central observation of the literature review presented in Chapter 1 (section 1.3) was that positive schizotypy measures which tap predominantly into the aspects of unusual beliefs and experiences appeared to have a more consistent positive relationship with creativity across the studies, with less consistent findings for studies using measures containing a suspiciousness/paranoia subscale. This raised the question of whether the inclusion of a suspiciousness/paranoia subscale impacts the pattern of results regarding positive schizotypy and creativity, particularly in the context of evidence suggesting that suspiciousness/paranoia may have some overlap with negative schizotypy (Kwapil et al., 2013; Raine, 1994), which is seen to have a differing – and even an inverse – relationship with creativity (Acar & Sen, 2013). The study presented in this chapter aimed to take a first step in addressing the question of whether unusual beliefs and experiences – aspects appearing to most consistently relate to heightened creativity - have a differing relationship to creativity depending on whether or not they are accompanied by high suspiciousness/paranoia.

#### **3.1.1 Preliminary data collection**

As noted in Chapter 2 (section 2.2.4), the survey which was used in the current study was also used for the basis of screening for eligible participants to take part in Studies 2 and 3. These later studies were planned with pre-defined positive schizotypy score criteria (as are further detailed in the respective methodology sections, Chapters 4 and 5) within the context of norms of the general population who completed the survey. Since there was an overlap in study recruitment (i.e., Study 2 recruitment would commence prior to recruitment ceasing for the current study, and before the sample means from the larger, final sample in the current study were identified), a preliminary sample of participants who completed the online survey as part of the current study ( $N = 117$ ) was used as a 'stable' baseline guide for positive schizotypy criteria for recruitment in Studies 2 and 3. The sample norm data for all subscales of schizotypy (as assessed by the Schizotypal Personality Questionnaire [SPQ]; Raine et al., 1991, as was used throughout

all three studies and further details for which are provided in this chapter<sup>1</sup>), from this preliminary sample can be found below, in Table 3.1.

**Table 3.1.** Means (SD) of a preliminary general population sample ( $n = 117$ ) for the Schizotypal Personality Questionnaire (SPQ).

<b>Measure/Subscale</b>	<b>Mean (SD)</b>
<b>SPQ<sup>Total</sup></b>	20.29 (12.68)
<b>SPQ<sup>Positive</sup></b>	7.57 (5.98)
Magical Thinking	.84 (1.22)
Unusual Perceptual Experiences	1.81 (1.90)
Ideas of Reference	2.62 (2.44)
Suspiciousness/Paranoia	2.31 (2.13)
<b>SPQ<sup>Negative</sup></b>	8.57 (5.97)
<b>SPQ<sup>Disorganised</sup></b>	4.65 (3.63)

The final positive schizotypy (total and subscale) means for the full, larger sample of the current study, inclusive of the preliminary sample and as are reported in the presented manuscript, remained consistent with those reported in Table 3.1. Thus, the scores of this preliminary sample were considered representative of general population means on which to base recruitment for the later studies.

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<sup>1</sup> Previously reported alpha coefficients for the questionnaires used in the published study were not included in the manuscript due to the word count limit. These can be found at the end of this chapter, p. 79.

### 3.2 Published study

The following report of the study is the revised and accepted manuscript of the study published as:

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#### **Title: Positive Schizotypy and the Experience of Creativity: The Distinctive Roles of Suspiciousness and Dispositional Mindfulness**

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#### **Abstract**

Positive schizotypy has been shown to predict emergence of schizophrenia-spectrum disorders, with suspiciousness/paranoia regarded a key risk factor. However, magical thinking and unusual perceptual experiences, other aspects of positive schizotypy, are associated with creativity. We investigated whether suspiciousness attenuates the relationship of magical thinking and unusual experiences with creativity experience, and explored the interaction of dispositional mindfulness with positive schizotypy and creative experience. 342 (256 females) healthy adults (mean age: 25.9; SD 8.4) completed online self-report measures of schizotypy, creative experience, and dispositional mindfulness.

Moderation analysis showed that suspiciousness attenuated the positive relationship of magical thinking ( $b = -.29, p = .03$ ) and unusual perceptual experiences ( $b = -.23, p = .01$ ) with an aspect of creative experience related to positive affect – power/pleasure. This effect was not present for 4 other aspects of creative experience. Multiple linear regressions revealed higher dispositional mindfulness to interact with aspects of positive schizotypy associated with heightened creative experience of power/pleasure ( $b = .06, p = .03$ ), clarity/preparation ( $b = .03, p = .004$ ), and differing levels of anxiety associate with creative engagement ( $b = -.06, p = .003$ ;  $b = .03, p = .047$ ). Higher dispositional mindfulness was also associated with lower suspiciousness ( $r_s = -.33, p < .001$ ). The study highlights the importance of considering the role of suspiciousness/paranoia when investigating the relationship between positive schizotypy and creativity. The findings provide support for the application of mindfulness-based interventions for mitigating psychosis-risk associated with suspiciousness, whilst supporting the otherwise favourable association of positive schizotypy with creativity.

**Keywords:** schizotypy; schizophrenia; psychosis; paranoia; dispositional mindfulness; creativity

## 1. Introduction

Schizotypy refers to a set of personality traits found in the general population, with most evidence supporting a three-factor structure corresponding to symptom dimensions of schizophrenia: positive, negative, and disorganised (Mason et al., 1997; Nelson et al., 2013). Schizotypy shows a substantial overlap with schizophrenia across multiple cognitive, behavioural, and neurobiological domains (Ettinger et al., 2014), reflecting a latent predisposition to schizophrenia (Lenzenweger, 2015); however, schizotypal traits can also exist as a normative aspect of personality and do not invariably lead to schizophrenia-spectrum disorders.

Positive schizotypy in particular is thought to predict later emergence of schizophrenia-spectrum disorders (Debbané et al., 2015; Kwapil et al., 2013), with suspiciousness/paranoia – an aspect of positive schizotypy - being a key risk-factor to psychosis conversion (Wilcox et al., 2014), especially in high-risk individuals (Salokangas et al., 2013). However, another side of the coin of positive schizotypy is the association with heightened creativity – a highly beneficial trait, for both an individual and society. A range of approaches have been used to investigate this link, including assessing self-rated creative achievement (e.g. Polner et al., 2015), self-rated creative ability/behaviour (e.g. Batey & Furnham, 2008), holding a creative profession (e.g., Nettle & Clegg, 2006), or assessing creativity using objective tests (e.g., Fink et al., 2014;

Rawlings & Locarnini, 2008). Whilst some studies have reported a link between creativity and positive schizotypy (for a meta-analysis, see Acar & Sen, 2013), others have not observed it when using the same assessments of schizotypy and creativity (e.g., Michalica & Hunt, 2013; Rybakowski & Klonowska, 2011).

The most widely used self-report measures of positive schizotypy in creativity research are the Oxford-Liverpool Inventory for Feelings and Experiences (O-LIFE; Mason et al., 1995) and the Schizotypal Personality Questionnaire (SPQ; Raine, 1991). Both encapsulate magical thinking and unusual perceptual experiences as aspects of positive schizotypy; however, only the SPQ has a subscale measuring suspiciousness/paranoia (referred to as *Suspiciousness* or *Suspiciousness/Paranoid Ideations*, Raine 1991). Studies using the SPQ tend to consider positive schizotypy overall, rather than examining separate sub-scales (e.g., Fink et al., 2014; Gibson et al., 2009; Rominger et al., 2014). However, suspiciousness/paranoia may overlap with negative schizotypy (Raine et al., 1994; Kwapil et al., 2013), a dimension which may have differing or even inverse relationship with creativity (Acar & Sen, 2013). Further, paranoia is predicted by cognitive inflexibility (Freeman et al., 2008) - contrary to what is conducive to creativity (Nijstad et al., 2010). It is therefore possible that suspiciousness/paranoia could have an attenuating effect on the relationship between creativity and the aspects of positive schizotypy which have been previously linked to heightened creativity (namely magical thinking and unusual experiences), confounding results of previous research. Given that a larger proportion of the studies using the SPQ/SPQ-brief version (Raine & Benishay, 1995) have reported negative findings on the positive schizotypy and creativity relationship than those using O-LIFE (with a larger number of studies to use O-LIFE overall), an investigation of the role of suspiciousness/paranoia in the relationship between positive schizotypy and creativity is warranted.

Understanding the role of suspiciousness/paranoia in the relationship between positive schizotypy and creativity might have a direct bearing on psychosis prevention strategies. Our recent research suggests that training in mindfulness, a present-moment receptive awareness promoting openness, non-judgement and non-reactivity towards experience (Bishop et al., 2004), might contribute to prevention. We have found that experienced mindfulness meditators score higher on *Magical Thinking* but lower on *Suspiciousness* subscales of the SPQ than the general population (Antonova et al., 2016), showing a dissociation between the aspects of positive schizotypy associated with creativity and psychosis risk, respectively. Moreover, experienced meditators show attenuated sensory filtering as compared with healthy controls (Antonova et al., 2015), a sensory information processing feature linked to higher real-world creative achievement (Zabelina et al,



2015). Together, these findings suggest that mindfulness might be protective against the aspects of positive schizotypy that present high risk for psychosis, namely suspiciousness/paranoia, in the presence of factors associated with heightened creative ability such as magical thinking and attenuated sensory information filtering. A one-week mindfulness-based intervention was found to reduce paranoia in university students (Kingston et al., 2019), confirming that paranoia is amenable to mindfulness training.

Whilst mindfulness can be developed as a skill through practices such as meditation, it has also been shown to be a normally distributed personality trait (Baer et al., 2006). It is, therefore, plausible that dispositional mindfulness might have a differential relationship with the aspects of positive schizotypy, specifically magical thinking and suspiciousness/paranoia, and thus impact the relationship between different aspects of positive schizotypy and creativity. However, the inter-relationship between positive schizotypy, creativity and dispositional mindfulness is presently unknown, whilst being needed to inform and provide impetus for future research into using mindfulness training for psychosis prevention in individuals at risk.

Based on the previous research and above considerations, the main aims of the present study were novel and two-fold: i) to investigate whether the relationship between the aspects of positive schizotypy previously linked to heightened creativity – specifically, magical thinking and unusual experiences - and creative experience is attenuated by suspiciousness/paranoia; and ii) to explore whether dispositional mindfulness interacts differentially with different aspects of positive schizotypy (magical thinking and unusual experiences vs suspiciousness/paranoia) in their relationship with creative experience.

## **2. Methods**

### **2.1. Participants**

Three-hundred and forty-two (256 females; 84 males; 2 did not disclose) healthy volunteers aged 18-65 (mean age 25.9 years; SD = 8.4, range: 18-61) were recruited via London-based universities, creative Facebook groups and local forums. Participants were asked to confirm (via checkbox in the survey) that they met the following inclusion criteria: i) fluency in English; ii) no history or current diagnosis of a mental illness, neurodevelopmental or neurological disorders (as diagnosed by a professional health practitioner, neurologist, psychiatrist or psychologist), or iii) no history of or current substance abuse.

## 2.2. Design and Procedures

A cross-sectional online survey was conducted using via ‘*Bristol Online Surveys*’ platform. The study was advertised as ‘*Investigating the relationship between creativity, mindfulness and personality traits*’ to circumvent stigma associated with the term *schizotypy* due to its association with psychopathology. Completion of the survey constituted consent for study participation and £5 Amazon vouchers were given as remuneration.

The study was approved by the King’s College London Research Ethics Committee (LRS-17/18-5604).

## 2.3. Self-report measures

For the description of self-report measures and example items see Table A.1 of the Supplementary Materials. The demographics section of the survey included items sampling participants’ age, gender, and educational level (as indicated by highest achieved or current diploma/degree). Participants were also asked to indicate whether they currently engaged in regular creative activity (whether through study, profession, or hobby).

*Schizotypy*: The Schizotypal Personality Questionnaire (SPQ; Raine, 1991) was used to quantify schizotypal traits. The SPQ has 74 items constituting nine subscales capturing features of schizotypal personality, modelled on the *Diagnostic and Statistical Manual of Mental Disorders* (rev. 3rd ed.; *DSM-III-R*; American Psychiatric Association, 1987) for schizotypal personality disorder. The SPQ captures three symptom dimensions of schizophrenia: positive, negative and disorganised. Positive dimension subscales include: *Odd Beliefs/Magical Thinking*, *Unusual Perceptual Experiences*, *Ideas of Reference*, and *Suspiciousness*. The SPQ yields high internal reliability and validity (Raine, 1991).

*Creative Experience*: Most self-report studies to date used creative achievement and/or creative profession to assess creativity when investigating the schizotypy-creativity relationship, with only one study investigating phenomenology of creativity (Nelson & Rawlings, 2010). Given that the current study population comprised mainly young individuals (students), making it inappropriate to measure creativity by outcomes such as creative achievements or profession, we assessed creative experience using The Experience of Creativity Questionnaire (ECQ; Nelson & Rawlings, 2009). The ECQ consists of 63 items assessed on a Likert-scale and contains seven factors over two

parts: A and B. Part A captures the experience of the creative process: *Distinct Experience* (i.e., as compared with everyday life), *Anxiety*, *Absorption*, *Power/Pleasure*, *Clarity/Preparation*. Part B taps into the (existential) meaning of being engaged in creative activity. Only the responses to the items of Part A were included in the current investigation, since they tap into experiential aspects directly related to the creative process, and were found to positively associate with positive schizotypy as measured by O-LIFE (Nelson & Rawlings, 2010). The ECQ has demonstrated sound construct validity in a sample of 100 artists, but as stated by the authors “the ECQ could potentially be used in studies of creativity with non-artist samples or in studies of other creative domains. For example, a sample not selected for creativity could complete the questionnaire by thinking about their most creative experience in any domain or in everyday life.” (Nelson & Rawlings, 2009, p.50).

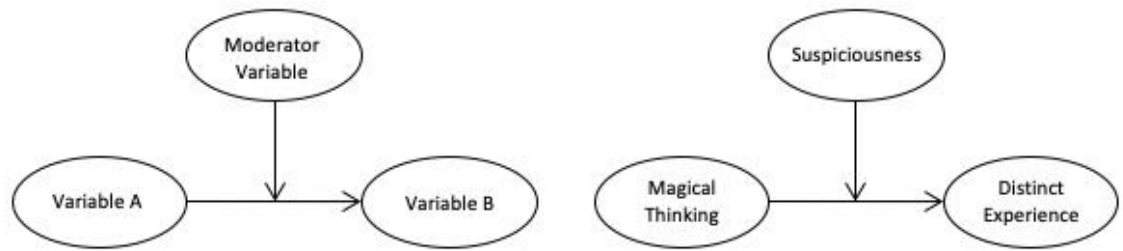
*Dispositional Mindfulness*: The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) is a 39-item Likert-scale questionnaire measuring five facets: *Observing*, *Acting with Awareness*, *Describing*, *Non-Reacting*, and *Non-Judging*. The FFMQ is a widely used measure of dispositional mindfulness with good reliability and validity, with higher scores (indicating higher trait mindfulness) found to associate with better psychological wellbeing (Baer et al., 2006; 2008).

## **2.4. Data analysis strategy**

The data were inspected for random response patterns using the analysis of univariate and multivariate outliers, as well as survey response times; no problematic responders were identified.

All variables were checked for distribution normality using Q-Q plots. The scores for the *Magical Thinking* subscale of the SPQ were positively skewed; consequently, non-parametric approaches were used throughout, including Spearman correlations to investigate relationships between the various scales, and bootstrapping to derive *p*-values and confidence intervals for the main analyses.

To investigate whether the associations between positive schizotypy aspects *Magical Thinking* and *Unusual Experiences* with each of the ECQ Part A subscales are attenuated by *Suspiciousness* (aim i), moderation analysis was performed using ‘PROCESS’ for SPSS (Hayes, 2013) with 10,000 bootstraps to derive *p*-values corresponding to an alpha level of .01 to adjust for multiple models. Simple slopes analysis was performed to further inspect moderations when *Suspiciousness* was at low, mean, and high levels (Hayes, 2013).



**Fig 1.** An example of a moderation analysis model testing the moderating effect of SPQ Suspiciousness subscale scores on the relationship between SPQ subscale Magical Thinking and ECQ factor Distinct Experience scores.

To explore whether dispositional mindfulness interacts differentially with the aspects of positive schizotypy (*Magical Thinking* and *Unusual Experiences* vs. *Suspiciousness* and *Ideas of Reference*) in their relationship with creative experience (aim ii), linear regressions with interaction effects were performed. To decrease the risk of Type I error (given the number of SPQ subscales and FFMQ facets), the number of models was reduced by deriving conglomerate scores for i) *Magical Thinking* + *Unusual Experiences* (MTUE) and ii) *Suspiciousness* + *Ideas of Reference* (SusploR). The subscales were combined into conglomerate scores on the basis of our previous research showing a dissociation between *Magical Thinking* and *Unusual Experiences* vs. *Suspiciousness* and *Ideas of Reference* in mindfulness meditators (Antonova et al., 2016). Cronbach's alpha for combined items for MTUE and SusploR was .77 and .89, respectively, indicating good reliability of the conglomerate scores. A total of 25 regression models were run to explore interaction effects, with 10,000 bootstraps to derive *p*-values corresponding to the alpha level of .01 to adjust for multiple models.

The regression models were as follows:

$$Y_i = (b_0 + b_1A_i + b_2B_i + b_3C_i + b_4AC_i + b_5BC_i) + e_i$$

Where A is the score on the first measure, B is the score on the second measure, C is the score on the third measure, with AC and BC being the interaction terms for the first with the third and the second with the third measures respectively.

For example:

$$\text{ECQ Absorption} = (b_0 + b_1\text{MTUE}_i + b_2\text{SusploR}_i + b_3\text{FFMQ Observing}_i + b_4\text{MTUE} \times \text{FFMQ Observing}_i + b_5\text{SusploR} \times \text{FFMQ Observing}_i) + \text{error}_i$$

### 3. Results

#### 3.1. Sample characteristics

Sample characteristics can be found in Table 1. Supplementary Materials Table A.1 provides Cronbach's alpha coefficients and Table A.2 provides the mean scores (and standard deviations) of the study's sample for SPQ positive schizotypy, ECQ Part A, and FFMQ subscales.

**Table 1.** Demographic Sample characteristics.

Demographic	N=342
Age (Mean ± SD years, range)	25.97 ± 8.37, 18-61
<i>n (%)</i>	
<b>Gender</b>	
Male	84 (24.6)
Female	256 (74.9)
Prefer not to say	2 (0.6)
<b>Education Level</b>	
GCSE/Equivalent	13 (3.8)
College, no degree	56 (16.4)
Associate degree	11 (3.2)
Bachelor's degree	142 (41.5)
Master's degree	96 (28.1)
Professional degree	4 (1.2)
Doctorate	20 (5.8)
<b>Creative Activity Status</b>	
Regularly creative*	137 (40.1)
Not regularly creative/not specified	205 (59.9)

\*Regularly engages in creative activity either as hobby, study, or profession

The mean total SPQ score ( $M = 20.62$ ,  $SD = 13.09$ ) and SPQ positive schizotypy score ( $M = 7.69$ ,  $SD = 6.21$ ) were similar to those observed in general population samples in creativity studies (e.g., Folley & Park 2005; Gibson et al., 2009). Levels of dispositional mindfulness, whilst marginally higher for *Observing*, were comparable to meditation-naïve general population samples (e.g., Baer et al., 2008, 2011; López et al., 2016). The mean for total FFMQ score was slightly lower than those found in Baer et al.'s (2011) student sample. The sample means for ECQ Part A total and subscale scores (apart from *Clarity/Preparation*) were slightly lower to those found for the sample of 100 artists

(Nelson & Rawlings, 2009), with the subsample mean of participants regularly engaged in creative activity being more comparable, whereas the subsample for participants without regular engagement was lower.

Although we defined creativity in broad terms for the purpose of the present study as a process that could be employed in many different contexts, regular engagement in creative activity (e.g. visual art, creative writing, music), either through hobby, profession, or study, was consistently associated with higher scores on all ECQ facets (Table A.5). Further, being regularly engaged in creative activity was associated with higher scores on overall positive schizotypy and its subscales, except for *Suspiciousness*, with the strongest association being for *Magical Thinking* (Table A.6). Subsamples with and without regular engagement in creative activities did not differ on overall SPQ scores.

### 3.2. Moderation analysis

*Magical Thinking*, *Unusual Experiences*, and *Suspiciousness* subscales of the SPQ significantly positively correlated with the scores on ECQ facets related to positive 'flow'-type experience of creativity, namely *Distinct Experience*, *Absorption*, and *Power/Pleasure* (See Table A.2; Fig. A.1a).

*Suspiciousness* attenuated the positive associations of *Magical Thinking* and *Unusual Experiences* with *Power/Pleasure* (see Table 2 for the results of the moderation analysis). The attenuating effect of *Suspiciousness* upon the relationship between *Unusual Experiences* and *Power/Pleasure* was highly significant (interaction effect:  $b = -.23$ , 95%CI [-.42, -.05],  $p = .01$ ), whereas it was significant at the unadjusted alpha level of .05 for the relationship between *Magical Thinking* and *Power/Pleasure* (interaction effect:  $b = -.29$ , 95% CI [-.54, -.03],  $p = .03$ ). Simple slopes analysis indicated that when *Suspiciousness* scores were low-to mean, there was a significant positive linear relationship between *Unusual Experiences* and *Magical Thinking* with *Power/Pleasure* scores ( $p < .001$ ); however, this relationship was disrupted (and completely non-significant for *Unusual Experiences*) when *Suspiciousness* scores were higher than mean (see Table 2 and Fig. 2).<sup>2</sup>

No further significant moderations were observed (see Table A.3 for full results).

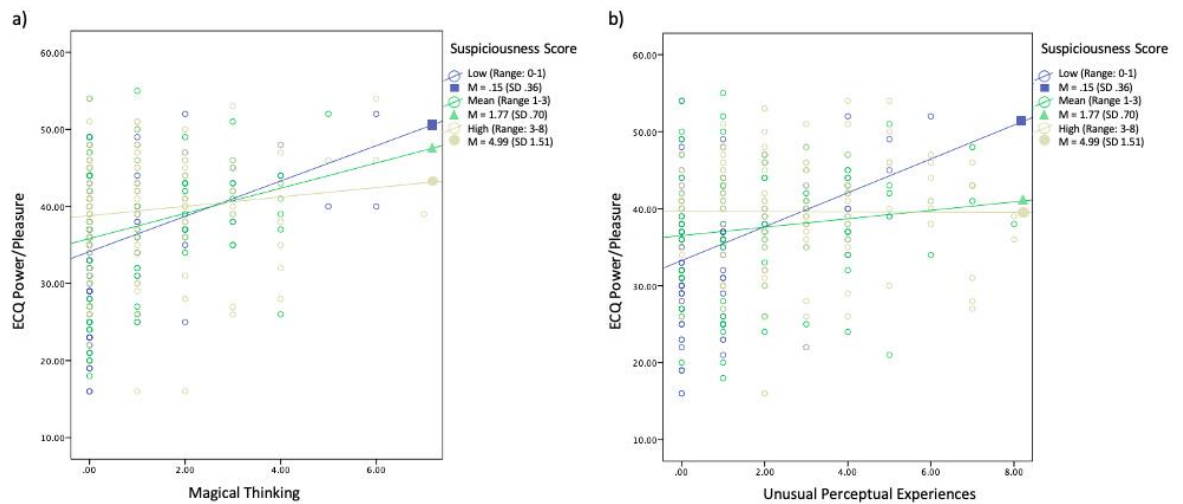
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<sup>2</sup> Post-hoc power analysis revealed that for our main hypothesis (moderation analysis), with the sample size of 342 and 3-predictor variable equations, the power for the detection of small-to-medium effect sizes obtained at the adjusted .01 level is .99 (Cohen, 1988; calculated using G\*Power, Erdfelder, Faul, & Buchner, 1996).

**Table 2.** Significant moderations and conditional effects of Suspiciousness on the relationship of SPQ Magical Thinking and Unusual Perceptual Experiences with ECQ Power/Pleasure.

	Model	$\beta$ (SE)	p value [95% CI]
<b>Magical Thinking</b>	Predictor		
	MT	1.52 (.29)	<.001 [.96, 2.08]
	Susp	.50 (.20)	.02 [.10, .90]
	MT x Susp	-.29 (.13)	.03 [-.54, -.03]
	<i>Model Summary <math>R^2 = .11</math>, <math>F(3,338) = 13.91</math>, <math>p &lt; .001</math>; <math>f^2 = .12</math></i>		
<b>Conditional Effects of Suspiciousness</b>			
	- 1 SD below Mean	2.16 (.43)	<.001 [1.32, 3.01]
	Mean	1.52 (.28)	<.001 [.96, 2.08]
	+ 1 SD Above Mean	.89 (.39)	.02 [.15, 1.62]
<b>Unusual Perceptual Experiences</b>	Unex	.80 (.23)	<.001 [.34, 1.25]
	Susp	.55 (.23)	.02 [.10, 1.00]
	UnEx x Susp	-.23 (.09)	.01 [-.42, -.05]
	<i>Model Summary <math>R^2 = .08</math>, <math>F(3,338) = 9.22</math>, <math>p &lt; .001</math>; <math>f^2 = .09</math></i>		
	<b>Conditional Effects of Suspiciousness</b>		
	- 1 SD below Mean	1.32 (.34)	<.001 [.64, 1.99]
	Mean	.80 (.23)	<.001 [.34, 1.25]
	+ 1 SD Above Mean	.27 (.28)	.33 [-.28, .92]

Abbreviations: MT = *Magical Thinking*; Susp = *Suspiciousness*; UnEx = *Unusual Perceptual Experiences*.



**Fig. 2.** Scatter plots of the raw data demonstrating the relationship between: a) SPQ Magical Thinking and ECQ Power/Pleasure, and b) SPQ Unusual Perceptual Experiences and ECQ Power/Pleasure for the sub-groups with low, mean, and high Suspiciousness scores.

### 3.2. Interaction effect analysis

There were a number of significant correlations between SPQ, FFMQ, and ECQ subscales (see Table A.2 and Fig. A.1). Higher total FFMQ and FFMQ subscale scores, except for *Observing*, significantly correlated with lower scores on SPQ *Suspiciousness*. Associations between FFMQ facets and ECQ Part A subscales were somewhat mixed, with positive correlations between FFMQ *Observing* and most ECQ subscales, and negative associations between most FFMQ facets and ECQ *Anxiety* (see Table A.2, and Fig. A.1). *Suspiciousness* and *Ideas of Reference* of the SPQ showed similar pattern of associations with the FFMQ subscales, whereas *Magical Thinking* and *Unusual Experiences* behaved similarly to each other, providing further justification for using conglomerate scores for *Magical Thinking* and *Unusual Experiences* (*MTUE*) and *Suspiciousness* and *Ideas of Reference* (*SusploR*) in exploring the interactions between positive schizotypy and dispositional mindfulness in relation to experience of creativity.

Table 3 presents a summary of the significant interaction effects (see Fig. A.2, and Table A.4 for the full results of linear regression analyses). FFMQ *Acting with Awareness* significantly interacted with *MTUE* in predicting *Clarity/Preparation* ( $b = .03, p = .004$ ), such that higher levels of *Acting with Awareness* increased the positive association between *MTUE* and *Clarity/Preparation* scores. FFMQ *Non-Reacting* significantly interacted with *MTUE* in predicting ECQ *Anxiety* ( $b = -.06, p = .003$ ), such that as *Non-Reacting* scores increased, the positive association between *MTUE* and *Anxiety* decreased. Higher levels of *Describing* strengthened the positive association between *MTUE* and *Power/Pleasure*, with the interaction effect being significant at the unadjusted alpha level ( $b = .06, p = .03$ ). A significant interaction between FFMQ *Describing* and *SusploR* indicated that as *Describe* scores increased, the stronger the positive association between *SusploR* and *Anxiety* scores became ( $b = .03, p = .047$ ).



**Table 3.** The results of multiple linear regression analysis with significant interactions between FFMQ facet scores and conglomerate scores for SPQ Magical Thinking + Unusual Experiences vs. Suspiciousness + Ideas of Reference on predicting ECQ factor scores.

		ECQ Factor									
		<i>Distinct Experience</i>		<i>Anxiety</i>		<i>Absorption</i>		<i>Power/Pleasure</i>		<i>Clarity/Preparation</i>	
FFMQ Facet	Predictor Variable	$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI
<b>Describing</b>	MTUE	-		.37** (.120)	[.12, .60]	-		.48** (.16)	[.18, .79]	-	
	SusploR	-		.29** (.09)	[-.13, -.46]	-		.42** (.11)	[.20, .64]	-	
	Desc	-		-.11* (.06)	[-.22, -.01]	-		.12 (.07)	[-.03, .26]	-	
	MTUE x Desc	-		-.02 (.02)	[-.06, .02]	-		.06* (.03)	[.00, .12]	-	
	SusploR x Desc	-		.03* (.01)	[.00, .06]	-		-.01 (.02)	[-.05, .03]	-	
	Model Summary	-		Adjusted $R^2$ = .14, $F(5,336) = 11.82, p < .001$		-		Adjusted $R^2$ = .11, $F(5,336) = 9.41, p < .001$		-	
<b>Non-Reacting (NR)</b>	MTUE	-		.37** (.12)	[.13, .61]	-		-		-	
	SusploR	-		.36** (.08)	[.16, .48]	-		-		-	
	NR	-		-.02 (.07)	[-.15, .11]	-		-		-	
	MTUE x NR	-		-.06** (.02)	[-.11, -.02]	-		-		-	
	SusploR x NR	-		.03 (.01)	[-.01, .06]	-		-		-	
	Model Summary	-		Adjusted $R^2$ = .13, $F(5,336) = 11.19, p < .001$		-		-		-	
<b>Acting with Awareness (AwA)</b>	MTUE	-		-		-		-		.22** (.07)	[.09, .35]
	SusploR	-		-		-		-		.07 (.05)	[-.02, .17]
	AwA	-		-		-		-		.06 (.03)	[-.01, .11]
	MTUE x AwA	-		-		-		-		.03** (.01)	[.01, .05]
	SusploR x AwA	-		-		-		-		-.01 (.01)	[-.02, .01]
	Model Summary	-		-		-		-		Adjusted $R^2$ = .06, $F(5,336) = 5, p < .001$	

\* $p < .05$ , \*\* $p < .01$

Abbreviations: AwA = Acting with Awareness; Desc = Describing; ECQ = Experience of Creativity Questionnaire; FFMQ = Five Facet Mindfulness Questionnaire; MTUE = Magical Thinking + Unusual Experiences conglomerate scores; NR = Non-Reacting; SusploR = Suspiciousness + Ideas of Reference conglomerate scores.

## 4. Discussion

The study aimed to investigate the inter-relationships between positive schizotypy, dispositional mindfulness, and experience of creativity. In partial support of our hypothesis, the positive linear relationship between the positive schizotypy aspects of magical thinking and unusual experiences with the experience of creativity was attenuated by higher levels of suspiciousness/paranoia. However, this effect was specific to the aspect of *Power/Pleasure*, and was significant at the unadjusted alpha level of .05 for *Magical Thinking*. No moderation effects were observed for *Distinct Experience*, *Absorption*, *Anxiety*, or *Clarity/Preparation*. Explorative analysis showed the interactive effects of dispositional mindfulness upon the relationship between the aspects of positive schizotypy and creative experience.

### 4.1. Moderation of the relationship between positive schizotypy and creative experience by suspiciousness

Suspiciousness/paranoia attenuated the positive relationship of magical thinking and unusual experiences with the power/pleasure aspect of creative experience. However, higher level of suspiciousness in itself was associated with higher power/pleasure. Nevertheless, when higher levels of magical thinking or unusual experiences were accompanied by *low-to-mean* suspiciousness levels, the self-reported power/pleasure was higher than when they were accompanied by *higher* levels of suspiciousness (see Fig. 2).

This pattern of the results may explain the inconsistency observed in the previous studies using the SPQ to investigate the relationship between positive schizotypy and creativity (for example, Minor et al., 2014 found a significant positive relationship, but Fink et al., 2013; Gibson et al., 2009; Rominger et al., 2014 did not). The findings using the O-LIFE, which captures magical thinking and unusual experiences but not suspiciousness, have been more consistent, with many studies having observed positive relationships between positive schizotypy and creativity (e.g., Batey & Furnham, 2008; Nettle & Clegg, 2006; Rawlings & Locarnani, 2008; Winston et al., 2014; but see Claridge & McDonald, 2009; Rybakowski & Klonowska 2011). Our findings suggest that the inconsistency between studies using different self-report measures may arise due to the quantification of positive schizotypy with or without suspiciousness as one of its aspects. Conversely, inconsistencies between the studies using the same self-report measure could be due to the samples being different on the levels of suspiciousness/paranoia; something that would be missed if suspiciousness is not assessed at all, or if only the total positive schizotypy score of the SPQ is used in probing the relationship with creativity. Future

studies should give special consideration to the role of suspiciousness when investigating the relationship between positive schizotypy and creativity. The studies using O-LIFE should additionally quantify suspiciousness/paranoia; for example, by utilising the recommended Paranoia/Suspiciousness Questionnaire (PSQ; Rawlings and Freeman, 1997), whereas the studies using the SPQ should pay attention to the ‘composition’ of high positive schizotypy by the scores on different subscales (e.g. high magical thinking and/or unusual experiences vs. suspiciousness/paranoia).

The observed attenuating effect of suspiciousness/paranoia was specific to the experience of power/pleasure, even though magical thinking and unusual experiences (as well as suspiciousness) were significantly positively correlated with other ‘flow’- type aspects of creative experience as measured by *Distinct Experience* and *Absorption* ECQ sub-scales. The *Power/Pleasure* subscale taps into a positive affect experienced during a ‘flow’-like state associated with being emerged in a creative activity (pleasure), as well as a sense of control (power) (Csikszentmihalyi, 1990; Nelson and Rawlings, 2009). Pleasure is a defining feature of ‘flow’ (Nelson & Rawlings, 2009) and a key part of the creative process (Henderson, 2004; Russ, 1993) that contributes to intrinsic motivation for creative activity (Nelson & Rawlings, 2007), aiding creative output (Amabile et al., 1985; Amabile et al., 1996). The specificity of the observed attenuating moderation upon power/pleasure as an aspect of creative experience should be investigated further, alongside understanding the interaction of magical thinking and/or unusual experiences with suspiciousness in relation to the type of creative activity and output.

#### **4.2. Inter-relationships between positive schizotypy, dispositional mindfulness, and creative experience**

When exploring the interaction effects between dispositional mindfulness and conglomerate scores on *Magical Thinking/Unusual Experiences* vs. *Suspiciousness/Ideas of Reference* on predicting ECQ subscale scores, mindfulness facets *Describing*, *Non-Reacting*, and *Acting with Awareness* were found to affect the relationship between the aspects of positive schizotypy and creative experience as captured by ECQ subscales *Power/Pleasure*, *Anxiety*, and *Clarity/Preparation*.

Specifically, *Describing* strengthened the predictive power of *Magical Thinking/Unusual Experience* upon *Power/Pleasure*. However, *Describing* also enhanced the predictive power of *Suspiciousness/Ideas of Reference* upon *Anxiety*. The items constituting ECQ’s *Anxiety* subscale mainly refer to the state of fragility, vulnerability, and exhaustion following the creative activity, but some items refer to the creative process itself as being

fragile due to absorption being interrupted by becoming self-conscious. Suspiciousness/paranoia and ideas of reference as instances of self-referential processing might 'colour' the ability to describe experiences through self-critical lens, increasing the sense of instability of the 'flow' state. Given the enhancing effect of *Describing* on the relationship between *Magical Thinking/Unusual Experiences* and *Power/Pleasure*, mindfulness training to reduce suspiciousness may remove the double-edge sword of the ability to describe experiences by reducing critical self-referencing and the activity of the associated Default Mode Network (DMN) - the main mechanism underlying the efficacy of mindfulness-based interventions (e.g. Berkovich-Ohana et al., 2012; Brewer et al., 2011; Farb et al. 2007; Goldin et al., 2009).

The potential positive effect of mindfulness training on creative experience in people with positive schizotypy is further indicated by the finding that *Non-Reacting* weakened the positive association between *Magical Thinking/Unusual Experience* and *Anxiety*. *Non-Reacting*, an ability to be present with one's experiences, whether pleasant or unpleasant, without reacting to or being caught up in them, might buffer against anxiety/vulnerability-provoking experience during and after creative process. Non-reactivity as one of the last mindfulness skills to emerge as a result of mindfulness training using Mindfulness-Based Cognitive Therapy (Kuyken et al., 2010), and was found to differentiate meditators from non-meditators (Antonova et al., 2016; Soler et al., 2014), adding impetus for using mindfulness-based interventions for developing non-reactivity towards the aspects of creative process that might be experienced as negative/unpleasant.

*Acting with Awareness* enhanced the predictive power of *Magical Thinking/Unusual Experience* upon *Clarity/Preparation*. *Acting with Awareness* facet is mainly comprised of the items pertaining to the Mindful Attention and Awareness Scale (Brown and Ryan, 2003), measuring the propensity to run on 'automatic pilot'/mind-wander during daily activities, so its association with being clear and aware of one's actions before and during creative engagement is intuitively appealing. *Acting with awareness* predicts cognitive flexibility and control (Moore & Malinowski, 2009), known to aid creativity (Zabelina & Robinson, 2010).

In addition to the interactions, dispositional mindfulness, except for the facet *Observing*, significantly correlated with lower suspiciousness, complimenting previous findings (Antonova et al., 2016; Kingston et al., 2019). Mindfulness promotes inter-personal attitudes (Condon, 2017) incompatible with suspiciousness/paranoia (Freeman et al., 2005), increasing metacognitive insight and decentred awareness (Chadwick, 2006),

which may reduce reactivity to and fixation upon suspicious/paranoid thoughts. Greater dispositional mindfulness also negatively correlated with ideas of reference, in line with the results of Antonova et al. (2016), a trait linked to both paranoia (Bebbington et al., 2013; Fenigstein & Vanable, 1992) and over-active DMN in schizophrenia, associated with hyper self-referencing (Cannon, 2015; Whitfield-Gabrieli et al., 2009).

Previous research points to a genetic overlap between creativity and schizophrenia and related disorders, with polygenic risk scores for these disorders being shown to significantly associate with creativity (Li et al., 2020; Power et al., 2015). Our findings provide further support for the notion that schizophrenia-related genotype/phenotype may afford evolutionary benefits such as creative ability, particularly in milder expressions of its features (Kinney et al., 2001, Acar et al., 2018) such as positive schizotypy (Acar & Sen, 2013), which might explain its presence in the general population. On the other hand, suspiciousness/paranoia, an aspect of positive schizotypy, carries high predictive power for conversion to psychosis in high-risk individuals (Cannon et al., 2008). The findings of the current study suggest that it has an attenuating effect of positive association of magical thinking and unusual experiences with the aspects of creative experience related to positive affect. Given that higher dispositional mindfulness was also associated with lower suspiciousness, together, our findings provide support for the use of mindfulness-based interventions in protecting against psychosis risk presented by suspicious/paranoia, whilst preserving and possibly enhancing an otherwise favourable association of magical thinking and unusual experiences with the creative process.

### **4.3. Study limitations**

The present study was primarily concerned with moderation and interaction effects, rather than prediction models of ‘best fit’; however, we note the relatively small effect sizes observed for the models. This may indicate noise due to measurement error (Loken & Gelman, 2017), with ECQ sub-facet ‘*Clarity/Preparation*’ having poor reliability in the present sample (Cronbach alpha of .53, see Table A.1). More generally, the ECQ’s validity and internal consistency is yet to be established. However, it is reassuring that we have replicated the findings using the SPQ to those reported by Nelson and Rawlings (2010) using O-LIFE. Furthermore, reassuringly higher scores on all facets of creative experience were associated with being regularly engaged with creative activity in the present sample, aiding ECQ’s construct validity.

The use of self-report mindfulness measures in the general population has been criticized due to the possibility of the items being misinterpreted by meditation-naïve individuals (Grossman, 2008). However, the observed interactive effects fit well within the theoretical framework used in this study. They do, nevertheless, require a replication due to the large number of tests performed, with some associations observed at the unadjusted alpha level.

## **5. Conclusions**

The study provides preliminary evidence that higher levels of suspiciousness/paranoia disrupt the positive relationship of magical thinking and unusual experiences with creative experience, which might help to explain the inconsistency of previous research into the link between positive schizotypy and creativity. The explorative findings suggest that dispositional mindfulness enhances the associations of magical thinking and unusual experiences with the aspects of creative experience related to positive affect and clarity/preparation. An overall pattern of the results, including the inverse relationship between most aspects of dispositional mindfulness and suspiciousness/paranoia, warrants the application of mindfulness-based interventions for reducing suspiciousness/paranoia as psychosis risk factor, whilst supporting the otherwise favourable association of magical thinking and unusual experiences with creativity.

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The funders reviewed the study as part of the competitive grant application review process but did not have any role in conducting research or reporting its findings.

## **Credit authorship contribution statement**

The study was designed by E. Antonova, P. Chadwick, and H. McDonald. Data collection was performed by H. McDonald, M. Babunashvili, and A. Finn. Data analysis strategy was developed and implemented by H. McDonald in consultation with A. Willard, E. Antonova, L. Valmaggia, and with contributions from I. Bakolis. H. McDonald has written the manuscript with the input, feedback, and revisions from E. Antonova, L. Valmaggia, P. Chadwick, and A. Willard.

## **Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### **<sup>1</sup> Previously reported alpha coefficients for questionnaires:**

Schizotypal Personality Questionnaire (Raine, 1991): The SPQ has been reported to have high reliability (Raine, 1991), with a Cronbach's alpha of .90 for the schizotypy scale as a whole, and alphas ranging from .71-.81 for positive schizotypy subscales (*Magical Thinking* = .81, *Unusual Perceptual Experiences* = .71; *Ideas of Reference* = .71; *Suspiciousness/Paranoid Ideation* = .78); .66–.72 for negative schizotypy subscales (*No Close Friends* = .67; *Constricted Affect* = .66; *Social Anxiety* = .72), and .70-.76 for disorganised schizotypy subscales (*Odd Speech* = .70; *Odd Behaviour* = .76).

The Experience of Creativity Questionnaire (Nelson & Rawlings, 2010): Subscales of the ECQ Part A have been demonstrated as having good reliability (Guttman coefficients as reported by Nelson & Rawlings, 2010: *Distinct Experience* = .81; *Anxiety* = .89, *Absorption* = .79; *Power/Pleasure* = .90), apart from *Clarity/Preparation* (.60).

Five Facet Mindfulness Questionnaire (Baer et al., 2006): The FFMQ subscales have previously shown good reliability (Cronbach's alpha: *Observing* = .83, *Describing* = .91, *Acting with Awareness* = .87, *Non-judging* = .87, *Non-reacting* = .75; Baer et al., 2006).

## **Chapter 4 (Study 2): Empirical investigation into the relationship between positive schizotypy, creativity and sensory information processing**

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### **4.1 Introduction**

#### **4.1.1 Overview**

The specific mechanisms which underlie the link between positive schizotypy and heightened creativity remain unclear. As outlined in Chapter 1 (Section 1.4), independent lines of research suggest this link may be underlined by a more open information processing style. Whilst implicated in schizophrenia development and considered a likely endophenotype in schizophrenia-related populations (Braff & Geyer, 1990; Braff et al., 1991; Freedman et al., 1991; Venables, 1964), more open information processing has also been observed in healthy creative individuals (e.g., De Manzano 2010; Martindale et al., 1996; Zabelina et al., 2015). However, the link between creativity, sensory information processing and positive schizotypy has not yet been investigated within a single sample.

The current chapter will firstly provide an overview of an established method for assessing sensory information processing – habituation of the acoustic startle response - before giving a brief outline of the methodological considerations for the assessment of creativity for the current study. It will then present the study aiming to empirically investigate whether the link between positive schizotypy and creativity is underlined by a more open information processing style.

#### **4.1.2 Positive schizotypy, creativity and sensory information processing**

##### **4.1.2.1 Assessment of sensory information processing: sensory information filtering and habituation**

One way to assess the ability to filter non-salient sensory information is by quantifying habituation to repeated stimuli; habituation to repetitive sensory information is considered the simplest form of non-associative learning (Abel et al., 1998). It can be indexed by suppressed amplitude of the auditory P50 event-related potential (measured via electroencephalography) in response to repeated auditory stimuli (Oranje et al., 2006; Schwarzkopf et al., 1993). A well-recognised paradigm for assessing habituation is to measure the startle reflex – a ubiquitous cross-species response to strong, unexpected



sensory stimuli (Braff et al., 1992; Braff & Geyer, 1990). In humans, startle reflex is commonly indexed by an involuntary eye blink response to a sudden loud noise (normally around 116db burst of white noise), which can be measured by the contraction of the orbicularis oculi muscle via electromyography (EMG; Abel et al., 1998). In healthy individuals, startle reflex amplitude reduces with repeated presentation of startling stimuli, since the information becomes redundant over time and is no longer novel (i.e., carries no information value). This is indicative of habituation to (filtering of) the incoming sensory information. Startle reflex habituation is considered a reliable paradigm for quantifying sensory information filtering across different populations (Abel et al., 1998).

#### **4.1.2.2 Evidence of reduced habituation in schizophrenia and positive schizotypy**

Attenuated habituation of sensory stimuli is seen in individuals with schizophrenia (Akdog et al., 2003; Bolino et al., 1994; Bolino et al., 1992; Geyer & Braff, 1982; Ludewig et al., 2003; Meincke et al., 2004; Takahashi et al., 2008). It has also been observed in individuals with schizotypal personality disorder (Cadenhead et al., 1993; Hazlett et al., 2015; Raine, 1997), and in healthy individuals with higher levels of schizotypy (Park et al., 2015; Wan et al., 2007; Wang et al., 2004), including positive schizotypal traits (Croft et al., 2001; Croft et al., 2004; but also cognitive-disorganisation dimension traits: Evans et al., 2007; Park et al., 2015).

Some studies have reported no (or only a trend for) reduction in habituation rates in schizophrenia (Braff et al., 1992; Ludewig et al., 2002) or schizotypy (Abel et al., 2004; Cadenhead et al., 2000; Meyhofer et al., 2019); however, these studies evaluated startle habituation using stimuli imbedded within a paradigm assessing pre-pulse inhibition (PPI). The PPI paradigm uses varied intensity and intervals of auditory stimuli, which include 'pulse-alone' (startle) trials that could be used to quantify habituation rates. It is argued that this method may be less adept at gauging habituation, and may be more adequately assessed in paradigms using stimuli of identical intensity (McDiarmid et al., 2017; Meincke et al., 2004).

#### **4.1.2.3 Evidence of reduced habituation in creative individuals**

As discussed in Chapter 1 (section 1.4), creative individuals similarly appear to have a more open style of sensory information processing. Reduced habituation is seen in healthy creative individuals (Martindale et al., 1996), and has been associated with better performance on components of divergent thinking (specifically, fluency; Ahsan et al., 2020), as well as higher real-world creative achievement (Zabelina et al., 2015). However, the relationship between habituation and creativity may not be uniform across

objective creativity tasks; for example, Ahsan et al., (2020) found an association between reduced filtering and increased fluency, but not originality, on a divergent thinking task. Conversely, Zabelina et al., (2015) found that originality on a divergent thinking task was associated with *increased* filtering. This suggests that reduced habituation may differentially relate to aspects of creativity and highlights in the need for taking a multifaceted approach to the assessment of creativity for the current investigation.

### **4.1.3 Methodological considerations for the assessment of creativity in positive schizotypy**

#### **4.1.2.1. Need for multiple creativity measures**

It has been recommended that researchers utilise as many measurement tools as is feasible for the assessment of creativity to help the growth of creativity research and assessment (Silvia et al., 2012). As discussed in Chapter 1 (section 1.3.1.2), Thys and colleagues (2014) recommend utilising the four '*P*' dimensions as a more adequate methodology for investigating creativity in psychopathology research. Specifically, This entails using multiple assessments (subjective and objective) to tap into the creative *Person*, *Process*, *Product* and *Place/Press*.

#### **4.2.1.2. Scoring domains of objective creativity tasks**

Several domains of divergent thinking can be assessed using objective measures (see Chapter 1, section 1.3). Some studies assess only a selection of creativity domains, such as fluency, or derive composite scores across multiple domains, usually justified by typically high correlations found between domains (e.g., Kim et al., 2006). However, the domains are dissociable depending on task instruction, indicating that they are distinct processes (Dumas & Runco, 2018). Thus, selective or conglomerate scoring methods may overgeneralise results or obscure nuanced patterns of the relationship between positive schizotypy and distinct features of creative thinking. Consequently, in addition to using multiple measures of creativity, it is worthwhile teasing apart the relationship of positive schizotypy with the distinct domains of divergent thinking that objective measures tap into.

#### **4.1.3.1 Sampling and analysis considerations**

Most studies used correlational analyses across a full range of positive schizotypy scores with performance on creativity assessments (as discussed in Chapter 1, section 1.3.2.1; e.g., Badzakova et al., 2011; Burch et al., 2006; Claridge & McDonald, 2009; Gibson et

al., 2008). Selective sampling (i.e. sampling high and low positive schizotypy scorers) may provide more robust detection of differences in creative performance. This is demonstrated by a positive relationship having been found when using group comparisons based on pre-selected positive schizotypy score criteria (Minor et al., 2014; Schuldborg et al., 1998), but not when comparing groups based on a median split within a sample with a full range of scores (Dinn et al., 2002).

#### **4.1.3.2 Summary**

Separate lines of evidence point to a shared link between positive schizotypy, creativity, and reduced habituation of sensory information. However, this has not yet been investigated in a single sample. There are also several methodological issues to be addressed regarding the assessment of creativity in positive schizotypy, i.e., assessing multiple domains of creativity using both subjective and objective measures in the same sample, using separate indexes for different aspects of objective task performance (rather than conglomerate scores), and directly comparing high with low positive schizotypy scorers.

#### **4.1.4 Aims and hypotheses**

##### **4.1.4.1 Primary aim: novel investigation into the interrelationship between positive schizotypy, creativity and sensory information filtering using robust methodology**

Using a paradigm optimised for assessing acoustic startle habituation, the primary aim of the current study was to empirically investigate whether the relationship between positive schizotypy and creativity is mediated by sensory information filtering within the same sample. For the comparability with previous research, total scores of positive schizotypy were used for the current investigation.

To firstly assess the relationship between positive schizotypy and creativity, the study followed recommendations of Thys et al. (2014) in taking a multifaceted approach to measuring creativity. Table 4.1 provides an overview of how the current study addressed the methodological issues identified when investigating the relationship between positive schizotypy and creativity. The current study utilised 3 of the 4 '*P*'s of creativity, since the widely used measure of *Place/Press* – creative achievement/profession – was not considered appropriate for the current sample (comprised mainly of young adults/students).

**Table 4.1.** Overview of methodological considerations for assessing the positive schizotypy-creativity relationship, with details of how these were addressed in the current investigation.

Methodological Issue	How it was addressed
Need for a multi-faceted approach to assessing creativity in psychopathology research	<p>Use of the four creative 'P's as a guide<sup>1</sup> for assessing creativity, utilising both subjective and objective measures of creativity:</p> <ul style="list-style-type: none"> <li>• <i>Person</i>: self-reported creative personality</li> <li>• <i>Process</i>: self-reported creative experience; objectively measured divergent thinking; objectively measured associational thinking style</li> <li>• <i>Product</i>: Objectively measured divergent thinking, with statistical and independently judging methods</li> </ul>
Need for scoring multiple domains of divergent thinking to avoid overgeneralisation of the relationship between positive schizotypy and creativity across distinct domains	<p>Assessing all aspects/domains of creativity that the objective measures of divergent thinking tap into:</p> <ul style="list-style-type: none"> <li>• Fluency, Flexibility, Originality, Elaboration</li> </ul>
Assessing the positive schizotypy-creativity link using correlational design	Use of selective sampling; directly comparing creativity in high vs. low-to-moderate scorers on positive schizotypy

<sup>1</sup>Whilst the four 'P's were used to guide the methodology of the current study, the fourth 'P' (Place/Press) was not utilised, since the widely used measure of this aspect (creative achievement/profession) was not considered appropriate for the current sample (which was comprised mainly of young adults/students).

#### 4.1.4.2 Hypotheses

The following hypotheses were tested:

*Hypothesis 1*: Individuals high in positive schizotypy will score significantly higher on the subjective and objective creativity measures compared with participants with low-to-moderate schizotypy.

*Hypothesis 2*: Individuals high in positive schizotypy will show significantly attenuated acoustic startle habituation compared with individuals with low-to-moderate positive schizotypy.

*Hypothesis 3*: The positive relationship between positive schizotypy and creativity will be mediated by acoustic startle habituation, with both higher positive schizotypy and creativity being associated with attenuated habituation.

#### 4.1.4.3 Secondary aims

Given the recommendations to use multiple measures of creativity due to different measures being designed to tap into different aspects of creativity, an exploratory aim of the current study was to investigate to what extent the creativity measures correlated with each other in the current sample.

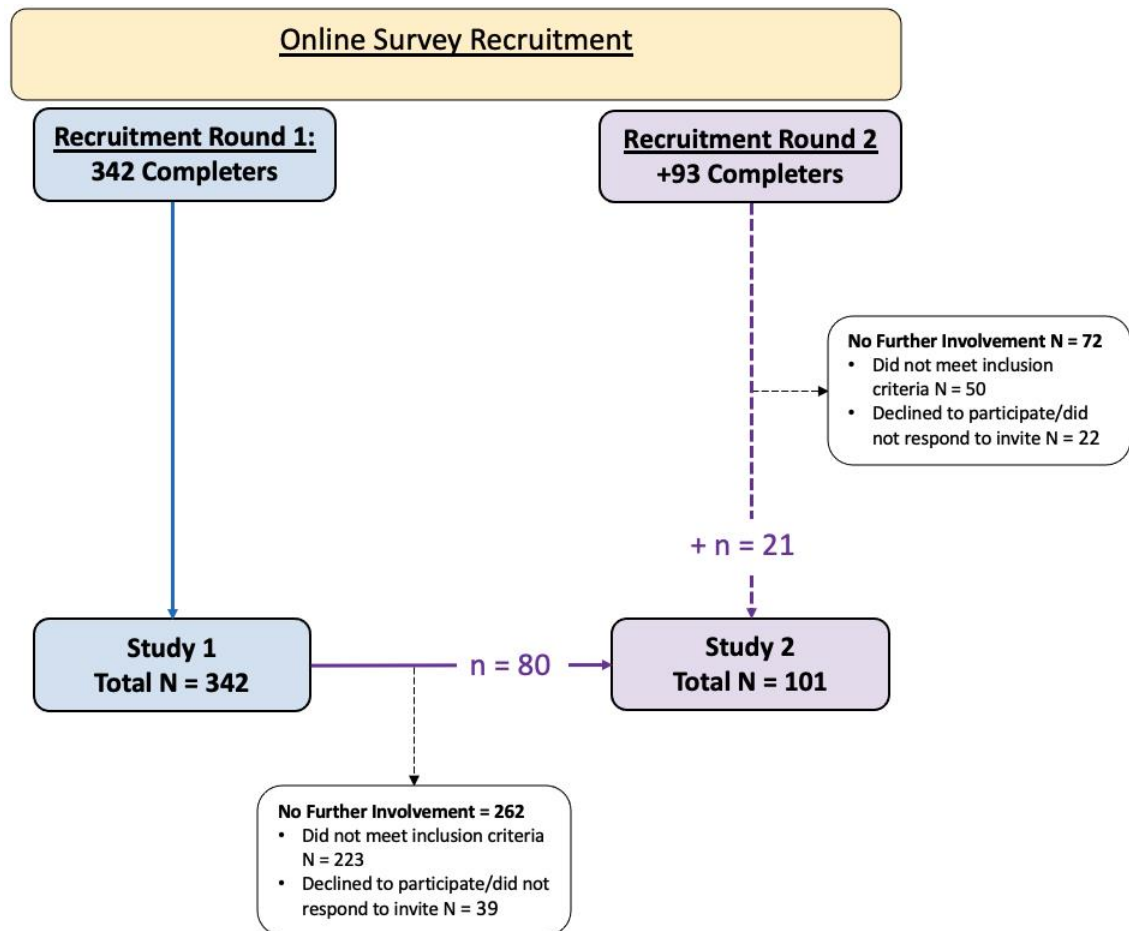
With consideration to the findings of Study 1 (Chapter 3) of a dampening effect of *Suspiciousness* upon the positive relationship between *Magical Thinking/Unusual Experiences* and positive aspects of creative experience, in the case of null hypothesis for Hypothesis 1 of the present study being accepted (i.e., no significant differences between high and low-to-moderate positive schizotypy groups on creativity), the role of suspiciousness/paranoia in the negative findings were investigated.

## 4.2 Methods

### 4.2.1 Participants

A total of  $n = 101$  participants took part in the current study (*Mean* age = 26.27, *SD* = 10.30, range = 18-64, 79% females), comprising of  $n = 80$  participants from Study 1 (Chapter 3) and a further  $n = 21$  participants who completed the survey as part of recruitment screening (see Fig. 4.1). The selective sampling criteria were: +0.5 *SD* above the mean on the positive dimension of the Schizotypal Personality Questionnaire (SPQ) for the high positive schizotypy (HPS) group and -0.5 *SD* below the mean on the positive dimension of the SPQ for the low-to-moderate positive schizotypy (L-MPS) group.

These criteria were based on data from a preliminary sample of  $n = 117$  (Chapter 3, section 3.1.1), which generated total schizotypy and positive schizotypy mean scores comparable to those reported in previous studies (see Table 4.2). As such, this mean was used as a 'centre point' on which to base positive schizotypy selection criteria for the groups in the current study. Mean scores for the final sample from Study 1 ( $N = 342$ ) remained unchanged, further justifying the use of these criteria. An additional exclusion criterion specific to the L-MPS group was scoring within the upper 10<sup>th</sup> percentile on the negative and disorganised dimensions of the SPQ; this was to avoid inadvertent comparison of the HPS group to individuals characterised by low-moderate positive schizotypy but particularly high negative or disorganised schizotypy, due to the absent or even negative association of these dimensions with creativity (see Chapter 3, section 3.2) .



**Figure 4.1.** Flowchart for recruitment for Studies 1 and 2.

**Table 4.2.** SPQ<sup>Total</sup> and Positive Schizotypy<sup>Total</sup> mean scores found in the sample(s) of Study 1 (compared with previous general population samples), on which recruitment and group allocation scoring criteria for Study 2 were based.

	SPQ Mean Score	
	Schizotypy <sup>Total</sup>	Positive Schizotypy <sup>Total</sup>
<b>Study1:</b> Preliminary Sample ( <i>N</i> = 117)	20.29	7.57
<b>Study 1:</b> Final Sample ( <i>N</i> = 342)	20.62	7.69
<b>Previous general population studies:</b>		
Wan et al., 2008	20.56	-
Folley & Park, 2005	20.90	-
Gibson et al., 2009	20.60	7.9

Abbreviations: SPQ = *Schizotypal Personality Questionnaire*

Participants confirmed (via checkbox on the survey) that they met the primary inclusion criteria as detailed in Chapter 2, section 2.2.4 and the methods of Study 1 (Chapter 3, section 3.2), with the additional criteria of having normal hearing. Participants were excluded from the study if they were taking medications which may affect sensory filtering (such as selective serotonin reuptake inhibitors, Oranje et al., 2011). They were also excluded if they indicated that they had recently been engaging in formal, regular mindfulness practice (as defined by an *intentional commitment* of time to practice at least 10 minutes per day, 4-5 days per week within the past 3-4 months), since intensive mindfulness practice has been shown to associate with reduced acoustic startle habituation (Antonova et al., 2015). Participants were asked to abstain from recreational drug use for at least 48 hours prior to their lab visit.

Using the above selection and exclusion criteria, the sample in each group was: *n* = 57 participants in the HPS group (*Mean* age = 25.32, *SD* = 9.12; range: 18-58; 78% females); *n* = 44 participants in the L-MPS group (*Mean* age = 27.52, *SD* = 11.73; range: 18-64; 79% females).

#### 4.2.1.1 Smoking status

Cigarette smoking can influence sensory information filtering by reducing initial startle amplitude in healthy individuals (Kumari et al., 1996), as well as temporarily ‘normalising’ sensory filtering in psychosis-prone individuals (Kumari et al., 1997). All participants who identified as current regular smokers/(vapers) (*n* = 3) confirmed they had not consumed nicotine within the hour prior to attending the session. The half-life of nicotine

(approximately 2 hours; Benowitz, Hukkanen & Jacob, 2009) was ensured by the time the sensory information filtering paradigm was conducted.

#### **4.2.1.1 Power calculations**

Based on sample size and the statistics found in previous studies of the relationship between schizotypy and divergent thinking measures (Green & Williams, 1999), prospective power analysis indicated that with a sample size of  $n = 40$  in each group gives 0.82 power of detecting medium size effect in the mean divergent thinking between high and low positive schizotypy groups ( $SD = 0.5$ ) and medium size correlations between schizotypy and divergent thinking measures ( $r = 0.3$ ). A larger sample in each group was recruited for the robust investigation of the sensory information filtering as a mechanism mediating the relationship between positive schizotypy and creativity.

#### **4.2.2 Design and procedures**

A cross-sectional, between-subjects design was employed. Eligible participants were invited to the study via email and provided informed consent before taking part. The study was advertised as '*Investigating the Relationship between Personality, Creativity and Sensory Information Processing*'. All participants initially completed the online survey as outlined in the methods of Study 1 (Chapter 3, Section 3.2), including demographics (age, gender, education level and whether they engage in regular creative activity), as well as the self-report measures of schizotypy and subjective experience of creativity. All other assessments were completed at a lab at the Institute of Psychiatry, Psychology and Neuroscience, King's College London, UK, which took approximately 2 hours. Participants were remunerated with £20 (cash) and compensated for travel expenses.

#### **4.2.3 Materials**

Schizotypy: The SPQ (Raine, 1991): Details of this self-report measure can be found in the methods of Study 1 (Chapter 3, Section 3.2).

Table 4.3 contains a summary of the subjective and objective measures used to assess creativity.



**Table 4.3.** Subjective and objective measures used to assess 3 of the 4 'P' dimensions in the current study.

Person	Process	Product (of objective tasks)	Place/Press
<i>Subjective:</i> <ul style="list-style-type: none"> <li>• Creative Personality Scale (CPS)</li> </ul>	<i>Subjective:</i> <ul style="list-style-type: none"> <li>• Creative Experience Questionnaire (ECQ<sup>Part A</sup>)</li> </ul> <i>Objective:</i> <ul style="list-style-type: none"> <li>• Alternative Uses Task (AUT)</li> <li>• Essays</li> <li>• Kent-Rosanoff Word Associations</li> </ul>	<ul style="list-style-type: none"> <li>• Number/flexibility /elaboration of responses</li> <li>• Statistical Originality of responses</li> <li>• Quality of responses (Consensual Assessment Technique)</li> </ul>	N/A

#### 4.2.3.1 Subjective measures of creativity

The creative *Person* was measured using the Creative Personality Scale (CPS; Gough, 1979). This self-report measure contains 18 adjectives indicative of creative personality (e.g., 'Unconventional') and 12 contrasting adjectives (e.g., 'Narrow Interests'), with scores ranging from -12 to +18 (higher scores indicating creative personality). The CPS has been shown to be reliable within a healthy population comprised of both creative and non-creative individuals, with a Cronbach's alpha of .73 (Gough, 1979). Scores on this measure have previously been shown to positively associate with scores on other self-report and objective measures of creativity (Carson et al., 2005; Gibson et al., 2009; Gough, 1979; Rawlings & Locarnini, 2008) and is considered a valid measure of creative personality (Carson et al., 2005). Participants were asked to select all words they felt best described themselves.

The creative *Process* was measured using the Experience of Creativity Questionnaire (ECQ<sup>Part A</sup>; Nelson & Rawlings, 2009). Details of this measure can be found in the methods section of Study 1 (section 3.2 of Chapter 3). As in Study 1, only responses to Part A tapping into the experiential aspects of the creative process (rather than more general, contextual aspects covered by Part B) were used for the current study.

#### 4.2.3.2 Objective measures of creativity

The creative *Process* and *Product* were assessed using three measures:

1. The *Alternative Uses Task* (AUT; Guilford, 1967) is a divergent thinking task wherein participants were asked to think of as many different uses for three everyday objects as possible within a time limit of three minutes *per* object, as implemented by previous studies (e.g., Minor et al., 2014; Wang et al., 2017). Participants were explicitly instructed to 'be creative' in their responses, as previously recommended (Nusbaum et al., 2014). The objects (paperclip, newspaper and pencil) were selected on the basis of their use in previous research (e.g., Minor et al., 2014) and their varied structure content.

##### Scoring

Responses were recorded on a computer and scored for the following domains:

- Fluency: The total number of responses given.
- Flexibility: Responses were processed using the qualitative software 'NVivo' (version 11), where uses were labelled and clustered by category. For example, for 'Newspaper', the responses 'to make paper hat' and 'to make paper dress' would cluster under a single category of 'Make Clothing'. The total number of categories which each participants' responses fell across was then calculated.
- Originality: The statistical rarity of a response within the sample was calculated by awarding one point to every response which was provided by <5% of the total sample, and two points for every response which was provided by <1% of the sample.
- Elaboration (extension of ideas): Reflected in added details within responses. For example, 'to make a hat to keep your hair dry in the rain' as a use for *Newspaper* would be awarded a point for elaboration, whereas a response of 'to make a hat', which would score zero.

2. The creative *Essays* task (adapted from Miller & Tal, 2007) is a divergent thinking task wherein participants were asked to write short creative pieces for hypothetical scenarios. The following scenarios were presented to participants:

- 1) *Imagine that all clouds had really long strings hanging from them – strings hundreds of feet long. What would be the implications of that fact for nature and society?*
- 2) *If you could experience what it's like to be a different kind of animal for a day, what kind of animal would you want to be, and why?*
- 3) *What do you hope the world will be like in 100 years?*

A limit of 10 minutes per question was allocated, in contrast to the 2-6 minutes used by Miller & Tal (2007), since fewer questions were used. Three questions (of a possible 6) were chosen due to their neutrality, with alternative options being themed on marriage, sex change and attracting a mate. As with the AUT, participants were instructed to 'be creative'. This task and methods were chosen on the basis of the recommendations by service users (Feasibility and Acceptability Support Team for Researchers, NIHR, UK), who felt it was appropriate to provide participants with a task of more explicit opportunity to elaborate ideas without pressure to think of many different ideas (see section 2.3 of Chapter 2).

### Scoring

Scoring of this task focuses on overall idea *quality* rather than a number of ideas or statistical rarity of responses (in contrast to the AUT). This was assessed using the Consensual Assessment Technique (CAT; Amabile, 1982). Essays were scored by the researcher and three independent raters (blind to group allocation) using a scale of 1-5 (1 = not at all creative to 5 = highly creative). Pilot scoring for five responses was conducted by the raters using their best judgment of what is 'creative'. On the basis of the pattern of agreement, a loose guide for scoring the remaining responses were agreed upon between the raters. This was not a rigorous list on which to base a strict definition for creativity, but intended to be a scoring aid; for example, scoring was not limited to originality of ideas (given the large sample size and likelihood of repetitive concepts) or writing skill, but extended to affective elements and elaboration/depth of ideas. For major discrepancies, raters discussed their score and re-assessed the response separately. Composite score for the Essays were calculated by averaging the ratings across responses for the three questions, and inter-rater agreement rate was calculated.

3. Associational thinking style was measured using the *Kent-Rosanoff Word Associations Task* (K-RWA; Kent & Rosanoff, 1910). Creative individuals have been found to respond with more unusual word associations on this task (Rawlings & Locarnini, 2008). Due to time constraints, the first 50 words of the original 100 neutral

and common words were presented. Participants were asked to freely and quickly respond with a word they associate with each stimulus (for example, the associated response of 'Dark' to the target word 'Night'). Participants were instructed to respond to each word without deliberation and that there were no 'correct' answers.

### Scoring

Prior to statistical analysis, responses were screened for answers which constituted the words with the same root (e.g., 'happiness' and 'happy'). Scoring was in line with the methods used by Rawlings and Locarnini (2008), with responses categorised into three types:

- 'Idiosyncratic' (unusual/uncommon) responses were categorised as such if they were given only by 1-3% of the sample;
- 'Prime' responses were the most common word associations within the sample (which were not also opposite responses);
- 'Opposites' - responses that were the direct opposite to a word given (for example, the response 'Light' for the word 'Dark'). Though not of primary interest, this category was included for completion, since it was noted by Rawlings and Locarnini (2008) that some research has shown that creative individuals and individuals with schizophrenia may be more likely to give opposite responses on associative word tasks (Rothenberg, 1973, 1983).

#### **4.2.4 Acoustic startle habituation paradigm**

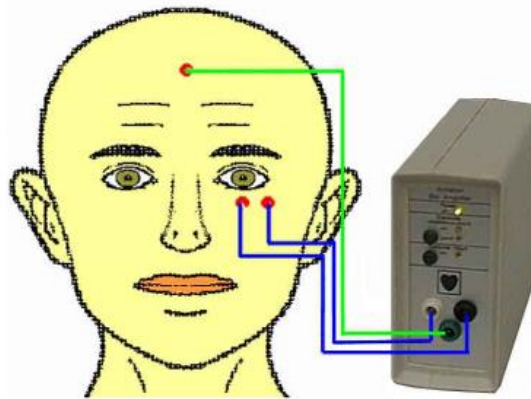
The acoustic startle habituation (ASH) paradigm consisted of 3 blocks of 12 trials with the average inter-stimulus interval of 15 seconds within each block (range 9-21 sec), and an inter-block interval of 40 sec to examine a short-term startle response recovery.

The startling stimulus was a 40-ms presentation of 115 dB (A) SPL white noise over 70 dB (A) continuous background white noise with the stimuli rise time of less than 1 ms. EMG activity was recorded for 250 ms from the onset of the pulse stimulus. The EMG activity was band-pass filtered with high and low-pass cut-off points set to 100Hz and 1kHz, respectively, with a 50Hz notch filter to avoid 50Hz interference. Amplification gain control of the EMG signal was kept constant for all participants. EMG signal from the right orbicularis oculi muscle was recorded to quantify involuntary eye blink reflex to startling auditory. Attenuated habituation of the startle response (the amplitude of the

eye blink) to the repeated auditory stimulus in comparison to the prior stimulus was reflective of decreased information filtering.

#### 4.2.3.1 Equipment

The paradigm was delivered and the EMG activity was recorded by a computerised startle response monitoring system (Mark II, SR-Lab, San Diego, California). The startle probes were delivered via headphones (TDH-39P, Maico). The EMG activity was recorded by placing two 4mm silver/silver chloride electrodes filled with a small amount of multi-purpose electrolyte gel (SignaGel®, Parker Laboratories Inc., USA) upon the right orbicularis oculi muscle, and a grounding electrode behind the right ear upon the mastoid (See Fig. 4.2). The skin surface was prepped with a sterile swab prior to electrode placement, which were attached using adhesive rings (13mm x 5mm).



**Figure 4.2.** Example diagram of a startle reflex experimental set-up and EMG electrode positioning. The grounding electrode (in green) was positioned behind the ear for the current study.

#### 4.2.3.2 Procedure

Participants sat in an upright position during testing in a quiet, moderately lit lab during testing, and were given a demonstration of the background noise and 2 startle probes (not included for analysis) before beginning the testing session. Participants were asked to maintain a relaxed gaze towards a slightly raised neutrally coloured sticker on the wall ahead of them. All participants were instructed to remain 'alert and awake' throughout the session, without paying particular attention to the noises or attempting to suppress eye blinks in response to them. The researcher sat laterally to the participants (i.e., away from their peripheral vision) to avoid distraction during data acquisition. The testing

session began with a 4-minute acclimatization period of the continuous white noise; the total duration of the experiment was approximately 20 min.

### ASR Data Processing

The EMG data were visually inspected on a trial-by-trial basis offline and responses were scored using the analytic programme of the system, which converted data from analogue to milliseconds (for latency-to-peak) and digit units (for response amplitude). Response onset was defined by a shift of 7.63 uV from the baseline occurring within 20-120 ms from the onset of the startle stimulus. Latency to peak was defined as the latency to the point of peak amplitude which occurred within 18-150 ms of the onset of the startle stimuli. Responses were rejected if the onset-peak latency differed by more than 95 ms, or when the baseline values shifted by more than 50 units.

Data were excluded from ASH analysis for participants who had >50% rejected trials. For participants who had rejected responses for some (i.e., <50%) of the of the trials means were imputed using the average trial values for the participant in question.

Habituation slopes for the 3 blocks of 12 trials and the overall habituation slope (across all 36 trials) were calculated for each participant using the following equation (as used in previous studies; Antonova et al., 2015; Orr et al., 1997):

$$Y = \alpha + bX$$

Where  $X$  corresponds to the trial number (trial specific stimulus), and  $Y$  corresponds to the square root of the response amplitude for that trial. The trial number ( $X$ ) is log-transformed, and startle amplitudes ( $Y$ ) are square-root transformed to reduce variability, skewness and heteroscedasticity associated with large responses occurring in some individuals. The intercept ( $\alpha$ ) corresponds to initial reactivity (the amplitude response to the first trial's startle stimulus). The primary variable of interest is the slope ( $b$ ), which reflects the individual rate of habituation. Larger negative  $b$  values indicate *faster* and/or *steeper* habituation. Using habituation slope is argued to be more sensitive to using block averages for quantifying startle habituation (McDiarmid et al., 2017).

## 4.3 Data analysis strategy

All statistical analyses were performed using SPSS (IBM, version 24).

### 4.3.1.1 Data diagnostics

The data for all variables were checked for distribution normality by visually inspecting Q-Q plots and histograms for each group separately. Where the data were not normally distributed, non-parametric statistical approaches were used for the analyses involving these variables. Box-plot graphs were used to check for outliers on all variables.

### 4.3.2.2 Reliability assessment

Cronbach's alpha was calculated for the ECQ<sup>Part A</sup> scales across the whole sample to further establish its reliability in a general population sample.

Inter-rater reliability for the Essays task (as scored by independent raters) was estimated using the Intraclass Correlation Coefficient (ICC; Bartko, 1966). The ICC was calculated using a two-way mixed-effects model with an absolute agreement definition.

### 4.3.2.3 Group demographics

An independent *t*-test was used to identify any group differences in mean age, and chi-square tests were used to test for group differences in gender, current education level and creative activity status. Independent *t*-tests were also used to assess group differences in SPQ subscale scores.

### 4.3.2.4 Hypothesis testing

Hypothesis 1: Mann-Whitney *U* tests and independent *t*-tests were used to examine whether the HPS group scored significantly higher on subjective and objective creativity measures than the L-MPS group. Where significant group differences were identified, within-group correlations were conducted to further investigate relationships between positive schizotypy subscales and creativity measures.

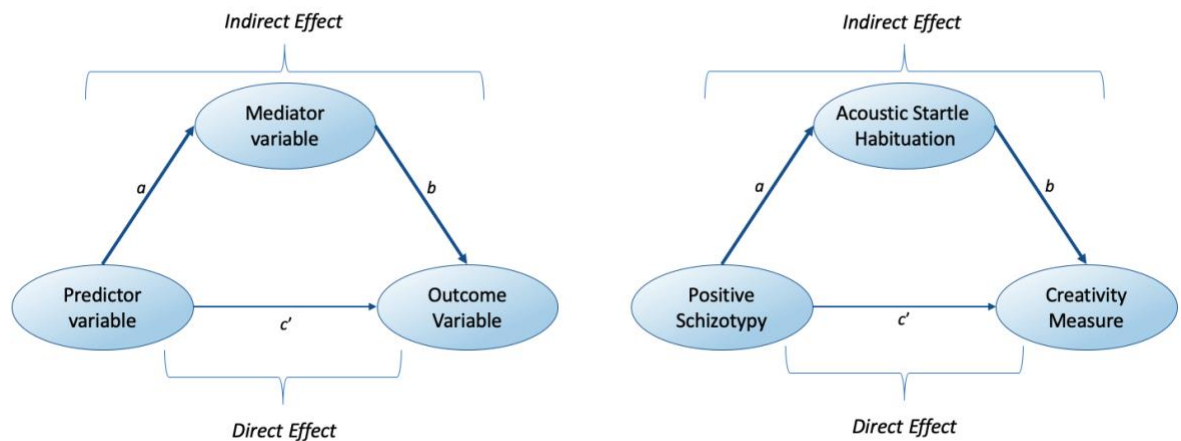
Hypothesis 2: Mann-Whitney *U* and independent *t*-tests were used to assess group differences on acoustic startle response, including initial reactivity (square root of the response amplitude for the first trial of the first block), latency to peak (ms), and habituation over i) the 3 blocks of 12 trials (mean beta slopes per block) and ii) overall startle habituation (the mean beta slope over all 36 trials).

**Hypothesis 3:** Mediation analysis was implemented to examine whether startle habituation performance mediates the positive relationship between positive schizotypy and creativity, using the 'PROCESS' macro for SPSS (model 4, version 3; Hayes, 2013) with 10,000 bootstraps to derive robust 95% confidence intervals for estimating indirect effects, as recommended by Hayes (2009). The mediation models were run within each group separately, with the ASH slopes that best index habituation (block 1 and overall habituation slopes) entered as the mediators in separate models (Fig 4.3ii).

i. Simple relationship



ii. Mediated relationship



**Figure 4.3.** An example of a simple relationship (i) and a mediation model diagram (ii) testing the relationship of the positive schizotypy subscale of the SPQ and a creativity measure as mediated by acoustic startle habituation, where letters a, b, c and c' represent the unstandardised regression coefficients between the variables.

#### 4.3.1.2 Secondary analyses

**Relationship between creativity measures:** Bivariate correlations, using Pearson or Spearman (for the variables where the data were non-normally distributed) correlation coefficients, were used to investigate the relationships between creativity measures (subjective with subjective, objective with objective, and subjective with objective).

**Effect of suspiciousness:** Where there were no significant group differences on creativity measures, moderation analysis was performed to test for a moderating effect of



*Suspiciousness* upon the relationship between *Magical Thinking* and *Unusual Experiences* (the aspects of positive schizotypy thought to be related to increased creativity) with the respective creativity measure. This was carried out using 'PROCESS' for SPSS (model 1, version 3; Hayes, 2017), with 10,000 bootstraps to derive robust 95% confidence intervals for estimating moderation effects. Simple slopes analysis was performed to further inspect the conditional effects of low, mean, and high levels of *Suspiciousness* (Hayes, 2017).

## 4.4 Results

### 4.4.1 Inter-rater and scale reliability

The ECQ<sup>Part A</sup> showed acceptable-to-good reliability in the current sample, with the CA of .82 for *Distinct Experience*, .88 for *Absorption*, .67 for *Anxiety*, .78 for *Power/Pleasure* and .63 for *Clarity/Preparation*.

The ICC (absolute agreement) for the raters of the Essays task was .85 [95% CI: .80-.89], indicating good interrater reliability (Koo & Li, 2016).

### 4.4.2 Final sample

The final sample used for the analysis of subjective and objective measures of creativity was  $n = 57$  (HPS) and  $n = 44$  (L-MPS), apart from the analysis of the K-RWA task (HPS  $n = 57$ ; L-MPS  $n = 43$ ) where responses were not available for one participant due to technical error.

The final sample for the ASH paradigm analyses was  $n = 50$  (HPS) and  $n = 43$  (L-MPS); data for <8% of the full sample (HPS  $n = 5$ , LMPS  $n = 1$ ) were rejected due to low data quality (see section 4.2.3.2 for rejection criteria), and data from one further participant from the HPS group were not available for the ASR task, since they withdrew from the task due to a strong dislike of the pulse stimuli. A further participants' ASH data (HPS group) were excluded as the participant was identified as a repeated extreme outlier. Trial means were imputed for <14% of the full sample, which were included in the analyses, ( $n = 8$  HPS participants,  $n = 6$  L-MPS participants; see section 4.2.3.2).

Demographic characteristics of the participants in two groups are presented in Table 4.4. There were no significant differences between the groups on mean age, gender, education level or being engaged in regular creative activity. However, It was noted that a larger proportion of individuals, across the whole sample, who reported being regularly

actively creative ( $n = 39$ ), fell within the HPS group (64.1%, compared with the L-MPS group; 35.9%). This reflected a larger proportional difference than for the number of participants who were not regularly engaged in creative activity across the whole sample ( $n = 62$ ) which fell into each group - the proportions for which were more similar (HPS: 51.6% vs L-MPS: 48.4%).

**Table 4.4.** Sample demographics, with statistics, for the high (HPS) and low-to-moderate (L-MPS) positive schizotypy groups.

Demographic	Group		Statistics		
	HPS ( $n = 57$ )	L-MPS ( $n = 44$ )	$t$	$\chi^2$	$p$
	Mean $\pm$ SD	Mean $\pm$ SD			
<b>Age</b> (years) [range]	25.32 $\pm$ 9.12 [18-58]	27.52 $\pm$ 11.73 [18-65]	1.06	-	.290
	<u><math>n</math> (%)</u>	<u><math>n</math> (%)</u>			
<b>Gender</b>			-	.005	.941
Male	12	9			
Female	45	35			
<b>Education Level</b>			-	6.78	.341
GCSE/Equivalent	2 (3.5)	2 (4.5)			
College, no degree	11 (19.3)	10 (22.7)			
Associate degree	3 (5.3)	2 (4.5)			
Bachelor's degree	27 (47.4)	11 (25)			
Master's degree	11 (19.3)	14 (31.8)			
Professional degree	1 (1.8)	3 (6.8)			
Doctorate	2 (3.5)	2 (4.5)			
<b>Creative Activity Status</b>			-	1.52	.218
Regularly creative*	25 (43.9)	14 (31.8)			
Not regularly creative	32 (56.1)	30 (68.2)			

\*Regularly engages in creative activity either as hobby, study, or profession

Table 4.5 presents group scores on schizotypy. The HPS group scored significantly higher on all aspects of positive schizotypy compared with the L-MPS group (Total:  $U = <.00$ ,  $p <.001$ ; *Magical Thinking*:  $U = 570.00$ ,  $p <.001$ ; *Unusual Perceptual Experiences*:  $U = 379.50$ ,  $p <.001$ ; *Ideas of Reference*:  $U = 65.50$ ,  $p <.001$ ; *Suspiciousness*:  $U = 135.00$ ,  $p <.001$ ).

The group means for negative and disorganised schizotypy domains fell beneath the upper 25<sup>th</sup> percentile of scores of the general population, based on the sample of Study 1 (upper 25<sup>th</sup> percentile for negative = 12.25; disorganised = 8.00, for a sample of  $N = 342$ ). This indicated that neither group were characterised by particularly high scores on these domains. However, the HPS group scored significantly higher than the L-MPS group on both domains (negative:  $U = 606.00$ ,  $p <.001$ ; disorganised:  $U = 433.50$   $p = <.001$ ).

**Table 4.5.** Group means (and medians) and standard deviations with statistics for group differences on the Schizotypal Personality Questionnaire (SPQ).

Schizotypy (SPQ)	Group		Test Statistics	
	HPS ( <i>n</i> = 57)	L-MPS ( <i>n</i> = 44)	Mann-Whitney <i>U</i> ( <i>z</i> )	<i>p</i>
	Mean (Mdn) ± SD	Mean (Mdn) ± SD		
<b>SPQ<sup>TOTAL</sup></b>	35.28 (34.00) ± 10.26	13.36 (12.50) ± 5.57	25.50 (-8.42)	<.001
<b>Positive Schizotypy<sup>TOTAL</sup></b>	16.24 (15.00) ± 4.55	3.66 (4.00) ± 1.22	<.00 (-8.19)	<.001
Magical Thinking	1.93 (2.00) ± 1.72	.50 (.00) ± .66	570.00 (-4.98)	<.001
Unusual Perceptual Experiences	3.68 (3.00) ± 2.11	1.15 (1.00) ± 1.28	379.50 (-6.14)	<.001
Ideas of Reference	5.61 (5.00) ± 2.86	.98 (1.00) ± 1.15	65.50 (-7.80)	<.001
Suspiciousness	5.12 (5.00) ± 2.08	1.02 (1.00) ± 1.00	135.00 (-7.22)	<.001
<b>Negative Schizotypy</b>	11.42 ± 5.39 (11.00)	6.50 ± 4.26 (6.00)	606.00 (-4.45)	<.001
<b>Disorganised Schizotypy</b>	7.61 ± 3.65 (8.00)	3.23 ± 2.80 (2.50)	433.50 (-5.64)	<.001

Abbreviations: HPS = High Positive Schizotypy; L-MPS = Low-Moderate Positive Schizotypy

#### 4.4.3 Hypothesis 1: group comparisons for creativity

The results of the between-group analyses, including group mean (and median) scores, for all creativity measures (subjective and objective) are presented in Table 4.6.

##### 4.4.3.1. Subjective creativity measures

The HPS group scored significantly higher than the L-MPS group on all subscales of the ECQ<sup>Part A</sup>: *Distinct Experience* ( $U = 632.50$ ,  $p < .001$ ), *Anxiety* ( $U = 694$ ,  $p < .001$ ), *Absorption* ( $U = 903.50$ ,  $p = .016$ ), *Power/Pleasure* ( $U = 749$ ,  $p = .001$ ), *Clarity/Preparation* ( $U = 825.50$ ,  $p = .003$ ).

There were no significant differences between the groups on the CPS.

##### 4.4.3.2. Objective creativity measures

The HPS group gave significantly more *Idiosyncratic* (statistically uncommon) responses on the K-RWA ( $U = 916.50$ ,  $p = .028$ ), and significantly fewer *Prime* (most statistically common) responses ( $U = 874$ ,  $p = .013$ ) than the L-MPS group. There were no significant differences between the groups for the number of *Opposite* responses.

No significant differences between groups were found for the scores on the AUT (*Fluency*, *Flexibility*, *Originality*, or *Elaboration*), or the Essays task.

**Table 4.6.** Group means (and medians) and standard deviations with statistics for group differences on subjective and objective creativity measures.

Creativity Measure	Group		Statistics		
	HPS	L-MPS	<i>t</i>	Mann-Whitney <i>U</i> ( <i>z</i> )	<i>p</i>
	<i>Mean (Mdn) ± SD</i>	<i>Mean (Mdn) ± SD</i>			
<b>ECQ<sup>PART A</sup></b>					
Distinct Experience	30.75(31.00) ± 7.23	24.42 (25.00) ± 7.43	-	632.50 (-4.26)	<.001
Anxiety	23.30 (23.00) ± 2.35	18.44 (19.00) ± 5.08		694.00 (-3.84)	<.001
Absorption	37.75 (39.00) ± 7.32	33.33 (35.00) ± 8.88		903.50 (-2.40)	.02
Power/Pleasure	42.54 (42.00) ± 7.04	36.17 (37.00) ± 7.72		749.00 (-3.47)	.001
Clarity/Preparation	14.04 (14.00) ± 3.46	12.07 (12.00) ± 3.12		825.50 (-2.95)	.003
<b>Alternative Uses Task</b>					
Fluency	26.88 (25.00) ± 9.78	29.28 (26.50) ± 9.04	-	1040.00 (-1.47)	.14
Flexibility	24.70 (24.00) ± 8.79	27.68 (25.00) ± 9.00		1021.50 (-1.59)	.11
Originality	10.39 (10.0) ± 7.49	11.26 (7.38) ± 7.38		1119.50 (-.74)	.46
Elaboration	5.14 (5.00) ± 3.55	6.00 (5.00) ± 3.82		1107.00 (-.01)	.31
<b>Kent-Rosanoff Word Associations</b>					
Idiosyncratic	25.61 (25.50) ± 7.29	21.93 (21.00) ± 8.27	-	916.50 (-2.19)	.03
Primes	5.64(5.50) ± 3.42	7.49 (8.00) ± 3.58		874.00 (-2.50)	.01
Opposites	5.54 (4.00) ± 5.87	6.70 (7.00) ± 5.37		1059.50 (-1.20)	.23
<b>Essays Task</b>	8.90 (9.75) ± 2.55	8.72 (9.50) ± 2.46	-	1195.50 (-.21)	.83
<b>Creative Personality Scale</b>	4.74 ± 3.73	4.11 ± 3.47	.86	-	.39

Abbreviations: ECQ = *Experience of Creativity Questionnaire*; HPS = *High Positive Schizotypy*; L-MPS = *Low-Moderate Positive Schizotypy*

#### 4.4.3.3. Within-group correlations between positive schizotypy and creativity

Within-group correlations were conducted to further explore the relationship between positive schizotypy and creativity measures that significantly differentiated between the groups: ECQ<sup>PART A</sup> and K-RWA.

#### Relationships between positive schizotypy and creative experience

For correlations of positive schizotypy total and subscale scores with ECQ<sup>PART A</sup> subscale scores in the two groups see Table 4.7 below, and Figures B.1-B.2 of the appendix.

**Table 4.7.** Correlation coefficients for the bivariate correlations between the aspects of positive schizotypy and the Experience of Creativity Questionnaire within the high (HPS) and low-moderate (L-MPS) positive schizotypy groups.

	Positive Schizotypy <sup>Total</sup>	Ideas of Reference	Magical Thinking	Unusual Perceptual Experiences	Suspiciousness
<b>Distinct Experience</b>					
L-MPS	.20	-.08	.17	.25	-.14
HPS	.29*	.17	.31*	.34**	-.08
<b>Anxiety</b>					
L-MPS	.01	.10	-.02	.08	-.30*
HPS	.28*	.21	.29*	.28*	-.12
<b>Absorption</b>					
L-MPS	.29	.00	.02	.37*	-.14
HPS	.16*	.22	.08	.19	-.02
<b>Power/Pleasure</b>					
L-MPS	.08	-.14	.23	.29	-.25
HPS	.02	.08	.15	-.02	-.04
<b>Clarity/Preparation</b>					
L-MPS	.09	-.10	.13	.16	-.09
HPS	.11	.27*	.15	.11	-.15

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

#### HPS group correlations

Within the HPS group, *Total* positive schizotypy significantly and positively correlated with *Distinct Experience* ( $r = .29$ ,  $p = .03$ ), *Anxiety* ( $r = .28$ ,  $p = .04$ ) and *Absorption* ( $r = .16$ ,  $p = .04$ ). There was a significant positive relationship for: i) *Magical Thinking* with *Distinct Experience* ( $r = .31$ ,  $p = .02$ ) and *Anxiety* ( $r = .29$ ,  $p = .03$ ); ii) *Unusual Experiences* with *Distinct Experience* ( $r = .34$ ,  $p = .009$ ) and *Anxiety* ( $r = .28$ ,  $p = .04$ ); and iii) *Ideas of Reference* with *Clarity/Preparation* ( $r = .27$ ,  $p = .03$ ). There were no significant correlations between *Suspiciousness* and any of the ECQ<sup>Part A</sup> subscales.

#### L-MPS group correlations

For the L-MPS group, there was a trend for a positive correlation between *Total* positive schizotypy and *Absorption* ( $r = .29$ ,  $p = .06$ ). A significant negative relationship was found between *Suspiciousness* and *Anxiety* ( $r = -.30$ ,  $p = .045$ ), as well as a significant positive relationship between *Unusual Experiences* and *Absorption* ( $r = .37$ ,  $p = .02$ ). No other significant correlations were found between positive schizotypy and the ECQ<sup>Part A</sup> for this group.

### **Relationships between positive schizotypy and the Kent-Rosanoff Word Associations task**

See Table 4.8 for correlations between positive schizotypy and the KRWA task scores in the two groups (and Fig. B.3, of the appendix, for correlations within the HPS group).

**Table 4.8.** Correlation coefficients for the bivariate correlations between the aspects of positive schizotypy and the Kent-Rosanoff Word Association Task (*Idiosyncratic* and *Prime* responses) within the high (HPS) and low-moderate (L-MPS) Positive Schizotypy groups.

	<b>Total Positive Schizotypy</b>	<b>Ideas of Reference</b>	<b>Magical Thinking</b>	<b>Unusual Perceptual Experiences</b>	<b>Suspiciousness</b>
<b>Idiosyncratic</b>					
L-MPS	.01	-.25	.13	.26	-.17
HPS	.45***	.18	.35**	.41**	.09
<b>Primes</b>					
L-MPS	-.00	-.01	-.07	.06	.09
HPS	-.22	-.03	-.30*	-.12	-.09

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

#### HPS group correlations:

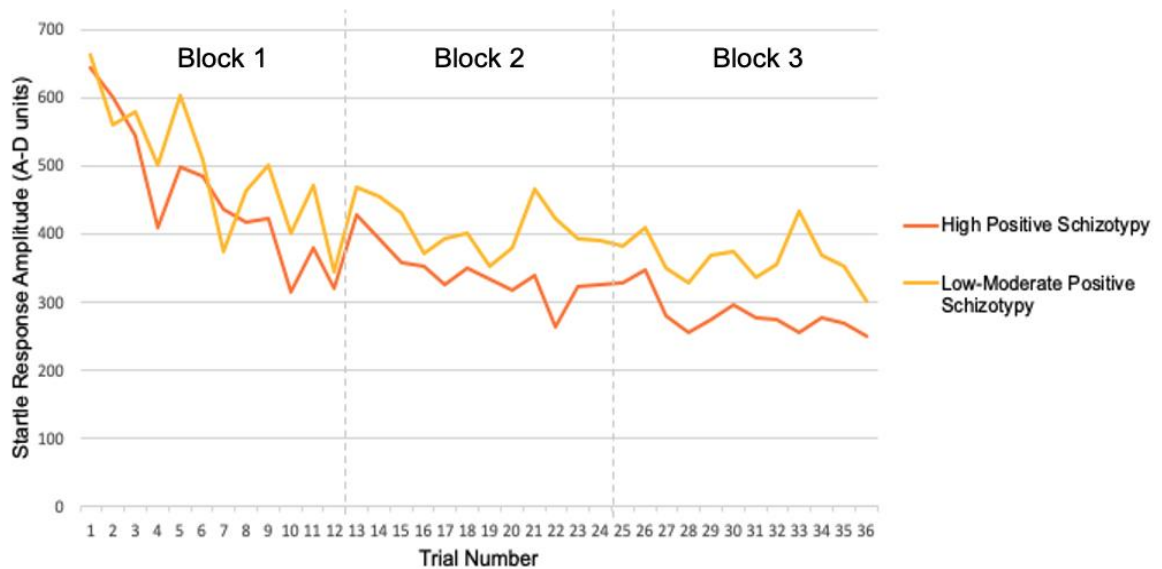
Significant positive correlations were observed in the HPS group for *Idiosyncratic* responses with: *Total* positive schizotypy ( $r = .45$ ,  $p < .001$ ), *Magical Thinking* ( $r = .35$ ,  $p = .009$ ) and *Unusual Perceptual Experiences* ( $r = .41$ ,  $p = .002$ ), but not with *Ideas of Reference* or *Suspiciousness*. A significant negative correlation was found between *Magical Thinking* and *Prime* responses ( $r = -.30$ ,  $p = .026$ ).

#### L-MPS group correlations:

No significant correlations were observed between the positive schizotypy and K-RWA for the L-MPS group; however, there was a trend for a positive correlation between *Unusual Perceptual Experiences* and *Idiosyncratic* responses ( $r = .26$ ,  $p = .09$ ).

#### **4.4.4 Hypothesis 2: group comparisons for acoustic startle habituation**

Fig. 4.4 presents the group mean startle amplitudes for each of the 36 trials. It can be seen for both groups that habituation was most pronounced in block 1 (indicated by the steepest slope), with slower habituation occurring in blocks 2 and 3, with little recovery for either group observed for the first trials of blocks 2 and 3. As such, block 1 and overall habituation (habituation across all trials) were confirmed as the primary indexes for assessing habituation.



**Figure 4.4.** Mean startle response amplitudes across all 36 trials (3 blocks of 12 trials) for the high positive schizotypy and low-to-moderate positive schizotypy groups.

Table 4.9 presents the group differences in initial acoustic startle reactivity, latency to peak, and habituation.

**Table 4.9.** Group means (and standard deviations) and statistics for group differences in the initial reactivity (square root of startle response amplitude the first trials of blocks 1-3), latency to peak (ms) and habituation slopes (blocks 1-3 and overall).

	Group		Statistic		
	HPS (n = 50) Mean ± SD	L-MPS (n = 43) Mean ± SD	t	Mann-Whitney U (z)	p
<b>Initial Reactivity</b>					
Block 1	22.64 ± 9.68	24.57 ± 7.83	-.10	-	.30
Block 2	19.33 ± 7.32	20.24 ± 7.78	-	1012.00 (-.33)	.75
Block 3	16.61 ± 7.54	17.98 ± 7.68	-	930.00 (-.97)	.33
<b>Latency to peak</b>					
			-		
Block 1	64.32 ± 5.87	62.97 ± 7.60		951.50 (-.64)	.52
Block 2	65.04 ± 6.80	63.17 ± 5.47		990.00 (-.33)	.74
Block 3	64.53 ± 6.71	63.10 ± 6.49		933.00 (-.79)	.43
<b>Habituation Slope</b>					
				-	
Block 1	-2.56 ± 2.97	-2.32 ± 2.34	-.36		.72
Block 2	-1.37 ± 1.66	-.71 ± 1.70	-1.91		.06
Block 3	-.81 ± 1.82	-.35 ± 1.51	-1.30		.20
Overall	-2.30 ± 1.50	-1.98 ± 1.40	-1.05		.30

Abbreviations: HPS = *High Positive Schizotypy*; L-MPS = *Low-Moderate Positive Schizotypy*

#### **4.4.4.1 Initial reactivity and latency to peak**

Initial reactivity did not significantly differ between the groups (raw startle response amplitude values: HPS:  $Mean = 621.50$ ,  $SD = 490.93$ ; L-MPS:  $Mean = 663.30$ ,  $SD = 372.52$ ;  $t = -.46$ ,  $p = .65$ ). There were no significant differences in startle reactivity between groups for the first trials of blocks 2 or 3, indicating that the groups did not significantly differ on startle response recovery. Mean latency to peak did not differ between the groups for any of the blocks.

#### **4.4.4.2 Startle habituation**

There were no significant group differences for habituation slopes for blocks 1-3 or overall slope; however, contrary to the predicted direction, there was a trend for greater habituation in the HPS group as indicated by a higher beta value (HPS:  $b = -1.37$ ,  $SD 1.66$ ; L-MPS:  $b = -.71$ ,  $SD 1.70$ ,  $p = .06$ ). As can be seen in Fig. 4.4, this is due to a visible peak in startle amplitude on trial 21 in the L-MPS group. A similar amplitude peak occurred on trial 33 in the L-MPS group. The data for these two trials were inspected for the presence of significant outliers, with three identified; however, the exclusion of these outliers did not influence the overall group pattern of startle amplitude responses or significantly impact the results of the between-group analysis, therefore their data were retained for further analysis.

#### **4.4.5 Hypothesis 3: acoustic startle habituation as a mediator of the relationship between positive schizotypy and creativity**

Given the large number of creativity variables, the number of mediation models conducted was reduced to decrease the risk of Type I errors. First, mediation analyses were performed only for creativity measures on which there were significant group differences (specifically, the ECQ<sup>PartA</sup> and K-RWA). This followed a theoretical expectation that any underlying effect of reduced sensory information filtering would be most likely observed where there is an ‘advantage’ of higher positive schizotypy in relation to creativity. Second, given the original aims and hypothesis of the current study (i.e., that reduced acoustic startle habituation would underlie a positive link between positive schizotypy and creativity), mediation analysis was performed only where there was a simple (correlational) relationship observed between positive schizotypy and the creativity measures within the HPS group. Further, with regards to the ECQ<sup>PartA</sup>, the aspects of positive ‘flow’-type creative experience related to deep immersion, focus on present experience and process (as represented by the subscales of *Distinct Experience*, *Absorption* and *Power/Pleasure*) are theoretically most likely representative



of underlying cognitive mechanisms related to fresh perception of experience (Nelson & Rawlings, 2010). In line with this reasoning, and according to the findings as reported in tables 4.7- 4.8, the ECQ subscales *Distinct Experience* and *Absorption*, and *Idiosyncratic* word associations of the K-RWA were entered into separate models as dependent variables.

A total of 6 models were run for the main analysis (with separate models using block 1 and overall habituation slopes as mediator variables, Table 4.10). No significant mediation effect of ASH (block 1 or overall slopes) upon the relationship between total positive schizotypy and heightened creative experience (ECQ *Distinct Experience* or *Absorption*) or wide associative thinking style (*Idiosyncratic* responses on the K-RWA) was found.

**Table 4.10.** Tests and statistics for mediation of acoustic startle habituation (block 1 and overall slopes) upon the relationship of total positive schizotypy (independent variable) and ECQ<sup>PartA</sup> subscales *Distinct Experience* and *Absorption*, and *Idiosyncratic* responses on the K-RWA within the high positive schizotypy group.

Mediator (Habituation Slope)	Dependent Variable (Creativity Measure)	Effect of PS on M (Path a)	Effect of M on DV (Path b)	Indirect Effect (Path a*b)	Bootstrapped CI	Direct effect
<b>Block 1</b>	Idiosyncratic WA	.02	-.11	-.002	-.10, .05	.77*
	ECQ Distinct Experience	.02	-.07	-.002	-.07, .06	.39
	ECQ Absorption	.02	-.03	-.001	-.07, .05	.18
<b>Overall</b>	Idiosyncratic WA	.02	-.48	-.009	-.08, .06	.79*
	ECQ Distinct Experience	.02	-.47	-.009	-.09, .06	.36
	ECQ Absorption	.02	.43	.008	-.05, .10	.19

\* $p < .001$

Abbreviations: DV = *Dependent Variable*; ECQ = *Experience of Creativity Questionnaire*; M = *Mediator*; PS = *Positive Schizotypy*; WA = *Word Associations*

## 4.4.6 Secondary analysis

### 4.4.6.1 Correlations between creativity tasks

All within-group correlations between the creativity measures are reported in Tables B.1 and B.2 of the appendix, Tables B.9 and B.10 for the whole sample.

### HPS group correlations

Several significant positive correlations were found within the HPS group between subjective measures of creativity; namely, ECQ *Distinct Experience*, *Power/Pleasure* and *Absorption* with the CPS.

The only subjective measure to correlate with the objective measures was the ECQ subscale *Clarity/Preparation*, which significantly negatively correlated with the AUT (*Fluency* and *Flexibility*) and *Opposite* responses on the K-RWA.

The objective measures of divergent thinking significantly and positively correlated with each other (Essays with all indices of the AUT). However, few correlations were found between the AUT and the K-RWA task, with only significant positive correlations for *Fluency* and *Flexibility* with *Opposite* word associations.

### L-MPS Group correlations

Fewer correlations between the subjective measures of creativity were found within the L-MPS group, with only ECQ *Absorption* significantly positively correlating with the CPS.

The only subjective measures to significantly positively correlate with the objective creativity measures were ECQ *Absorption* and *Anxiety* with *Idiosyncratic* word associations of the K-RWA. Significant negative correlations were found between ECQ *Distinct Experience* and the AUT (*Originality*), the Essays and *Opposite* word associations. A significant negative correlation was also found between ECQ *Anxiety* and scores on Essays.

Within the objective measures, significant positive correlations were found between indices of the AUT (*Fluency*, *Flexibility* and *Originality*) with the Essays scores. Finally, only K-RWA *Opposite* word associations positively associated with AUT *Originality*.

### Full Sample

Several correlations were found between the subjective creativity tasks across the whole sample, with the most consistent positive correlations occurring between aspects of creative experience (*Distinct Experience*, *Absorption*, *Power/Pleasure*) and the CPS.

Significant positive correlations were observed for both the ECQ (*Distinct Experience*, *Anxiety*, *Absorption*, *Clarity/Preparation*) and the CPS with *Idiosyncratic* word responses.

Significant negative correlations were found between indices of the ECQ (*Distinct Experience, Anxiety*) and *Prime* word associations, and between all indices of the ECQ (except for *Power/Pleasure*) with *Opposite* word associations. Only a significant negative correlation was found between ECQ *Clarity/Preparation* with the AUT indices (*Fluency, Flexibility, Originality*).

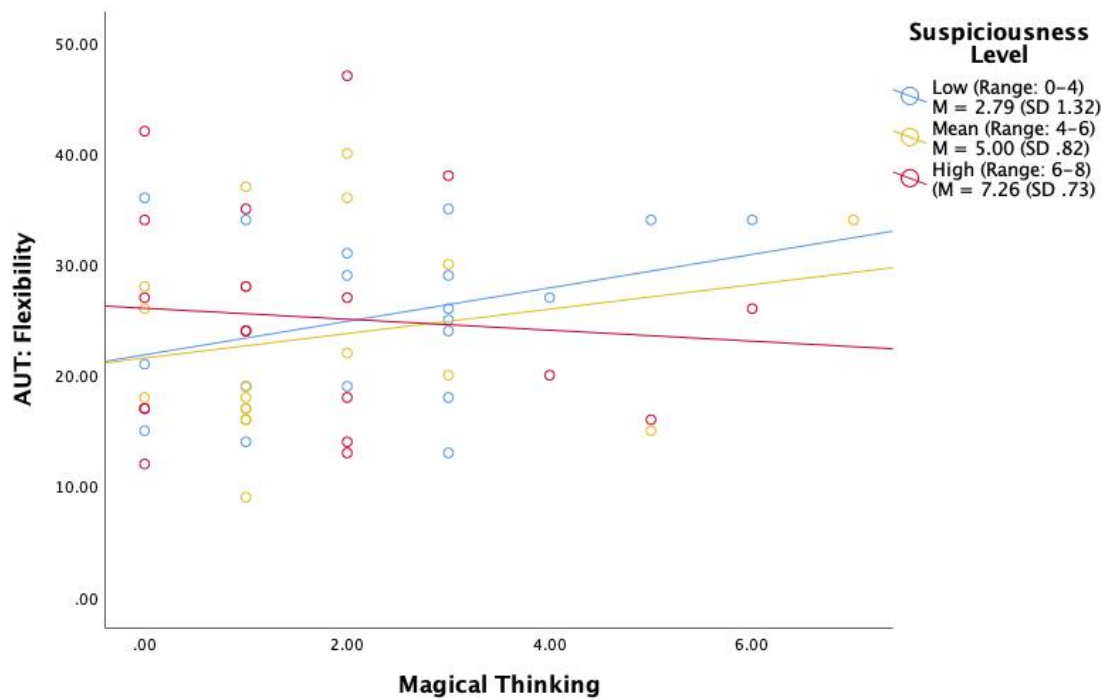
Significant positive correlations were found between all indices of the AUT with the Essays task, but scores on neither of these tasks correlated with unusual associations on the K-RWA. The most consistent and significant negative correlations occurred between aspects of creative experience with *Prime* and *Opposite* word responses, and for the specific creative experience aspect of *Clarity/Preparation* with AUT indices (*Fluency, Flexibility* and *Originality*).

#### **4.4.6.2 Moderating effects of suspiciousness/paranoia on objective creativity task performance**

Given the significantly higher scores on the *Suspiciousness* subscale in the HPS group compared with the L-MPS group in this study, and in the context of the findings of Study 1 (Chapter 3), moderation analyses were performed to assess whether this may help explain the lack of significant differences between the groups on other, objective creativity tasks: AUT and Essays. The moderation analyses were performed only for *Magical Thinking* and *Unusual Experiences* and their relationship with these tasks, following methodology of Study 1 and since these are the aspects of positive schizotypy most consistently shown to be positively associated with creativity. The moderation models were tested separately for each group.

##### HPS group

Within the HPS group, there was a significant interaction between *Magical Thinking* and *Suspiciousness* in predicting AUT *Flexibility* ( $b = -.63$ , 95%CI  $[-1.26, -.02]$ ,  $p = .04$ ). Simple slopes analysis indicated that when *Suspiciousness* scores were low, there was a highly significant positive linear relationship between *Magical Thinking* and *Flexibility* ( $b = 2.07$ , 95%CI  $[.62, 3.51]$ ,  $p = .006$ ), but this relationship became non-significant when *Suspiciousness* levels were mean-to-high ( $p = .23$ ,  $p = .56$ , respectively, Table B.3 of the appendix and Fig. 4.5, below). There was also a trend for attenuation by *Suspiciousness* upon the relationship between *Magical Thinking* and AUT *Fluency* ( $b = -.53$ , 95%CI  $[-2.60, 1.53]$ ,  $p = .09$ ), and *Originality* ( $b = -.40$ , 95%CI  $[-1.08, 1.33]$ ,  $p = .08$ ).



**Figure 4.5.** Scatter plot of the raw data within the HPS group demonstrating the relationship between: SPQ *Magical Thinking* and AUT *Flexibility* for sub-groups with low, mean, and high *Suspiciousness* scores.

#### L-MPS group

Within the L-MPS group, there were no significant effects for a moderation of suspiciousness, however there were trends for a significant attenuating effect of *Suspiciousness* upon the positive relationship between *Magical Thinking* and AUT *Fluency* ( $b = -7.29$ , 95%CI [-15.11, .53],  $p = .07$ ), and between *Unusual Experiences* and *Idiosyncratic* word associations ( $b = -2.17$ , 95%CI [-4.51, .17],  $p = .07$ ).

#### **4.4.6.3 Additional Analyses**

The following supplementary analyses are provided in Appendix B:

- Full sample analyses:
  - Correlations between positive schizotypy and subjective measures of creativity.
  - Correlations between positive schizotypy and objective measures of creativity.
  - Correlations between positive schizotypy and acoustic startle habituation.
  - Correlations between all creativity tasks and acoustic startle habituation.

- Mediation analysis of ASH on the relationship between positive schizotypy and creativity.
- Analysis of negative and disorganised schizotypy in relation to creativity and acoustic startle habituation.
- Regression analysis: predicting performance on objective creativity tasks
- The relationship of creative activity status with acoustic startle habituation and the creativity measures.

## 4.5 Discussion

### 4.5.1 Summary of the findings

This study aimed to empirically investigate whether the positive relationship between positive schizotypy and creativity is underlined (mediated) by reduced sensory information filtering, as indexed by acoustic startle habituation. It firstly investigated the relationship between positive schizotypy and creativity, using subjective and objective creativity measures designed to tap into multiple domains of creativity, as previously recommended (Thys et al. 2014). In partial support of the hypothesis, the HPS group scored significantly higher across all aspects of creative experience (*Process*, as measured by the ECQ<sup>PartA</sup>) compared with the L-MPS group. Further, the HPS group gave significantly more *Idiosyncratic* (unusual), and fewer *Prime* (common) responses on the K-RWA task, indicating wider associative thinking (*Process*). However, no group differences were observed for scores on the divergent thinking tasks assessing *Process* and *Product* (AUT and Essays) or the measure of creative *Person* (CPS).

Contrary to the prediction, there were no significant differences between the groups on ASH. The hypothesis that reduced sensory information filtering, as indexed by ASH, would mediate the positive relationship between positive schizotypy and creativity was also not supported, with no significant indirect effects of ASH upon the relationship between positive schizotypy and the creativity measures.

Secondary analysis revealed inconsistent correlations between the subjective and objective creativity tasks; several correlations were found between the objective divergent thinking measures tapping into *Process* and *Product*, however, on the whole, these did not positively correlate with the subjective measures of *Person* or *Process*. The subjective measures (tapping into *Person* and *Process*) positively correlated with each other. The only positive correlations found between objective and subjective measures

was in the case of wide associational thinking – which positively associated with creative experience and personality (*Person* and *Process*).

Finally, follow-up moderation analysis revealed that *Suspiciousness* significantly attenuated the relationship between *Magical Thinking* and AUT *Flexibility*, and trends for attenuation of *Suspiciousness* upon the relationship of *Magical Thinking* with AUT *Fluency* and *Originality*. A trend was also found within the L-MPS group for an attenuation of *Suspiciousness* upon the relationship between *Magical Thinking* and AUT *Fluency*, and between *Unusual Experiences* and *Idiosyncratic* word associations.

#### **4.5.2 Positive schizotypy and subjective measures of creativity (*Process* and *Person*)**

Participants in the HPS group scored significantly higher than the L-MPS group across all five subscales of the ECQ<sup>PartA</sup> as a measure of the creative *Process* (*Distinct Experience*, *Anxiety*, *Absorption*, *Power/Pleasure* and *Clarity/Preparation*), consistent with previous research (Nelson & Rawlings, 2010) and the findings of Study 1 (Chapter 3), providing further evidence of the relationship between positive schizotypy and heightened creative experience.

Higher *Magical Thinking* and *Unusual Experiences* appeared to primarily support heightened creative experience associated with higher positive schizotypy (Table 4.7), though few significant correlations were generally found between positive schizotypy and aspects of creative experience within either group. This is likely due to reduced power when the relationships are investigated in two groups separately, since more consistent significant positive associations were found between positive schizotypy and creative experience for the whole sample (see Table B.4 of the appendix). Of note, *Suspiciousness* did not significantly correlate with any aspect of creative experience within the HPS group (and only positively correlated with *Distinct Experience* across the whole sample). This contrasts the findings presented in Chapter 3, wherein *Suspiciousness* similarly correlated with all ECQ<sup>PartA</sup> subscales as the other positive schizotypy aspects, and supports the notion of a dissociation between *Magical Thinking/Unusual Experiences* and *Suspiciousness* in their relationship with the creative experience (*Process*).

For the L-MPS group, *Suspiciousness* negatively correlated with ECQ *Anxiety*; there is no clear explanation for lower anxious creative experience being specifically driven by higher suspiciousness for this group - particularly since scores on aspects which can

trigger a sense of vulnerability associated with the creative process, such as *Distinct Experience*, were not also significantly negatively associated with *Suspiciousness* (though all other aspects of creative experience were, non-significantly, inversely associated with *Suspiciousness*). There was, however, a significant positive correlation between *Unusual Experiences* and *Absorption* within this group.

No group differences were found for the measure of creative *Person* (CPS); however, there was an overall significant positive correlation between *Unusual Experiences* and the CPS across the whole sample, in line with expectations and previous findings of an overlap between positive schizotypy and measures of creative personality (MacPherson et al., 2011).

### **4.5.3 Positive schizotypy and objective measures of creativity**

#### **4.5.3.1 Associative thinking (*Process*)**

In line with the hypothesis, the HPS group made significantly more *Idiosyncratic* and significantly fewer *Prime* word associations on the K-RWA task than the L-MPS group. Wide semantic associations (the tendency to link uncommon concepts) is thought to be underlined by enhanced spreading activation in semantic networks, leading to a larger pool of ideas and connections between them, aiding originality (Kwapil et al., 1990; Kenett et al., 2014). This is a key thinking process observed in creative individuals (Gianotti et al., 2001; Mednick, 1962; Merten & Fischer, 1999; Pizzagalli et al., 2001; Rominger et al., 2017). Within group correlation analysis indicated that higher *Magical Thinking* and *Unusual Experiences* were uniquely associated with more *Idiosyncratic* responses as well as higher *Magical Thinking* and fewer *Primes* within the HPS group.

These results corroborate previous reports of a positive relationship between wide associations and positive schizotypy, particularly magical thinking (Duchene et al., 1998; Manschreck et al., 2012; Mohr et al., 2001; Rawlings & Locarnini, 2008; Rominger et al., 2011, 2017; Weinstein & Graves, 2002), and ties into evidence of allusive thinking style as a possible cognitive marker of predisposition to schizophrenia (McConaghy, 2000). The general absence of significant correlations for *Suspiciousness* or *Ideas of Reference* with the word associations task (with only a negative correlation between *Ideas of Reference* and *Primes* for the overall sample) provides further evidence of a dissociation between the positive schizotypy aspects in relation to creative process.

#### 4.5.3.2 Divergent thinking (*Process and Product*)

The current study attempted to address potentially confounding methods specific to using divergent thinking assessments by considering all indices which they can tap into, rather than using a selection of indices or composite scores. However, no significant group differences were found on divergent thinking as measured by the AUT or Essays task. Given that the HPS group demonstrated the creative process of wider associative thinking (on the K-RWA), it was unexpected that this group did not also score higher on the divergent thinking tasks. However, a similar discrepancy has been observed before; for example, Rossman & Fink (2010) found no significant association between performance on an associational task with fluency or flexibility, and only a modest association with originality (on a divergent thinking task incorporating AUT).

The dual pathway model of creativity proposes that creativity involves both automatic/associative processes and effortful controlled processes (Nijstad et al., 2010; Volle, 2018). The K-RWA task requires automatic/associative processes, whereas tasks such as the AUT may require additional goal directed, task-focussed attention (Benedek et al., 2014). As such, the K-RWA and AUT tasks may tap into distinct creative processes that have differential relationship with positive schizotypy. A further possibility is that suspiciousness may differentially impact divergent thinking performance and free associative thinking.

Indeed, *Suspiciousness* appeared to attenuate the positive association between AUT *Flexibility* and *Magical Thinking* for the HPS group. A significant positive association between these emerged only when *Suspiciousness* was at its lowest levels within this group, but this relationship was not observed when scores were at mean levels or higher. This offers some insight into why no significant differences were found for *Flexibility* between the groups, since the HPS group had significantly higher levels of suspiciousness/paranoia (*Mean* = 5.12) compared to the L-MPS group (*Mean* = 1.01). This, in addition to an overall significant negative correlation between *Suspiciousness* and *Flexibility* found for the sample as a whole, ties with evidence of an association between paranoia and cognitive inflexibility (Freeman et al., 2008).

This potential contribution toward the lack of group differences on the AUT is supported by the trend for an attenuating effect of *Suspiciousness* upon the relationship of *Magical Thinking* with *Fluency* and *Originality*. Cognitive flexibility is associated with better creative output (Nijstad et al., 2010; Zabelina & Ganis, 2018; Zabelina & Robinson, 2010) and is thought to facilitate idea originality on 'narrow' subject tasks (wherein participants must think within a narrow field or towards a specific topic; Nijstad et al., 2010) - a



requirement of the AUT (unusual uses for specific objects). Future research is needed to establish whether the dampening effect of high suspiciousness/paranoia upon the relationship between *Magical Thinking* and *Flexibility* has an indirect effect upon the creative *Product*, assessed by similar divergent thinking tasks. Such inquiries may help further explain previously mixed findings of the relationship between positive schizotypy and divergent thinking - particularly the AUT - in previous studies (see Chapter 1, section 1.3.2.3).

#### **4.1.1 Acoustic startle habituation as a mediator of the positive schizotypy-creativity relationship**

The hypothesis that ASH would mediate the relationship between higher positive schizotypy and increased creativity was not supported.

#### **4.5.3.3 Positive schizotypy and acoustic startle response**

Contrary to the hypothesis, there were no significant differences between the groups on the measures of acoustic startle response (initial reactivity, latency to peak, or habituation slopes for block 1 or the overall slope). Only a trend for *increased* habituation for the HPS group for block 2 was revealed. Mean amplitudes across all trials indicate this trend could have been driven by the visible peak at trial 21 (Fig. 4.4) within the L-MPS group, impacting the beta slope for this block in this group. These peaks could not be explained by outliers, and may reflect facilitated recovery (Rankin et al., 2009) at these trials for the L-MPS group, perhaps due to a slightly longer interstimulus interval between trial 20 and 21, increasing anticipation and thus facilitating the amplitude of startle response to the next stimulus.

The lack of group differences in habituation contrast the general pattern of results showing reduced sensory filtering associated with schizotypal traits (e.g., Park et al., 2015; Wan et al., 2007), including positive schizotypal traits (e.g., Croft et al., 2001). The current study used a paradigm optimised for assessing habituation (stimuli of identical intensity); this was to address the possibility that previous reports of normal habituation in individuals with high positive schizotypy (Meyhofer et al., 2019) and people with schizophrenia (e.g., Ludewig et al., 2002) was due to having indexed habituation by using startle stimuli (pulses) trials imbedded within a PPI paradigm. Although habituation and PPI are thought to both index sensory filtering mechanisms, they reflect independent forms of startle plasticity (Elwanger et al., 2003; Singer et al., 2013) with habituation reflecting open processing style in the attentive range (inter-stimulus intervals between startle probes or pulses ranging between 5 sec – 20 sec), as compared to the pre-

attentive range of the pre-pulse trials (30-120 ms) commonly used in the PPI paradigm. The current null findings for an association between positive schizotypy and habituation converge with previous studies that reported normal habituation in the context of disrupted PPI in positive schizotypy (Meyhofer et al., 2019) and schizophrenia (Ludewig et al., 2002), when habituation was indexed from the pulse trials embedded in the PPI paradigm. The reason for this is unclear.

#### **4.5.3.4 Acoustic startle habituation and creativity**

No significant associations between ASH and the creativity measures were observed for participants with high positive schizotypy, contrary to expectation. This was particularly unexpected in the case of wider associative thinking – a process which would reasonably be expected to involve ‘looser’ (more open) information processing style. Further, the findings are in contrast to theoretical expectation that the link between positive schizotypy and increased pleasurable ‘flow’-type experience may be related to an increased ‘newness’ and novelty of perception (Nelson & Rawlings, 2010). The negative findings for a relationship between habituation and any of the creativity tasks may be due to the types of creativity measures used; for example Zabelina and colleagues (2015) found an association between attenuated habituation and higher creative achievement – an assessment of creativity not included in the current study. However, they also found an (inverse) relationship between habituation and divergent thinking, which was not found to significantly relate to habituation, in either positive or negative direction, in the current study.

It is possible that the ASH paradigm might not be a sensitive index of sensory information filtering as a mechanism underlying creativity. Studies which assessed sensory filtering (gating) in the context of creativity (assessed using the divergent thinking measure Torrance Test of Creative Thinking; Ahsan et al., 2020; Zabelina et al., 2015) used Event Related Potentials (ERPs). One study found an association between *weaker* sensory gating and fluency (Ahsan et al., 2020); the other study (Zabelina et al., 2015) observed originality to be associated with *stronger* sensory gating, but real-world creative achievement was associated with *weaker* sensory gating at the P50 ERP. The P50 ERP is in the early attention range - but neither N100 or P200, which are at a later attentional range, were associated with divergent thinking or creative achievement. Given that the present sample of individuals high on positive schizotypy was not selected on the basis of their real-world creative achievement or regular engagement in creative activities, future studies need to investigate the link between positive schizotypy, creativity and sensory information filtering in the individuals that are both high on positive schizotypy

and creative engagement (either as a hobby or profession), and include measures of sensory information filtering (gating) at different attentional ranges.

Finally, the link between HPS and heightened creativity may be underlined by mechanisms other than sensory information filtering, such as associative learning processes (Nelson & Rawlings, 2010; Carson et al., 2003; in contrast to non-associative learning processes reflected by habituation) or increased ability for dissociative states, leading to intensified creative experience (Holt, 2019; Nelson & Rawlings, 2010).

#### **4.5.3.5 Relationships between creativity measures**

There were mixed correlations between the creativity measures within the groups, with the most consistent positive correlations occurring between the subjective measures (ECQ<sup>PartA</sup> and CPS) and between the divergent thinking tasks (AUT and Essays). Clearer patterns of relationships between the various measures became evident across the whole sample; several aspects of the ECQ<sup>PartA</sup> (*Distinct Experience*, *Absorption* and *Power/Pleasure*) significantly positively correlated with the CPS. All indices of the AUT positively correlated with the Essays task, both measures of divergent thinking; however, neither significantly correlated with unusual associations on the K-RWA task, suggesting that divergent and associative thinking styles are dissociable in the same sample, and might rely on different mechanisms, as discussed previously (section 4.5.3.2).

The only positive correlation between the CPS with the objective measures was with K-RWA *Idiosyncratic* word associations, providing evidence for a link between creative personality with the tendency to make unusual associations, but not with divergent thinking performance. The ECQ<sup>PartA</sup>, tapping into creative experience, as well as the CPS, correlated positively with K-RWA *Idiosyncratic* word associations, but there was a general absence of positive associations of the ECQ<sup>PartA</sup> with AUT or the Essays task, suggesting that the associations between creative *Person*, and *Process* are specific to associative thinking. The specificity of these associations further suggests that when no correlations between subjective and objective measures of creativity are observed, it is not simply due to the difference in the assessment methods (self-report vs task-based) – the aspects of creativity measured need to be taken into consideration.

These patterns of findings echo the inconsistent patterns of previous studies using both subjective and objective measures of creativity within the same samples (tapping into multiple ‘P’s; Chapter 1, section 1.3.2.6). The various measures (both subjective and objective) appear to tap into distinct, dissociable aspects of creativity (for example, the creative *Product* as measured through divergent thinking tasks may not effectively tap

into the creative *Person*, or vice versa), and the relationship between positive schizotypy and creativity may be dependent on the domain of creativity being assessed. This highlights the need for utilising multiple creativity measures within the same samples for a more nuanced understanding of the relationship between positive schizotypy and creativity.

#### 4.5.4 Limitations

Several limitations were identified. First, creative experience was not reported in relation to completing the objective creativity tasks; therefore, results inferred from correlations between the ECQ and other creativity tasks remain tentative. Whilst it would be reasonable to expect that the *propensity* for certain experience during creativity could be generalisable across different creative activities, it is not known whether the lab-based tasks elicit the same type or depth of creative experience as reported by participants in relation to a general creative activity. It is, however, reassuring to see consistent intercorrelations amongst experiential aspects of creativity with positive schizotypy (as is consistent with previous findings; Study 1 and Nelson & Rawlings, 2010), creative personality, creative activity engagement (appendix B.15), as well as wide/loose associational thinking processes – complimenting the results of Study 1 (Chapter 3), and in line with theoretical expectation.

It is also noted that the internal consistency for *Clarity/Preparation*, although slightly improved compared to Study 1, was fairly weak (.63). Future research would benefit from taking subjective reports of creative experience as elicited by engaging with lab-based creativity tasks, as well as investigating whether creative experience during these tasks influences output. This would be especially useful for investigating whether creative experience depends on the task at hand; for example, certain aspects of experience, such as *Clarity/Preparation*, might not necessarily be captured by lab-based tasks which require immediate, ‘fast’ thinking – such as the AUT – as reflected by the negative correlations found for *Clarity/Preparation* with some of the indices of the AUT (Table B.1 and B.9 of the appendix). This would also help establish validity of the ECQ and give insight into the relationship between creative experience and creative output in participants with positive schizotypal traits.

A further limitation is that the current sample of HPS individuals had varying levels of suspiciousness/paranoia. Given the current evidence that higher suspiciousness/paranoia may mask an otherwise positive relationship between positive schizotypal traits and the creative process (as indicated by the combined results of Study

1 and the current study), a consideration for future research would be to recruit individuals on the basis of being high on positive schizotypy as marked by high magical thinking/unusual experiences, but with low suspiciousness/paranoia. This would give opportunity to investigate the relationship between positive schizotypal traits and creativity without the potential for suspiciousness/paranoia to obscure it – particularly when using lab-based divergent thinking tasks such as the AUT.

Finally, auditory startle habituation may be genetically influenced (Hasenkamp et al., 2010) and reduced habituation (as indexed by the P50 ERP) has been observed in first-degree relatives of individuals with schizophrenia (Siegal et al., 1984). Given that data for familial history of disorders such as schizophrenia was not collected in the current study, the potential influence of the presence (or absence of) genetic factors upon habituation rates – such as having a first degree relative with schizophrenia – was not possible to detect. Collecting this type of data would be of use in future studies to assess whether reduced sensory filtering in healthy samples with high positive schizotypy may be more detectable where there other associated factors are present, such as increased genetic vulnerability.

#### **4.5.5 Conclusions**

The study provides evidence of a beneficial link of positive schizotypy with creative *Processes*, (and between unusual experiences and creative *Person*) but when process is assessed objectively, it is only observed when using a measure that taps into wider associational thinking style. However, these links were not mediated by reduced sensory information filtering as indexed by ASH, and further research is needed to understand which specific mechanism(s) may underlie this association. Given the current findings in the context of using an optimised paradigm for assessing habituation of the startle reflex, converged with findings of previous studies which did not find an effect of habituation as imbedded in PPI, alternative paradigms may serve as a more sensitive measure of sensory information filtering compared to habituation. Future studies would benefit from assessing sensory filtering mechanisms using different paradigms (e.g. ASH, PPI, ERPs) as well as at different attentional (pre-attentive and attentive) ranges within samples.

Finally, the study provides additional evidence of a dissociation between positive schizotypal traits in relation to creativity, with little-to-no beneficial association of suspiciousness/paranoia and creativity in the present sample. Moreover, the results

corroborate Study 1 findings that suspiciousness can have a disruptive effect on an otherwise positive relationship between positive schizotypy and creativity.

To conclude, although the study did not identify reduced filtering, as indexed by ASH, as the underlying link between positive schizotypy and heightened creativity in the current sample, it has confirmed suspiciousness to be a disruptive influence on the link between magical thinking and unusual perceptual experiences with creativity. Given the risk for psychosis associated with suspiciousness/paranoia in vulnerable individuals, there remains great value in targeting suspiciousness/paranoia reduction, whilst preserving and supporting the aspects beneficial for creativity in people with HPS.

## **Chapter 5 (Study 3): Using mindfulness to reduce suspiciousness/paranoia in individuals high in positive schizotypy with high suspiciousness: a pilot study**

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### **5.1 Introduction**

#### **5.1.1 Overview**

As discussed in Chapter 1 (section 1.2), positive schizotypy has been identified as a predictor of psychosis development (Debbané, 2015), with high suspiciousness/paranoia presenting a key risk factor in vulnerable individuals (Cannon et al., 2008), pointing to significant worth in reducing this aspect in individuals high in positive schizotypy.

There are several immediate benefits for the reduction of suspiciousness/paranoia in individuals with high positive schizotypy. As discussed in Chapter 1 (section 1.5.2.1), high suspiciousness/paranoia is problematic even in the short-term; it can be distressing and preoccupying (Freeman, 2007; Freeman & Garety, 2006) and is associated with problems in adapting to the social world (Collip et al., 2013). Individuals with positive schizotypal traits, such as magical thinking, are characterised by increased propensity for causal attributions to unrelated events (Brugger & Graves, 1997), giving rise to more opportunities for distress when such attributions may be paranoid in nature. Indeed, whilst positively associated with creativity (see Chapters 1, 3 and 4), unusual beliefs or experiences characteristic of positive schizotypy (Cicero & Kerns, 2010) can cause distress when accompanied by threatening appraisals (Brett et al., 2014). By reducing suspiciousness/paranoia, magical thinking and unusual experiences can remain in the context of supporting creative flourishing, whilst distress associated with them could be minimised in the short-term, theoretically mitigating psychosis risk in the long-term.

The current chapter will firstly provide an overview of the benefits of using a mindfulness-based approach for reducing suspiciousness/paranoia in individuals high on positive schizotypy; secondly, it will introduce the use of virtual reality for the assessment of state paranoia. It will then present the study that: 1) investigated, for the first time, the feasibility and acceptability of an online (app-based), 40-day mindfulness-based intervention (MBI) to reduce suspiciousness/paranoia in a sample of individuals high on positive schizotypy with high suspiciousness; and 2) assessed, for the first time, state paranoid ideation using virtual reality as an objective outcome measure of the MBI.

### **5.1.2 Rationale for using a mindfulness-based approach to reduce suspiciousness in individuals with high positive schizotypy**

As mentioned in Chapter 1 (section 1.5.1), reduced suspiciousness/paranoia in mindfulness practitioners has been found in the presence of higher magical thinking as compared with the general population (Antonova et al., 2016), suggesting that these aspects of positive schizotypy are dissociable with mindfulness practice. Further, higher dispositional mindfulness was found to significantly associate with lower suspiciousness/paranoia in the general population (Study 1, Chapter 3); the correlational analysis indicated that this was most strongly driven by the skill of non-judging – one of the mindfulness skills which best differentiates meditators from non-meditators (Antonova et al., 2016). The skill of non-judging is important for responding mindfully to paranoid thoughts (Chadwick, 2006) and negatively associates with both trait and state paranoia (Kingston et al., 2019). Notably, non-judging can even buffer against the impact of trait paranoia upon state paranoia (Kingston et al., 2019). Together, these findings suggest that mindfulness skills attained through practice – such as non-judging - would be particularly beneficial for individuals with high levels of suspiciousness/paranoia who are also prone to experiences that can trigger state paranoia, such as unusual experience or beliefs.

It has been noted that using cognitive reappraisal techniques which involve evidence-seeking to directly address persecutory thoughts can be challenging (Ellet, 2013); positive schizotypy is associated with increased tendency for jumping to conclusions (Hua et al., 2020) – a probabilistic reasoning bias towards making decisions based on insufficient evidence (Garety et al., 1991) which is also characteristic of paranoia (Freeman et al., 2008). However, mindfulness facilitates approaching each moment with a newness of perception, unclouded by prior experience (Siegal, 2009), thereby circumventing the need for sustained evidence-seeking to challenge beliefs (Vilardaga et al., 2013).

Furthermore, mindfulness-based training can be tailored to specific needs (such as distressing positive symptoms, Chadwick 2006); however, the principles it teaches apply toward *all* experience. Therefore, aspects which predict and maintain paranoia, such as affective states (e.g., anxiety or depression; Freeman et al., 2012; Freeman, 2008) could also benefit from mindfulness training. Finally, as discussed in Chapter 1 (section 1.5.2.3), mindfulness can increase cognitive flexibility and reduce self-referential thinking, both of which are associated with positive schizotypy and are integral to paranoid processes (Bebbington et al., 2013; Freeman et al., 2005; Mills et al., 2007).



### **5.1.3 Safety of mindfulness in psychosis-prone populations**

Questions have risen in recent years surrounding potential harmful effects of general use of meditation; for example, the exacerbation of existing mental health difficulties or inducing a sense of unreality (Lomas et al., 2015). However, unfavourable effects may be a result of attempting practises which are too advanced for relatively inexperienced meditators, and it has been noted that such effects are generally found to occur during intensive meditative retreats (Chadwick, 2014; Lindahl et al., 2017). Further, adverse events which occur during randomised control trials have been suggested to be no more common in the meditation-based intervention conditions than control conditions (Baer et al., 2019).

Consideration for safe practise should not, however, be overlooked (Baer et al., 2019), and particular caution has been advised for individuals with psychosis vulnerability (Yorston, 2001). Notably, delivering meditation training in sessions that are 10 minutes long (as compared to traditional 20-45 minute meditations) has emerged as acceptable and safe for individuals experiencing distressing symptoms of psychosis, with no adverse effects (Chadwick, 2006, 2014; Chadwick et al., 2005, 2009). Ten-minute meditation sessions could therefore be considered as safe for use in a healthy sample from the general population with increased vulnerability to psychosis, such as individuals with high levels of positive schizotypal traits with high suspiciousness.

### **5.1.4 Online delivery of mindfulness training**

Mindfulness interventions are generally delivered through 8-12 week programs (Kabat-Zinn, 1982; Teasdale et al., 2000) with weekly face-to-face sessions, led by a qualified mindfulness instructor (Kabat-Zinn, 1982; Kabat-Zinn, 2003). These can be costly and limit deliverability (Cavanagh et al., 2014); app-based interventions, on the other hand, are relatively inexpensive (Cavanagh et al., 2014) and, given the current prevalence of smart-device ownership, can vastly increase accessibility.

There is mounting evidence for the efficacy of online mindfulness-based interventions for targeting paranoia. Although mindfulness training is traditionally a long-term endeavour (Germer, 2005, pp. 115), significant reductions in paranoia in the general population have been observed after brief periods of online mindfulness training (Kingston et al., 2019). Such reductions in paranoia have been shown to be underlined (mediated) by increases in mindfulness skills following just two weeks of practise (Shore et al., 2018). Short-term online training can also effectively reduce a range of

psychological and psychosocial aspects associated with paranoia, including depression, stress, and anxiety (Cavanagh et al., 2013; Champion et al., 2018; Economides et al., 2018; Flett et al., 2019; Querstret et al., 2019).

In addition to relatively short interventions, benefits have been observed when the mindfulness sessions themselves were brief. Typical therapist-led courses incorporate mindfulness-based sessions lasting around 2 hours (e.g., Mindfulness-Based Stress Reduction, Kabat-Zinn, 1990). However, the online mindfulness interventions consisting of daily meditation sessions just ten minutes in length, as implemented by Shore et al (2018) and Kingston et al (2019), were effective in reducing paranoia in the general population. This indicates that not only can online mindfulness-based interventions alleviate paranoia, but the effect can be achieved within the remits of what is considered as safe for individuals who may be vulnerable to psychosis (as discussed in section 5.1.3).

### **5.1.5 Using virtual reality for the assessment of paranoia**

Paranoid ideation is typically assessed using self-report measures (e.g., the Paranoia Scale; Fenigstein & Vanable, 1992; Green et al. Paranoid Thought Scale; Green et al., 2008). However, such assessments are not suitable for measuring state paranoia – i.e., paranoid ideation which occurs in real time in response to certain situations. In recent years, virtual reality (VR) has emerged as an ecologically valid, reliable and objective measure of state paranoia. Immersive VR transports individuals into digitally-created social environments which are both interactive and multi-sensory, with neutrally designed stimuli. Replicating real-world experiences within the lab allows for an experimentally controlled approach to assessing persecutory ideation (Valmaggia et al., 2007), and the use of VR has been shown to be safe for individuals from the general population (Freeman et al., 2008b), as well as in clinical and clinically at risk groups (Valmaggia et al., 2007; Veling et al., 2014; 2016). To the best of our knowledge, the assessment of state paranoia using VR has not yet been conducted in a sample of individuals high in positive schizotypy with high suspiciousness/paranoia or used as an outcome measure of a psychologically intervention in general or in this group specifically.

## **5.1.6 Aims and objectives**

### **5.1.6.1 Primary aims**

#### **Acceptability and feasibility of an online MBI in a sample of individuals high in positive schizotypy with high suspiciousness/paranoia**

The current study aimed to assess the acceptability and feasibility of an online, app-based mindfulness intervention in a sample of participants with high positive schizotypy with high suspiciousness/paranoia. The intervention was delivered via *Headspace*, a commercially available meditation app, over the course of 40 days (in accordance with the typical meditation package lengths available within the app). This consisted of daily 10-minute meditations, in line with previous studies (Shore et al., 2018) and congruent with the interests of safety for psychosis-vulnerable individuals (section 5.1.3). The study looked to establish whether the length of the intervention, including the duration of the meditation sessions, were both feasible and acceptable. Engagement, retention and adherence to the intervention were objectively assessed.

#### **Using mindfulness to reduce suspiciousness/paranoia**

A further aim of the study was to establish whether the MBI would lead to a reduction in suspiciousness/paranoia in the sample, using both self-report and real-time objective methodology (VR) for the assessment of paranoid ideation.

### **5.1.6.2 Hypothesis**

It was hypothesised that larger reductions in both self-reported (trait) and objectively measured (state) paranoia would be observed in individuals following completion of the 40-day online MBI, compared to individuals in a closely matched active control condition (40 days of online reflective journaling via a freely available app *Reflectly*).

### **5.1.6.3 Secondary aims**

As pointed out in section 5.1.2, reductions in affective states which are implicated in the onset and maintenance of paranoia, such as depression, stress and anxiety (Freeman et al., 2008, 2012; Lincoln et al., 2009), have been observed following mindfulness interventions delivered using the *Headspace* app (Champion et al., 2018; Economides et al., 2018; Flett et al., 2019). Therefore, a secondary aim of the study was to examine if the mindfulness group showed larger reductions in depression, anxiety and stress following the 40-day mindfulness-based intervention compared to the active control condition.

## 5.2 Methods

### 5.2.1 Participants

#### Disruptions to recruitment due to Covid-19

The study prematurely ceased due to the outbreak of Covid-19 in early March 2020. Nine individuals who were recruited could not complete the study due to government lockdown guidelines, which prevented all lab testing.

#### 5.2.1.1 Final sample

The final sample comprised of a subset of twenty-four participants who took part in Study 2 (*Mean* age = 27.04, *SD* = 11.24, range = 18-58, 83% females). Participants were asked to confirm that they met the primary inclusion criteria as outlined in Studies 1 and 2 (Chapters 3 and 4), including confirmation that they had not engaged in formal, regular practice (as defined by an *intentional commitment* of time to practice at least 10 minutes per day, 4-5 days per week within the past 3-4 months). A further requirement to take part was to be in possession of a smart phone or tablet on which to install and access the apps (*Headspace* or *Reflectly*) used in the study.

#### 5.2.1.2 High positive schizotypy (HPS) with high suspiciousness/paranoia

Consistent with the HPS criteria set out for Study 2, participants were recruited on the basis of scoring at least +0.5 *SD* above the mean on overall positive schizotypy as assessed by the Schizotypal Personality Questionnaire (SPQ; Raine, 1991). The further criterion of scoring at least +0.7 *SD* above the mean on the *Suspiciousness* subscale was also applied, corresponding to endorsing at least half of the items for this subscale. This was based on the normative data from the preliminary general population sample ( $n = 117$ ; see section 3.1.1 of Chapter 3), which produced a mean positive schizotypy score of 7.57 (*SD* = 5.98) and a mean *Suspiciousness* score of 2.31 (*SD* = 2.13). These means remained unchanged within the larger sample of Study 1 ( $N = 342$ ; *Mean* total positive schizotypy = 7.69, *SD* = 6.21; *Mean Suspiciousness* = 2.30, *SD* = 2.24), further justifying the use of these criteria.

### 5.2.2 Design and Procedures

A randomised active control trial design was used. Eligible participants were invited to take part via email and were required to provide informed consent before being randomised, in pairs, to one of two conditions (MBI or active control). Randomisation

was carried out using a randomising algorithm within Microsoft Excel software. The trial profile is presented in the consort diagram (Fig. 5.1) and a summary of assessment timepoints are available in Fig. C.1 of the appendix. Pre-intervention assessments were completed by participants at baseline (T0), followed immediately by the intervention (or active control), with a self-report assessment phase (self-reported paranoia, depression, anxiety, stress) after the initial 10 days (T1), and the full battery of assessments administered within 2 weeks of intervention completion (T2).

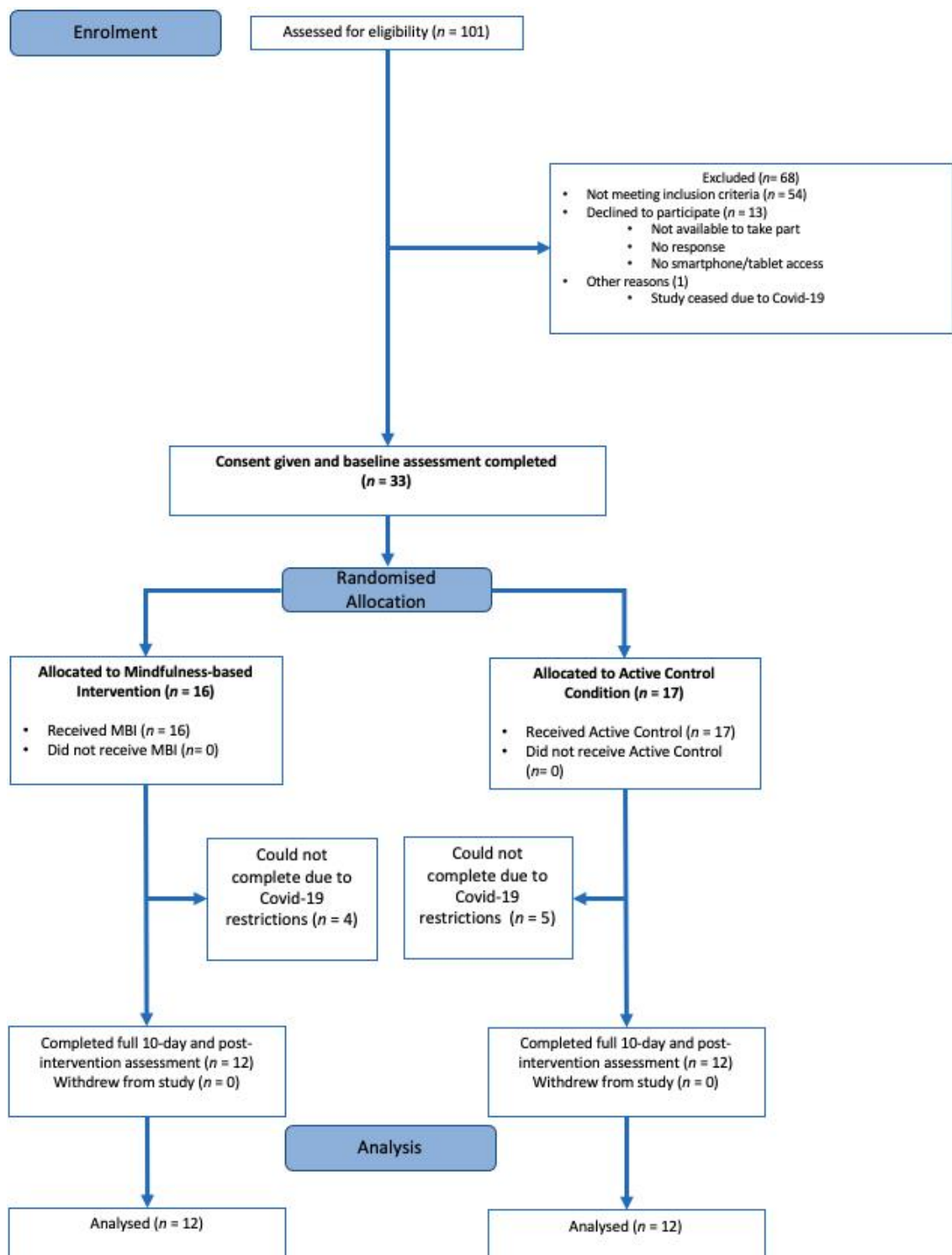
All baseline and post-intervention testing took place at a lab at the Institute of Psychiatry, Psychology and Neuroscience, King's College London, UK, and the T1 assessments (self-report measures only) were completed by participants online at home. Baseline and post-intervention sessions took approximately 2 hours, and the T1 survey took approximately 20 minutes. All participants were remunerated with £50 (cash), as well as a complimentary 1-month subscription to *Headspace* for taking part, and were compensated for travel costs.

### **5.2.3 Intervention and active control**

Participants created an app account using a unique password (pre-determined by the researcher), during the baseline assessment session. The apps used for the trial were available across widely used platforms (Apple/Android). Participants were not blinded to group allocation, and were informed that the purpose of the trial was to compare the effects of both conditions.

#### **5.2.3.1 Mindfulness-based Intervention – Headspace**

The MBI was delivered using *Headspace* – a commercially available mobile application (<https://www.headspace.com>). The intervention consisted of daily, formal guided mindfulness practises. Each meditation lasted approximately 10 minutes, integrating periods of focussed attention (returning awareness to a single focus, e.g., the breath), open monitoring (open awareness of sensations, thoughts and feelings present in the body) and choiceless awareness (awareness without effort or focus).



**Figure 5.1.** Consort diagram of trial profile.

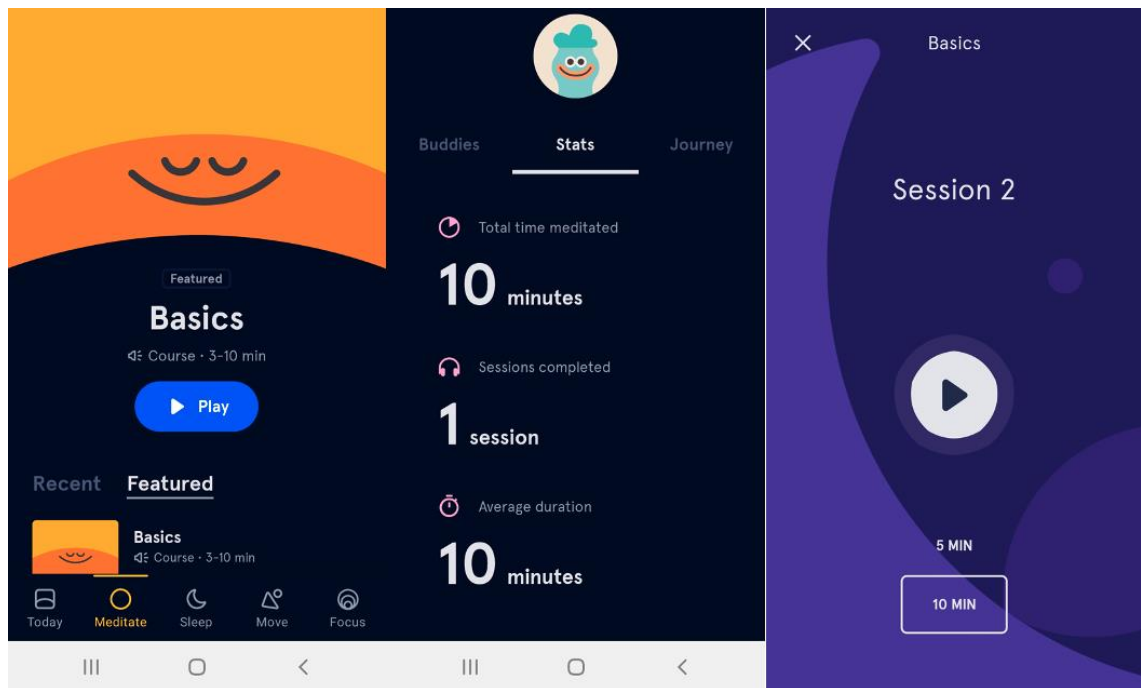
The initial 10 days covered the foundations of mindfulness (*Basics* package, free) to familiarise participants with the concepts and process of formal meditation, such as using the breath as an object of focus (mindful breathing). Following completion of the 10-day *Basics* package, participants were provided with a pre-paid pass to access the 30-day *Managing Anxiety* package. This package was chosen on the basis of a close association of anxiety with paranoia and anticipation of threat (Freeman, 2008, Freeman et al., 2012), and was therefore regarded as the most relevant for the aims of the study from all available *Headspace* packages.

The *Managing Anxiety* sessions were focussed around applying mindfulness to thoughts and feelings related specifically to anxiety and worry of all levels (from mild worry to persistent anxiety); a central consideration for use of these meditations was the normalisation of anxious thoughts and feelings, which were targeted without directly drawing attention to themes which carry stigma (i.e., paranoia). Furthermore, this package taps into the theme of interpersonal relationships, pro-social behaviour and empathy; for example, how the practise might impact and benefit others and the concept of shared experience – contrasting characteristics of paranoia (Freeman et al., 2005).

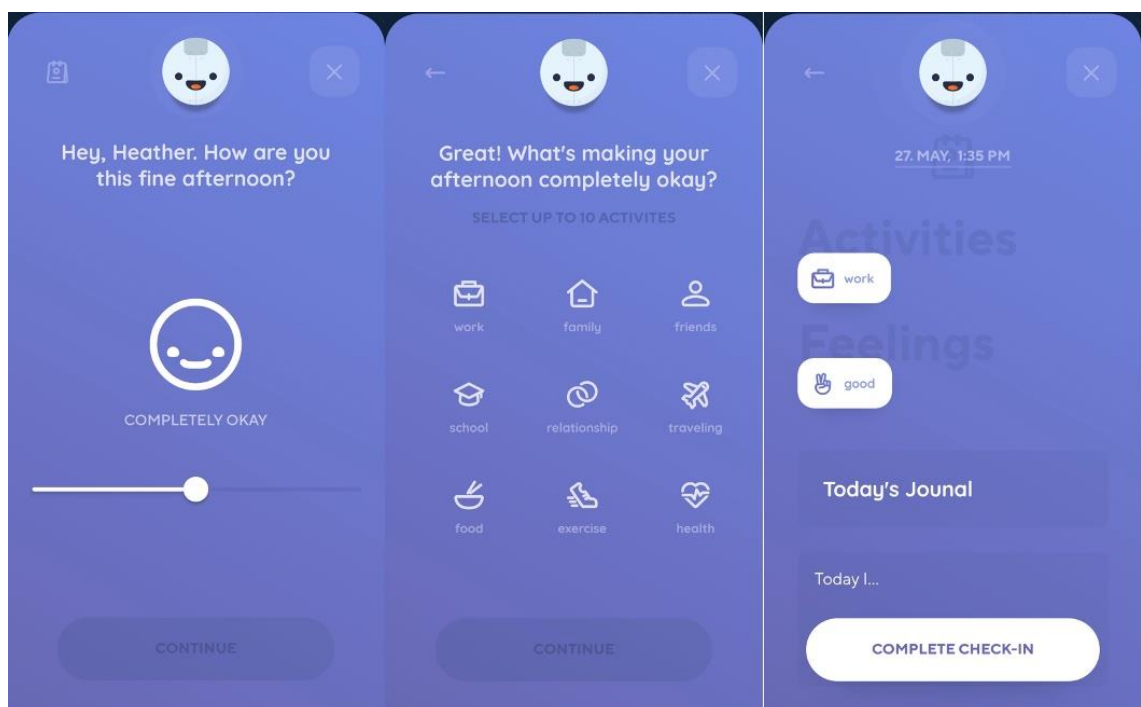
Participants were instructed to complete no more than one meditation per day and to pick up where they left off in the case of a missed session - even if this meant they would not complete all 40 sessions. The app was designed such that users were not able to access a meditations before completing all that came before it, ensuring that all sessions were completed in the same order. Participants were instructed not to engage with any other formal mindfulness-based practises or materials during the trial.

#### **5.2.3.2 Active Control: Reflective Journaling**

The active control condition was reflective journaling using the freely available online mobile app *Reflectly*, allowing for a neutral yet engaging activity for the control group. This app was similar to *Headspace* in terms of user interface to help match likelihood of engagement between groups (see Figs. 5.2 and 5.3). Further, reflective journaling encourages bringing reflective attention to daily experiences without any mindfulness training or instruction, helping to determine whether any observed effects were unique to formal, mindfulness-based practice as taught within the MBI.



**Figure 5.2.** Screenshots of the MBI group app, *Headspace*.



**Figure 5.3.** Screenshots of the active control group app, *Reflectly*.

The length and regularity of journaling sessions matched the MBI (ten minutes per day for 40 days). Participants were not directed to reflect about anything specific, but were given guidance to journal about a range of topics of any leaning, such as ‘daily goals, concerns, relationships or values’. The instructions were designed so that the journaling process remained neutral, and to reduce likelihood of negative rumination. Participants were reassured that their journal entries would remain entirely confidential and would not



be read by the researcher or used for analysis. The app allowed participants to only complete one journal entry per day, picking up where they left off in the case of a missed session, and all participants were instructed not to engage in mindfulness-based practises or materials during the trial.

#### **5.2.4 Minimising attrition: program orientation and researcher-participant communication**

A common challenge with online interventions is participant retention and engagement (Elfeky 2020; Pratap et al., 2020; Watson et al., 2018), with some studies reporting attrition rates of up to 62% for online mindfulness-based interventions (e.g., Cavanagh et al., 2013, Davis & Zautra 2013; Shore et al., 2018) including trials using *Headspace* (e.g., Howells et al., 2016 who reported attrition rates of 62%; but see Champion et al., 2018 and Flett et al., 2019, who's attrition rates were more favourable at 24% and 17%, respectively).

Lower attrition is found for studies which employ strategies such as engagement reminders (Linardon and Fuller-Tyszkiewicz, 2020); to minimise attrition, therefore, the current study was designed with regular reminders/supportive emails and text messages for participants at 10-day intervals throughout the intervention (see appendix Fig. C.1 and appendix C.12). Participants were also invited to get in touch with the researcher if they had questions or concerns during their involvement, keeping clear and open communication channels.

Retention may also benefit from personalised enrolment methods (Linardon and Fuller-Tyszkiewicz, 2020). To implement this, first, participants downloaded and installed the app assigned to their condition during their baseline lab visit to ensure any difficulties with app set-up could be immediately resolved. Second, all participants were given a detailed program orientation, including a demonstration of the app, verbal clarification of what was required of them, and were provided with information leaflets relevant to their group allocation (appendix Figs. C.2-C.9). These incorporated details of app management, instruction reminders, common questions (such as how to sit during a meditation, what to do if they forget to use the app) and potential obstacles they may experience (such as frequently forgetting to use the app, losing motivation), with tips to address them.

### **5.2.5 Trial safety and harms**

The study was conducted by the researcher, who had an understanding and experience of mindfulness practice and the trial was supervised by qualified mindfulness instructors and clinicians. Close communication was kept between the researcher and the participants, and between the supervisors and researcher throughout the trial. All participants were invited to contact the researcher at any time during (or after) the trial if they had any concerns or difficulties. At the end of the trial, they were also asked for qualitative feedback regarding any difficulties experienced during the intervention. Signposting to further information and help regarding distressing suspiciousness/paranoia were in place from the start of the trial.

### **5.2.6 Acceptability/Feasibility**

#### **5.2.6.1 Engagement and adherence**

Engagement was objectively monitored via the tracking tools available within the apps; the number of meditation sessions/journal entries completed by the participants were recorded by the researcher. All participants were made aware that their engagement with the apps would be recorded for the purposes of acceptability/feasibility.

Adherence to the content and the number of sessions completed per day (i.e., whether more than one session was completed within the same day) were tracked within the *Headspace* app. Tracking of this type was only available for the MBI group; whilst the control group app limited one journal entry to be registered per date, it was possible for a user to input journals retrospectively. It was therefore technically possible for participants to input multiple reflections within a single day, but the occurrence of this was not trackable and therefore not available for analysis in the active control group.

Finally, participants from the MBI group were given an opportunity to provide some qualitative feedback at the end of the trial which might inform the acceptability and feasibility of the intervention (e.g., whether there were any difficulties, how they felt about the length of the course, etc.).

#### **5.2.6.2 Motivation – VAS**

To account for motivation as a potential confounder of group differences and to give insight into the acceptability of the MBI, participants were asked to rate how motivated they felt to continue using the app which was assigned to them (including beyond taking

part in this study at T2). A visual analogue scale (VAS; on a scale of 1 = '*not at all motivated*' to 10 = '*extremely motivated*') was included in the T1 and T2 assessments.

### **5.2.7 Hypothesis: outcome measures**

To test the hypothesis that the 40-day mindfulness-based intervention would be associated with a larger reduction in paranoia compared to the active control condition, both trait (self-report) and state (objective) measures of paranoia were used.

#### **5.2.7.1 Trait measure of suspiciousness/paranoia**

Paranoia Scale (FVPS; Fenigstein & Venable, 1992): Designed for the assessment of non-clinical paranoia, this self-report questionnaire comprises 20 items reflecting general paranoid beliefs (e.g., *It is safer to trust no-one*). Items are rated on a 5-point Likert-scale (1 = *not at all applicable to me*, 5 = *extremely applicable to me*), with a score range of 20-100 and higher scores reflecting higher paranoia. The scale is widely used, with a previously reported Cronbach's alpha of .84 and good test-retest reliability (.70; Fenigstein & Venable, 1992). This scale has been shown to be sensitive to change following a brief online mindfulness intervention in healthy individuals (Shore et al., 2018).

#### **5.2.7.2 State measure of suspiciousness/paranoia: virtual reality**

##### **Immersive virtual reality**

State suspiciousness/paranoia was objectively assessed using a previously developed and validated protocol using an inter-personal VR environment at the KCL's Virtual Reality lab (development by Dr Lucia Valmaggia, project supervisor, as part of a prior study unrelated to this thesis). This is designed to imitate a neutral, nonthreatening environment with computer-programmed human avatars of varied gender and ethnicity. This method has recently been demonstrated to have good test-retest reliability, with no evidence of habituation or sensitisation effects with repeated exposure after 40 days (Massaro, 2020, unpublished thesis).

##### VR Materials

Participants wore a head-mounted VR display with integrated headphones (HMD; Oculus Rift, Version 2) which gave them a fully immersive 3D experience. The software used was Virtualware, via the VR platform Unity, commissioned by King's College London, and ran on a desktop PC (Alienware). Participants were provided with a control

pad with an analogue stick (Xbox, Microsoft) to use for movement through the environment (forward and backwards) in combination with turning their body direction (with 360° movement freedom).

### VR Procedure

The procedure used for VR data collection followed previously used protocol (Riches et al., 2019, and appendix C.10) The researcher explained the series of events which would take place during the participant's time in the VR environment prior to them putting on the headset. To familiarise participants with engaging with the VR environment, the first scene presented was of a street in which participants were invited to look around and use the control pad to move forward toward a green mark on the ground. These marks served as an indicator for the direction they would be moving throughout the session. From the street, participants were directed to a pub entrance. Before entering the pub scene, all participants were given the same instruction, in line with previous studies (Riches et al., 2019; Valmaggia et al., 2015):

*“While you are in the pub, please try to get an impression of what the people in the pub think about you, and what you think about them. If someone asks you a question, try to reply to them.”*

Upon entering the ‘pub’, participants were met by the host who invited them to introduce themselves and meet the other guests. The participant moved around the room meeting the avatars, whilst a variety of ambient background ‘pub’ audio played, including verbal stimuli which could be interpreted as positive (“*she’s so nice!*”), negative (“*what a loser*”) or neutral (“*what a joke*”). Upon meeting the final group of avatars, the participant was invited by male avatar, ‘John’, to join his table with a small group of others and chat with the group, before leaving the pub.

State Social Paranoia Scale (SSPS; Freeman et al., 2007b): The SSPS comprises 20 items and uses a 5-point Likert-scale (1 = *Do not agree*, 5 = *Totally agree*), with higher scores indicating higher levels of state persecutory thinking. Participants were asked to complete the form in relation to how they felt within the virtual social environment and the avatars. The scale is made of three subscales (items reflecting feelings of persecution, positive ideation and neutral ideation). Only the items of persecutory thinking were included for the analysis (10 items; e.g., *Someone had bad intentions towards me*). The SSPS has been shown to be reliable (Cronbach’s alpha = .91), and

has demonstrated good test-retest reliability (.78) as well as convergent and divergent validity (Freeman et al., 2007b).

*VR Experience and Slater-Usuh-Steed Sense of Presence Questionnaire (SUS; Slater et al., 1994):* Following methods of previous research (Riches et al., 2019) and to identify any potential confounding effects of sense of presence, all participants were asked whether they had previously used VR and if they regularly play video games. The SUS comprises 6 items measuring a sense of presence in a VR environment using a 7-point Likert-scale. The items were adjusted to apply to the environment which the participants experienced in this study (e.g., *I had a sense of being there, in the pub*). The SUS has been demonstrated to have good psychometric properties (Usuh, 2000, Riches et al., 2019), with a previously reported Cronbach's alpha of .89 across a sample of healthy individuals with high and low paranoia engaging with the same virtual reality 'pub' environment as the current study (Riches, 2016, unpublished thesis).

*VR Task Fidelity:* VR task completion (full, partial or non-completion) was recorded by the researcher. Participants who did not fully complete the task were excluded from analysis and reasons for non-completion were recorded. Researcher-participant communication and interruptions during the VR session were also recorded; for the purposes of maintaining a sense of presence in VR, participants were made aware that the researcher would not speak to them during the task unless the participant needed to ask the researcher a question or were struggling with the task. Any researcher-participant communication or interruptions made during the task were recorded; however, the data were used in the analysis.

## **5.2.8 Secondary measures**

### **5.2.8.1 Depression, anxiety and stress**

*Depression, Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995):* This is a widely used self-report measure of symptoms of depression (low positive affect), anxiety (physical arousal) and stress (tension) assessed over the past week, comprising 42 items and using a 4-point Likert-scale (0 = *did not apply to me at all*, 3 = *applied to me very much*). It has shown to be reliable, with Cronbach's alphas for the subscales Depression, Anxiety and Stress subscales reported as .91, .84 and .90, respectively (Lovibond and Lovibond, 1995). Excellent test-retest reliability has also been reported (.99, Akin and Çetin., 2007) and it is considered a valid assessment for use in clinical and non-clinical populations (Antony et al., 1998; Crawford & Henry, 2003). Scores on

the DASS are found to positively relate to paranoia (Freeman et al., 2008), negatively relate to dispositional mindfulness (Cash & Wittingham, 2010; Pidgeon et al., 2013) and reductions in scores have been observed following mindfulness-based training (Gallego et al., 2014; Warnecke et al., 2011).

#### **5.2.8.2 Dispositional mindfulness**

Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006): Details of the FFMQ can be found in the methods section of Study 1 (Chapter 3, section 3.2). The measure was used to check for baseline group differences on dispositional mindfulness and to explore changes in mindfulness skills after 40 days of the MBI.

#### **5.2.9 Piloting of online applications and measures**

The lab-based assessment protocol and the T1 survey were piloted on 5 independent volunteers. The content of both apps (including all sessions of the *Headspace Basics* and *Managing Anxiety* packages) were screened for suitability by the researcher and supervisors before study commencement. Both apps were also piloted for 10 days by an independent researcher for the ease of use, troubleshooting and reliability in tracking engagement.

### **5.3 Data analysis strategy**

Statistical analyses were performed using SPSS (IBM, version 24).

#### **5.3.1 Baseline participant characteristics**

##### **5.3.1.1 Demographics and characteristics**

An independent *t*-test was used to test for baseline group differences in age, and chi-square tests for differences in gender, ethnicity and current education level. Independent *t*-tests were also used to test for group differences in baseline schizotypy scores and dispositional mindfulness.

##### **5.3.1.2 Primary outcomes: paranoia**

Independent *t*-tests were used to test for group differences in baseline trait paranoia (self-report) and state paranoia (as elicited by the VR environment).

### **5.3.2 VR task fidelity**

Chi-square tests were used to test for group differences in the number of participants who completed the full VR task and how many participants the researcher spoke to during the VR session.

### **5.3.3 VR sense of presence**

Independent *t*-tests and chi-square tests were conducted to assess baseline group differences in sense of presence during VR and prior experience of using VR and video games.

#### **5.3.3.1 Secondary measures**

Independent *t*-tests were conducted to test for baseline group differences in depression, anxiety, and stress. Chi-square tests were used to assess baseline group differences in how many participants scored within each severity category for symptoms of depression, anxiety and stress (based on the cut-off points provided by Lovibond & Lovibond, 1995).

### **5.3.4 Feasibility and acceptability**

#### **5.3.4.1 Engagement, adherence and motivation to continue**

Engagement and adherence were recorded and effect sizes (ES; Cohen's *d*) and 95% CIs were calculated for group differences in average motivation to continue with practice at T1 and T2 assessment points.

### **5.3.5 Changes in primary outcomes: trait and state paranoia**

#### **5.3.5.1 Change in scores at the group level**

Effect sizes (Cohen's *d*) were calculated for each group to indicate whether there was an effect of group upon score changes in trait and state paranoia from baseline to post-intervention assessment. As recommended by Feingold (2013), only baseline *SDs* were used for calculation to ensure that these values were not influenced by the allocated intervention/active control (p.144). Pooled *SDs* were used in the formula, since group assignment was randomised at study onset and it is suggested that these provide a more precise estimate of the treatment effect (Morris, 2008). The following equation was used (Feingold, 2013):

$$d = \frac{M_{CHANGE-T} - M_{CHANGE-C}}{SD_{POOLED}}$$

Where  $M_{CHANGE-T}$  is the mean score change (difference between the mean scores at baseline and 40-day assessment [T2]) for the MBI group,  $M_{CHANGE-C}$  is the mean score change for the active control group,  $SD_{POOLED}$  is the pooled baseline  $SD$  for both groups.

### 5.3.5.2 Change at the individual level: Reliable Change Index

To assess individual effects of the intervention upon the primary outcomes, the Reliable Change Index (RCI; Jacobson & Truax, 1991) was used to examine changes in trait and state paranoia on a case-by-case basis. The RCI uses the test-retest reliability and standard deviation of a measure to evaluate whether a change in scores on a measure over time for an individual is reflective of 'real' and 'reliable' change, i.e. significantly greater than the change which could occur by chance due to random measurement error. The RCI was calculated in an Excel (Microsoft) spreadsheet using the formulae derived by Zahra (2010 [online at: <http://daniel-zahra.com/publications.htm>]):

$$RCI = \frac{X_2 - X_1}{S_{diff}}$$

$$S_{diff} = \sqrt{2(S_E)^2}$$

$$S_E = S_1\sqrt{1 - r_{xx}}$$

Where  $X_1$  is the individual score at baseline (T0),  $X_2$  is the individual score at post-intervention assessment (T2), and  $S_{diff}$  is the standard error of the difference;  $S_E$  is the standard error of measurement and  $r_{xx}$  is the test-retest reliability of the scales (FVPS: Fenigstein & Vanable 1992; SSPS: Freeman et al., 2007b). In the original formula,  $S_1$  is the  $SD$  of the pre-treatment (T0) for the experimental group; however, the  $SD$ s of general population norm data as reported in the previous studies were used for the calculation in this study, due to the small size of the current sample. The RCI was also used to investigate whether reliable change was observed for self-reported paranoia at T1 assessment.



### 5.3.5.3 Secondary analysis: changes in depression, anxiety, stress and mindfulness

Effect sizes (Cohen's *d*) were calculated for each group to indicate whether there was a group effect for the overall mean DASS and FFMQ scores from baseline to post-intervention assessment using the same method as described in section 5.4.5.1.

## 5.4 Results

### 5.4.1 Baseline Characteristics

There were no significant baseline between-group differences in age, gender, current level of education or ethnicity (Table 5.1).

**Table 5.1.** Baseline means (and standard deviations) for the MBI and active control groups on demographic characteristics, with the test statistics for between-group differences.

Demographic	Group		Statistic		
	MBI ( <i>n</i> = 12)	Control ( <i>n</i> = 12)	<i>t</i>	$\chi^2$	<i>p</i>
	<i>Mean ± SD</i>	<i>Mean ± SD</i>			
<b>Age</b> (years) [range]	26.83±10.46 [18-58]	27.25 ± 12.43 [18-57]	.09	-	.93
	<i>n (%)</i>	<i>n (%)</i>			
<b>Gender</b>			-	<.00	1.00
Male	2 (16.7)	2 (16.7)			
Female	10 (83.3)	10 (83.3)			
<b>Education Level</b>			-	5.21	.27
GCSE/Equivalent	1 (8.3)	0 (0)			
College, no degree	1 (8.3)	1 (8.3)			
Associate degree	1 (8.3)	0 (0)			
Bachelor's degree	4 (33.3)	9 (75.0)			
Master's degree	5 (41.7)	2 (16.7)			
<b>Ethnicity</b>			-	1.33	.51
White	4 (33.3)	4 (33.3)			
Asian/Asian Brit	5 (41.7)	7 (58.3)			
Black/African/Caribbean/Black British	3 (25.0)	3 (8.3)			

Abbreviations: MBI = *Mindfulness-based Intervention*

#### 5.4.1.1 Schizotypy

Table 5.2 presents the mean group scores on the SPQ schizotypy subscales. There were no significant group differences on total schizotypy, positive, negative or disorganised domains, and no significant differences on any of the positive schizotypy subscales, including *Suspiciousness*.

**Table 5.2.** Baseline means (and standard deviations) with test statistics for group differences on schizotypy.

Schizotypy (SPQ)	Group		Statistic	
	MBI	Control	<i>t</i>	<i>p</i>
	( <i>n</i> = 12)	( <i>n</i> = 12)		
	<i>Mean ± SD</i>	<i>Mean ± SD</i>		
<b>Total SPQ score</b>	38.92 ± 12.41	34.08 ± 9.20	1.08	.29
<b>Positive Schizotypy (total)</b>	16.58 ± 6.05	15.50 ± 4.93	.48	.64
Magical Thinking	1.58 ± 1.73	1.25 ± 1.66	.48	.64
Unusual Perceptual Experiences	3.08 ± 1.93	2.09 ± 2.31	.19	.85
Ideas of Reference	5.58 ± 2.78	5.50 ± 2.11	.08	.94
Suspiciousness	6.33 ± 1.44	5.83 ± 1.40	.86	.40
<b>Negative Schizotypy</b>	14.33 ± 4.96	11.83 ± 3.90	1.37	.18
<b>Disorganised Schizotypy</b>	8.00 ± 3.69	6.75 ± 3.11	.90	.38

Abbreviations: MBI = *Mindfulness-based Intervention*; SPQ = *Schizotypal Personality Questionnaire*

#### 5.4.1.2 Paranoia

Table 5.3 presents group baseline scores for paranoia. There were no significant differences at baseline on trait or state paranoia. All but two participants (*n* = 1 MBI; *n* = 1 Control) endorsed paranoid items on the SSPS in relation to the VR environment, with mean scores for the whole sample (*Mean* = 18.29, *SD* = 7.06) falling closely to previously reported scores in a sample taken from a population with increased risk of psychosis (Valmaggia et al., 2015). Overall elevated scores on trait paranoia were found for the sample as a whole (FVPS *Mean* = 54.50, *SD* = 16.01) by comparison with other non-clinical population studies (e.g., Freeman et al., 2005).

**Table 5.3.** Baseline means (and standard deviations) for the MBI and active control groups on self-reported paranoia, with the test statistics for between-group differences.

Paranoia Measure	Group		Statistic		
	MBI	Control	<i>t</i>	<i>χ</i> <sup>2</sup>	<i>p</i>
	( <i>n</i> = 12)	( <i>n</i> = 12)			
	<i>Mean ± SD</i>	<i>Mean ± SD</i>			
<b>FVPS</b>	57.92 ± 18.01	51.08 ± 13.63	1.05		.31
<b>SSPS<sup>Persecution</sup></b>	19.42 ± 8.73	17.17 ± 8.73	.77		.45

Abbreviations: FVPS = *Fenigstein Variable Paranoia Scale*; MBI = *Mindfulness-based Intervention*; SSPS = *State Social Paranoia Scale*

### 5.4.1.3 Secondary Measures

Table 5.4 presents group mean scores for symptoms of depression, anxiety and stress at baseline. There were no significant baseline between-group differences in scores on any of the DASS subscales.

**Table 5.4.** Baseline means (and standard deviations) for the MBI and active control groups on self-reported depression, anxiety and stress, with the test statistics for between-group differences.

Secondary Outcomes: DASS	Group		Statistic			
	MBI ( <i>n</i> = 12)	Control ( <i>n</i> = 12)	<i>t</i>	<i>p</i>	<i>X</i> <sup>2</sup>	<i>p</i>
<b>DASS<sup>Depression</sup></b>						
<b>Mean ± <i>SD</i> Score</b>	18.00 ± 13.13	9.67 ± 10.05	1.75	.10	-	-
Score Category ( <i>n</i> , %)			-	-	7.53	.11
Normal	(5, 41.7%)	(7, 58.3%)				
Mild	(0, 0%)	(2, 16.7%)				
Moderate	(2, 16.7%)	(0, 0%)				
Severe	(2, 16.7%)	(3, 25%)				
Extremely Severe	(3, 25%)	(0, 0%)				
<b>DASS<sup>Anxiety</sup></b>						
<b>Mean ± <i>SD</i> Score</b>	11.17 ± 7.08	10.08 ± 8.83	.33	.74	-	-
Score Category ( <i>n</i> , %)			-	-	4.76	.31
Normal	(6, 50%)	(5, 41.7%)				
Mild	(1, 8.3%)	(2, 16.7%)				
Moderate	(1, 8.3%)	(3, 25%)				
Severe	(3, 25%)	(0, 0%)				
Extremely Severe	(1, 8.3%)	(2, 16.7%)				
<b>DASS<sup>Stress</sup></b>						
<b>Mean ± <i>SD</i> Score</b>	18.25 ± 11.55	15.83 ± 10.78	.53	.60	-	-
Score Category ( <i>n</i> , %)			-	-	3.00	.56
Normal	(6, 50%)	(6, 50%)				
Mild	(1, 8.3%)	(0, 0%)				
Moderate	(1, 8.3%)	(3, 25%)				
Severe	(3, 25%)	(3, 25%)				
Extremely Severe	(1, 8.3%)	(0, 0%)				

Abbreviations: *DASS* = Depression, Anxiety and Stress Scale; *MBI* = Mindfulness-based Intervention

Table 5.5 presents group comparisons for dispositional mindfulness at baseline. No significant group differences were found for any aspect of dispositional mindfulness.

**Table 5.5.** Baseline means (and standard deviations) for the MBI and active control groups on dispositional mindfulness, with the test statistics for between-group differences.

Secondary Outcomes: Mindfulness	Group		Statistic	
	MBI	Control	<i>t</i>	<i>p</i>
	( <i>n</i> = 12)	( <i>n</i> = 12)		
	Mean ± SD	Mean ± SD		
<b>FFMQ<sup>Total</sup></b>	116.08 ± 18.38	116.42 ± 25.60	-.04	.97
Observing	27.83 ± 3.83	26.83 ± 5.36	.53	.60
Describing	26.33 ± 5.25	24.92 ± 6.70	.58	.57
Acting With Awareness	21.92 ± 5.35	22.25 ± 7.05	-.13	.90
Non-Judging	20.50 ± 7.53	23.33 ± 7.28	-.94	.36
Non-Reacting	19.50 ± 5.50	19.08 ± 6.49	.17	.87

### 5.4.2 VR Task Fidelity

All 24 participants completed the full VR task at both T0 and T2. The researcher spoke to 4 participants during the VR task at the baseline (T0) assessment (MBI *n* = 2; Control *n* = 2).

### 5.4.3 VR Sense of Presence

There were no significant differences for sense of presence (immersion) for the groups at baseline. There were no significant differences in previous VR or video game experience (Table 5.6).

**Table 5.6.** Baseline means (and standard deviations) for the MBI and active control groups on virtual reality (VR) sense of presence, and prior experience of VR and video game use, with the test statistics for between-group differences.

	Group		Statistic		
	MBI	Control	<i>t</i>	<i>X</i> <sup>2</sup>	<i>p</i>
	( <i>n</i> = 12)	( <i>n</i> = 12)			
	Mean ± SD	Mean ± SD			
<b>Sense of Presence<sup>VAS</sup></b>	7.58	5.92	1.38	-	.18
<b>SUS<sup>TOTAL</sup></b>	30.25	27.17	.97	-	.33
	<i>n</i> (%)	<i>n</i> (%)			
<b>Previous VR experience</b>	6 (50%)	9 (75%)	-	1.60	.21
<b>Regularly plays Computer games</b>	2 (16.67%)	3 (25%)	-	2.92	.62

Abbreviations: SUS: *Slater-Usch-Steed Sense of Presence Questionnaire*; VAS: *Visual Analogue Scale*

#### 5.4.4 Retention, engagement and acceptability

Table 5.7 provides a summary of session completion for both groups. There was 100% retention, and engagement rates were high at both 10 days and 40 days, with an average of 91% session completion for the MBI group and 82% session completion for the control group across 40 days. Motivation to continue at T1 was similar for both groups, but was slightly higher for the MBI group with regards using the app beyond the study (at T2).

**Table 5.7.** Group means (and standard deviations) for the MBI and active control groups for session completion and motivation to continue using the app after 10 days (T1) and 40 days (T2), with effect sizes and 95% CIs.

	MBI ( <i>N</i> = 12)	Control ( <i>N</i> = 12)		
	Mean ± <i>SD</i> (overall %)	Mean ± <i>SD</i> (overall %)		
Average rate of sessions completed				
T1	9.33 ± 1.44 (93.3%)	8.42 ± 1.56 (84.2%)		
T2	36.58 ± 2.81 (91.3%)	33.12 ± 5.61 (82.9%)		
			<i>d</i>	95% <i>CI</i>
Motivation to continue				
T1	7.00 ± 1.28	6.75 ± 2.86	.11	[-1.25, 1.02]
T2	7.83 ± 1.47	6.58 ± 2.97	.53	[-1.69, 0.62]

#### Adherence

All participants in the MBI group adhered to the correct content. Five (42%) of the participants in the MBI group had at least one occurrence of completing more than one meditation session in a single day from the *Managing Anxiety* package. This typically occurred on 2-3 occasions; however, two participants completed more than one session in a day on 5-6 occasions.

#### Qualitative feedback:

The overall feedback from participants was positive, with many keen to continue practise following their involvement in the study. Excerpts from the qualitative feedback provided by participants is available in Appendix C (C.11).

## **5.4.5 Primary Hypothesis: changes in paranoia**

### **5.4.5.1 Trait Paranoia**

Table 5.8 presents the group means for self-reported trait paranoia at each time point, as well as mean change from baseline to T2, and number of participants showing reliable change for trait paranoia change from baseline to T2. Four MBI participants and three control participants showed reliable reductions from T0-T2, and no study participant showed a reliable increase over the course of the study. No overall group effect was observed from T0-T2.

### **5.4.5.2 State Paranoia: VR**

Table 5.9 presents the mean scores and mean change for both groups from baseline to post-intervention assessments.

A medium-to-large ES ( $d = .63$ ) for reductions of persecutory ideation from T0 to T2 was found, in favour of the MBI group. Four participants within the MBI group showed reliable reductions of persecutory ideation evoked by the VR social situation following the intervention. Scores for these participants shifted from scores reflecting clinical levels of persecutory ideation on the SSPS to scores reflecting general population means (Valmaggia et al., 2015). In the control group, one participant showed a reliable reduction. One participant in each group showed a reliable increase in scores.

## **5.4.6 Secondary outcomes**

Table 5.10 provides group mean scores for at each time point, as well as mean change from T0 to T2.

### **5.4.6.1 Depression, anxiety and stress**

Reductions in mean depression scores were observed for both groups at T2 compared to baseline; however, there was no overall effect of group ( $d = .02$ ). Similarly, there were reductions for both groups on mean anxiety at T2 compared to baseline; however, there was an overall larger reduction in favour of the control group ( $d = .37$ ). Again, both groups displayed reduced scores at T2 in comparison to baseline, but there was a small overall effect of group on stress symptoms after 40 days ( $d = .13$ ).

#### 5.4.6.2 Dispositional mindfulness

Small effects of group on trait mindfulness were observed for increases in total FFMQ scores ( $d = .20$ ), *Acting with Awareness* ( $d = .21$ ) and a large effect for increases in *Non-Judging* ( $d = .71$ ) in favour of the MBI group (Table 5.11). There was little-to-no effect of group upon *Describing* or *Non-Reacting*.

**Table 5.8.** Group means (and standard deviations) for the MBI and active control groups scores on the Fenigstein & Varnable Paranoia Scale (FVPS) at each assessment time point, with effect sizes and 95% CIs for group comparisons of overall score change after the full 40 days.

Self-rated Paranoia (FVPS)	Group and Timepoint						Statistic	
	MBI ( <i>n</i> = 12)			Control ( <i>n</i> = 12)			<i>d</i>	95% CI
	T0	T1	T2	T0	T1	T2		
Mean ± SD	57.92 ± 5.19	56.08 ± 5.51	50.67 ± 5.60	51.08 ± 3.93	44.17 ± 5.71	44.42 ± 4.43	-	-
Total <i>n</i> demonstrating reliable reduction (from baseline)	-	1	4	-	3	3	-	-
Overall Change (Mean ± SD) T0-T2	-7.25 ± 11.89			-6.67 ± 10.54			.04	[-1.17, 1.10]

**Table 5.9.** Group means (and standard deviations) for the MBI and active control groups scores on the State Social Paranoia Scale (SSPS) at each assessment time point, with effect sizes and 95% CIs for group comparisons of overall score change after the full 40 days.

VR rating (SSPS)	Group and Timepoint				Statistic	
	MBI ( <i>n</i> = 12)		Control ( <i>n</i> = 12)		<i>d</i>	95% CI
	T0	T2	T0	T2		
Mean ± SD	57.92 ± 5.199	50.67 ± 5.60	51.08 ± 3.93	44.42 ± 4.43	-	-
Overall change (Mean ± SD) T0-T2	-4.83 ± 9.89		-.33 ± 4.87		.63	[-.53, 1.79]
Total <i>n</i> demonstrating reliable reduction	4		1		-	-



**Table 5.10.** Group means (and standard deviations) for the MBI and active control groups sores on the Depression, Anxiety and Stress Scale (DASS) at each assessment time point, with effect sizes and 95% CIs for group comparisons of overall score change after the full 40 days.

DASS subscale	Group and Timepoint						Statistic	
	T0	MBI ( <i>n</i> = 12) T1	T2	T0	Control ( <i>n</i> = 12) T1	T2	<i>d</i>	95% <i>CI</i>
<b>DASS<sup>Depression</sup></b>								
<i>Mean ± SD</i>	18.00 ± 3.79	13.58 ± 3.31	15.08 ± 3.53	9.67 ± 2.90	8.92 ± 2.51	7.00 ± 2.69		
Overall Change ( <i>Mean ± SD</i> ) from T0- T2			-2.92 ± 11.78			-2.67 ± 9.64	.02	[-1.11,1,15]
<b>DASS<sup>Anxiety</sup></b>								
<i>Mean ± SD</i>	11.17 ± 2.04	6.58 ± 1.58	9.33 ± 2.18	10.08 ± 2.55	5.83 ± 1.69	5.25 ± 1.46		
Overall Change ( <i>Mean ± SD</i> ) T0-T2			-1.83 ± 5.77			-4.83 ± 7.42	.37	[-.77, 1.52]
<b>DASS<sup>Stress</sup></b>								
<i>Mean ± SD</i>	18.25 ± 3.33	13.33 ± 2.15	15.75 ± 3.00	15.83 ± 3.11	12.25 ± 3.08	11.58 ± 2.64		
Overall Change ( <i>Mean ± SD</i> ) T0-T2			-2.50 ± 9.44			-4.25 ± 10.07	.16	[-.98, 1.29]

**Table 5.11.** Group means (and standard deviations) for the MBI and active control groups sores on the Five Facet Mindfulness Questionnaire (FFMQ) at each assessment time point, with effect sizes and 95% CIs for group comparisons of overall score change after the full 40 days.

FFMQ Subscale	Group and Timepoint						Statistic	
	T0	MBI ( <i>n</i> = 12) T1	T2	T0	Control ( <i>n</i> = 12) T1	T2	<i>d</i>	95% <i>CI</i>
<b>FFMQ<sup>Total</sup></b>								
<i>Mean ± SD</i>	116.08 ± 18.38	116.17 ± 15.40	123.50 ± 21.29	116.42 ± 25.60	114.67 ± 17.53	119.42 ± 20.85		
Overall Change ( <i>Mean ± SD</i> ) from T0-T2			7.42 ± 12.94			3.00 ± 22.46	.20	-0.94, 1.33
<b>FFMQ<sup>Observing</sup></b>								
<i>Mean ± SD</i>	27.83 ± 3.83	24.58 ± 5.70	27.08 ± 5.36	26.83 ± 5.36	23.50 ± 7.11	25.50 ± 6.65		
Overall Change ( <i>Mean ± SD</i> ) T0-T2			-.75 ± 3.27			-1.33 ± 3.28	.13	-1.01, 1.26
<b>FFMQ<sup>Describing</sup></b>								
<i>Mean ± SD</i>	26.33 ± 5.25	26.25 ± 6.29	26.33 ± 5.81	24.92 ± 6.69	25.42 ± 6.14	26.83 ± 7.88		
Overall Change ( <i>Mean ± SD</i> ) T0-T2			.00 ± 5.08			1.92 ± 7.17	.32	-1.46, 0.82
<b>FFMQ<sup>ActingWithAwareness</sup></b>								
<i>Mean ± SD</i>	21.92 ± 5.35	23.12 ± 6.60	23.92 ± 6.89	22.25 ± 7.04	22.75 ± 6.30	22.92 ± 5.04		
Overall Change ( <i>Mean ± SD</i> ) T0-T2			2.00 ± 5.58			.67 ± 8.19	.21	-0.92, 1.35
<b>FFMQ<sup>Non-Judging</sup></b>								
<i>Mean ± SD</i>	20.50 ± 7.53	24.75 ± 6.68	25.67 ± 8.00	23.33 ± 7.28	22.58 ± 7.43	23.08 ± 5.52		
Overall Change ( <i>Mean ± SD</i> ) T0-T2			5.17 ± 6.01			-.25 ± 7.11	.73	-0.44, 1.90
<b>FFMQ<sup>Non-Reacting</sup></b>								
<i>Mean ± SD</i>	19.50 ± 5.50	17.42 ± 3.92	20.50 ± 5.99	19.08 ± 6.49	20.42 ± 6.42	21.08 ± 5.98		
Overall Change ( <i>Mean ± SD</i> ) T0-T2			1.00 ± 4.67			2.00 ± 3.22	.17	-1.3, 0.97

## 5.5 Discussion

The current pilot study aimed to investigate the feasibility and acceptability of a 40-day online MBI in a sample of individuals high in positive schizotypy with high suspiciousness/paranoia. The intervention was demonstrated as both feasible and acceptable, with excellent retention (100%) and adherence. The primary hypothesis was that larger reductions in trait and state paranoia would be observed following 40 days of mindfulness, compared to an active control condition (40 days of online reflective journaling). The hypothesis was partially supported, with no overall effect of group on measures of trait paranoia after 40 days, but a large group effect was found for reductions in state paranoia (as assessed using VR) in favour of the MBI group. In addition to overall group reductions, several participants in the MBI group demonstrated reliable reductions in state persecutory thinking induced by the VR environment compared with the control group.

A secondary aim was to investigate whether a reduction in symptoms of depression, anxiety and stress would also be observed following the mindfulness intervention. There was no effect of group upon reductions on depression and stress after 40 days and, contrary to expectation, there was a small-to-medium group effect for anxiety due to the score reduction in the *control* group.

### 5.5.1 Acceptability and feasibility

#### 5.5.1.1 Retention and Engagement

The current study objectively tracked engagement via the *Headspace* app; engagement rates (in terms of session completion) were high across the full 40 days, indicating that the participants were highly committed to the intervention. Moreover, there were no drop-outs from the trial. Online mindfulness interventions typically report attrition rates of 8%-60% (Spijkerman et al., 2016); several factors could have contributed to the high retention and engagement in the current trial. First, some recent online mindfulness trials have not involved face-to-face contact between the researcher and participants (e.g., Cavanagh et al., 2018; Champion et al., 2018; Shore et al., 2018). Conversely, the participants of the present study had in-person contact with the researcher at the start of the trial, providing opportunity for questions, concerns and clarifications about meditation and app-use.

It should be noted that participants in the current study had all participated in Study 2 and therefore the sample was likely to be highly motivated in terms of engagement with

the research; previously meeting with the researcher during Study 2 may have also improved researcher-participant rapport and trust. Further, supplementary information was provided at baseline, as well as regular reminders with invitations to contact the researcher were provided throughout the study, which can improve retention (Linardon & Fuller-Tyszkiewicz, 2020). It is possible that these factors – particularly giving context around mindfulness practice and building rapport – may have paralleled features of traditional MBIs which typically provide regular opportunities for trust-building and questions/issues to be addressed during face-to-face sessions. This could echo a good therapeutic alliance, as is strived for in clinical settings, which can predict amenability to mindfulness interventions (Goldberg et al., 2013). Future studies should also consider the effect of such factors upon outcome measures, since it has been noted that rapport-building with the facilitator of online MBIs may be an important factor for achieving comparable outcomes to those reported in traditional face-to-face MBIs (Krägeloh et al., 2019).

Finally, it is not always clearly reported whether incentives are offered to participants for study completion (e.g., Cavanagh et al., 2018; Shore et al., 2018), and some studies have offered vouchers to access the mindfulness apps used in the study (e.g., Champion et al., 2018). In the current study, all participants were offered monetary remuneration (as well as a voucher for *Headspace*) for their time completing the intervention and lab sessions, which could be a factor contributing to high retention. However, this would not explain high rates of session completion, since the offer did not apply to any ‘minimum’ amount of sessions to be completed throughout the intervention; participants were explicitly advised to not be concerned if they did not manage to complete all 40 sessions, since this would be informative with regards to the acceptability/feasibility of the intervention.

#### **5.5.1.2 Adherence to instruction**

Participants adhered to the correct content and generally found the *Headspace* app easy to navigate and keep track of practise (as reflected in general participant feedback, see Appendix C.11), suggesting that the largely self-directed delivery style of the intervention was acceptable and feasible. However, several participants completed more than one mindfulness session per day at least once, despite instruction not to do so. Possible reasons for this may include trying to catch up with forgotten sessions or, as was noted by some participants, instances of completing a meditation late at night (or in the very early hours of the morning) and another within the same 24-hour period. This was not regarded as particularly problematic within the context of the current study, since it was an infrequent occurrence for most participants; however, continued use of pragmatic

tracking of practise is recommended for future research, as well as investigating whether disrupted regularity of practise may effect outcomes.

### **5.5.2 Reductions in paranoia**

There was no overall effect of group upon trait paranoia after 40 days, as assessed by the FVPS, in contrast to expectation based on previous research reporting significant reductions on this measure following online MBI compared to a control condition (Shore et al., 2018). It should firstly be noted that the current sample was recruited on the basis of having high suspiciousness, and the sample overall had higher paranoia scores at baseline in comparison to the sample in the study of Shore and colleagues (2018), which may have impacted the results. Further, the current study used an active control condition, rather than a wait-list condition as used by Shore et al. (2018), which could have had bearing on observed effects. The comparable reductions for self-reported paranoia between the groups in the current study suggests there may be a common benefit of the MBI and reflective journaling conditions. Therapeutic benefits of expressive writing have been previously identified, including emotional adaption to stressful events (Lepore, 1997) and anxiety (Goodman, 2018). However, the content of the journals was not examined in this study, therefore it is not possible to conclusively determine whether the style of reflective journaling contributed to comparable effects upon self-reported paranoia as were seen in the MBI group.

In contrast, there was a medium-to-large effect of group upon reductions of state paranoia as elicited by the VR environment in favour of the MBI group, with more participants demonstrating reliable reductions in persecutory ideation within the MBI group than the control group. These results suggest a there is a mechanism specific to mindfulness for the reduction of state persecutory ideation. Mindfulness does not endeavour to eliminate the presence of thoughts (Kabat-Zinn, 1990), but it can mitigate automatic assumptions that thoughts reflect reality (Williams & Kuyken, 2012). Bringing an open and non-defensive attitude to the present-moment experience may reduce evaluative reactivity and increase adaptive responding to, and reduce distress of, perceived social threats (Brown et al., 2008; Jankowski & Holas, 2014), leading to a more neutral and less distressing (or 'triggering') experience during the VR environment.

Further, mindfulness is positively associated with metacognitive insight and decentred awareness (Chadwick et al., 2006; Teasdale et al., 2002), which may have contributed to noticing and adaptively managing 'here and now' evaluations and cognitions in relation to the VR social situation. These findings provide encouraging evidence for the use of

mindfulness to buffer against everyday distressing experiences of persecutory thinking - a distinct change which may have otherwise been missed through isolated use of traditional, self-report paranoia assessments. This not only highlights the worth of using experimentally controlled digital environments for the assessment of paranoia, but the finding of overall negligible alterations in state paranoia for the control group also provides support for the use of VR for assessing *change* in paranoia following intervention.

Mindfulness training led to larger increases in *Non-Judging* compared to the control group (with a large effect size), which can improve the ability to disengage from automatic judgements (Siegal, 2007); paranoid thinking has long been linked to negative judgements of both self and others (Chadwick & Trower, 1997). These results are in line with reports of increased non-judging acting to buffer the impact of trait paranoia on experiences of state paranoia (Kingston et al., 2019), suggesting that non-judgement of experience, attained by mindfulness training, can help mitigate daily experiences of suspiciousness/paranoia. These findings have particular relevance for individuals with high levels of positive schizotypy, who may have an increased tendency for state paranoia as elicited by unusual thought content (e.g., jumping to conclusions; Hua et al., 2020) or unusual experiences which could be distressing when accompanied by threatening appraisals (Brett et al., 2014).

### **5.5.3 Depression, Anxiety and Stress**

There was no effect of group upon overall changes in depression or stress, with a medium effect size found for group upon symptom improvements of anxiety after 40 days, in favour of the control group. This was an unexpected finding, given previous reports of reductions on these symptoms following app-based mindfulness training (e.g., Cavanagh et al., 2013; Champion et al., 2018; Economides et al., 2018; Flett et al., 2019). Effect sizes of smartphone interventions upon anxiety are generally found to be significantly greater compared to wait-list control trial designs than trials using active controls (Firth et al., 2017); wait-list controls are often used for trials rather than active control conditions (Cavanagh et al., 2013; Champion et al., 2018; Querstret et al., 2019). In contrast, this study used an active control of reflective journaling, which may have elicited its own therapeutic benefits (as discussed in section 5.5.2). It is also possible that the focus on sensations of anxiety over days 10-40 in the *Headspace* programme increased awareness of anxiety for MBI participants. Non-reactivity and non-judgement skills which can be applied to increased observation of negative affective symptoms may need more time to further develop in order to establish unique reductions, and it should be considered that further reductions in DASS scores may have been observed following

continued practice beyond 40 days. Indeed, significant increases in mindfulness skills are seen to precede significant decreases in self-reported affective states (such as stress) by weeks, and spikes in non-reacting and non-judging have been seen after 6 weeks of training (Baer et al., 2012). Finally, the DASS does not tap into symptom-related distress, therefore it was not possible to test for changes in this aspect. Lastly, it is reassuring that the group means did not indicate overall increases in symptoms at T2 compared to baseline, and there were no qualitative reports of adverse effects or distress.

#### **5.5.4 Limitations**

The chief limitation of the current study is the small sample size, which limited the study's power to find significant group effects. Nevertheless, the study reached the recommended minimum  $n = 12$  per arm for pilot trials (Julious, 2005) and the observed medium-to-large effect size found for reduction in state paranoia warrant larger trials. Better-powered trials would also provide opportunity to further confirm underlying mechanisms which are specific to online mindfulness training (e.g., whether improvements are mediated by specific mindfulness skills), as have been reported previously (Shore et al., 2018).

A further limitation is that no follow-up assessment was conducted; the current results provide insight into short-term effects of a 40-day online MBI upon paranoia; however, it would be necessary to investigate longer-term effects of the intervention upon the primary outcomes, particularly in the context of decreasing psychosis risk. Given the high motivation of participants to continue with practise, it would also be useful to gather perspective on the likelihood and long-term effects of continued vs. discontinued practice following interventions.

The self-report measure of paranoia (FVPS) was chosen due to its sensitivity to change in previous MBI trials (e.g., Shore et al., 2018); however, it has been argued that items on this measure may reflect themes related to depression (Green et al., 2008), which may help explain the similarly negative findings for group effects on both depression and FVPS scores at the end of the trial. The use of alternative self-report paranoia measures may be worth considering for future trials.

Finally, there was no objective measure of quality of meditation practice - the quality of meditation practise has been shown to impact psychological outcomes such as depression and stress (Ribeiro et al., 2018) and it is feasible that this could also apply changes on suspiciousness/paranoia. Indeed, some participants described themselves

as not psychologically engaging with the meditations (see Appendix C.11), including one participant who demonstrated no change on state paranoia. Further, rumination was not assessed, which is associated with maintenance of paranoia (Martinelli et al., 2013) and has been identified as a barrier for psychological engagement with mindfulness training (Banerjee et al., 2018). Taking psychological engagement into account, along with further exploration of the subjective experience of meditation practise (such as rumination) in future trials, would be beneficial for gaining a better insight into factors which could influence outcomes.

### **5.5.5 Conclusion**

Ten minutes of mindfulness practice over the course of a 40-day MBI, delivered online via a mobile app, has been shown to be feasible and acceptable in a sample of individuals high in positive schizotypy with high suspiciousness/paranoia. A medium-to-large effect size for reductions in state paranoia, as assessed objectively using VR, was found in favour of the MBI group (compared to an active control group), warranting larger trials. Importantly, the MBI was largely self-directed, with no regular face-to-face interaction with a trained instructor or clinician, suggesting that such interventions can be delivered at relatively low cost. However, for future trials, in-person contact prior to the intervention and support throughout the trial, including program orientation, reminders and informational resources are recommended for high retention and engagement. Incentives should also be considered as a possible influence for retention in future trials, but this may not apply to engagement or adherence. Importantly, there were no serious adverse effects of the intervention, indicating that the MBI is a safe method to alleviate experiences of state paranoia in a sample of participants with increased vulnerability to psychosis development; however, the long-term efficacy of mindfulness upon paranoia, as well as affective factors related to paranoia, such as anxiety, needs clarification. Future trials should also consider assessing levels of subjective distress associated with such factors.

Overall, the findings are consistent with the proposal that mindfulness training could mitigate the association between higher levels of positive schizotypal traits and psychosis risk through reduction of suspiciousness/paranoia. Finally, the results support the VR use to objectively assess change in state paranoia following interventions generally and for the MBIs in individuals high in positive schizotypy with high suspiciousness/paranoia, specifically.



## Chapter 6. General Discussion

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### 6.1 Overview of studies

*Studies 1 and 2* aimed to investigate the positive schizotypy-creativity relationship by addressing methodological limitations of previous research (as identified in the literature review of Chapter 1), which may have contributed to previously mixed findings. This was done using two core approaches: first, the multidimensional nature of positive schizotypy was considered, taking into account the distinct role of suspiciousness/paranoia – a commonly overlooked aspect of positive schizotypy with regards to creativity, and an aspect which may overlap with features un conducive to creativity (i.e., negative schizotypy; Acar & Sen, 2013; Kwapil et al., 2013, and cognitive inflexibility; Freeman et al., 2008). Second, a multifaceted approach to assessing creativity was adopted, following previous recommendations for assessing creativity in psychopathology research (Thys et al., 2014).

*Study 1* investigated the relationship between positive schizotypy and creative experience (*Process*), and directly tested whether the presence of suspiciousness/paranoia may impact this relationship. Given the previous evidence for a disassociation between aspects of positive schizotypy in mindfulness practitioners (i.e., having lower suspiciousness but higher magical thinking than the general population; Antonova et al., 2016), a further unique contribution was to explore whether dispositional mindfulness interacted with positive schizotypy in predicting creative experience.

*Study 2* expanded the investigation of the positive schizotypy-creativity relationship by using multiple measures of creativity (both subjective and objective, tapping into multiple creative '*P*'s: *Person*, *Process* and *Product*) and examined whether sensory information filtering, as indexed by the auditory startle habituation, is a possible mechanism underlying this link. Further aims of this study were to investigate to what extent the creativity measures correlated with each other, given that they were designed to tap into different domains of creativity, as well as to take the role of suspiciousness/paranoia into account in the case of null findings for the relationship between positive schizotypy and creativity.

The focal point of *Study 3* was to assess whether suspiciousness/paranoia – an evidently problematic aspect of positive schizotypy identified as a risk factor for the development of psychosis in vulnerable individuals (Cannon et al., 2008) - could be reduced in

individuals with high positive schizotypy using mindfulness skill training. This study used an RCT design to investigate whether a 40-day online mindfulness-based intervention (MBI; consisting of daily 10-minute meditations) could lead to a larger reduction of suspiciousness/paranoia, compared with an active control condition, in a sample of individuals high in positive schizotypy with high suspiciousness/paranoia. In addition to a commonly-used self-report measure of paranoia, the study implemented a novel objective measure of state paranoid ideation (VR). This study was planned with the related aim to preserve the reduced sensory information filtering should it have been found to underline the positive relationship between positive schizotypy and creativity in *Study 2*. A final aim was to investigate whether a larger reduction in self-reported depression, anxiety and stress, previously suggested to be associated with paranoia, would also be observed following the MBI (compared with the active control condition).

## 6.2 Summary of Findings

First, the findings of *Studies 1* and *2* provided evidence that positive schizotypy differentially relates to the aspects of creativity; in both studies, positive schizotypy was positively linked to phenomenological *Processes* of creativity, and *Study 2* provided evidence for wider associative thinking *Processes*, thought to aid creativity, in individuals with high positive schizotypy. However, performance on divergent thinking tasks (tapping into creative *Product* as well as *Process*) or scores on a measure of creative *Person* did not significantly differ between the individuals with high or low-to-moderate positive schizotypy (though the aspect of unusual experiences uniquely positively correlated with the subjective measure of creative *Person* across the full sample).

Further, the results provided evidence that *individual* aspects of positive schizotypy have differing effects upon creativity; thus, the aspects of magical thinking and unusual experiences appeared to be most clearly related to significantly wider associative thinking in individuals with high positive schizotypy, and were consistently associated with heightened creative experience. Conversely, there was no obvious advantage of suspiciousness for creativity, and high levels of this aspect dampened down otherwise beneficial associations of creativity with magical thinking/unusual experiences. This was significant in the case of pleasurable creative experience in *Study 1* and flexibility of creative thinking in *Study 2*, with a similar trend effect observed for fluency and originality. This offered partial explanation for the lack of an overall association between positive schizotypy and divergent thinking. Finally, *Study 1* provided evidence for a negative association between mindfulness and suspiciousness/paranoia, along with

novel evidence for a benefit of higher levels of dispositional mindfulness for the relationship between higher positive schizotypy and aspects of creative experience.

With regards to the mechanism(s) which may underline the positive schizotypy-creativity relationship, the results of *Study 2* indicated that the association of high positive schizotypy with heightened aspects of creative experience and wide associative thinking was not mediated by reduced sensory information filtering, as indexed by acoustic startle habituation. Contrary to expectation, no differences in habituation were identified between groups of individuals with high and low-to-moderate positive schizotypy, and no associations were found for any aspects of positive schizotypy with habituation. There were also no significant associations between the measures of creativity and habituation in individuals with HPS.

The results of *Study 3* indicated that a 40-day, online mindfulness-based intervention consisting of 10-minute daily meditations (delivered via the *Headspace* mobile app) was feasible and acceptable for use in a sample of individuals with high positive schizotypy and high suspiciousness/paranoia, with 100% retention and high rates of adherence to daily practice. In line with expectation, larger reductions in state persecutory ideations as evoked by a VR social environment were observed following the 40-day MBI, as compared with 40 days of reflective journaling. This signified potential for mindfulness in reducing psychosis risk in individuals with high positive schizotypy. However, reflective journaling appeared to elicit better improvements in self-reported symptoms of anxiety compared with the MBI. The reasons for this are unclear, but it is possible that the individuals in the MBI group had become more aware of their anxiety and more experientially open to it (as reflected in the increase in non-judgment as a mindfulness skill in the MBI group), whilst reductions in anxiety might not have occurred in the course of a 40-day mindfulness training (and might be linked to non-reactivity, which takes longer to develop; e.g. Kuyken et al., 2010).

### **6.3 Implications**

Directing attention towards beneficial aspects of traits associated with psychopathologies and mental illness will not only encourage taking into account in psychosis prevention and treatment the aspects which may be highly valued by the individual, but can help move towards de-stigmatisation of human experience as captured by the construct of positive schizotypy. This is especially relevant with regards to the fully dimensional view of schizotypy (Claridge, 1997) and the prevalence of anomalous experiences in the general population (Nuevo, 2012; van Os, 2009). The

current findings contribute to a view that, although positive schizotypy carries predictive power for psychosis conversion (Debbané, 2015), magical thinking and unusual experiences as aspects of positive schizotypy may not be harmful *per se* and, in fact, carry benefits. Whilst in line with the notion and contributing to evidence that schizophrenia genotype/phenotype remains in the general population due to a creative advantage of milder expressions of its positive features (Acar et al., 2018), the present findings highlight worth in disentangling the risks and benefits of these features. Further, they suggest that not only there is a dissociation between positive and negative/disorganised schizotypal traits in relation to creativity (Acar & Sen, 2013), but a dissociation can be found within positive schizotypy itself.

There are key implications for the combined findings of *Studies 1* and *2*; first, as has been discussed throughout Chapters 3 and 4, they further our understanding of the relationship between positive schizotypy and creativity, and offer some clarity for previously mixed findings. Positive relationships may be masked by an influence of high suspiciousness/paranoia, which would not have been captured in previous investigations through using schizotypy measures not containing a subscale for this aspect - or only assessing positive schizotypy on the whole when using measures which do. This might also depend on the domain of creativity being assessed, and may be most prevalent in the case of divergent thinking tasks, given the results of *Study 2* (where free associative thinking processes associated with creativity seemed unaffected by suspiciousness/paranoia, but indices of divergent thinking explicitly requiring creative production appeared to be impacted).

Moreover, the essence of the presented investigations concerned the preservation of creative advantages of positive schizotypy whilst reducing the potential risk associated with suspiciousness/paranoia, and the results of these studies have implications which lay within this context. There is consideration for the contributory role of paranoia in unconventional thinking such as conspiracy theories (Brotherton & Eser, 2015) which could be considered as creative products (Bonetto & Arciszewski, 2021). However, it has been argued that conspiracy-related ideation would likely be secondary to unusual links between events being made as a function of, for example, increased magical thinking (March & Springer, 2019). The correlations within the high positive schizotypy group in *Study 2* are in line with this proposal, suggesting that, in the first instance, the propensity to make unusual associations (an antecedent to creativity) is driven by increased magical thinking/unusual experiences, but not suspiciousness. The studies provide confidence that the reduction of suspiciousness/paranoia would not come at the detriment of creativity in high positive schizotypal individuals; indeed, on the contrary, this trait

appears to add no advantage and can in fact be detrimental to creativity within the context of high magical thinking/unusual experiences.

Although the mechanism underling the link between positive schizotypy and creativity was not identified in the course of this investigation, the results of *Studies 1* and *2*, as well as the overall principle, are still meaningful with regards to developing strategies for targeting aspects of positive schizotypy that present psychosis risk whilst preserving those which are valued. Herein lies optimism for moving towards preventative approaches for individuals with psychosis vulnerability which can be tailored to improve quality of life and support creative traits which are beneficial to both the individual and society. The results of *Study 3* indicate that mindfulness-based interventions are one such strategy. First, the reduction of state suspiciousness/paranoia in individuals with high positive schizotypy presents an opportunity to reduce potential ‘here and now’ distress, as is associated with paranoid thoughts (Freeman, 2007), and distress which can result from interpersonal and threatening appraisals toward anomalous experience (Brett et al., 2014). Crucially, for individuals with higher vulnerability, skills afforded by mindfulness practice could curtail developmental trajectories toward full-blown psychosis – the risk for which is associated with heightened paranoia in such individuals (Cannon et al., 2008; Wilcox et al., 2014).

*Study 3* adds to the growing literature on e-health, particularly in relation to suspiciousness/paranoia (Kingston et al., 2019; Shore et al., 2018) and specifically so in participants high in positive schizotypy. Future delivery of such interventions is also an important area for consideration; there is an ever-increasing pressure upon mental health services, which has only worsened the recent events of the Covid-19 pandemic (Johnson et al., 2021). The practicalities of having remote and largely self-directed mindfulness training programs available for implementation have become ever-more prominent. Importantly, the use of mobile apps for the delivery of mindfulness-based interventions provides an easily accessible and cost-effective alternative to traditionally delivered therapies, which often have long waiting lists and typically require the services of trained mindfulness therapists or clinicians for multiple sessions over a substantial period of time. Further, the study shows the feasibility of providing both mindfulness and reflective journaling for individuals with high positive schizotypy. Alongside finding preliminary evidence for mindfulness reducing state suspiciousness/paranoia in these individuals, the study also found evidence that daily reflective journaling may reduce anxiety - this latter finding warrants further investigation in its own right.

## 6.4 Overall methodological limitations

In addition to the methodological limitations discussed within the individual studies of the thesis, there are some further limitations to take into consideration. First, although schizotypy is generally agreed to fall across three domains, a fourth factor of schizotypy - *Impulsive Nonconformity* (as has previously been identified, and encapsulated within other questionnaires, such as the O-LIFE) - has been shown to relate to creativity, in addition to personality features such as *Openness* (Burch et al., 2006). These were not measured in the series of studies presented; it is, therefore, not possible to identify whether these traits may have interacted with positive schizotypy and/or influenced scores on the creativity measures within *Studies 1* and *2*. Indeed, it could be argued that unconventional ideas may be communicated more freely by individuals with more impulsive or open personality types (Li et al., 2014).

A further consideration is that the participant flow between the studies was designed to maximise recruitment, given the generally low prevalence of high positive schizotypy (around 8%; Linscott & Morton, 2017) and the foreseen challenges for recruitment rates for *Study 3*, which required participants with both high positive schizotypy and high suspiciousness/paranoia. Notwithstanding such challenges, recruitment for *Study 3* reached the previously recommended minimum sample for pilot trials (Julious, 2005) before the pandemic struck. However, due to the recruitment flow design, the participants in *Study 2* had varying degrees of suspiciousness/paranoia, and the investigation into the relationship among positive schizotypy, creativity and reduced information filtering may have benefited from specifically recruiting a sample scoring low on suspiciousness/paranoia.

It should be noted that the original, binary (forced Yes/No) response scale of the SPQ was used in the current study; whilst this was beneficial for comparing the current sample means to previous studies, using a Likert-scale format may have increased the likelihood of identifying participants who may have otherwise given more guarded responses when faced with forced-choice items (Wuthrich & Bates, 2005), potentially leading to better recruitment rates for *Study 3* as well as a more nuanced differentiation of high positive schizotypy levels overall and its specific aspects. Furthermore, responses using a Likert-scale are much more likely to be normally distributed, increasing validity and sensitivity of statistical procedures employed in the course of this research (e.g. mediation and moderation analyses).

## 6.5 Future directions/research

Given that both positive schizotypy and creativity are multi-dimensional constructs, researchers should carefully operationalise each construct for their study, framing hypotheses in terms of inter-relationships amongst specific dimensions, rather than looking at the overall relationship. For example, the current research highlighted that the four 'P's of creativity are distinct and dissociable, and future research should consider using multiple measures (both subjective and objective) to tap into them. This is relevant even within the same 'P' domain; for example, in the case of assessing the creative *Person* for the purposes of this research, 'creative activity' was defined in general terms, and the sample was not selected on the bases of creative activity status. This might help explain the lack of an association between positive schizotypy status and the measure of creative personality in *Study 2*, and may in part explain why no association was observed between creative activity status with creative personality in the supplementary analyses. Future research should take a categorical approach, recruiting individuals with high positive schizotypy on the basis of actively engaging in a creative activity (as a hobby, profession or education) and those for whom creative activity is defined in more general terms, as well as individuals with low-to-moderate positive schizotypy. Further, as noted in *Study 2*, recruiting participants on the basis of having high positive schizotypy as predominantly characterised by high levels of magical thinking/unusual experiences, but low suspiciousness/paranoia would provide an opportunity for a clearer view on the beneficial relationship between positive schizotypy and creativity without being potentially confounded by suspiciousness/paranoia.

A question mark remains above the conditions disadvantaging creativity – particularly in the case of divergent thinking. Whilst suspiciousness/paranoia has been identified as an area for consideration, the specific ways in which suspiciousness/paranoia hampers creativity in individuals with high magical thinking/unusual experiences needs clarification. Further, although the overall results fit within a framework for supporting creativity whilst reducing risks linked with suspiciousness/paranoia, conclusions cannot be made about whether these associations were indeed preserved following the MBI in *Study 3*. Given the results of *Study 1*, wherein dispositional mindfulness was found to interact with aspects of positive schizotypy in predicting creative experience, it would be informative to investigate the relationship between magical thinking and unusual experiences with creativity following reduction of suspiciousness/paranoia through mindfulness skill training.

One of the original aims of the current work was to investigate whether mindfulness would preserve the sensory information filtering – as indexed by acoustic startle habituation - theorised to underlie heightened creativity in individuals with high positive schizotypy; however, given that startle habituation was not found to underlie the relationship between positive schizotypy and creativity in *Study 2*, this was not additionally examined in *Study 3*. Further research to help identify which distinct mechanism(s) are implicated in the link between positive schizotypy traits and creativity is needed to help determine how to best support these conditions during psychosis prevention interventions for psychosis-prone individuals. Such investigations should employ a number of paradigms tapping into the sensory information filtering/gating (e.g., startle habituation, PPI, P50 ERPs) in the same sample of individuals with high positive schizotypy when investigating positive schizotypy-creativity relationship. The identification of such mechanism(s) would facilitate future research in examining whether and how mindfulness training might interact with conditions underlying creativity. Further, it would be advantageous to consider the role of disorganised schizotypal traits in relation to such mechanisms in future studies; the disorganised dimension has been associated with attenuated habituation (e.g., Evans et al., 2007), and the sample of *Study 2* had relatively low levels of disorganised schizotypal traits. Although no associations were found between disorganised schizotypy and habituation in the supplementary analyses of *Study 2*, it is worth considering that different profiles of habituation might be observed for individuals high on both positive and disorganised traits. Recruiting and comparing participants who are high in positive, in combination with low or high disorganised schizotypy, might help identify the specificity of schizotypal domains upon sensory information filtering.

As noted in the discussion of *Study 3* (Chapter 5), an important aim for future research would be to run larger (and longer) MBI trials, including follow-ups to assess longevity of their effects. Future trials assessing the effects of the MBI on suspiciousness/paranoia in high positive schizotypal individuals should make use of virtual reality as an ecologically valid and safe way to objectively assess changes in paranoia change following mindfulness training. Further, given the evidence for the benefits of mindfulness for individuals with psychosis (e.g., Khoury et al., 2013), future research might also assess the use of VR as an outcome measure in MBI trials for these individuals. Lastly, given the long-term aim to mitigate the risks of psychosis, such research should be conducted with a view to pave way for well-powered prospective studies to establish whether mindfulness training reduces prevalence of psychosis onset in individuals high in positive schizotypy with high suspiciousness.



It should be reiterated that the samples recruited for the present studies were from a general population with no current diagnoses or personal history of serious mental health problems, since the intention was to investigate positive schizotypy in the context of a fully dimensional model within a non-clinical population (e.g. not confounded by stress of more severe expressions of these traits, such as symptoms of psychosis). However, transient psychotic-like experiences are often found in the general population (van Os, 2009), and it was not possible to investigate whether the relationships observed in the present studies were influenced by current or recent transient psychotic-like experiences, which may have reflected more severe expressions of schizotypal traits, since these data were not captured. Given the inverted U-shape observed between psychopathology and creativity (Acar et al., 2018), it would be beneficial for future studies to investigate whether – and at what point – the relationship between positive schizotypy and creativity may change depending on different severity of traits or whether this is influenced by occurrence or severity of transient, psychotic-like experiences.

## **6.6 Conclusion**

Suspiciousness/paranoia is implicated in risk of psychosis onset for individuals with high positive schizotypy, and may hinder the creative advantages theorised to underpin psychotic-like traits remaining within the general population. The current set of studies provide a stepping-stone towards developing low-cost and easily accessible mindfulness-based interventions in order to alleviate state experiences of suspiciousness/paranoia, and future research might explore whether this alters aetiological trajectories towards psychosis. With hope to ease suffering and reduce the long-term risks associated with positive schizotypy whilst supporting the advantages associated with these traits, future research and models of care may work towards destigmatisation schizophrenia-like experience and aiding human flourishing.

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## Appendix A. Chapter 3 (Study 1) Supplementary Materials

**Table A. 1.** Cronbach's alpha for the current sample (N = 342), descriptions and item examples for the subscales of the SPQ (positive schizotypy dimension), FFMQ, and ECQ (Part A).

Scale/Subscale	Cronbach's Alpha	Description	Item Example
<b>SPQ positive subscales</b>			
<b><i>Odd Beliefs/ Magical Thinking</i></b>	<i>a</i> = .66	Belief in the supernatural/paranormal, e.g., telepathy.	'Are you sometimes sure that other people can tell what you are thinking?'
<b><i>Unusual Perceptual Experiences</i></b>	<i>a</i> = .70	Perceiving things which others don't, e.g., hallucinations.	'Have you ever seen things invisible to other people?'
<b><i>Ideas of Reference</i></b>	<i>a</i> = .79	Attributing personal significance to external events.	'When you see people talking to each other, do you often wonder if they are talking about you?'
<b><i>Suspiciousness</i></b>	<i>a</i> = .80	Distrust of others, perceptions of threat from others.	'Do you often pick up hidden threats or put-downs from what people say or do?'
<b>FFMQ</b>			
<b><i>Observing</i></b>	<i>a</i> = .81	Noticing internal and external experiences (e.g., thoughts, feelings, external sensory information such as sounds and smells).	'I pay attention to sensations, such as the wind in my hair or sun on my face.'
<b><i>Describing</i></b>	<i>a</i> = .88	Ability to label and describe internal experiences.	'I can usually describe how I feel at the moment in considerable detail.'
<b><i>Acting with Awareness</i></b>	<i>a</i> = .86	Attending, with awareness, to the present moment or current activity (as opposed to 'running on automatic pilot').	'When I do things, my mind wanders off and I'm easily distracted (reversed).'
<b><i>Non-Judging (of inner experience)</i></b>	<i>a</i> = .91	Ability to bring a non-judgmental attitude to thoughts and feelings.	'I make judgements about whether my thoughts are good or bad (reversed).'
<b><i>Non-Reacting (to inner experience)</i></b>	<i>a</i> = .80	Ability to not get caught up in thoughts and feelings, letting them come and go as they occur.	'I perceive my feelings and emotions without having to react to them.'
<b>ECQ Part A</b>			
<b><i>Distinct Experience</i></b>	<i>a</i> = .82	Creativity as a distinct experience compared to everyday experience, including reduced self-awareness and boundaries.	'I experienced relief that I was removed from the world of everyday perception.'
<b><i>Anxiety</i></b>	<i>a</i> = .71	A sense of vulnerability or anxiety associated with the creative process.	'I believed strongly in what I was creating, without doubting or questioning myself (reversed).'
<b><i>Absorption</i></b>	<i>a</i> = .87	A sense of being deeply absorbed in the creative process.	'I lost awareness of time and my physical surroundings.'

<b><i>Power/Pleasure</i></b>	<i>a</i> = .78	Affective-related aspect, reflecting a sense of pleasure and control during the creative process.	'It was characterised by intense feelings of joy and satisfaction.'
<b><i>Clarity/Preparation</i></b>	<i>a</i> = .53	A sense of certainty about which direction the creative work will be taken, including the preparation for the process.	'I put myself in the mood I wanted my creative work to take on.'

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Abbreviations: ECQ = *Experience of Creativity Questionnaire*; FFMQ = *Five Facet Mindfulness Questionnaire*; SPQ = *Schizotypal Personality Questionnaire*

**Table A. 2.** Spearman correlations between the SPQ (positive schizotypy), FFMQ, and ECQ Part A with mean scores and standard deviations.

	PS Total	IOR	MT	UE	Susp	ECQ A Total	DE	Anx	Abs	P/P	C/P	FFMQ Total	Obs	Desc	AwA	NJ	NR
<b>Mean (SD)</b>	7.69 (6.21)	2.56 (2.46)	.98 (1.89)	1.86 (1.92)	2.30 (2.24)	130.30 (27.80)	25.76 (7.90)	19.65 (5.77)	34.24 (8.51)	37.52 (7.98)	13.13 (3.23)	125.29 (18.16)	27.43 (5.87)	27.50 (6.14)	24.84 (5.84)	24.45 (7.20)	21.07 (4.75)
<b>PS Total</b>	-																
<b>IOR</b>	.84**	-															
<b>MT</b>	.62**	.41**	-														
<b>UE</b>	.76**	.47**	.51**	-													
<b>Susp</b>	.80**	.60**	.29**	.44**	-												
<b>ECQ A Total</b>	.42**	.38**	.32**	.30**	.26**	-											
<b>DE</b>	.42**	.38**	.30**	.31**	.30**	.90*	-										
<b>Anx</b>	.36**	.33**	.19**	.26**	.29**	.73**	.71**	-									
<b>Abs</b>	.28**	.26**	.26**	.22**	.14*	.90**	.74**	.55**	-								
<b>P/P</b>	.36**	.33**	.29**	.23**	.23**	.85**	.65**	.45**	.73**	-							
<b>C/P</b>	.12**	.20**	.18**	.14*	.10	.51**	.31**	.11*	.43**	.54**	-						
<b>FFMQ Total</b>												-					
	-.24**	-.21**	.17	-.11*	-.33**	.03	-.06	-.21**	.13**	.08	.17**		-				
<b>Obs</b>	.12**	.13*	.21**	.22**	.04	.36**	.32**	.16**	.38**	.30**	.26**	.43**	-				
<b>Desc</b>	-.22**	-.18**	-.21	-.09	-.31**	-.04	-.11	-.18**	.05	.03	.08	.68**	.14**	-			
<b>AwA</b>	-.18**	-.11*	-.04	-.16**	-.20**	-.15**	-.20**	-.25**	-.08	-.82	.06	.64**	.01	.34**	-		
<b>NJ</b>	-.38**	-.32**	-.12*	-.28**	-.39**	-.15**	-.18**	-.26**	-.03	-.12*	-.01	.68**	-.04	.31**	.39**	-	
<b>NR</b>	-.07	-.11*	.07	.02	-.13*	.14**	.08	-.02	.18**	.17**	.16**	.59**	.26**	.24**	.27**	.27**	-

\* $p < .05$ , \*\* $p < .01$

Abbreviations: ABS = Absorption; Anx = Anxiety; AwA = Acting with Awareness; C/P = Clarity/Preparation; DE = Distinct Experience; Desc = Describing; ECQ A Total = Experience of Creativity Questionnaire Part A Total; FFMQ Total = Five Facet Mindfulness Questionnaire Total; IOR = Ideas of Reference; MT = Magical Thinking; NJ = Non-judging; NR = Non-reacting; Obs = Observing; P/P = Power/Pleasure; PS Total = Positive Schizotypy Total; Susp = Suspiciousness.

**Table A. 3.** The results of all models testing the moderation effect of SPQ *Suspiciousness* on the relationship of SPQ *Unusual Perceptual Experiences* and *Magical Thinking* with the ECQ Part A factors.

SPQ Factor	ECQ Facet	Predictors	$\beta$ (SE)	p value [95% CI]
<b>Unusual Perceptual Experiences</b>	<b>Distinct Experience</b>	Unusual Perceptual Experiences	1.19 (.25)	<.001[.70, 1.69]
		Suspiciousness	.59 (.21)	.006[.17, 1.01]
		UnEx x Susp	-.11 (.10)	.26[-.30, .08]
		Constant	25.97 (.43)	<.001[25.11, 26.82]
		Model Summary	$R^2 = .14$ ; $F(3,338) = 16.52$ , $p < .001$	
	<b>Absorption</b>	Unusual Perceptual Experiences	1.05 (.24)	<.001[.59, 1.52]
		Suspiciousness	.17 (.24)	.47[-.29, .64]
		UnEx x Susp	-.18 (.10)	.08[-.39, .02]
		Constant	43.58 (.46)	<.001[33.67, 35.49]
		Model Summary	$R^2 = .06$ ; $F(3,338) = 8.28$ , $p < .001$	
	<b>Anxiety</b>	Unusual Perceptual Experiences	.71 (.18)	<.001[.35, 1.07]
		Suspiciousness	.47 (.16)	.003[.16, .78]
		UnEx x Susp	.06 (.07)	.39[-.19, .08]
		Constant	19.76 (.32)	<.001[19.13, 20.40]
		Model Summary	$R^2 = .12$ ; $F(3,338) = 14.02$ , $p < .001$	
	<b>Power/Pleasure</b>	Unusual Perceptual Experiences	.80 (.23)	<.001[.34, 1.25]
		Suspiciousness	.55 (.23)	.02[.10, 1.00]
		UnEx x Susp	-.23 (.09)	.01[-.42, -.05]
		Constant	37.95 (.45)	<.001[37.07, 38.83]
		Model Summary	$R^2 = .08$ ; $F(3,338) = 9.22$ , $p < .001$	
	<b>Clarity/Preparation</b>	Unusual Perceptual Experiences	.27 (.10)	<.01[-.07, .48]
		Suspiciousness	.07 (.09)	.44[-.11, .26]
		UnEx x Susp	.07 (.04)	.06[-.15, .00]
		Constant	13.27 (.19)	<.001[12.89, 13.64]
		Model Summary	$R^2 = .03$ ; $F(3,338) = 3.97$ , $p = .008$	
<b>Magical Thinking</b>	<b>Distinct Experience</b>	Magical Thinking	1.42 (.33)	<.001[.77, 2.07]
		Suspiciousness	.77 (.20)	<.001[.38, 1.17]
		MT x Susp	-.14 (.17)	.41[-.48, .20]
		Constant	25.86 (.42)	<.001[25.04, 26.68]
		Model Summary	$R^2 = .13$ ; $F(3,338) = 14.86$ , $p < .001$	
	<b>Absorption</b>	Magical Thinking	1.42 (.30)	<.001[.84, 2.01]
		Suspiciousness	.25 (.22)	.25[-.18, .68]
		MT x Susp	-.16 (.25)	.30[-.45, .14]
		Constant	34.35 (.45)	<.001[33.47, 35.23]
		Model Summary	$R^2 = .06$ ; $F(3,338) = 9.20$ , $p < .001$	
	<b>Anxiety</b>	Magical Thinking	.56 (.21)	.007[.15, .96]
		Suspiciousness	.62 (.14)	<.001[.34, .09]
		MT x Susp	.00 (.11)	.98[-.21, .22]
		Constant	19.65 (.30)	<.001[19.06, 20.24]
		Model Summary	$R^2 = .09$ ; $F(3,338) = 9.81$ , $p < .001$	
	<b>Power/Pleasure</b>	Magical Thinking	1.52 (.29)	<.001[.96, 2.08]
		Suspiciousness	.50 (.20)	.02[.10, .90]
		MT x Susp	-.29 (.13)	.03[-.54, -.03]
		Constant	37.72 (.42)	<.001[36.90, 38.54]
		Model Summary	$R^2 = .11$ ; $F(3,338) = 13.91$ , $p < .001$	
	<b>Clarity/Preparation</b>	Magical Thinking	.39 (.13)	.003[.13, .65]
		Suspiciousness	.07 (.08)	.40[-.09, .23]
		MT x Susp	-.02 (.06)	.71[-.14, .09]
		Constant	13.14 (.18)	<.001[12.79, 13.50]
		Model Summary	$R^2 = .03$ ; $F(3,338) = 3.87$ , $p = .009$	

Abbreviations: ECQ = *Experience of Creativity Questionnaire*; MT = *Magical Thinking*; SPQ = *Schizotypal Personality Questionnaire*; Susp = *Suspiciousness*.

**Table A. 4.** Full results of multiple linear regression analysis testing the interaction effects between FFMQ facet scores and conglomerate scores for SPQ *Magical Thinking + Unusual Experiences* vs. *Suspiciousness + Ideas of Reference* on predicting ECQ factor scores.

		ECQ Factor									
Predictor Variable		Distinct Experience		Anxiety		Absorption		Power/Pleasure		Clarity/Preparation	
FFMQ Facet		$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI	$\beta$ (SE)	95% CI
<b>Observing</b>	MTUE	.56** (.20)	[.184, .93]	.28* (.13)	[.02, .53]	.47* (.20)	[.07, .85]	.39* (.18)	[.03, .72]	.09 (.07)	[-.05, .24]
	SusploR	.42** (.11)	[.20, .64]	.33** (.08)	[.17, .49]	.16 (.12)	[-.08, .40]	.34** (.12)	[.12, .57]	.08 (.05)	[-.01, .17]
	FFMQ Obs	.33** (.07)	[.20, .48]	.12* (.05)	[.02, .23]	.48** (.07)	[.34, .62]	.34** (.07)	[.21, .48]	.12** (.03)	[.07, .18]
	MTUE x Obs	-.02 (.04)	[-.08, .05]	2.81 (.02)	[-.04, .04]	-.04 (.03)	[-.10, .03]	-.05 (.03)	[-.11, .01]	-.01 (.01)	[-.03, .02]
	SusploR x Obs	.00 (.02)	[-.03, .05]	.00 (.01)	[-.02, .03]	-.01 (.02)	[-.05, .03]	-.01 (.02)	[-.05, .03]	-.00 (.01)	[-.02, .01]
	Model Summary	Adjusted $R^2$ = .22, $F(5, 336) = 20.59, p < .001$		Adjusted $R^2$ = .13, $F(5, 336) = 11, p < .001$		Adjusted $R^2$ = .19, $F(5, 336) = 16.58, p < .001$		Adjusted $R^2$ = .18, $F(5, 336) = 15.67, p < .001$		Adjusted $R^2$ = .08, $F(5, 336) = 7.16, p < .001$	
<b>Describing</b>	MTUE	.72** (.17)	[.38, 1.06]	.37** (.12)	[.14, .61]	.66** (.18)	[.31, 1.01]	.48** (.16)	[.18, .79]	.14* (.07)	[.01, .28]
	SusploR	.42** (.12)	[.20, .65]	.29** (.09)	[-.12, .46]	.23 (.13)	[-.02, .47]	.42** (.11)	[.20, .64]	.12** (.05)	[.02, .21]
	FFMQ Desc	-.05 (.07)	[-.18, .08]	-.11* (.06)	[-.22, -.01]	.11 (.08)	[-.05, .27]	.12 (.07)	[-.02, .26]	.06* (.03)	[.01, .11]
	MTUE x Desc	.00 (.03)	[-.05, .06]	-.02 (.02)	[-.06, .02]	.03 (.03)	[-.03, .08]	.06* (.03)	[.01, .11]	.01 (.01)	[-.01, .03]
	SusploR x Desc	.03 (.02)	[-.01, .06]	.03* (.01)	[-.00, .06]	.01 (.02)	[-.03, .05]	-.01 (.02)	[-.05, .03]	.01 (.01)	[-.01, .02]
	Model Summary	Adjusted $R^2$ = .17, $F(5, 336) = 14.99, p < .001$		Adjusted $R^2$ = .14, $F(5, 336) = 11.82, p < .001$		Adjusted $R^2$ = .07, $F(5, 336) = 6.39, p < .001$		Adjusted $R^2$ = .11, $F(5, 336) = 9.41, p < .001$		Adjusted $R^2$ = .05, $F(5, 336) = 4.63, p < .001$	
<b>Acting with Awareness (AwA)</b>	MTUE	.70** (.17)	[.35, 1.03]	.27* (.12)	[.03, .50]	.74** (.17)	[.40, 1.07]	.57** (.17)	[.24, .90]	.22** (.07)	[.08, .36]
	SusploR	.38** (.12)	[.16, .61]	.31** (.09)	[.15, .50]	.13 (.13)	[-.12, .38]	.35** (.12)	[.12, .57]	.07 (.05)	[-.02, .17]
	AWA	-.17* (.07)	[-.31, -.03]	-.17** (.06)	[-.28, -.06]	-.07 (.09)	[-.23, .10]	-.04 (.08)	[-.19, .12]	.06 (.03)	[-.01, .11]
	MTUE x AwA	.01 (.03)	[-.04, .07]	-.03 (.02)	[-.06, 0.1]	.04 (.03)	[-.02, .11]	.04 (.03)	[-.01, .10]	.03** (.01)	[.01, .05]
	SusploR x AwA	.01 (.02)	[-.03, .05]	.02 (.02)	[-.01, .05]	-.01 (.02)	[-.05, .04]	.01 (.02)	[-.03, .05]	-.01 (.01)	[-.02, .01]
	Model Summary	Adjusted $R^2$ = .18, $F(5, 336) = 15.97, p < .001$		Adjusted $R^2$ = .15, $F(5, 336) = 13.03, p < .001$		Adjusted $R^2$ = .07, $F(5, 336) = 6.21, p < .001$		Adjusted $R^2$ = .10, $F(5, 336) = 8.75, p < .001$		Adjusted $R^2$ = .06, $F(5, 336) = 5, p < .001$	
<b>Non-Judging (NJ)</b>	MTUE	.69** (.18)	[.34, 1.04]	.32** (.12)	[.08, .55]	.71** (.18)	[.35, 1.06]	.53** (.17)	[.20, .86]	.17* (.07)	[.02, .31]
	SusploR	.43** (.12)	[.20, .67]	.26** (.09)	[.09, .43]	.17 (.14)	[-.09, .44]	.39** (.12)	[.15, .63]	.10* (.05)	[.00, .20]
	NJ	-.03 (.05)	[-.14, .08]	-.13** (.05)	[-.22, -.04]	.03 (.07)	[-.10, .17]	.01 (.07)	[-.12, .14]	.03 (.03)	[-.03, .08]
	MTUE x NJ	-.01 (.02)	[-.05, .03]	-.01 (.02)	[-.04, .03]	.02 (.02)	[-.02, .06]	.02 (.02)	[-.03, .06]	.01 (.01)	[-.01, .03]
	SusploR x NJ	.02 (.02)	[-.01, .05]	.01 (.01)	[-.01, .03]	-.00 (.02)	[-.04, .03]	.02 (.02)	[-.01, .05]	.01 (.01)	[-.01, .02]
	Model Summary	Adjusted $R^2$ = .17, $F(5, 336) = 14.72, p < .001$		Adjusted $R^2$ = .14, $F(5, 336) = 12.20, p < .001$		Adjusted $R^2$ = .06, $F(5, 336) = 5.64, p < .001$		Adjusted $R^2$ = .10, $F(5, 336) = 8.44, p < .001$		Adjusted $R^2$ = .04, $F(5, 336) = 3.54, p = .004$	

<b>Non-Reacting (NR)</b>	<i>MTUE</i>	.69** (.17)	[.35, 1.01]	.37** (.12)	[.14, .60]	.61** (.17)	[.26, .95]	.44** (.16)	[.13, .74]	.12 (.07)	[-.01, .26]
	<i>SusploR</i>	.44** (.12)	[.22, .67]	.32** (.08)	[.16, .48]	.23 (.12)	[-.01, .47]	.43** (.11)	[.21, .64]	.11* (.05)	[.02, .20]
	<i>NR</i>	.14 (.09)	[-.02, .32]	-.02 (.06)	[-.15, .10]	.35** (.09)	[.17, .53]	.35** (.08)	[.19, .51]	.13** (.04)	[.06, .20]
	<i>MTUE x NR</i>	-.03 (.04)	[-.09, .05]	-.06** (.02)	[-.11, -.02]	-.04 (.03)	[-.09, .03]	-.02 (.03)	[-.07, .05]	-8.19 (.02)	[-.03, .03]
	<i>SusploR x NR</i>	-.01 (.03)	[-.06, .04]	.03 (.02)	[-.01, .06]	-.01 (.02)	[-.06, .04]	-.03 (.02)	[-.07, .01]	-.01 (.01)	[-.03, .01]
<i>Model Summary</i>		<i>Adjusted R<sup>2</sup> = .17, F(5,336) = 15.17, p &lt; .001</i>		<i>Adjusted R<sup>2</sup> = .13, F(5,336) = 11.19, p &lt; .001</i>		<i>Adjusted R<sup>2</sup> = .11, F(5,336) = 9.13, p &lt; .001</i>		<i>Adjusted R<sup>2</sup> = .14, F(5,336) = 12.31, p &lt; .001</i>		<i>Adjusted R<sup>2</sup> = .07, F(5,336) = 5.72, p &lt; .001</i>	

\**p* < .05    \*\**p* < .01

Abbreviations: AwA = *Acting with Awareness*; ECQ = *Experience of Creativity Questionnaire*; FFMQ = *Five Facet Mindfulness Questionnaire*; MTUE = *Magical Thinking + Unusual Perceptual Experiences conglomerate scores*; NJ = *Non-Judging*; NR = *Non-Reacting*; OBS = *Observing*; SusploR = *Suspiciousness + Ideas of Reference conglomerate scores*.



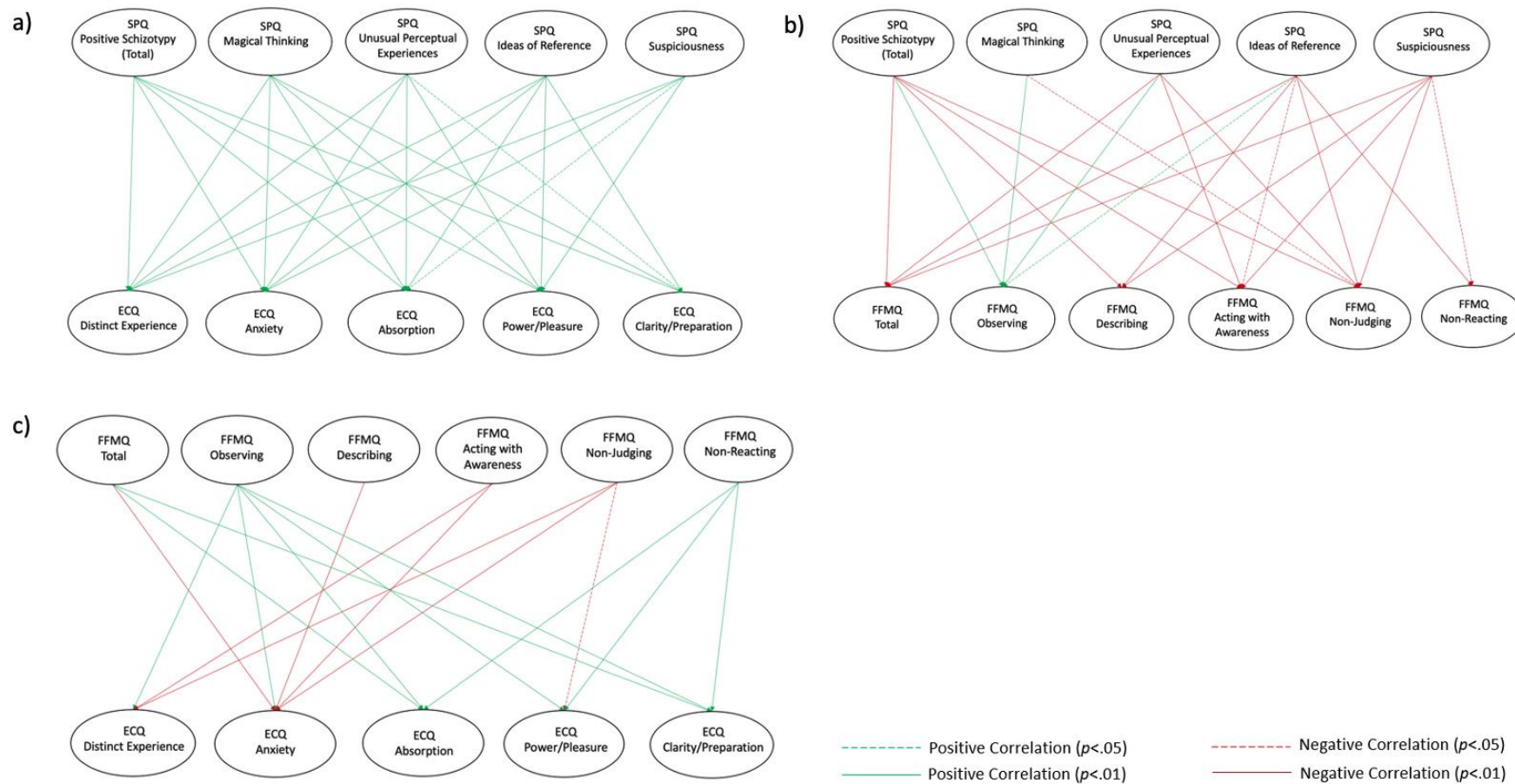
**Table A. 5.** The results of the independent t-tests for the differences in ECQ Part A & B factor scores between the subsamples who reported being regularly engaged in creative activity (either as hobby, study, or profession) and those who did not.

	<b>Creatively Active (n = 137)</b>	<b>Not Creatively Active (n = 205)</b>	<b>t-statistic</b>	<b>Cohen's d</b>
	<b>Mean (SD)</b>	<b>Mean (SD)</b>	<b>p &lt; .001</b>	
<b>ECQ Part A Factor</b>				
<i>Distinct Experience</i>	28.76 (7.30)	23.76 (7.29)	6.04	.69
<i>Anxiety</i>	21.45 (5.80)	18.45 (5.46)	4.86	.53
<i>Absorption</i>	37.93 (6.76)	31.78 (8.69)	7.35	.79
<i>Power/Pleasure</i>	40.55 (7.43)	35.50 (7.70)	6.03	.75
<i>Clarity/Preparation</i>	13.92 (2.86)	12.60 (3.36)	3.78	.42
<b>ECQ Part B Factor</b>				
<i>Transformation</i>	26.61 (5.42)	23.06 (6.19)	5.47	.61
<i>Centrality</i>	30.36 (7.40)	24.63 (7.05)	7.21	.79
<i>Beyond the Personal</i>	9.92 (2.79)	7.60 (3.03)	7.19	.77

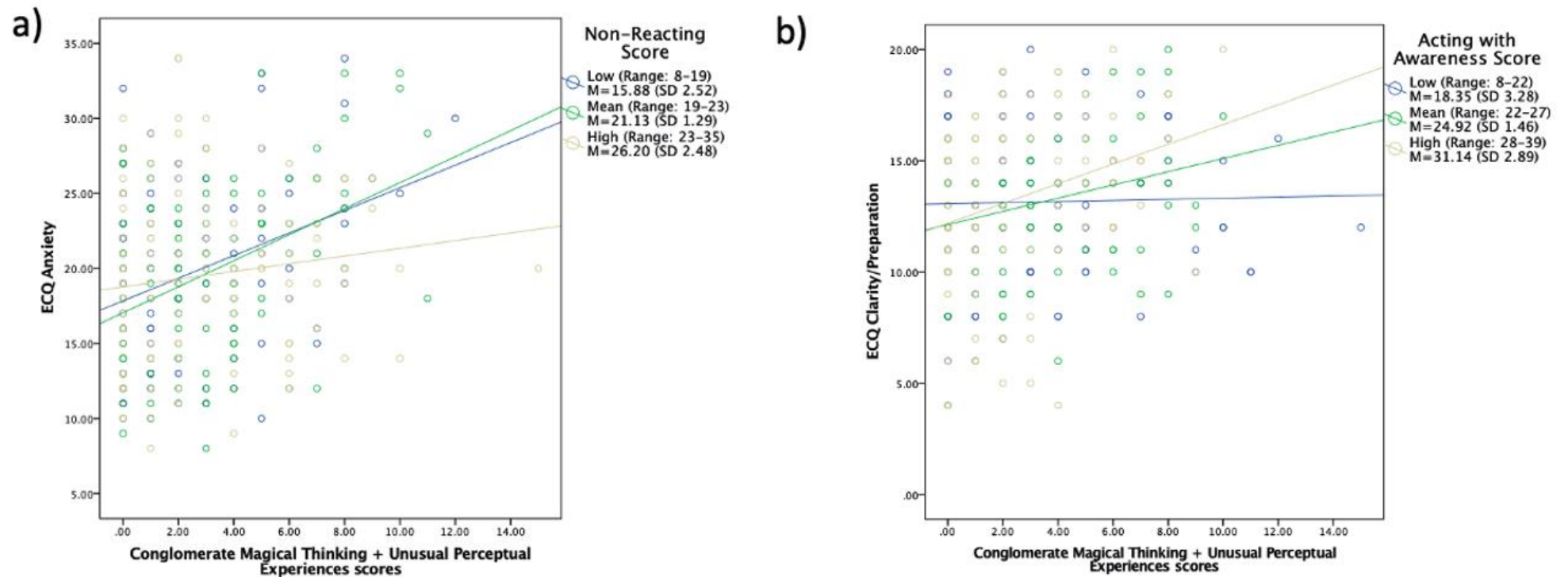
**Table A. 6.** The results of the independent t-tests for the differences in SPQ scores between the subsamples who reported being regularly engaged in creative activity (either as hobby, study, or profession) and those who did not.

	<b>Creatively Active (n = 137)</b>	<b>Not Creatively Active (n = 205)</b>	<b>t-statistic</b>	<b>Cohen's d</b>
	<b>Mean (SD)</b>	<b>Mean (SD)</b>		
<b>SPQ Total</b>	22.04 (12.14)	19.66 (13.63)	1.65	.18
<b>SPQ Positive Schizotypy Subscale</b>				
<i>Odd Beliefs/Magical Thinking</i>	1.34 (1.59)	.75 (1.17)	3.72***	.42
<i>Unusual Perceptual Experiences</i>	2.13 (2.07)	1.68 (1.80)	2.09*	.23
<i>Ideas of Reference</i>	2.93 (2.47)	2.29 (2.42)	2.36*	.26
<i>Suspiciousness</i>	2.37 (2.20)	2.26 (2.27)	.459	.05
<b>Total Positive Schizotypy</b>	8.77 (6.22)	6.98 (6.12)	2.64**	.29

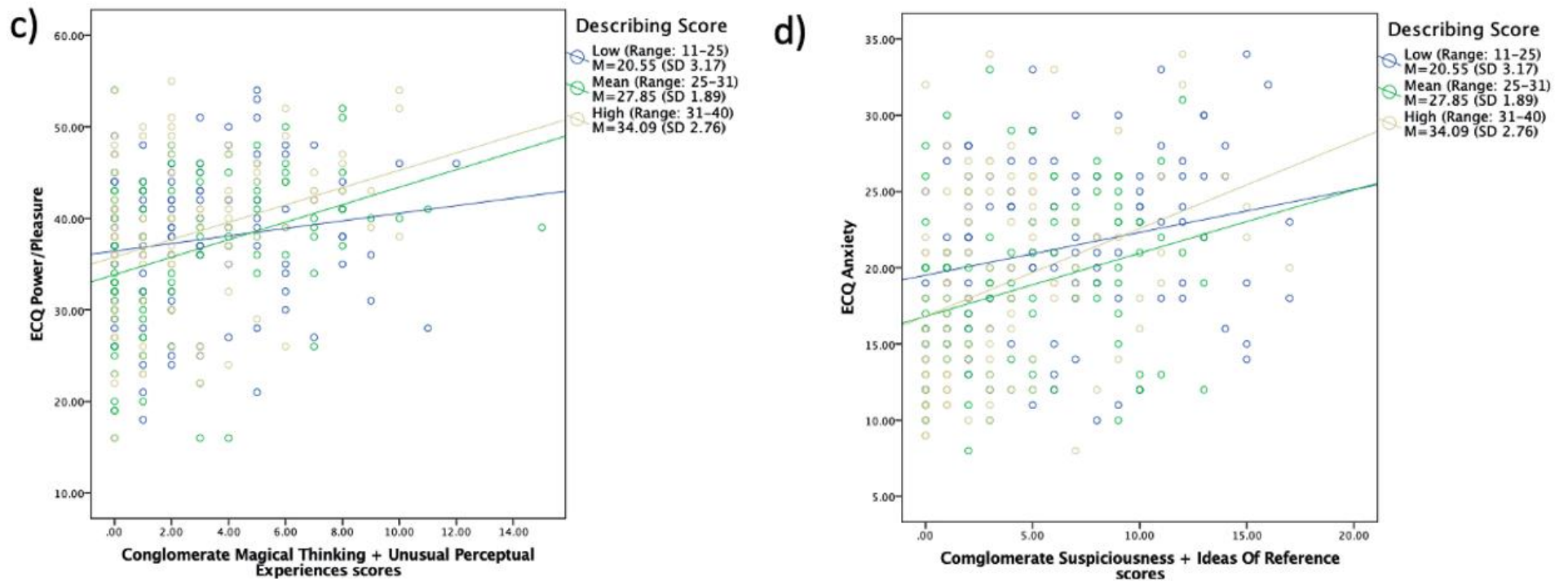
\*p<.05, \*\* p<.01, \*\*\* p<.001



**Fig. A.1.** The diagram of correlations between: a) SPQ positive schizotypy subscales and ECQ factors; b) SPQ positive schizotypy subscales and FFMQ facets; and c) FFMQ facets of the and ECQ factors.



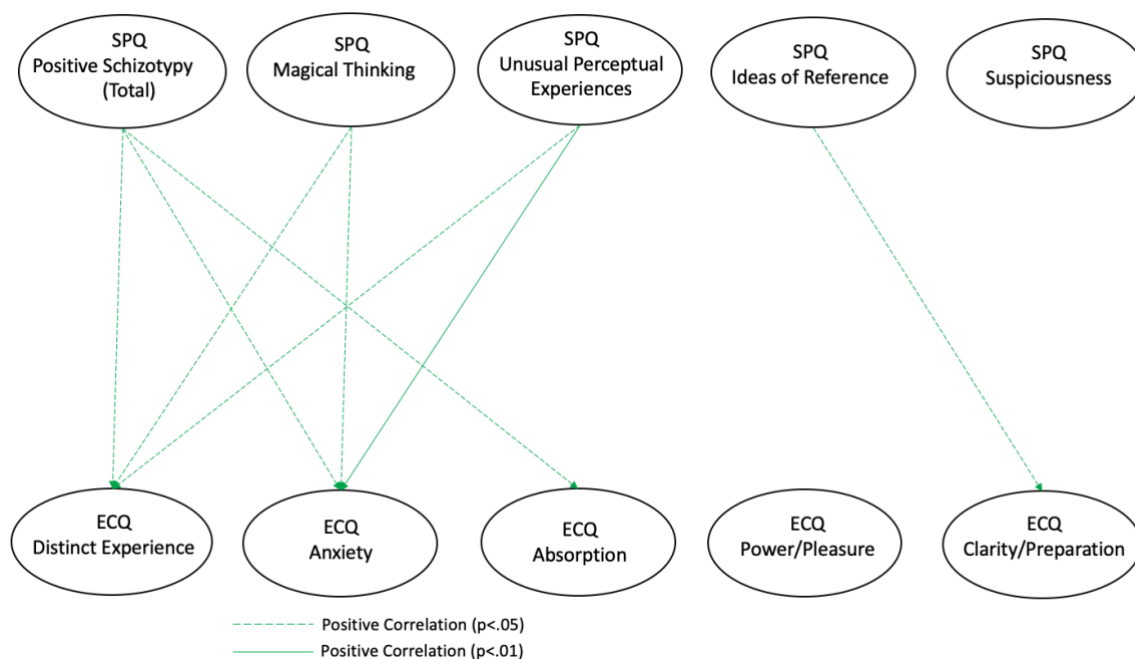
**Fig. A.2. (Pt.1)** Scatter plots of the raw data demonstrating significant interactions between conglomerate scores for *Magical Thinking + Unusual Perceptual Experiences* (MTUE) and FFMQ facets in predicting ECQ factor scores: a) *Anxiety*, b) *Clarity/Preparation* for the sub-groups with low, mean, and high scores on the respective FFMQ facets.



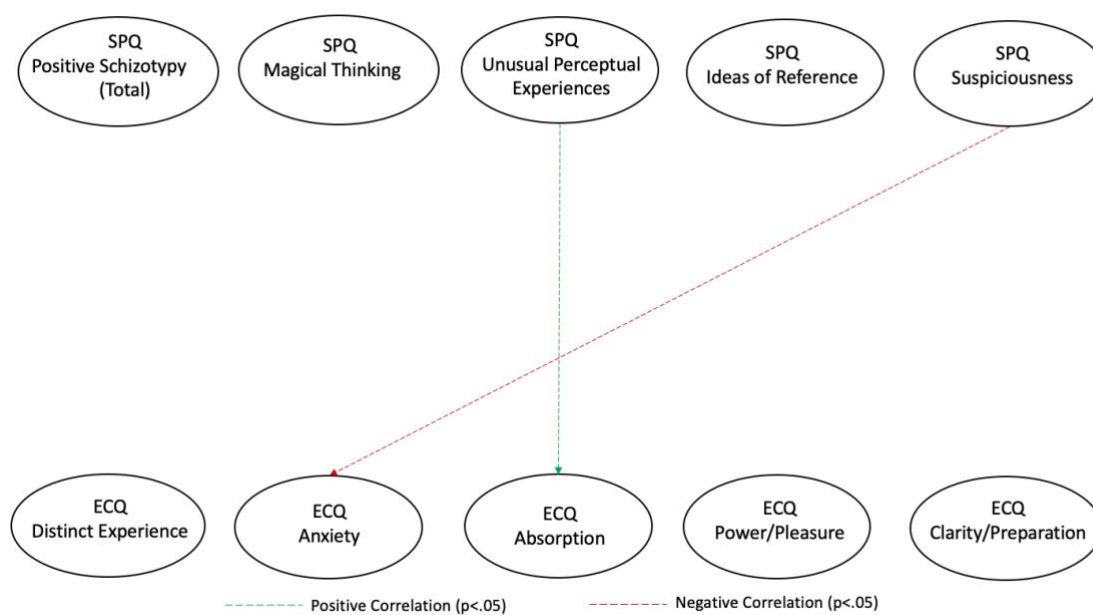
**Fig. A.2. (Pt. 2)** Scatter plots of the raw data demonstrating significant interactions between conglomerate scores for *Magical Thinking + Unusual Perceptual Experiences* (MTUE) and FFMQ facets in predicting ECQ factor scores: c) *Power/Pleasure*; and d) conglomerate scores for *Suspiciousness + Ideas of Reference* (SusploR) and FFMQ facet *Describing* in predicting ECQ factor *Anxiety* for the sub-groups with low, mean, and high scores on the respective FFMQ facet.

## Appendix B. Chapter 4 (Study 2) Supplementary Materials

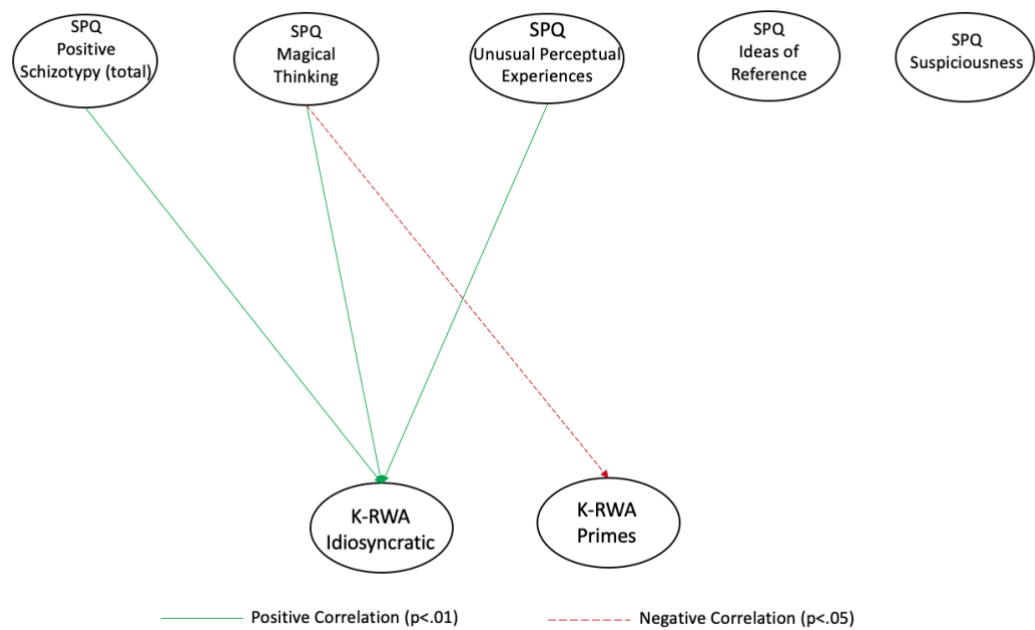
### Between-group correlation figures for the relationship between positive schizotypy and creativity



**Figure B. 1.** Visual Representation of bivariate correlations between aspects of positive schizotypy and experience of creativity within the HPS group.



**Figure B. 2.** Visual Representation of bivariate correlations between aspects of positive schizotypy and experience of creativity within the L-MPS group.



**Figure B. 3.** Visual Representation of bivariate correlations between aspects of positive schizotypy and the variables of the Kent-Rosanoff Word Associations task within the HPS group.

## Secondary Analyses

### Correlations between creativity tasks

**Table B. 1.** Bivariate correlation coefficients for the subjective and objective creativity measures for the high (HPS) and low-to-moderate schizotypy (L-MPS) groups.

	ECQ Distinct Experience	ECQ Anxiety	ECQ Absorption	ECQ Power /Pleasure	ECQ Clarity/ Preparation	CPS
<b>AUT Fluency</b>						
L-MPS	-.27	-.19	-.01	-.01	-.06	.01
HPS	.08	.01	-.08	-.12	-.31*	.02
<b>AUT Flexibility</b>						
L-MPS	-.20	-.21	-.07	.00	-.08	-.04
HPS	.06	.00	-.10	-.12	-.35**	.04
<b>AUT Originality</b>						
L-MPS	-.31*	-.29	-.22	-.30	-.20	.06
HPS	.29*	.16	.05	-.10	-.22	.01
<b>AUT Elaboration</b>						
L-MPS	.34	-.07	-.03	-.11	-.12	-.08
HPS	.22	.09	.23	.30*	.09	.08

<b>WA Idiosyncratic</b>						
L-MPS	.46**	.41**	.31*	.22	.12	.29
HPS	.39**	.21	.21	.02	.21	.22
<b>WA Primes</b>						
L-MPS	-.15	-.29	-.03	.08	.05	-.16
HPS	-.14	-.07	.09	-.01	.03	-.04
<b>WA Opposites</b>						
L-MPS	-.39**	-.26	-.24	-.28	-.18	-.09
HPS	-.22	-.05	-.19	-.04	-.36**	-.17
<b>Essays</b>						
L-MPS	-.39**	-.34*	-.18	-.25	-.07	.03
HPS	.29*	.17	.27*	.25	-.00	.07
<b>CPS</b>						
L-MPS	.25	.11	.43**	.26	.18	-
HPS	.34**	.24	.31*	.15	.20	

\*\* p<.01; \*p<.05

Abbreviations: AUT = *Alternative Uses Task*; CPS = *Creative Personality Scale*; ECQ = *Experience of Creativity Questionnaire*

**Table B. 2.** Bivariate correlation coefficients for the objective creativity measures for the high (HPS) and low-to-moderate schizotypy (L-MPS) groups.

	AUT Fluency	AUT Flexibility	AUT Originality	AUT Elaboration	WA Idiosyncratic	WA Primes	WA Opposites	Essays
<b>AUT Fluency</b>	-							
L-MPS								
HPS								
<b>AUT Flexibility</b>	.98***	-						
L-MPS	.98***							
HPS								
<b>AUT Originality</b>	.75***	.76	-					
L-MPS	.76***	.73***						
HPS								
<b>AUT Elaboration</b>	.35*	.36*	.40**	-				
L-MPS	.19	.24	.17					
HPS								
<b>WA Idiosyncratic</b>	-.13	-.12	-.17	-.11	-			
L-MPS	-.18	-.18	-.10	.03				
HPS								
<b>WA Primes</b>						-		
L-MPS	.06	.07	-.03	-.00	-.60***			
HPS	-.13	-.12	-.04	-.24	-.42***			
<b>WA Opposites</b>	.22	.19	.37**	.18	-.77***	.26	-	
L-MPS	.32*	.28*	.24	.24	-.72***	.01		
HPS								
<b>Essays</b>								-
L-MPS	.52***	.53***	.35*	.26	-.11	.05	.15	
HPS	.48***	.52***	.45***	.57***	.03	-.10	-.01	

\*p<.05 \*\* P<.01 \*\*\* P<.001

Abbreviations: AUT = *Alternative Uses Task*; WA = *Word Associations*

## Moderation of Suspiciousness

**Table B. 3.** Significant moderations and conditional effects of Suspiciousness upon the relationship of SPQ Magical Thinking and Unusual Perceptual Experiences with AUT Flexibility (within the high positive schizotypy group).

Model	$\beta$ (SE)	p value [95% CI]
<b>AUT Flexibility</b>		
MT	.75 (.61)	.23 [-.51, 2.02]
Susp	.50 (.65)	.44 [-.65, 1.81]
MT x Susp	-.63 (.30)	.04 [-1.26, -.02]

Model Summary  $R^2 = .08$ ,  $F(3,53) = 3.32$ ,  $p = .03$

### Conditional Effects (Of Suspiciousness score)

- 1 SD below Mean	2.07 (.72)	.01 [.62, 3.51]
Mean	.75 (.61)	.23 [-.48, 1.97]
+ 1 SD above Mean	-.57 (.99)	.57 [-2.56, 1.42]

Abbreviations: *AUT* = Alternative Uses Task; *ECQ* = Experience of Creativity Questionnaire; *MT* = Magical Thinking; *Susp* = Suspiciousness

## Correlations between Positive schizotypy and Creativity

The majority of previous research looking at the positive schizotypy-creativity link have used correlational analysis across varying schizotypy scores. To probe the possibility that analysis and/or sampling methods could influence findings, exploratory correlations were conducted across the whole sample to investigate whether a positive relationship would otherwise be observed between positive schizotypy aspects and the measures of creativity.

For full sample correlations between positive schizotypy and all measures of creativity, see Tables A.4.B-A.4.5, and Figs. A.B.4 - A.B.6.

**Table B. 4.** Bivariate correlation coefficients for the aspects of SPQ Positive Schizotypy and subjective creativity measures (Experience of Creativity Questionnaire and Creative Personality Scale; CPS) for the full sample.

	Positive Schizotypy (Total)	Ideas Of Reference	Magical Thinking	Unusual Experiences	Suspiciousness
Distinct Experience	.48***	.39***	.42***	.47***	.24*
Anxiety	.41***	.41***	.33***	.37***	.19
Absorption	.31**	.27**	.17	.34***	.12
Power/Pleasure	.33***	.30**	.33**	.30**	.18
Clarity/Preparation	.31***	.33***	.28**	.26**	.16
CPS	.13	.05	.11	.24*	-.02

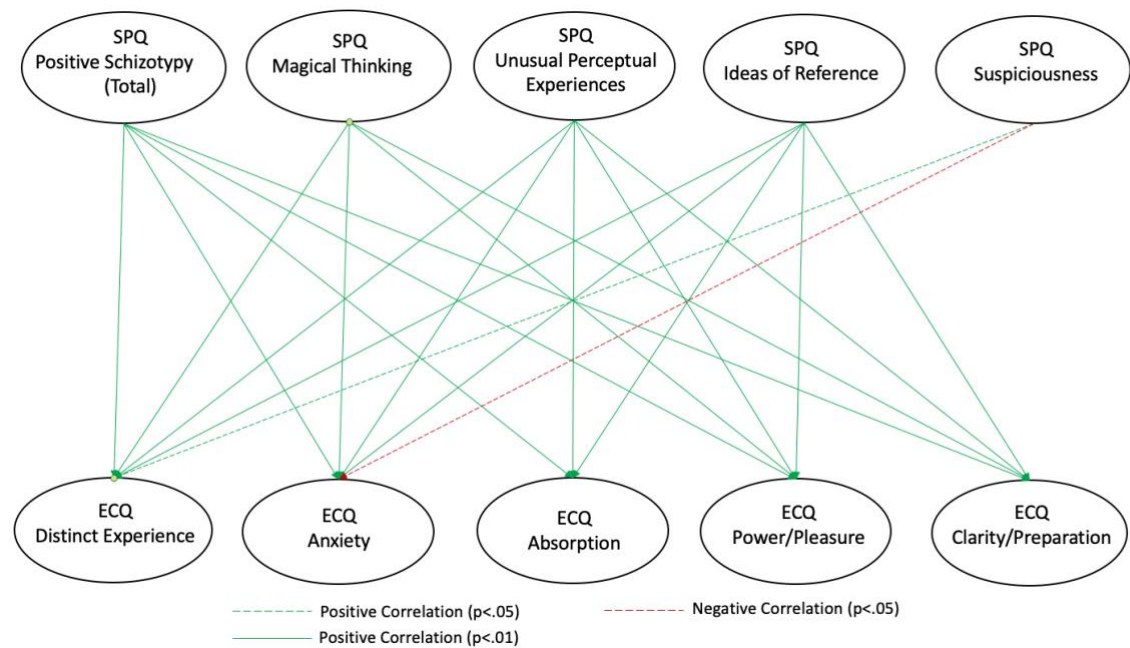
\*\*\*  $P < .001$  \*\*  $P < .01$  \*  $p < .05$



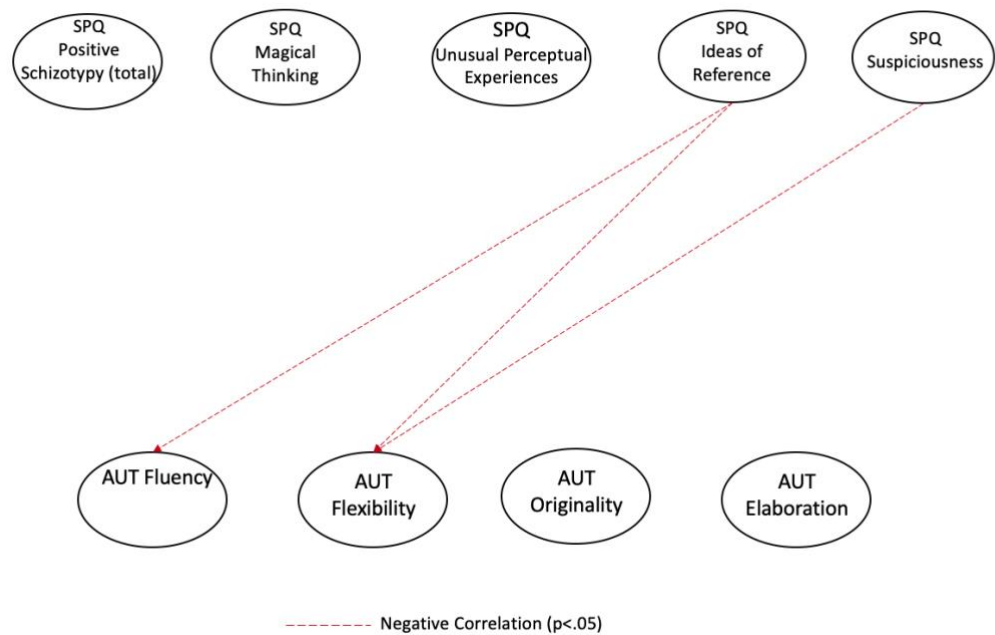
**Table B. 5.** Bivariate correlation coefficients for the aspects of positive schizotypy and the objective creativity measures for the full sample.

	Positive Schizotypy (Total)	Ideas Of Reference	Magical Thinking	Unusual Experiences	Suspiciousness
<b>Fluency</b>	-.17	-.21*	.01	-.04	-.19
<b>Flexibility</b>	-.19	-.22*	.00	-.06	-.20*
<b>Originality</b>	-.05	-.04	.07	-.01	-.08
<b>Elaboration</b>	-.10	-.06	.00	-.05	-.15
<b>Word Associations - Idiosyncratic</b>	.32***	.17	.33***	.41***	.15
<b>Word Associations - Primes</b>	-.28**	-.21*	-.32**	-.20*	-.18
<b>Word Associations - Opposites</b>	-.24*	-.21	-.23*	-.33***	-.10
<b>Essays</b>	.07	.11	.12	.05	-.06

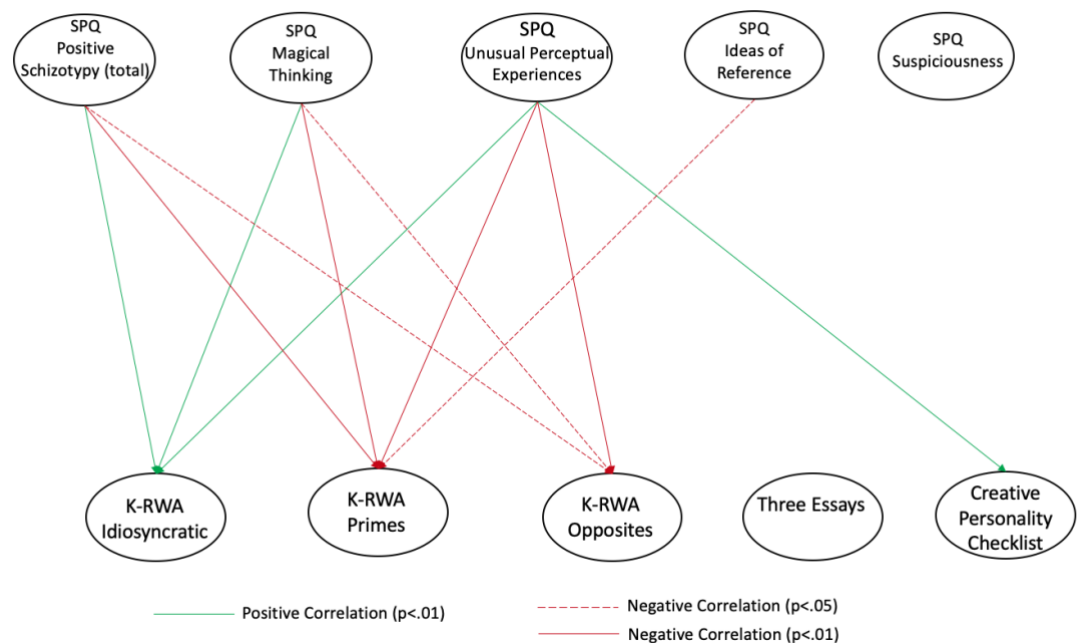
\*\*\* P<.001 \*\* P<.01 \*p<.05



**Figure B. 4.** Visual representation of bivariate correlations for the full sample between aspects of positive schizotypy (Schizotypal Personality Questionnaire; SPQ) and the Experience of Creative Questionnaire (ECQ).



**Figure B. 5.** Visual representation of correlations for the full sample between aspects of positive schizotypy (Schizotypal Personality Questionnaire; SPQ) and the Alternative Uses Task (AUT) variables.



**Figure B. 6** Visual Representation of the bivariate correlations for the full sample between aspects of positive schizotypy (Schizotypal Personality Questionnaire; SPQ) and the variables of the Kent-Rosanoff Word Associations task (K-RWA), the Essays task and the Creative Personality Scale (CPS).

### Correlations between positive schizotypy and acoustic startle habituation

Low power within the sub-samples (given their smaller sample sizes) may have explained a lack of significant correlations between positive schizotypy and ASH slopes.

Therefore, full sample correlations between these measures were conducted (see Tables A.B.6-A.B.7). There were no significant correlations found for acoustic startle habituation with aspects of positive schizotypy, or creativity, across the full sample.

**Table B. 6.** Bivariate correlation coefficients for aspects of positive schizotypy and acoustic startle habituation slopes (blocks 1, 2, 3 and overall slopes) for the full sample.

	Positive Schizotypy <sup>Total</sup>	Ideas Of Reference	Magical Thinking	Unusual Experiences	Suspiciousness
<b>Block 1</b>	-.05	-.02	-.18	.01	.03
<b>Block 2</b>	-.15	-.17	.06	-.10	-.20
<b>Block 3</b>	-.13	-.12	-.06	-.08	-.08
<b>Overall</b>	-.08	-.08	-.13	-.03	-.06

**Table B. 7.** Bivariate correlation coefficients for subjective measures of creativity and acoustic startle habituation slopes (blocks 1, 2, 3 and overall slopes) for the full sample.

	ECQ Distinct Experience	ECQ Anxiety	ECQ Absorption	ECQ Power/Pleasure	ECQ Clarity/Preparation	CPS
<b>Block 1</b>	.06	.04	.12	.15	.13	-.20
<b>Block 2</b>	-.08	-.10	-.03	.11	.03	.02
<b>Block 3</b>	.04	.05	.13	.07	-.03	.10
<b>Overall</b>	.05	-.02	.14	.14	-.07	.06

Abbreviations: CPS = *Creative Personality Scale*; ECQ = *Experience of Creativity Questionnaire*

**Table B. 8.** Bivariate correlation coefficients for objective creativity tasks and acoustic startle habituation slopes (blocks 1, 2, 3 and overall slopes) for the full sample.

	AUT Fluency	AUT Flexibility	AUT Originality	AUT Elaboration	WA Idiosyncratic	WA Primes	WA Opposites	Essays
<b>Block 1</b>	-.11	-.10	-.12	.05	.02	.12	-.09	.06
<b>Block 2</b>	.17	.20	.09	.09	.04	-.00	-.07	.12
<b>Block 3</b>	-.03	-.06	-.08	-.09	-.17	.07	.01	.03
<b>Overall</b>	-.02	-.01	-.04	.02	-.02	.16	-.05	.08

Abbreviations: AUT = *Alternative Uses Task*; WA = *Word Associations*

## Correlations between creativity tasks

**Table B. 9.** Bivariate correlation coefficients between the subjective and objective creativity tasks for the full sample.

	ECQ Distinct Experience	ECQ Anxiety	ECQ Absorption	ECQ Power/ Pleasure	ECQ Clarity/ Preparation	CPS
<b>AUT Fluency</b>	-.08	-.11	-.07	-.12	-.26**	.01
<b>AUT Flexibility</b>	-.12	-.14	-.11	-.13	-.29**	-.00
<b>AUT Originality</b>	.01	-.14	-.07	-.19	-.22*	.02
<b>AUT Elaboration</b>	.05	.01	.09	.12	-.01	.00
<b>WA Idiosyncratic</b>	.44***	.35***	.28**	.17	.21*	.26**
<b>WA Primes</b>	-.23**	-.24**	-.04	-.07	-.06	-.13
<b>WA Opposites</b>	-.30**	-.21*	-.23*	-.18	-.29**	-.16
<b>Essays</b>	.02	-.03	.10	.07	.02	.05
<b>CPS</b>	.32***	.19	.37***	.23*	.18	-

Abbreviations: CPS = *Creative Personality Scale*; ECQ = *Experience of Creativity Questionnaire*; WA = *Word Associations*

**Table B. 10.** Bivariate correlation coefficients for the objective creativity tasks for the full sample.

	AUT Fluency	AUT Flexibility	AUT Originality	AUT Elaboration	WA Idiosyncratic	WA Primes	WA Opposites	Essays
<b>AUT Fluency</b>	-							
<b>AUT Flexibility</b>	.99***	-						
<b>AUT Originality</b>	.76***	.74***	-					
<b>AUT Elaboration</b>	.25*	.29**	.26**	-				
<b>WA Idiosyncratic</b>	-.16	-.16	-.14	-.05	-			
<b>WA Primes</b>	-.02	-.01	-.02	-.10	-.55***	-		
<b>WA Opposites</b>	.27**	.25*	.30**	.06	-.76***	.17	-	
<b>Essays</b>	.49***	.52***	.40***	.43***	-.02	-.02	.04	-

Abbreviations: AUT = *Alternative Uses Task*; WA = *Word Associations*

## Full sample mediation analysis

Low power and variability within the sub-samples (given their smaller sample sizes) may have explained a lack of significant mediation of ASH. Therefore, the analysis was repeated across the full sample, with the addition of a model for *Power/Pleasure*, given the significant positive correlation between *Total* positive schizotypy and this aspect of the ECQ across the whole sample and its implication with positive ‘flow’-type experience. There were no significant mediation effects of ASH (block 1 or overall slopes) upon the relationship between total positive schizotypy and the ECQ<sup>PartA</sup> subscales (*Distinct Experience*, *Absorption* and *Power/Pleasure*), or wide associative thinking style (*Idiosyncratic* word associations) across the full sample (Table A.B.11). However, there was a significant effect of overall habituation (across all blocks) upon ECQ *Power/Pleasure*, indicating that reduced habituation was associated with increased scores on this aspect of creative experience.

**Table B. 11.** Mediation effects of acoustic startle habituation (block 1 and overall slopes) upon the relationship of total positive schizotypy (independent variable) and ECQ and K-RWA across the whole sample.

Mediator (Habituation Slope)	Dependent Variable (Creativity Measure)	Effect of PS on M (Path a)	Effect of M on DV (Path b)	Indirect Effect (Path a*b)	Bootstrapped CI	Direct effect (Path c)
<b>Slope_B1</b>	Idiosyncratic WA	-.01	.11	-.001	-.03, .03	.40***
	ECQ Distinct Experience	-.01	.27	-.003	-.04, .03	.53***
	ECQ Absorption	-.01	.32	-.003	-.04, .03	.36**
	ECQ Power/Pleasure	-.01	.58*	-.006	-.07, .04	.36***
<b>Slope_All</b>	Idiosyncratic WA	-.02	-.10	.002	-.03, .004	.40***
	ECQ Distinct Experience	-.02	.50	-.008	-.05, .02	.53***
	ECQ Absorption	-.02	.65	-.011	-.07, .02	.36**
	ECQ Power/Pleasure	-.02	.97*	-.016	-.08, .02	.36***

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

Abbreviations: DV = *Dependent Variable*; ECQ = *Experience of Creativity Questionnaire*; M = *Mediator*; PS = *Positive Schizotypy*; WA = *Word Associations*

## Effects of Negative and Disorganised Schizotypy

A significant difference was observed between the groups on negative and disorganised schizotypy domains, which previous research has suggested may have a differing relationship with creativity (Acar & Sen, 2013) and/or sensory information filtering (Evans et al., 2007). Since the HPS group scored significantly higher on both negative and disorganised schizotypy, correlational analyses were conducted to inspect whether significant differences in groups (or lack thereof) for creativity and acoustic startle

habituation could be due to underlying associations between negative/disorganised schizotypy with the various aspects of creativity or ASH. Spearman correlations were used to probe these relationships, the results for which are reported in Tables A.B.12 and A.B.13.

**Table B. 12.** Correlation coefficients for the bivariate correlations between negative/disorganised Schizotypy with the subjective and objective creativity measures for the full sample and within groups.

	Total Negative Schizotypy	Total Disorganised Schizotypy
<b>ECQ Distinct Experience</b>		
Full Sample	-.04	.37***
L-MPS	-.23	.30*
HPS	-.25	.09
<b>ECQ Anxiety</b>		
Full Sample	.11	.38***
L-MPS	-.02	.34*
HPS	-.14	.20
<b>ECQ Absorption</b>		
Full Sample	-.01	.33
L-MPS	-.17	.28
HPS	-.06	.23
<b>ECQ Power/Pleasure</b>		
Full Sample	-.05	.26***
L-MPS	-.22	.27
HPS	-.19	-.01
<b>ECQ Clarity/Prep</b>		
Full Sample	-.89	.08
L-MPS	-.30*	-.03
HPS	-.26	-.13
<b>CPS</b>		
Full Sample	-.24*	.09
L-MPS	-.44**	-.28
HPS	-.11	.10
<b>AUT Fluency</b>		
Full sample	-.13	-.05
L-MPS	-.13	-.05
HPS	-.02	.09
<b>AUT Flexibility</b>		
Full Sample	-.14	-.07
L-MPS	-.16	-.04
HPS	-.00	.08
<b>AUT Originality</b>		
Full Sample	-.08	.01
L-MPS	-.08	-.13
HPS	-.03	.20
<b>AUT Elaboration</b>		
Full Sample	-.03	-.13
L-MPS	.18	-.05
HPS	-.09	-.08
<b>WA Idiosyncratic</b>		
Full Sample	-.03	.23*
L-MPS	-.26	.34*
HPS	-.04	-.05
<b>WA Primes</b>		
Full Sample	.07	-.11
L-MPS	.13	-.11
HPS	.29	.12
<b>WA Opposites</b>		
Full Sample	.02	-.14
L-MPS	.27	-.26
HPS	-.06	.10
<b>Essays</b>		
Full Sample	-.11	.04
L-MPS	-.15	-.21
HPS	-.11	.04

\*P<.05; \*\*P<.01; \*\*\*P<.001

Abbreviations: AUT = *Alternative Uses Task*; ECQ = *Experience of Creativity Questionnaire*; HPS = *high positive schizotypy group*; L-MPS = *Low-Moderate positive schizotypy group*; WA = *Word Associations*

Table **B. 13**. Correlation coefficients for the bivariate correlations between Negative/Disorganised Schizotypy with acoustic startle habituation slopes (block 1, 2, 3 and overall slope) for the full sample and within groups

	Total Negative Schizotypy	Total Disorganised Schizotypy
<b>Block 1</b>		
Full Sample	.15	.11
L-MPS	.07	.20
HPS	.21	.11
<b>Block 2</b>		
Full Sample	-.17	.01
L-MPS	-.28	.05
HPS	.03	.23
<b>Block 3</b>		
Full Sample	-.05	.11
L-MPS	-.14	.27
HPS	-.12	.15
<b>Overall</b>		
Full Sample	.06	.12
L-MPS	-.38	.20
HPS	.19	.19

There was a significant negative correlation between negative schizotypy and ECQ *Clarity/Preparation* for the L-MPS group. A significant negative correlation between scores on the CPS and negative schizotypy was found for the full sample, however when running the analysis for separate groups this association remained only in the L-MPS group. No significant correlations were found between negative schizotypy and the AUT, *Three Essays* task, K-RWA tasks or acoustic startle habituation for the full sample or within the groups.

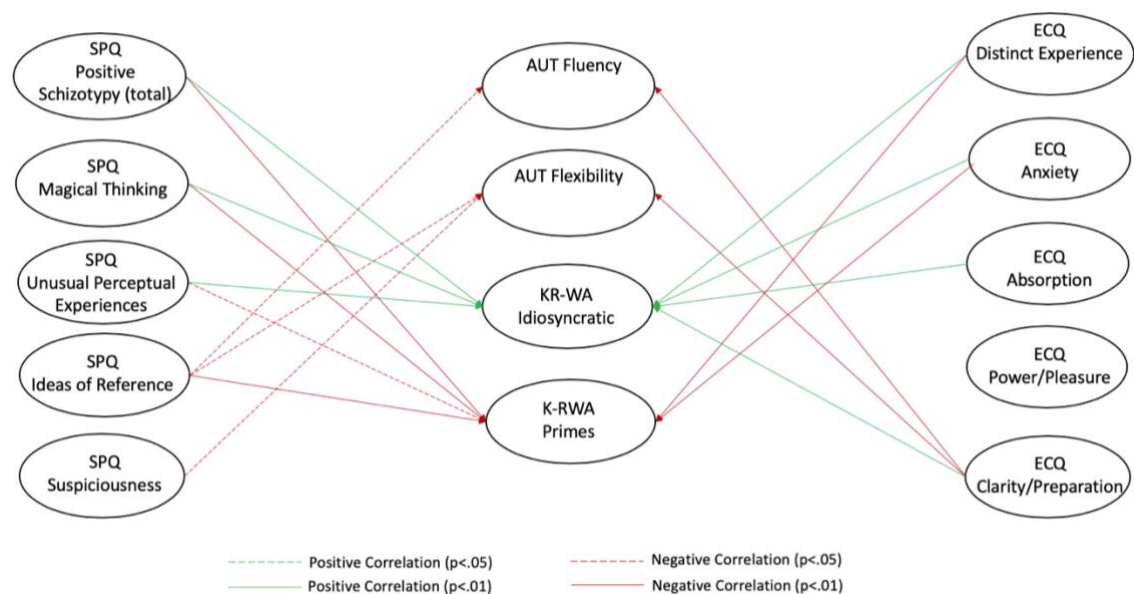
Since ECQ *Clarity/Preparation* and CPS scores were significantly associated with negative schizotypy scores for the L-MPS group, whether this had bearing on results for group differences was explored using one-way analysis of covariance (ANCOVA) (with negative schizotypy score entered as a covariate) and partial correlations (with 5,000 bootstraps for robust testing of non-normally distributed variables to derive robust 95% CI). The homogeneity of variance and homogeneity regression assumptions were met for the ANCOVA analysis. A significant relationship of negative schizotypy with *Clarity/Preparation* was confirmed ( $F[1,98] = 9.10, p = .003$ ). A significant group difference for *Clarity/Preparation* ( $F[1,99]=16.16, p <.001$ ) was maintained after controlling for negative schizotypy scores, with the adjusted means indicating higher scores for the HPS group (*Mean* = 14.5) compared to the L-MPS group (*Mean* = 11.60). When negative schizotypy scores were partialled out, a significant positive correlation

remained for *Clarity/Preparation* with *Total* positive schizotypy ( $r = .27, p = .04, 95\%CI [.01, .48]$ ) and *Ideas of Reference* ( $r = .35, p = .01, 95\% CI [.07, .57]$ ) for the HPS group only. No significant correlations were observed between positive schizotypy and *Clarity/Preparation* for the *L-MPS* group whilst controlling for negative schizotypy scores.

For the *CPS*, the homogeneity of regression assumption was violated ( $p = .046$ ), therefore ANCOVA was not appropriate to conduct.

### Regression Analysis: predicting performance on objective creativity tasks

To probe whether aspects of positive schizotypy and the subjective experience of creativity as measured by the ECQ<sup>PartA</sup> subscales could predict performance on the objective creativity tasks, multiple regression analyses were conducted based on the significant correlations which occurred between objective creativity tasks with both the aspects of positive schizotypy and ECQ<sup>PartA</sup> subscales for the whole sample (Fig. A.4.7). Regression models were performed using the ‘Enter’ method, and included only the variables which significantly correlated (positive schizotypy aspects of the SPQ and subscales of the ECQ<sup>PartA</sup>) with the corresponding creativity tasks (specifically, AUT *Fluency* and *Flexibility*, and *Idiosyncratic* and *Primes* of the K-RWA task). Analysis was run using 10,000 bootstraps for robust testing of non-normally distributed variables. See Table A.4.14 of the appendix for all regression coefficients and 95% confidence intervals.



**Figure B. 7.** Visual representation of bivariate correlations across the whole sample between aspects of positive schizotypy (Schizotypal Personality Questionnaire; SPQ) and creative experience (Experience of Creativity Questionnaire; ECQ) with the objective measures of creativity (on which there was a significant group difference).



#### *Alternative Uses Task: Fluency*

Due to the significant negative correlations for *Ideas of Reference* of the SPQ and *Clarity/Preparation* of the ECQ<sup>PartA</sup> with *Fluency* scores on the AUT, these were the predictors entered into the model. The two predictor model was significant  $F(2, 98) = 3.33, p = .04, R^2 = .064$ , however only *Clarity/Preparation* was marginally significant as a predictor in the model ( $b = -.49, 95\%CI [-1.01, -.01], p = .052$ ).

#### *Alternative Uses Task: Flexibility*

Scores for *Ideas of Reference and Suspiciousness* of the SPQ, and *Clarity/Preparation* of the ECQ<sup>PartA</sup> were entered as predictors into the model, since they significantly negatively correlated with AUT *Flexibility*. The three-predictor model was significant  $F(3, 97) = 3.17, p = .03, R^2 = .089$ . Only the regression weight for *Clarity/Preparation* reached significance ( $b = -.54, 95\%CI [-1.08, -.01], p = .049$ ), indicating that higher scores on *Clarity/Preparation* significantly predicted lower scores on *Flexibility* whilst controlling for the other variables in the model.

#### *Word Associations: Idiosyncratic responses*

The variables *Magical Thinking* and *Unusual Perceptual Experiences* of the SPQ, and *Distinct Experience, Anxiety, Absorption* and *Clarity/Preparation* of the ECQ<sup>PartA</sup> were entered as predictors in the model, based their significant positive correlations with idiosyncratic responses on the *K-RWA* task. Group allocation was entered as a dummy variable, since prior analysis indicated a significant difference between groups on this task. The seven-predictor model was highly significant  $F(7, 93) = 4.84, p < .001, R^2 = .27$ , however none of the regression weights for the variables reached significance (though *Distinct Experience* approached significance:  $b = .32, 95\%CI [-.00, .65], p = .055$ ).

#### *Word Associations: Primes*

The variables *Ideas of Reference, Magical Thinking* and *Unusual Perceptual Experiences* of the SPQ, and *Distinct Experience* and *Anxiety* of the ECQ<sup>PartA</sup> were entered as predictors in the model, based on their significant negative correlations with 'Prime' responses on the *K-RWA* task, with group allocation entered as a dummy variable (HPS coded as 1, L-MPS coded as 0) since prior analysis indicated a significant difference between groups on this task. The six-predictor model was significant  $F(6, 93) = 2.20, p = .05, R^2 = .12$ . Only *Magical Thinking* was found to be a (marginally) significant predictor ( $b = -.55, 95\% CI [-1.11, .01], p = .052$ ).

**Table B. 14.** Multiple linear regression models for predicting performance on the Alternative Uses Task and Kent-Rosanoff Word Association task (across the whole sample).

Predictor Variable	Alternative Uses Task						Kent-Rosanoff Word Associations Task					
	Fluency			Flexibility			Idiosyncratic			Primes		
	$\beta$ (SE)	$p$	95% CI	$\beta$ (SE)	$p$	95% CI	$\beta$ (SE)	$p$	95% CI	$\beta$ (SE)	$p$	95% CI
SPQ IoR	-.42 (.35)	.22	[-1.07, .27]									
ECQ C/P	-.49 (.26)	.05	[-1.01, -.01]		-			-			-	
Model Summary	Adjusted $R^2$ = .05, $F(2, 98) = 3.33, p = .04$											
SPQ IoR				-.35 (.33)	.28	[-1.02, .27]						
SPQ Susp				-.24 (.43)	.57	[-1.07, .59]						
ECQ C/P		-		-.54 (.24)	.02	[-1.01, -.09]		-			-	
Model Summary	Adjusted $R^2$ = .06, $F(3, 97) = 3.17, p = .03$											
SPQ MT							.81 (.51)	.10	[-.19, 1.82]			
SPQ UnEx							.77 (.45)	.09	[-.12, 1.64]			
ECQ DistXp							.32 (.17)	.055	[-.00, .65]			
ECQ Anx							.11 (.18)	.52	[-.27, .43]			
ECQ Abs		-			-		-.08 (.14)	.57	[-.34, .21]		-	
ECQ C/P							.12 (.60)	.60	[-.33, .57]			
Group							-2.07 (1.94)	.29	[-5.93, 1.67]			
Model Summary							Adjusted $R^2$ = .21, $F(7, 92) = 4.73, p < .001$					
SPQ IoR										.09 (.18)	.62	[-.20, .86]
SPQ MT										-.55 (.28)	.05	[-.15, .63]
ECQ DistXp										-.00 (.24)	.99	[-.12, .14]
ECQ Anx		-			-			-		-.11 (.08)	.60	[-.03, .06]
Group										-1.10 (1.16)	.35	[-3.23, 1.27]
Model Summary							Adjusted $R^2$ = .07, $F(6, 93) = 2.20, p = .05$					

Abbreviations: Anx = Anxiety; C/P = Clarity/Preparation; DistXp = Distinct Experience; ECQ = Experience of Creativity Questionnaire; IoR = Ideas of Reference; MT = Magical Thinking; SPQ = Schizotypal Personality Questionnaire; Susp = Suspiciousness; UnEx = Unusual Perceptual Experience

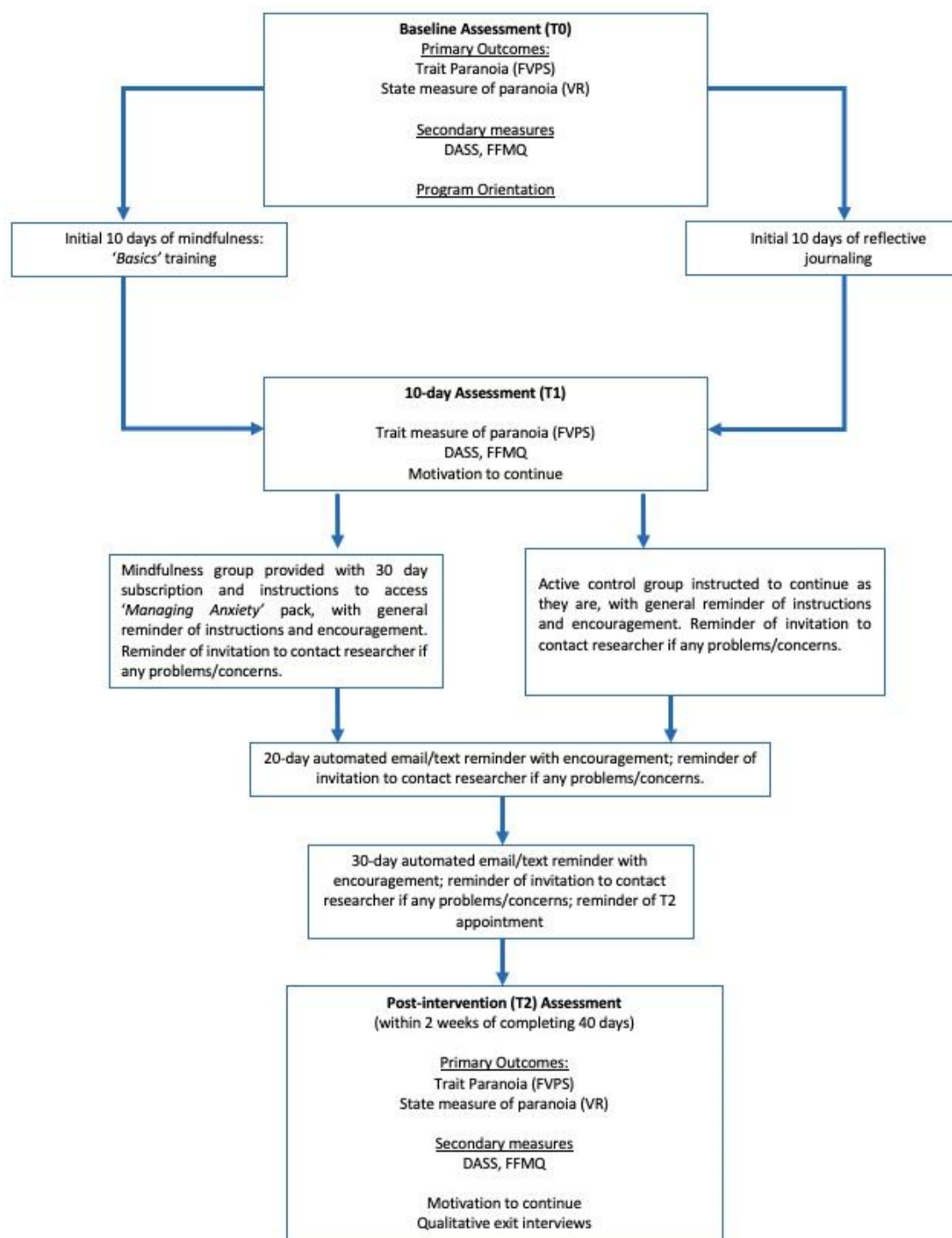
## Creative activity status

Independent *t*-tests and Mann-Whitney *U* tests were conducted to explore whether the status of being regularly engaged in creative activity would be associated with scores on the various creativity tasks and acoustic startle habituation (using creative activity status as an independent variable). Means (and medians) for each group (active creative [AC] and not active creative [NAC]) are presented in table A.B.15). Participants who reported being regularly engaged in creative activities scored significantly higher on all subscales of the ECQ<sup>Part A</sup> compared to those who did not. The AC group scored significantly higher on the *Three Essays* task and had more *Idiosyncratic* responses on the K-RWA task compared to the NAC group. There were no significant group differences for *Primes* or *Opposites* on the K-RWA task, however there was a trend for fewer *Primes* for the AC group ( $p = .08$ ). There were no significant group differences on the CPS or indices of the AUT task, however there was a trend for higher scores on AUT *Elaboration* for the CA group ( $p = .09$ ). There were no significant group differences on acoustic startle habituation.

**Table B. 15.** Means (and standard deviations) for subjective and objective creativity measures, and acoustic startle habituation slopes (block 1, 2, 3 and overall slope), for participants who reported being regularly engaged in creative activity compared to participants who did not report being regularly engaged in creative activity.

Creativity Measure	Group		Statistic		
	Active Creative (N = 39)	Not Active Creative (N = 62)	<i>t</i>	Mann-Whitney <i>U</i> ( <i>z</i> )	<i>p</i>
	Mean (Mdn) ± SD	Mean (Mdn) ± SD			
<b>ECQ<sup>Part A</sup></b>			-		
Distinct Experience	30.87 (31.00) ± 7.31	26.13 (26.00) ± 7.71		776.00 (-3.02)	.002
Anxiety	23.15 (23.00) ± 6.32	20.05 (20.00) ± 5.04		845.00 (-2.54)	.01
Absorption	39.49 (40.00) ± 5.82	33.47 (35.00) ± 8.72		685.00 (-3.66)	<.001
Power/Pleasure	41.41 (42.00) ± 6.94	37.77 (40.00) ± 7.80		897.50 (-2.18)	.03
Clarity/Preparation	14.18 (15.00) ± 3.13	12.60 (13.00) ± 3.47		923.50 (-2.00)	.045
<b>Alternative Uses Task</b>			-		
Fluency	28.92 (28.00) ± 9.17	27.43 (26.00) ± 9.73		1055.50 (-1.07)	.28
Flexibility	26.44 (26.00) ± 8.29	25.85 (25.00) ± 9.43		1114.50 (-.66)	.51
Originality	11.62 (11.00) ± 6.89	10.21 (8.00) ± 7.44		1012.50 (-1.37)	.17
Elaboration	6.18 (6.00) ± 3.46	5.08 (4.00) ± 3.77		966.00 (-1.70)	.09
<b>Kent-Rosanoff Word Associations</b>			-		
Idiosyncratic responses	26.10 (25.00) ± 7.70	22.79 (23.00) ± 7.81		914.50 (-1.95)	.05
Primes	5.72 (5.00) ± 3.49	6.87 (7.00) ± 3.60		941.00 (-.76)	.08
Opposites	5.80 (5.00) ± 5.61	6.10 (4.00) ± 5.74		1142.50 (-.33)	.74
<b>Three Essays Task</b>	9.43 (10.25) ± 2.37	8.42 (8.13) ± 2.50	-	900.00 (-1.98)	.048
<b>Creative Personality Scale</b>	4.87 ± 3.45	4.21 ± 3.70	.90	-	.37
<b>Acoustic Startle (habituation slope)</b>	(n = 26)	(n = 57)			
Block 1	-2.31 (-2.46) ± 2.49	-2.45 (-.69) ± 2.63	.33	-	.75
Block 2	-1.01 (-.88) ± 1.57	-1.10 (1.12) ± 1.80	.23		.82
Block 3	-.77 (-.66) ± 1.57	-.49 (-.38) ± 1.77	-.78		.44
Overall	-2.22 (-2.30) ± 1.36	-2.10 (-1.84) ± 1.52	-.40		.69

## Appendix C. Chapter 5 (Study 3) Supplementary Materials



**Figure C. 1.** RCT assessments (with timepoints) and protocol

**Table C. 1.** Number of participants within each group (Mindfulness-based intervention [MBI] and Control group) scoring within each severity category for the Depression, Anxiety and Stress Scale (DASS) at the end of the trial.

<b>DASS subscale</b>	<b>MBI (N = 12)</b>	<b>Control (N = 12)</b>
	<i>n, %</i>	<i>n, %</i>
<b>DASS<sup>Depression</sup></b>	(5, 41.7%)	(9, 75%)
Normal	(2, 16.7%)	(1, 8.3%)
Mild	(2, 16.7%)	(1, 8.3%)
Moderate	(0, 0%)	(0, 0%)
Severe	(3, 25%)	(1, 8.3%)
Extremely Severe		
<b>DASS<sup>Anxiety</sup></b>	(7, 58.3%)	(11, 91.7%)
<b>Normal</b>	(0, 0%)	(0, 0%)
Mild	(2, 16.7%)	(0, 0%)
Moderate	(1, 8.3%)	(1, 8.3%)
Severe	(2, 16.7%)	(0, 0%)
Extremely Severe		
<b>DASS<sup>Stress</sup></b>		
Normal	(6, 50%)	(8, 66.7%)
Mild	(3, 25%)	(1, 8.3%)
Moderate	(0, 0%)	(2, 16.7%)
Severe	(3, 25%)	(1, 8.3%)
Extremely Severe	(0, 0%)	(0, 0%)

#### What time of day should I do the guided meditation?

You can do the guided meditation at any time of day which is best suited to you. It is useful to integrate your exercise with another part of your daily routine. This will get you in the habit of practising every day. For example, after brushing your teeth, or after a meal of the day.

#### What if I forget to practise?

It doesn't matter how enthusiastic you are about training the mind, there's a good chance that at some stage you will find yourself missing a day or not finding the time to do the exercise – and that's completely normal – we understand that life happens! It comes down to making/scheduling time – but also if you miss a day, don't be too hard on yourself – *simply pick it up the next day from where you left off.*

#### Tips:

- Keep a Headspace app shortcut on your home screen so it is visible.
- Try to keep a regular routine to practise to help get you into the habit of practising.
- Utilise the app reminders.
- **Please do not** complete more than one meditation in a single day, as this will mean that you will practise more than the 10-minutes per day specified for this study.

#### What if I get sleepy or fall asleep during the guided meditation?

You may find your mind might become drowsy at times. This may be residual tiredness coming to the surface which can be a good thing. However, if you find yourself being drowsy/falling asleep most of the time, there are a couple of things you try, such as focusing on just one breath at a time (rather than counting), or taking a couple of deeper breaths and fill those lungs with oxygen before you start the meditation!

- Do not get frustrated if you feel sleepy or fall asleep during your exercise – just notice any feelings of sleepiness – not getting swept away by them, not resisting, just allowing that feeling to be present, to come and go.
- If sleepiness during the exercise is a persistent problem for you, it may be helpful to schedule the exercise at an alternative time of day when you may be more alert. It may also be helpful to check in with your posture (adopting an alert posture, such as keeping your back straight but without any tension, will also help your mind stay alert).

#### Your Log-in Details:

### Further Information, Tips and FAQs for Mindfulness Practice

This leaflet contains some information about the programme, tips and questions you may have about your meditation practice.



Figure C. 2. Participant information leaflet (tips and frequently asked questions) for the mindfulness-based intervention group



### Programme Structure

The first 10 days will be the 'Basics 1' pack, which will give you the basic practice you need to get started with meditation. **These first 10 days are really important** to give you a good foundation from which to build your practice for the rest of the programme. *Even if you have previous experience of mindfulness meditation, the basics will be a useful tool to get you used to practising regularly again.*

### Getting Started

Open the app.

- At the top of the Home screen, under 'Basics 1' tap 'BEGIN'.
- Tap anywhere to continue reading through the introductory information until you reach 'Session 1'.
- **Always select the '10 mins' option** by scrolling to the relevant option before playing the meditation.
- Tap the play button.

Continue this instruction for each of the daily sessions you do.

**At the end of the first 10 days**, the researcher will contact you to see how you are getting on, provide you with the 10-day point questionnaires, and you will have an opportunity to ask any questions.

**You will then be provided access to the remaining sessions:**

### The remaining 30 days

Open the app.

- Under 'My courses' on the Home screen, swipe to 'Managing Anxiety' (Skipping past Basics 2 & 3) and tap.
- Tap 'Begin Course'.
- **Always select the '10 mins' option** by scrolling to the relevant option before playing the meditation. Press play and enjoy!
- Continue the daily sessions by selecting 'Begin' at the top of the Home screen each day.

### Taking time for yourself.

Remember – this is your opportunity to take 10 minutes out of every day just for *you*! Have a sense of how it feels to take some time out, this is not intended to feel like a chore, it should be a treat! This is time for you to sit back and not do anything at all, finding the balance of relaxation and focus on the other as you rest the mind in the present moment.

### Tips and FAQs

#### What should I wear?

You can wear whatever you would like, as long as you're comfortable. The most important thing is having enough room to breathe comfortably – it may be more difficult to relax in a seated position if you are wearing e.g., jeans which feel particularly tight around your stomach. To help you feel more grounded, make sure to have your feet flat on the ground.

#### How should I sit?

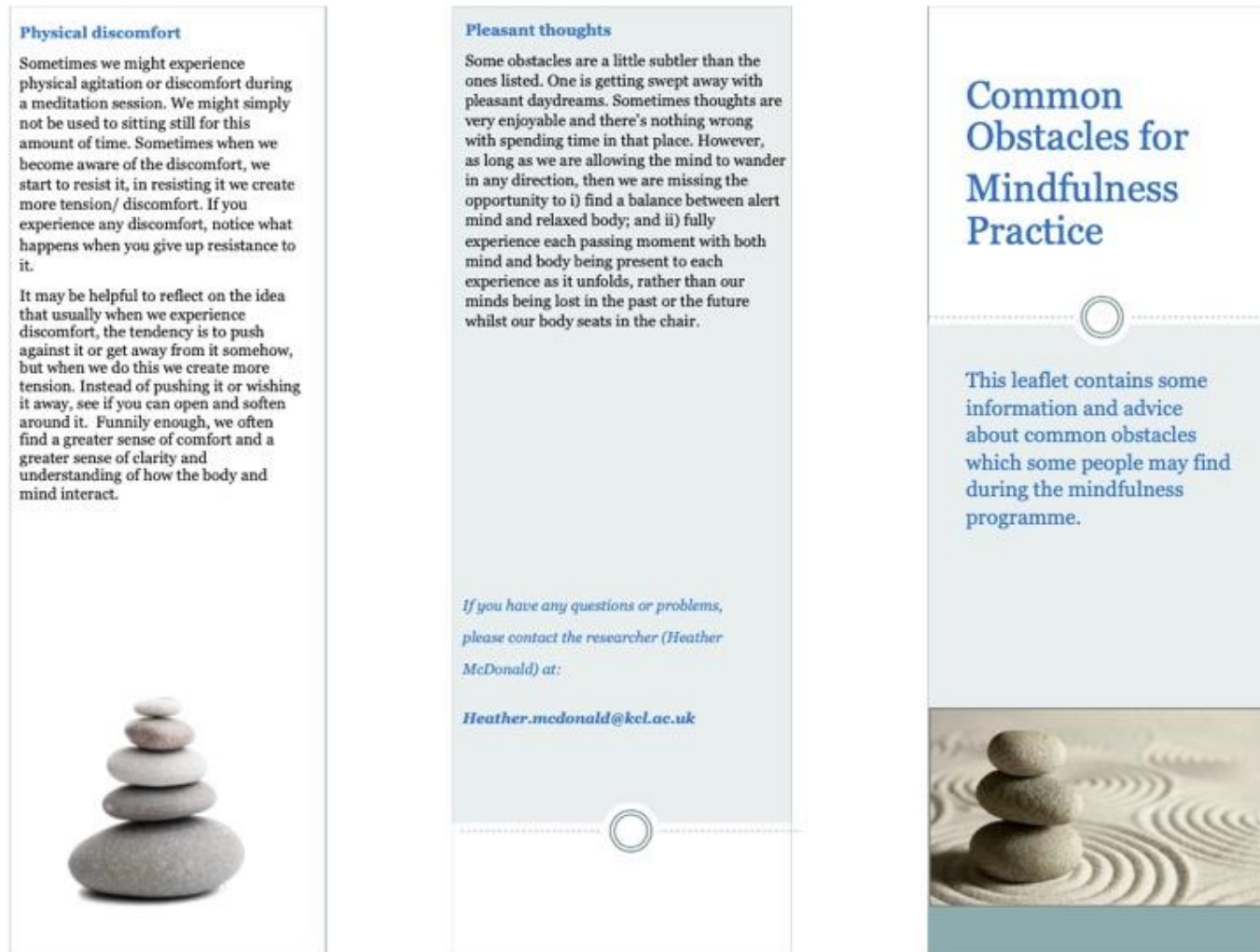
It's what you do with your mind rather than what you do with your body that is most important. For the purposes of this daily practise, it's fine to use a chair, or sit on the floor. The important thing is to be comfortable, relaxed and at ease, with a posture that will support your practice. Keeping your back straight and shoulders dropped and relaxed will help to keep your mind alert during your practice session.

By adopting a physical posture that reflects the quality of mind you'd like to develop, it will make it that much easier to do so.



**Figure C. 3.** Participant information leaflet (tips and frequently asked questions) for the mindfulness-based intervention group





**Figure C. 4** Participant information leaflet (common obstacles) for the mindfulness-based intervention group





- During your exercise, it might be helpful to bring to mind a couple of people who are close to you, who might benefit from you doing this exercise.
- Take time to reflect on how different the mind feels when your relationships are going very well and you're happy, and how different the mind feels when relationships are difficult. What a difference a calm mind can make to those relationships in your life!

#### Restlessness

One of the most common things people come across during meditation is the feeling of restlessness/agitation in the mind. When this arises, the natural tendency is to resist it, but this creates a greater sense of restlessness/tension to the mind. Remember, when you begin the exercise each day, part of checking in with the body is to really help ground the mind and reduce that feeling of restlessness. Underneath all those thoughts is a place of calm and quiet if we can just let go of the resistance and simply allow thoughts to come and go – and in time the mind will naturally come to a place of rest.

**Tip:** Taking into consideration how the exercise can impact (positively) others around us can make the mind a little softer/flexible/patient, and can help make the practise feel a little easier.

#### Boredom

Many people experience boredom – which is not surprising, given how stimulating everyday life is. Sitting with no distraction can feel quite boring if we are not used to it. This can arise due to either having not developed sufficient curiosity in the exercise or wanting to be somewhere else/do something else, or simply not being present – being present and curious can make it less likely for us to

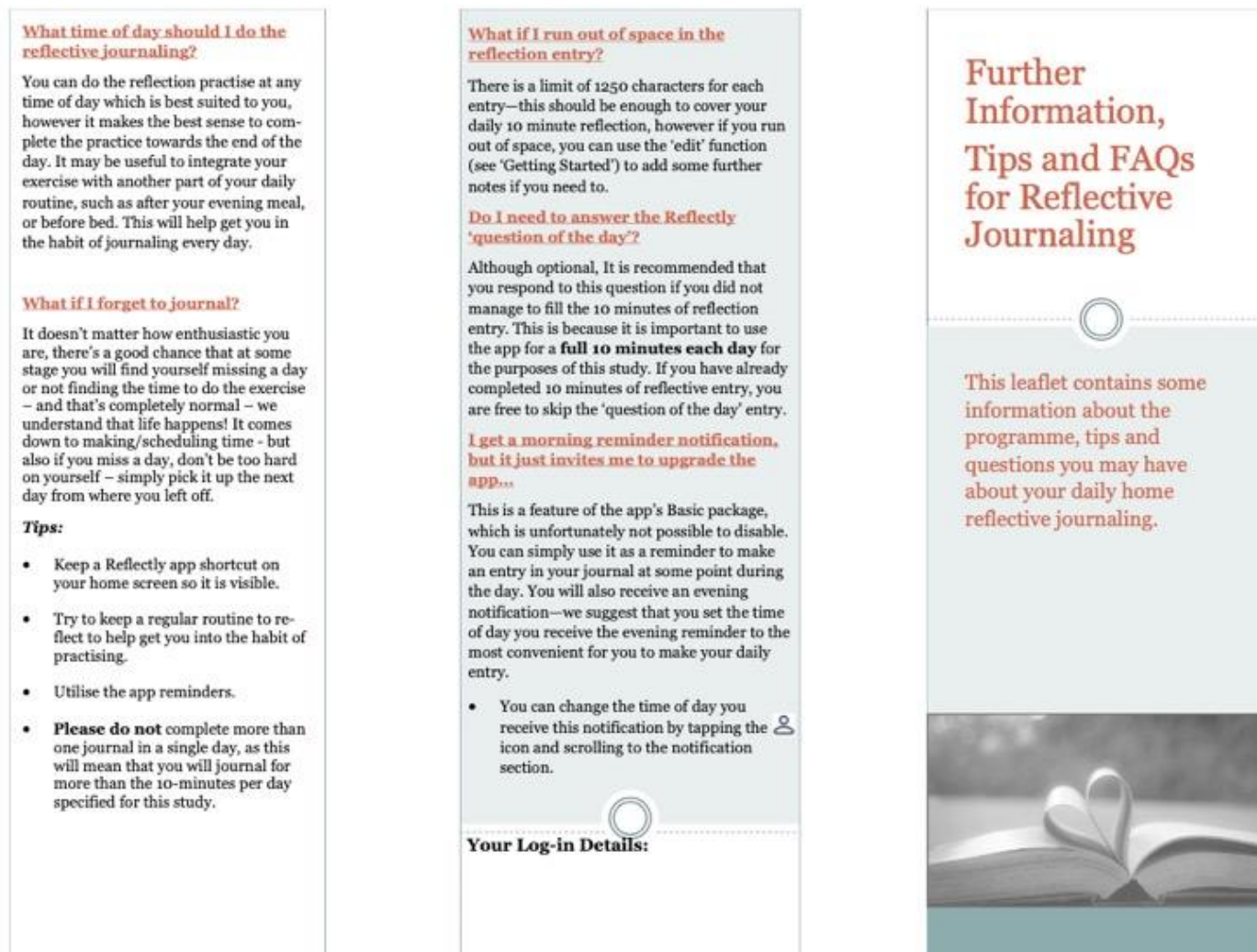
us to experience boredom.

Sometimes we may become impatient with the exercise as we have not developed a sense of 'change' quickly enough. If we only interested in getting a result, and not in the journey or process, we are never really going to find the answer we are looking for – because the journey and the process is the answer. It's about learning to *become aware* of the experience, whatever it is in any single moment, with an open, curious mind. This helps us to understand the dynamics of our mind and get a greater sense of calm and clarity in everyday life. At times the exercise can feel repetitive, but that's how we learn any new skill in life – by repeating it, giving the mind the time and space to become familiar and it becomes natural.

• **Tip:** During your exercise, be curious in the present moment. This means not assuming that each breath is the same as the next – noticing each and every one, with a fresh perspective.



Figure C. 5. Participant information leaflet (common obstacles) for the mindfulness-based intervention group



**Figure C. 6.** Participant information leaflet (tips and frequently asked questions) for the active control group

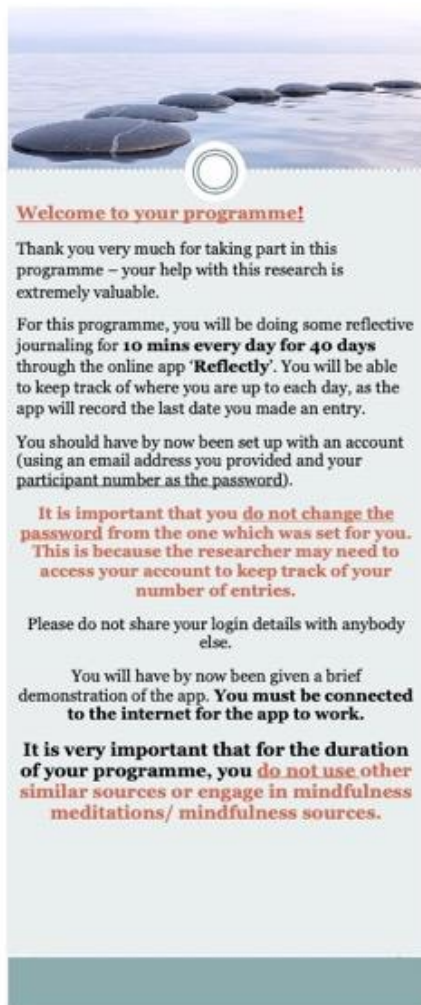
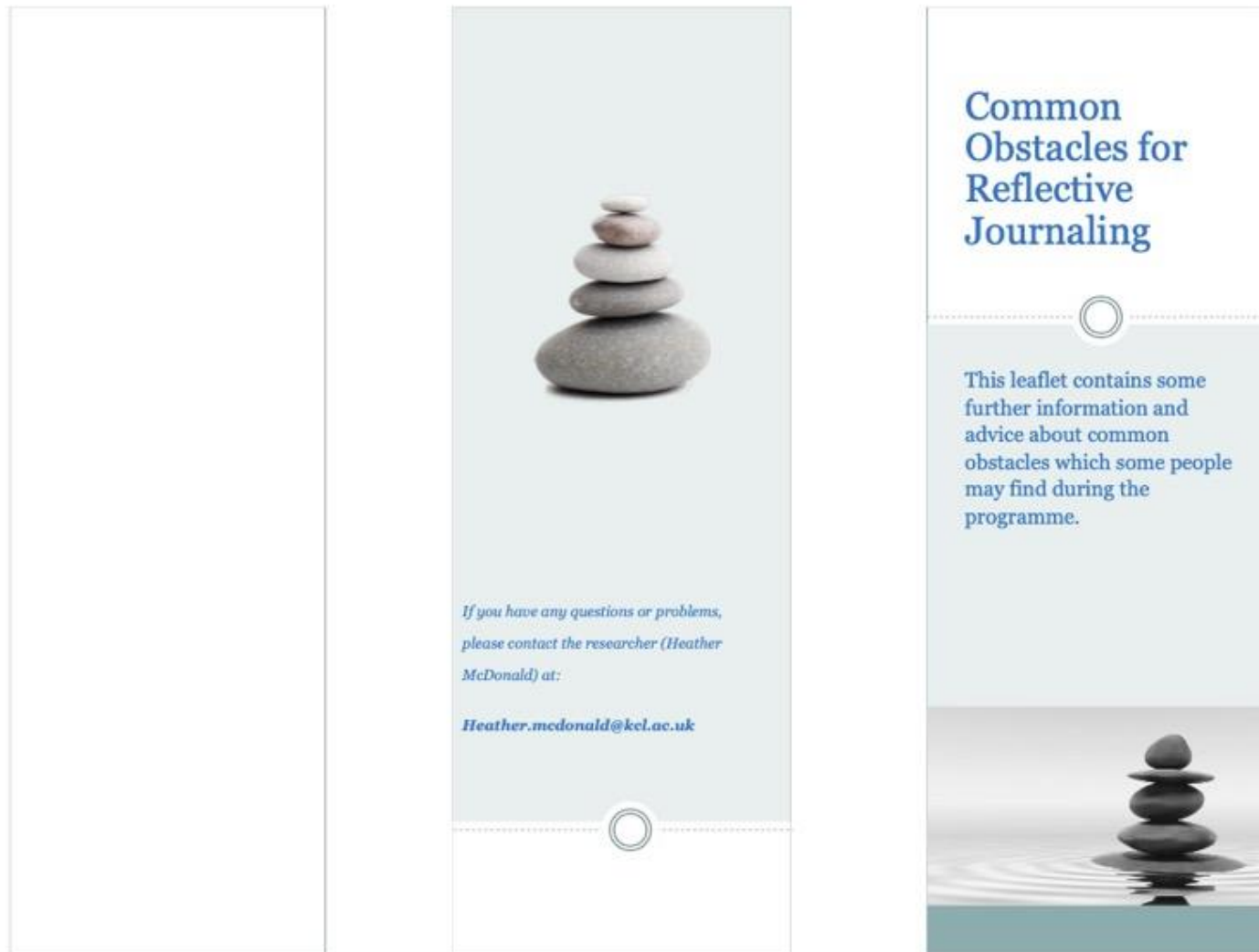
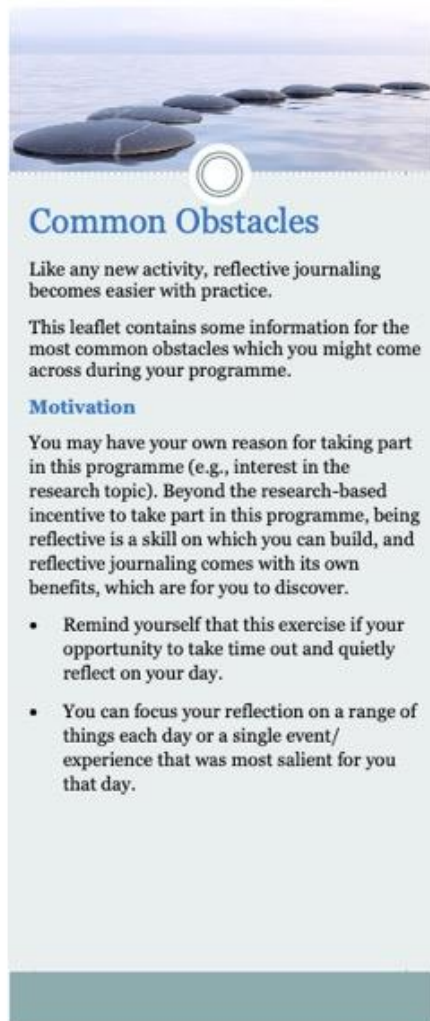


Figure C. 7. Participant information leaflet (tips and frequently asked questions) for the active control group



**Figure C. 8.** Participant information leaflet (common obstacles) for the active control group





### Boredom

Many people experience boredom during any type of repeated activity – which is not surprising, given how stimulating everyday life is. Sitting with no distraction can feel quite boring if we are not used to it. Don't worry if you experience boredom at some point! This can arise due to wanting to be somewhere else/do something else. The more you practise doing this activity for 10 minutes per day, the more you will get used to it, and the better you will become at resting your mind on this task. It's natural for it to take more effort on some days than others to sit and journal.

### Not knowing what to write

The app is designed in such a way to help you get you started with your entry for that day. This can be how you generally felt that day and what you were up to that day. However, you are free to write about any aspect of your day. If you didn't get up to much that day, or don't have any particular thoughts – that's fine too, just write about that! You may find that with practise, you will get better at journaling and find that your writing may start to flow more as you become used to the process.

**Important Note:** If you forget to journal one day, try not to be tempted to make more than one day's journal entry on a single day (e.g., reflective journaling for the day before in addition to today's journal entry). This is because:

- It may become more of a *memory* exercise than a reflective exercise
- Could detract from the days' experiences
- May mean that you journal for more than the specified 10 minutes for that day.

### Other tips:

- We recommend setting a 10 minute timer when you journal, so you can keep track of how long you have spent on the activity.
- Remember not to worry too much about what you write or how you write it. There is no prescriptive or 'right' way to journal!
- If you get stuck with what to write, sometimes it is helpful to start with 'I don't know what to write...' and see where it takes you.



**Figure C. 9.** Participant information leaflet (common obstacles) for the active control group

## Appendix C. 10. VR Data Collection

**Researcher. Meet participant in reception of HWB or main building. Bring them up to Interview room.**

**Researcher. Interview room**

- **Briefing:** *Sample script: "Thank you for coming to do the first part of the study today. You were sent an Information Sheet. Did you read the Information Sheet? [If yes:] Did you have any questions? [Use information sheet as prompt and answer questions.] [If no:] Would you like to have a quick read of it now? Take your time ... Did you have any questions? [If participant would like a summary, key points in brief are:] "The purpose of today is to do a virtual reality task and ask you a few questions before and after about how you found the experience. The virtual reality scenario is a social situation. All of the information that we collect today is completely confidential. You are free to stop the study or take a break at any time." [If the participant asks any questions about the design of the study or how they were selected:] "I'm afraid I can't answer that question before you do the virtual reality task but there will be a debriefing at the end of the whole study where I will be able to answer any questions."*
- **Consent form:** Sign or collect signed copy. Researcher to sign and retain 1 copy. Make sure participant has completed all sections correctly before you sign. Ask participant if they would also like a copy for their records and, if so, complete a second consent form.
- **Questions on tablet:** *Sample script: "We would just like to ask you a few questions before you do the virtual reality task. We have the questions on this tablet. Let me know if you have any questions ..."*

**End:** *Sample script: "It is now time to do the virtual reality task."*

## Part 2.

### VR lab

- **Introduction:** *Sample script: "This is the part of the study where we will do the virtual reality task"*
- **Explain VR equipment:** Before putting on the headset, show the participant the Oculus headset and the joypad. Show them which button on the joypad they will be able to use. Tell the participant: *"You will be able to move around with a combination of turning with your body and by using the joypad. Move around slowly at first as you get used to the virtual environment; otherwise you might feel dizzy. If you've used a joypad before, it might be a bit different to what you are used to as you will be partially guided in your movement and cannot move completely freely"* Demonstrate this to participant while holding the joypad.
- **Start VR:** Get participant into position, holding joypad and wearing VR headset. Make sure headset cable is not tangled. *Sample script: "Don't worry about the cable. I will make sure you do not get tangled."* Blue light on headset must be on. Once the participant is comfortable and ready, press PLAY.
- **Demo VR exercise:** [Now read the following:] *"You will first be in a street. Have a look around the street slowly ... When you are ready, use the joypad to move yourself to the green circle on the ground ... You will get to a pub. Turn your body to the right to face the pub ... In the pub look for more green circles on the ground. You will need to go from one green circle to another. If you cannot find a green circle, have a look around for it. When*

*you get to a green circle, you will need to stop for a little while. While you are in the pub please try get an impression of what the people in the pub thinks about you and what you think about them. If someone asks you a question, try to reply to them* [Everyone **MUST** get this instruction.] *“Do you have any questions?”*

- **Main VR task:**

S

Press PLAY at pub doorway

'PAUSE' > CONTINUE

AFTER PATRICK > CONTINUE

2<sup>ND</sup> INTERACTION > WALK AROUND

AFTER TV PROGRAMME > CONTINUE

CLOSING INSTRUCTION > CONTINUE

- **FIDELITY:** Record on tablet. DO NOT SPEAK TO PARTICIPANT WHILE IN THE PUB UNLESS NECESSARY.
- **Remove VR equipment**
- **Questions (Qualitative).** *“I am going to ask you a question about your experience within the VR environment and record your answers. Your name will not be used and your responses will remain confidential. Did any particular thoughts or feelings come up for you during the VR task?”*
- **Questions on tablet:** *“Now that you’ve done the virtual reality task, we would just like to ask you a few more questions on this tablet. ....*
- **End:** Sample script: *“Thank you for doing the virtual reality task...”*



**Figure C. 10.** Scene from inside the Virtual Reality Environment.

## **Appendix C.11. Qualitative feedback from participants in the mindfulness-based intervention group.**

The following excerpts were provided by participants in the mindfulness-based intervention group regarding acceptability and feasibility of the intervention.

### Tracking personal progress

Participants generally found it easy to keep track of session progress, noting that this was due to the trackability of sessions within the 'Headspace' app:

*"Every time I went on, it told me which [session] I'd done last. So I felt like I went in the right order and followed it in the right way".*

### Difficulties

Overall, the most difficult aspect participants found about the intervention was remembering to complete the sessions every day and integrating meditation into a daily routine; however, some participants this easier over time. Two participants noted that they sometimes were unable to access the meditation due to network difficulties.

*"...at the beginning I would forget but then when I found the time to repeat it every day, then it was easier. Then I remembered almost every day."*

*"I had a few moments where it kept telling me that it didn't have any access to data despite me being connected to WiFi or 4G."*

### Length of course and Sessions

The 40-day course length and 10-minute meditation time was generally found to be acceptable; however, one participant found meditating every day a large commitment, but remarked this may have been due to the time of day she scheduled the sessions.

*"the length itself, 40 days, I think is good because you do get to do basic skills and then if you do the three levels and they're all different, while being about the same thing... it never got boring."*

*"...It was a bit of a commitment. You know, doing it every day, but then I think it could be because I was doing it just before bed and by that time I was just so shattered."*



*“Because it was 10 minutes a day, it was just something I actually looked forward to doing by the end of the course”*

### Session Content

Overall, participants enjoyed the sessions and found them easy to follow, however two participants noted having difficulty with grasping concepts such as ‘body scan’ (as part of open monitoring meditation).

*“Body scan was hard because it was hard to know exactly what that was... I realised I was doing it too fast... and then I realised I was doing it too slow.”*

Several participants noted a reduction of meditation guidance as the sessions went on, some of whom found this made the meditations more difficult, though not all participants found this particularly problematic and understood why guidance became less frequent.

*“...the first sessions, the voice was talking and telling you what to do. But then at the more advance sessions there were a lot of empty silent spaces and sometimes I would forget I was supposed to meditate... I think the point is to also be able to do it yourself, so I don't think it's bad”.*

*“Towards the end, of course, it was less guided. It was better for me when he gave more guidance”*

### Psychological engagement with the meditations:

Some participants felt that they did not fully adhere to the instructions of the meditations.

*“I can admit something now [laughs]. When I was listening to it, I was listening to what the guy was saying but I found that there were times I would do my own thing.”*

*“Some of them I was engaged, not all of them, I'm not going to lie. Maybe the first couple because I was quite excited to use it... but then I think it was second set of ten days, I feel like I didn't quite get into as well.”*

## Appendix C.12. Email Reminders for Participants

	MBI	Active Control
<b>10 Days</b>	<p>Well done for reaching the 10 day point using <i>Headspace</i> – I hope you are enjoying using the app so far. I would be very grateful if you could complete the following online survey at some point <b>today</b> (or if you are unable, the next day/asap). I will send you a text reminder tomorrow. It will take <b>approximately 15 minutes to complete</b>, and is the only survey you will need to complete before coming back for your next lab visit.</p> <p>Here is the link to the survey, your participant number is [XXX] (it will ask you to enter this at the beginning of the survey):</p> <p>[Link to survey]</p> <p>You will soon receive (if you haven't already) an email <b>directly from Headspace</b> with a gifted 1 month subscription attached, please:</p> <p>Click 'activate subscription' within the email you receive to activate access to the app for the remaining 30 days.</p> <p>Once activated, within the app, go to <b>'Library' &gt; 'Featured' &gt; 'Stress and Anxiety'</b></p> <p>Select <b>'Managing Anxiety'</b> &gt; 'begin'. The package should now start to appear on your home page within the app, ready for you to continue using for the remaining 30 days.</p> <p>If you have any trouble accessing this package, or aren't sure, please let me know.</p> <p><b>NOTE: If you have not yet completed the whole of the 'Basics 1' pack, please firstly complete this initial 10-daypackage before moving onto the new 'Managing Anxiety' package.</b></p> <p>Please remember to always select the <b>'10 minutes'</b> option as you have been doing for the last 10 days, and stick to <b>only</b> this package (you will have an opportunity to freely explore the rest of the app after your second lab visit).</p> <p>Please be reminded to only do 10 minutes of <i>formal</i> practice (i.e.,</p>	<p>Well done for reaching the 10 day point using <i>Reflectly</i> – I hope you are enjoying using the app so far. At this point, I would be very grateful if you could complete the following online survey at some point today (or if you are unable, the next day/asap). It will take <b>approximately 15 minutes to complete</b>, and is the only survey you will need to complete before coming back for your next lab visit.</p> <p>Here is the link to the survey, your participant number is [XXX] (it will ask you to enter this at the beginning of the survey):</p> <p>[Link to survey]</p> <p>Keep going, remembering to only use the app for 10 minutes per day, as you have been for the last 10 days. If you forget to journal one day, just pick up where you left off (please do not do 2 journals in the same day).</p> <p>If you have any questions or concerns about your use of the app or about journaling, please let me know – we can arrange a phone call if this would be helpful to you.</p> <p>Many thanks and best wishes, Heather</p>

	<p>the guided mediation through the app). If you forget to practise one day, just pick up where you left off (please do not do 2 guided meditations in the same day)</p> <p>If you have any questions or concerns about your use of the app/practise, please let me know – we can arrange a phone call if this would be helpful to you.</p> <p>Do let me know if you haven't received your voucher from Headspace by tomorrow (also worth checking your junk mail box as well).</p> <p>Many thanks and best wishes, Heather</p>	
<b>20 Days:</b>	<p>Well done on completing 20 days of Headspace! You're half way! I hope you are still enjoying using the app and perhaps even learning some new skills.</p> <p>Don't worry if you haven't managed to complete all 20 days at this point – just keep going, picking up where you last left off as you go. It's just as valuable for the study to take into account how easy you find it to use the app every day! If you are struggling to find time each day to practice your 10 minutes, or find you are prone to forgetting:</p> <ul style="list-style-type: none"> <li>• Utilise the app reminders/notifications (you can find these in the 'your account &gt; settings' section)</li> <li>• Try tying your 10 minutes in with part of your daily routine – e.g., waking up/going to bed/brushing your teeth.</li> <li>• Remember, If it frustrates you – acknowledge it, sit with it for a moment – be kind to yourself and not critical.</li> </ul> <p>Over time, you will find more and more ease in taking 10 minutes every day for yourself and to rest your mind on this practise.</p> <p>Remember – its completely normal if during your practise, you still find your mind wanders off again and again – this is what the mind naturally does! When you notice it has wandered off, gently and kindly bring your attention back to whatever part of the practise you are doing (e.g., body scan, breathing etc). The aim of the practice/being mindful is not to empty our mind of thought, but to be more aware of what is happening – in any situation - so that we have better ability to gently bring it back and help it settle.</p>	<p>Well done on completing 20 days of Reflectly! I hope you are still enjoying using the app.</p> <p>Don't worry if you haven't managed to complete all 20 days at this point – just keep going, picking up where you last left off as you go. It's just as valuable for the study to take into account how easy you find it to use the app every day! If you are struggling to find time each day to practice your 10 minutes, or find you are prone to forgetting:</p> <ul style="list-style-type: none"> <li>• Utilise the app reminders/notifications</li> <li>• Try to keep a regular routine for journaling to help get you into the habit of journaling.</li> <li>• Be kind to yourself and not critical.</li> </ul> <p>Over time, you will find more and more ease in taking 10 minutes every day for yourself and to rest your mind on journaling.</p> <p>I am always here if you have any questions or problems</p> <p>Many thanks and best wishes, Heather</p>

	I am always here if you have any questions or problems.	
<b>30 Days</b>	<p>Well done on reaching 30 days! I really appreciate your help with this research! Keep going!</p> <p>Just a reminder that we are due to meet for your final lab on the [DATE] at [TIME]. I will also send you a reminder the day before. I will meet you at the reception of the Addiction Sciences Building, IoPPN (SE5 8BB). <b>Please do not delete your app account until after this visit.</b></p> <p>You will receive remuneration and a 1 month Headspace subscription at this visit as a thank you for taking part in this research. Please also remember any travel receipts to also claim these back.</p> <p>I'm looking forward to seeing you then!</p> <p>Many thanks and best wishes, Heather</p>	

## Appendix D. Research Ethics Committee Approval

Research Ethics  
Office

Franklin Wilkins Building  
5.9 Waterloo Bridge Wing  
Waterloo Road  
London SE1 9NH  
Telephone 020 7848 4020/4070/4077  
rec@kcl.ac.uk



Heather McDonald

28 March 2018

Dear Heather,

LRS-17/18-5604

I am pleased to inform you that full approval for your project has been granted by the PNM Research Ethics Panel

Ethical approval is granted for a period of **three years** from 28 March 2018

You should report any untoward events or unforeseen ethical problems to the panel Chair, via the Research Ethics Office, within a week of occurrence. Information about the panel may be accessed at:

<http://www.kcl.ac.uk/innovation/research/support/ethics/committees/ssh/rep/index.aspx>

If you wish to change your project or request an extension of approval, please complete and submit a Modification Request to [crec-lowrisk@kcl.ac.uk](mailto:crec-lowrisk@kcl.ac.uk). Please quote your ethics reference number, found at the top of this letter, in all correspondence with the Research Ethics Office. Details of how to complete a modification request can be found at:

<http://www.kcl.ac.uk/innovation/research/support/ethics/applications/modifications.aspx>

All research should be conducted in accordance with the King's College London *Guidelines on Good Practice in Academic Research* available at:

<http://www.kcl.ac.uk/college/policyzone/assets/files/research/good%20practice%20Sept%2009%20FINAL.pdf>

Please note that we may, for auditing purposes, contact you to ascertain the status of your research. We wish you every success with your research.

Best wishes,  
Mr James Patterson  
Senior Research Ethics Officer

**For and on behalf of:**

PNM Research Ethics Panel

## Appendix E. Participant Information Sheet

### INFORMATION SHEET FOR PARTICIPANTS

REC Reference Number: LRS-17/18-5604

### YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET



**Study title:** Investigating the relationship between creativity, personality, mindfulness and sensory information processing.

We would like to invite you to participate in a study being conducted for a PhD at the Institute of Psychiatry, Psychology and Neuroscience, King's College London. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide if you are willing to participate, you need to understand why the research is being done and what it would involve for you.

Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

#### **Why are we doing this research?**

We would like to get a better understanding of the relationship between aspects of personality, creativity and mindfulness. We are also interested to test whether the relationship between creativity and personality is linked to a particular way of processing sensory information. Finally, we would like to investigate whether mindfulness (the ability to attend to the present-moment experience) can help manage some aspects of personality (such as anxieties in relation to others) thought to interfere with creativity and have an impact on everyday experiences. Our overall aim is to explore if mindfulness can help support traits which promote creativity.

#### **Who is eligible to participate?**

We are looking for participants aged between 18 and 65 years who have no history or current diagnosis of a serious mental health illness, neurodevelopmental and neurological disorders, or substance abuse. You can participate if you are fluent in English, have normal hearing and do not suffer from photosensitive epilepsy.

#### **When and where will the study take place? What will you be asked to do?**

If you decide to participate, we will first ask you to complete an online survey at a place and time convenient to you (you will be provided with a link to the survey). Your responses to the online survey will help us determine whether you fit our criteria for study participation. If you are invited to take part in the main study, your participation will involve two visits to the lab at the Institute of Psychiatry, Psychology and Neuroscience (IoPPN, Denmark Hill, SE5 8AF) approximately 40 days apart and some 'homework' in between the lab visits using an online app.

The online survey contains three questionnaires. One assesses creativity, such as what type of experience you tend to have when you engage in creative activities (e.g., how pleasurable the experience is). One assesses dispositional mindfulness (e.g., how aware you tend to be of in daily life or how much you 'run on an automatic pilot'). One

assesses personality traits, with questions about what kind of experiences you have in relation to other people (e.g., if you find it easy to make conversation with others), some beliefs (e.g., belief in the supernatural) and perceptual experiences (e.g., in terms of your sense of smell/hearing).

If you fit the study criteria based on your online survey responses, you will be invited to the lab on a day and time convenient for you. In the lab, you will be asked to complete a short virtual reality (VR) task. You will wear a VR headset and be immersed in an everyday environment (a pub) for 5 minutes and you will be asked to rate your experience afterwards.

You will also be asked to complete a few questionnaires relating to your everyday thoughts and feelings regarding other people (e.g., if you have recently felt stressed about the behaviour of those around you), how you have felt over the previous week (e.g., if you have recently felt anxious, stressed or down), your worry style (e.g., if you tend to worry about things) and a questionnaire about how you typically act towards yourself in difficult times.

Finally, you will be tested on a sensory information processing task. You will hear a series of mildly startling sounds delivered via headphones. Two small sensors will be placed below your right eye and one behind your right ear. A small amount of water-based conductive gel that will be in contact with your skin will be used for the sensors to make the signal better. The sensors will record your eye blinks in response to sounds. Although these sounds are designed to mildly startle you, they should not be too unpleasant.

After the lab testing, you will be asked to engage in 10-minute daily activity at home for the duration of 40 days. This will be either guided mindfulness meditations using Headspace app or listening to mindfulness-based reflective journaling via the Reflectly app. After the first 10 days, you will be asked to fill in a few questionnaires at home (online). After 40 days, you will be asked to come to the lab to repeat the VR sessions, questionnaires, and sensory information processing task. You may also be asked to take part in a semi-structured interview, in which the researcher will ask you about your experience of the home daily activity (e.g., how you found it) and your experiences regarding other people (e.g., thoughts and feelings in social situations).

### **How long will the study last?**

The online survey will take approximately 20-30 minutes to complete. The first visit to the lab will take approximately 2 hours to complete all tests including the VR task, questionnaires and sensory information task. The questionnaires to be completed at the 10-day time point of daily activity will take approximately 15 minutes to complete at home. The daily activity programme will last for 40 days, consisting of one 10-minute home activity session per day. The final visit to the lab (after the 40 days) will last approximately 2-2.5 hours (depending on if you are asked to take part in an interview).

### **Will you be compensated for your time?**

You will be entered into a prize draw to win £25 worth of Amazon vouchers for completing the online survey. You will receive **£50 (cash)** and a free Headspace app subscription for 1 month (worth £9.99) for completing the 40-day programme and reassessment. All travel expenses will be reimbursed upon presentation of the receipt(s).

### **Are there any risks involved in participating?**

There is no risk involved in participating.

### **Are there any benefits involved in participating?**

As well as being compensated for your time, you may find that the daily activity programme provides you with some useful techniques for managing stress and daily challenges. After the study completion, should you wish it, we will send you a summary describing the findings of the current study and alerting you to any research publication we have generated from the project.

### **How will we maintain your privacy and confidentiality?**

We will give you an identification number to replace any information we have in the data file that identifies your name and your address or any other contact details we have for you. All your data will be anonymised and linked only to a numerical ID.

Any data we receive from you will be stored on secure computers in locked offices and in locked file cabinets. At the conclusion of the study, anonymised data may be shared with other researchers outside of the Research team. This means that, with your permission, researchers outside our Research team will have access to the data you provided. However, they will have no means of identifying you.

Your responses to our questions will remain completely confidential within the limits of the law. Confidentiality will need to be broken in the event that you disclose information that suggests your own health and safety or that of someone else is currently in danger.

### **Indemnity and legal rights**

Your legal rights are not affected by agreeing to participate in this study.

### **Participation and withdrawal**

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to complete a consent form at each stage of the study. If you decide to take part you will be free to withdraw at any time, without giving a reason.

For those participants who have either withdrawn or were excluded, all data will be removed from the study.

If after your participation, you no longer wish your already collected data to be included in the publication of this study, you are free to withdraw your data at any time up until the time of writing up of the results for publications (December 2019). Please make a note of your unique participant ID which you are given at the survey stage of your participation, so that you can quote it should you later decide to withdraw your data.

### **What if something goes wrong?**

If you feel this study harms or upsets you in any way you can contact King's College London using the details below for further advice and information:

The Chair, Psychiatry, Nursing and Midwifery Research Ethics Subcommittee. Email: [rec@kcl.ac.uk](mailto:rec@kcl.ac.uk)

### **Participation in future studies**

If you agree to take part you will be asked whether you are happy to be contacted about participation in future studies. Your participation in this study will not be affected should you choose not to be re-contacted.

### **Who has reviewed the study?**

This study is being supervised by Dr Elena Antonova, Professor Paul Chadwick and Dr Lucia Valmaggia. All research at King's College London is also reviewed by a Research Ethics Subcommittee, to protect your safety, rights, wellbeing and dignity.



This study was reviewed by the Psychiatry, Nursing & Midwifery Subcommittee (REF: PNM/ LRS-17/18-5604).

**Contact details**

If you have any questions relating to this research, or concerns about participation, please contact:

Name: Miss Heather McDonald

Tel: 020 7848 0846

Email: heather.mcdonald@kcl.ac.uk

Postal address: Box PO78, Department of Psychology, Institute of Psychiatry (P078), King's College London, London, SE5 8AF.

***We wish to thank you for taking the time to read this sheet and considering taking part in the research study.***

**IF YOU HAVE ANY QUESTIONS AT ALL, PLEASE ASK THEM NOW.**

## Appendix F. Participant Consent Form

### CONSENT FORM FOR PARTICIPANTS IN RESEARCH STUDIES

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

**Title of Study:** Investigating the relationship between creativity, mindfulness, personality traits and sensory information processing.



**King's College Research Ethics Committee Ref:** LRS-17/18-5604

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Please tick  
or initial

- I agree to take part in the above research. I have read the Participant information sheet. I understand what my role will be in this research. All my questions have been answered with satisfaction. ☐
- I understand that if I decide at any time during the research that I no longer wish to participate in this project, I can notify the researchers involved and withdraw from it immediately without giving any reason. Furthermore, I understand that I will be able to withdraw my data up until April 2020. ☐
- I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with the terms of the General Data Protection Regulation. ☐
- I consent to my anonymous data being shared with researchers outside of the research team. ☐
- I agree to being re-contacted about future studies. ☐
- I understand that everything I disclose during the study will remain completely confidential within the limits of the law. I understand that confidentiality will need to be broken in the event that I disclose information that suggests my own health and safety or that of someone else is currently in danger. ☐
- I consent to my interview being audio-recorded. ☐
- I consent to my audio recording being shared with an external transcription service. ☐

#### Participant's Statement:

I, \_\_\_\_\_

agree that the research project named above has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Signed

Date

#### Investigator's Statement:

I, \_\_\_\_\_

Confirm that I have carefully explained the nature and demands of the proposed research to the participant.

Signed

Date

## Appendix G. Participant Invitation Emails

Many thanks for getting in touch!

Please find attached the information sheet which provides the details of the full study.

In brief, the study has three parts: the first part is an online survey looking at the link between creative experience, trait mindfulness and personality, which takes 20-25 minutes to complete. Depending on your responses to the online survey, you might be invited to take part in the next part of the study. This would involve attending the King's College London lab at the IOPPN, Denmark Hill (SE5 8BB) on a single occasion for around 2 hours and complete some simple creativity tasks and an auditory response task.

You will receive a £5 Amazon voucher for completing the online survey and you would be paid £20 cash for the second stage (plus travel expenses upon presentation of the receipts). You may then be invited to take part in the third stage of the study, the details of which are in the information sheet but would be fully explained to you upon invitation to take part.

Please note that you are free to withdraw from the study at any time, should you take part.

**If, after reading the information sheet, you feel you fit the eligibility criteria and would still like to take part and would like a link to the survey, please simply reply to this email and I will send you the link to the survey and a participant code.** Do feel free to ask any questions.

Thank you very much in advance for your assistance with our research  
Best wishes,  
Heather

### Invitation to Study 2:

Thank you again for completing the survey for the study 'Creativity, Mindfulness, Personality and sensory information processing', I really appreciate your contribution to this research project.

I would like to invite you to take part in part 2 of this study. Please find another copy of the information sheet attached to this email with the relevant parts highlighted.

In brief, you will be asked to complete one short questionnaire, 2 simple tasks related to creativity + a word associations task, and a simple auditory response task, which will take about 2 hours altogether. You will receive £20 cash as a thank you for your participation upon completing the tasks. Travel expenses will also be reimbursed upon presentation of the receipt(s).

The session will take place at the IOPPN, Denmark Hill campus (SE5 8BB).

If you are interested in taking part, please reply to this email so we can arrange a date and time which best suits you.

Please feel free to email me with any questions.

I look forward to hearing from you.

Best wishes,  
Heather

### Invitation to Study 3:

I hope you are well! Thanks again for coming in for Stage 2 – it was nice to meet you. I would like to invite you to take part in the 3<sup>rd</sup> stage of the study. Please find attached the information sheet, with the relevant section highlighted.

In brief, you would be asked to attend the lab at the IoPPN (Denmark Hill) to fill in some questionnaires and to take part in a short Virtual Reality task. This lab visit will last around 1 hour. You would then be asked to complete 10 minutes of daily home activity (either mindfulness-based meditations or reflective journaling via an online app) at home for 40 days. You would then attend the lab a second time to repeat the questionnaires. You would be paid £50 cash upon completion, as well as a gifted subscription to a mindfulness app. You would also be reimbursed for travel expenses (upon presentation of the receipts).

***Please note that for this study you will need access to a smart device (either phone/tablet etc) to access the online app at home.***

If you have any questions, please do not hesitate to contact me via this email address.

Many thanks and best wishes,  
Heather

## Appendix H. Research Advertisement

### **Investigating the relationship between creativity, personality, mindfulness and sensory information processing - Healthy volunteers required:**

Circular email for use for recruitment of healthy volunteers for study ref LRS-17/18-5604, approved by King's College London Psychiatry, Nursing and Midwifery Research Ethics Subcommittee (PNM RESC). This project contributes to the College's role in conducting research, and teaching research methods. You are under no obligation to reply to this email; however, if you choose to, participation in this research is voluntary and you may withdraw at any time.

#### **Why are we doing this research?**

In this study, we are investigating the relationship between creativity, personality traits, mindfulness and sensory information processing.

#### **Who can take part?**

We are looking for individuals who are:

- Between 18-65 years old
- Fluent in English
- Have no personal history of a serious mental health illness (as diagnosed by qualified psychiatrist) and/or substance abuse.
- Have normal hearing
- Do not suffer from photosensitive epilepsy

#### **What does this study involve?**

The study involves taking part in an online survey which takes around 25-30 minutes to complete. Depending on your responses, you might be invited to the lab at the IoPPN, Denmark Hill (SE5 8BB) to complete an additional questionnaire, two simple creativity tasks, a word associations task and an auditory response task (stage 2). This testing session will last approximately 2 hours. You may then be invited back to the lab to complete a short virtual reality task, some questionnaires, and take part in a home activity-based programme (stage 3). Your participation at every stage of this study is completely voluntary.

You will be offered an Amazon voucher worth £5 for completing the online survey. You will receive further £20 (cash) as a remuneration for your participation upon completing stage 2, and a further £50 (cash) upon completing stage 3 of the study. Travel expenses will be reimbursed **upon presentation of the receipt(s)**.

Full information about the study will be available in the relevant information sheet, which we will give you to read and then keep, before we ask you to consent to the study.

#### **How to get involved?**

If you are interested in participating in this study, or in learning more about the study, please contact Heather McDonald([heather.mcdonald@kcl.ac.uk](mailto:heather.mcdonald@kcl.ac.uk)).

## Appendix I. Screening Items

- Please confirm you have read the Information sheet provided to you **fully**, meet the requirements to take part in this study (Inclusion criteria: aged 18-65 years, no history or current diagnosis of a serious mental health illness, neurological disorder [as diagnosed by a medical practitioner] or substance abuse; fluent in English; normal hearing; do not suffer from photosensitive epilepsy) and are happy to take part:
  - *Yes I confirm I read the information sheet, meet the specified requirements and am happy to take part in this study.*
- Are you currently taking any medication?
  - Yes
  - No
  - *If 'Yes', please specify*
- Please confirm that you meet the following requirements for taking part:
- Please enter the participant ID provided in the email with the survey link:
- What is your age?
- What do you identify your gender as? Please select one answer:
  - Female
  - Male
  - Trans
  - Other/prefer not to say
  - *If you selected 'other', please specify*
- What is your ethnicity?
- What is your current level of education?
  - Less than a high school diploma
  - High school degree or Equivalent (e.g., GCSE)
  - College (diploma/Level 3/A-Level, no degree)
  - Associate degree (e.g., AA, AS)
  - Bachelor's Degree (E.g., BA, BSc)
  - Master's Degree (e.g., MA, MSc)
  - Professional degree (e.g., MD)
  - Doctorate (E.g., PhD)
- What is your profession? If you are a student, please type N/A
- If you are a student, what subject are you currently studying?
- If you are regularly engaged in an undergraduate/post graduate course and/or profession or hobby of a creative field, please choose as many options as apply to you below, or if it is not listed, select 'other' and specify. If this does not apply to you, please select 'Other' and enter 'N/A'.
  - Actor
  - Dancer
  - Musician (Performance)
  - Musician (Composer)
  - Visual Artist
  - Writer
  - Sculptor
  - Other (please specify)
- Have you been engaging in a **regular (at least 10 minutes per day, at least 4-5 days a week) formal** mindfulness practice (an intentional commitment of time to practice) **within the past 3-4 months**, including meditation, yoga, tai chi, or other?  
(this includes either secular, Buddhist or other)
  - Yes

- No
- For the purposes of the further stages of the study, please indicate your general availability/whether you are likely to be in London for the next 6 months (please include whether you plan to go on holiday/leave London temporarily during the coming months). This is so we can try to organise the lab visits around your availability.

Smoking:

Do you currently smoke/vape/consume nicotine? Y/N

If No, have you ever smoked/consumed nicotine? Y/N

Please select all which applies to you:

Cigarettes (hand-rolled?) / E-cigarettes / Cigar/ Pipe / Chew Tobacco / Nicotine patches/gum etc.

For how long have/had you been smoking?

On average, how much [cigarettes/tobacco/times vape] do you/did you have per day/week/month?

During the last 30 days?

**(Upon arrival to the lab, If a smoker)** When was the last time you smoked/When was your last [cigarette/nicotine product]?