Scandinavian Journal of Psychology, 2016, 57, 256–270 DOI: 10.1111/sjop.12287

Personality and Social Psychology

Emotion processing deficits in the different dimensions of psychometric schizotypy

STELLA G. GIAKOUMAKI

Department of Psychology, University of Crete, Greece

Giakoumaki, S. G. (2016). Emotion processing deficits in the different dimensions of psychometric schizotypy. *Scandinavian Journal of Psychology, 57,* 256–270.

Schizotypy refers to a personality structure indicating "proneness" to schizophrenia. Around 10% of the general population has increased schizotypal traits, they also share other core features with schizophrenia and are thus at heightened risk for developing schizophrenia and spectrum disorders. A key aspect in schizophrenia-spectrum pathology is the impairment observed in emotion-related processes. This review summarizes findings on impairments related to central aspects of emotional processes, such as emotional disposition, alexithymia, facial affect recognition and speech prosody, in high schizotypal individuals in the general population. Although the studies in the field are not numerous, the current findings indicate that all these aspects of emotional processing are deficient in psychometric schizotypy, in accordance to the schizophrenia-spectrum literature. A disturbed frontotemporal neural network seems to be the critical link between these impairments, schizotypy and schizophrenia. The limitations of the current studies and suggestions for future research are discussed.

Key words: Emotions, schizophrenia spectrum, schizotypy, affect recognition, prosody.

Stella G. Giakoumaki, *Department of Psychology*, *University of Crete*, *Gallos University Campus*, *Rethymno 74100*, *Crete*, *Greece*. *Tel: 0030-28310-77541; fax: 0030-28310-77578;* e-mail: sgiakoumaki@uoc.gr

INTRODUCTION

Schizotypy refers to a personality structure specified by the presence of sub-threshold psychotic symptoms, and is suggested to indicate "proneness" or "liability" to schizophrenia and spectrum disorders (Lenzenweger & Korfine, 1995). Thus, increased schizotypal traits have been reported both in schizophrenia patients (Brosey & Woodward, 2015) and clinical (Debbané, Eliez, Badoud, Conus, Flückiger & Schultze-Lutter, 2015) or genetic (Prasad, Sanders, Sweeney *et al*., 2009) high-risk populations. Schizophrenia and schizotypy also share a similar factor structure: the symptomatology of schizophrenia can be described within a three-factor model (Positive, Negative, and Disorganized symptoms; Arndt, Alliger & Andreasen, 1991; Liddle & Barnes, 1990) and schizotypy can be further analyzed into Cognitive-Perceptual or Positive, Interpersonal or Negative and Disorganized Schizotypal factors (Fossati, Raine, Carretta, Leonardi & Maffei, 2003; Raine, Reynolds, Lencz, Scerbo, Triphon & Kim 1994; Reynolds, Raine, Mellinger, Venables & Sarnoff, 2000; Wei, Chuhsing & Chaucer, 1997).

Interestingly, around 10% of the general population (Beauchaine, Lenzenweger & Waller, 2008) has elevated schizotypal traits, which are considered to place these individuals at heightened risk for developing schizophrenia and spectrum disorders (Chapman, Chapman, Kwapil, Eckblad & Zinser, 1994; Debbané *et al*., 2015; Kwapil, Gross, Silvia & Barrantes-Vidal, 2013; Raine 1991). Schizotypal traits can be detected with interviews (e.g., Structured Interview for Schizotypy; Kendler, Lieberman & Walsh, 1989) or self-report scales, the latter being highly cost-effective. For this purpose, a wide number of reliable and valid self-report scales have been developed (e.g., the Chapman Scales; Chapman, Chapman & Raulin, 1976; Chapman, Chapman & Raulin, 1978; the Oxford-Liverpool Inventory of Feeling and Experiences (O-LIFE; Mason, Claridge & Jackson, 1995; the Schizotypal Personality Questionnaire (SPQ); Raine, 1991; the Schizotypal Traits Questionnaire (STQ); Claridge & Broks, 1984). High schizotypal individuals in the general population are also reported to share core features of schizophrenia and spectrum disorders (e.g., Schizotypal Personality Disorder, SPD) such as: (a) impaired cognition (Giakoumaki, 2012); (b) neuroanatomical alterations (Ettinger, Meyhöfer, Steffens, Wagner & Koutsouleris, 2014); (c) genetic risk factors (Roussos, Bitsios, Giakoumaki *et al*., 2013; Roussos, Giakoumaki & Bitsios, 2009; Roussos, Giakoumaki, Georgakopoulos, Robakis & Bitsios, 2011); (d) poor social functioning (Henry, Bailey & Rendell, 2008; Kwapil *et al*., 2013); and (e) impoverished quality of life overall (Cohen & Davis, 2009; Xavier, Best, Schorr & Bowie, 2015).

A key aspect in schizophrenia (Horan, Blanchard, Clark & Green, 2008) and SPD pathology (Rosell, Futterman, McMaster & Siever, 2014) is the impairment observed in emotion-related processes, such as the experience, expression and identification of emotions. The neural substrates mediating/regulating emotion can be summarized into two main systems: the ventral system (encompassing the amygdala, insula, ventral striatum, and ventral regions of the anterior cingulate gyrus and prefrontal cortex) is responsible for the recognition of the emotional characteristics of stimuli and the consequent generation of affective responses; the dorsal system (comprising the hippocampus and dorsal regions of anterior cingulate gyrus and prefrontal cortex) is implicated in the regulation of emotions (Phillips, Drevets, Rauch & Lane, 2003). Structural and functional imaging studies have provided evidence for impairments in both of these systems in schizophrenia

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

(Phillips & Seidman, 2008) and SPD (Rosell *et al*., 2014). Importantly, psychometrically high-schizotypal individuals also manifest diminished emotional experiences as well as attenuated expression and identification of emotions (Horan *et al*., 2008; Phillips & Seidman, 2008), accompanied by abnormalities in the aforementioned brain circuitries (Phillips & Seidman, 2008).

The aim of this review is to summarize findings on impairments related to well-studied central aspects of emotional processes, such as emotional disposition, alexithymia, facial affect recognition (FER), and speech prosody, in the different facets (i.e., Positive, Negative and Disorganized) of psychometric schizotypy and to compare these with findings in the schizophrenia spectrum. Hence, a PubMed search was carried out with combinations of the search terms "schizophrenia," "schizotypal," "schizotypy," "emotion," "affect," "facial affect recognition," "alexithymia" and "prosody." The search covered publications from 1990 until July 2015. Studies were selected if: (a) they were written in English; (b) schizotypal traits were assessed with self-report questionnaires; and (c) participants were free of any psychiatric diagnosis. A summary of the studies reviewed and their findings are presented in Table 1.

EMOTIONAL DISPOSITION

Emotional disposition (i.e., the tendency to experience a certain type of emotion) in the schizophrenia spectrum has often been evaluated with personality traits integral in schizotypy (e.g., anhedonia) or with other personality characteristics which are closely associated with schizotypy (e.g., harm avoidance). The present review focuses on emotional disposition as assessed with instruments examining directly the experience, expression or identification of emotions.

As regards patients with schizophrenia, they have been repeatedly reported to score higher than healthy controls in measures of Negative Affect (NA) along with lower scores in Positive Affect (PA) (Blanchard, Mueser & Bellack, 1998; Horan & Blanchard, 2003; Kiwanuka, Strauss, McMahon & Gold, 2014; Li, Lui, Geng *et al*., 2015; Myin-Germeys, Delespaul & deVries, 2000; Sanchez, Lavaysse, Starr & Gard, 2014; Strauss, Wilbur, Warren, August & Gold, 2011; Tso, Grove & Taylor, 2014). Importantly, these features remain stable over time (Blanchard *et al*., 1998), they are evident from the first episode (Li *et al*., 2015; Mote, Minzenberg, Carter & Kring, 2014), they interfere with patients' daily living (Abram, Karpouzian, Reilly, Derntl, Habel & Smith, 2014; Tabak, Green. Wynn, Proudfit, Altshuler & Horan, 2015) and are also observed in their unaffected relatives (Docherty, Sponheim & Kerns, 2015).

The majority of studies assessing emotional disposition in psychometric schizotypy have three major common attributes: (a) the Chapman Scales (Chapman *et al*., 1976, 1978) are used for the assessment of schizotypy; (b) a "group-wise" comparison approach is employed, whereby participants scoring above certain cut-off criteria are considered "schizotypal" and are compared with subjects who do not meet this criterion; and (c) these groups are formed based on scores in the Social Anhedonia (SocAnh) scale. Thus, high SocAnh groups have been found to present with, increased NA along with decreased PA scores (Blanchard, Collins, Aghevli, Leung & Cohen, 2011; Gooding, Davidson, Putnam & Talent, 2002; Gooding, Johnson & Peterman, 2010; Gooding & Tallent, 2003; Leung, Couture, Blanchard, Lin & Llerena, 2010), higher frequencies of NA and lower intensities of PA (Kerns, Docherty & Martin, 2008) and lower emotional expressivity (Leung *et al*., 2010); they also ignore more and focus less on positive feelings while at the same time they focus more on negative feelings (Martin, Becker, Cicero, Docherty & Kerns, 2011) and they experience less anticipatory and consummatory pleasure (Martin *et al*., 2011).

Reduced anticipatory and consummatory pleasure have also been associated with other facets of schizotypy, as in a study using the SPQ (Raine, 1991), Shi, Wang, Cao *et al*. (2012) reported that highly Negative schizotypal individuals score lower in these measures. Berenbaum, Boden, Baker, Dizen, Thompson and Abramowitz (2006) also used the SPQ and found negative associations between Positive, Negative and Disorganized schizotypy with emotional clarity while attention to emotions correlated negatively only with Positive and Negative schizotypy; positive correlations between NA and all SPQ factor scores as well as between affect intensity and Positive and Disorganized schizotypy were also found in this study. Kwapil, Brown, Silvia, Myin-Germeys and Barrantes-Vidal (2012) also differentiated between Positive and Negative schizotypy using the Wisconsin Schizotypy Scales and found that increased Positive Schizotypy was associated with increased NA while increased Negative schizotypy was associated with reduced PA in everyday life experiences. Kerns and Becker (2008) focused on disorganized schizotypy and found that individuals scoring high in this dimension also score high in ambivalence, which is associated with difficulties in identifying feelings and emotional confusion.

Finally, Kerns (2005) reported that high scorers in Positive schizotypy (i.e., high scorers in either Magic Ideation or Perceptual Aberration) score higher than controls in NA and in the attention paid to emotions experienced but they score lower in clarity of emotions. In a study employing confirmatory factor analyses, Kerns (2006) administered the Chapman Scales and a range of trait affectivity scales. The schizotypy subscales were organized into three factors, namely Positive, Negative and Disorganized schizotypy, while the metrics of the affectivity scales were organized into two factors, namely Emotionality (consisting of attention paid to emotions experienced, intensity of emotions and influence of emotion on judgment and behaviour) and Emotional Confusion (consisting of ambivalence and clarity of emotions). He found positive associations between Disorganized and Negative schizotypy with emotional confusion, while increased Disorganized schizotypy was also associated with increased emotionality; the opposite pattern was found for Negative schizotypy (i.e., increased Negative schizotypy was associated with decreased emotionality).

ALEXITHYMIA

Alexithymia was first described by Nemiah and Sifneos (1970) and refers to difficulties in recognizing, identifying, and describing one's own emotions. Volumetric (Borsci, Boccardi, Rossi *et al*., 2009; Grabe, Wittfeld, Hegenscheid *et al*., 2014; Gündel, López-Sala, Ceballos-Baumann *et al*., 2004; Ihme, Dannlowski, Lichev *et al*., 2013; Liemburg, Swart, Bruggeman *et al*., 2012; Paradiso, Vaidya, McCormick, Jones & Robinson,

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Table 1. *Studies assessing emotional disposition, alexithymia, facial affect recognition and speech prosody in psychometric schizotypy*

Study	Participants N (males/females); mean age (years) ± SD	Design	Assessment of schizotypy	Assessment of emotion			
				Task/scale	Stimuli	Outcome measures	Results
Emotional disposition							
Gooding *et al.* (2002)	SocAnh: N = 36 (17/19); 18.97 ± 1.03 Con: N = 39 (20/19); 18.95 ± 0.94	Cross-sectional (Between-group comparisons)	Chapman scales	PANAS	20 emotional (10 positive & 10 negative) words; subjects rated the extent experiencing each emotion	PA/NA subscale scores	PA: SocAnh < Con ($P < 0.01$) NA: SocAnh > Con ($P < 0.01$)
Gooding & Tallent (2003)	SocAnh: N = 43 (18/25); 18.72 ± 1.03 Con: N = 39 (11/28); 18.69 ± 0.69)	Cross-sectional (Between-group comparisons)	Chapman scales	PANAS	As in Gooding *et al.* (2002)	PA/NA subscale scores	PA: SocAnh < Con ($P < 0.01$) NA: SocAnh > Con ($P < 0.01$)
Kerns (2005)	PoS: N = 34 (14/20); 18.70 ± 1.10 Con: N = 56 (28/28); 18.90 ± 1.30	Cross-sectional (Between-group comparisons)	Chapman scales	AIM	As in Berenbaum *et al.* (2006)	Affect intensity score	PoS = Con ($P > 0.06$)
				TMMS	As in Berenbaum *et al.* (2006)	Emotional clarity subscale score Attention subscale score	Emotional clarity: PoS < Con ($P < 0.001$) Attention: PoS > Con ($P < 0.05$)
				PANAS	As in Gooding *et al.* (2002)	NA subscale score	PoS > Con ($P < 0.01$)
Berenbaum *et al.* (2006)	College students: N = 247 (48.80%/ 51.20); 18.90 ± 1.40 Community group: N = 225 (47.60%/52.40); 43.90 ± 17.10	Cross-sectional (Correlational approach)	SPQ	TMMS	48-item scales assessing trait meta-mood	Emotional clarity subscale score (10 items assessing the degree individuals understand/identify their feelings) Attention subscale score (14 items assessing the amount of awareness/thought individuals allocate to their emotions)	Emotional clarity: negative correlations with PoS, NeS and DiS in the college group (Ps < 0.01) Attention: negative correlations with PoS and NeS in both groups (Ps < 0.01)
				PANAS	As in Gooding *et al.* (2002)	PA/NA subscale scores	NA: Positive correlations with all factor scores in the college sample; positive correlations with PoS and NeS in the community sample (Ps < 0.01)
				AIM	40-item questionnaire measuring trait levels of affect intensity	Affect intensity score	Positive correlations with PoS and DiS in the college sample (Ps < 0.01)

(continued)

Table 1 (continued)

Study	Participants N (males/females); mean age (years) ± SD	Design	Assessment of schizotypy	Assessment of emotion			Results
				Task/scale	Stimuli	Outcome measures	
Kerns (2006)	College students: N = 261 (42% /58%); 18.70 ± 1.20	Cross-sectional (Correlational approach)	Chapman scales	TMMS	As in Berenbaum *et al*. (2006)	Emotional clarity subscale score Attention subscale score	Emotional clarity: Positive correlation with DiS ($P < 0.05$) Attention: Negative correlation with NeS ($P < 0.05$)
				SAS	19- item scale measuring emotional confusion	Total score	Positive correlations with DiS and NeS (Ps < 0.05)
				AIM	As in Berenbaum *et al*. (2006)	Affect intensity	Negative correlation with NeS ($P < 0.05$)
				PMPI	10-item scale measuring influence of emotion on thinking and behavior under stress	Emotional processing subscale score	Positive correlation with DiS ($P < 0.05$)
Kerns & Becker (2008)	DiS: N = 32 (14/18); 18.50 ± 1.10 Con: N = 34 (15/19); 18.80 ± 1.30	Cross-sectional (Between-group comparisons)	Cognitive Slippage scale	SAS	As in Kerns (2006)	Total score	DiS > Con ($P < 0.01$)
Kerns *et al*. (2008)	SocAnh: N = 41 (14/27); 18.70 ± 1.20 PerMag: N = 30 (13/17); 18.60 ± 1.20 Con: N = 30 (10/20); 18.60 ± 1.20	Cross-sectional (Between-group comparisons)	Chapman scales	DRM	Individuals are asked to reconstruct all that happened to them on the previous day and to divide their experiences into discrete episodes. Then, they are asked to rate how they felt during each episode.	Intensity and frequency of affective states scores	Intensity of positive affect: SocAnh < PerMag < Con (Ps < 0.05) Frequency of negative affect: SocAnh = PerMag > Con (Ps < 0.05)
Gooding *et al*. (2010)	SocAnh: N = 64 (42/22); 19.48 ± 2.51 PerMag: N = 76 (48/28); 19.18 ± 2.19 Con: N = 110 (48/62); 19.01 ± 1.40	Cross-sectional (Between-group comparisons)	Chapman scales	PANAS	As in Gooding, Davidson, Putnam & Tallent (2002)	PA/NA subscale scores	PA: SocAnh < Con and PerMag > Con (Ps < 0.05) NA: SocAnh & PerMag > Con (Ps < 0.01)
Leung *et al*. (2010)	SocAnh: N = 34 (all females); 18.24 ± 0.61 Con: N = 45 (all females); 18.11 ± 0.32)	Cross-sectional (Between-group comparisons)	RSAS	GTS	90-item scale assessing trait affectivity	Trait PA/NA	PA: SocAnh < Con ($P < 0.05$) NA: SocAnh = Con ($P > 0.05$)

(continued)

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Table 1 (continued)

Study	Participants N (males/females); mean age (years) ± SD	Design	Assessment of schizotypy	Assessment of emotion			
				Task/scale	Stimuli	Outcome measures	Results
				EES	17-item that is a general index for outward expressivity	Positive/Negative expressivity	SocAnh < Con (P < 0.01)
				BEQ	16-item questionnaire assessing the general strength of emotion-response tendencies and the degree these tendencies are typically expressed as overt behaviour.	Positive/Negative Expressivity, Impulse Strength subscale scores	SocAnh < Con (Ps < 0.05)
Blanchard *et al.* (2011)	SocAnh: N = 86 (43%/57%); 18.00 Con: N = 89 (46.10% /53.90%); 18.00	Cross-sectional (Between-group comparisons)	SocAnh Scale	GTS	As in Leung, Couture, Blanchard, Lin & Llerena (2010)	Trait PA/NA	PA: SocAnh < Con (P < 0.001) NA: SocAnh > Con (P < 0.001)
Martin *et al.* (2011)	SocAnh: N = 54 (19/34); 18.75 ± 1.65 PerMag: N = 27 (11/16); 18.40 ± 0.58) Con: N = 304 (124/180); 18.70 ± 1.02	Cross-sectional (Between-group comparisons)	RSAS PerAb MagicId	FAST	16-item scale assessing attention to positive and negative emotions	Focus/Ignore Positive/ Negative Feelings scores	Focus on positive feelings: SocAnh < Con (P < 0.001) Ignore positive feelings: SocAnh > Con (P < 0.01) Focus on negative feelings: SocAnh & PerMag > Con (Ps < 0.001) Ignore negative feelings: PerMag > Con (P < 0.05)
				TEPS	18-item scale measuring anticipatory and consummatory pleasure	Anticipatory/ Consummatory pleasure scores	Anticipatory pleasure: SocAnh < Con (P < 0.05) Consummatory pleasure: SocAnh < PerMag & Con (Ps < 0.05)
Kwapil *et al.* (2012)	N = 412 (102 /310); 19.90 ± 2.90	Cross-sectional (Regression approach)	Wisconsin Schizotypy scales	ESMQ	A within-day self assessment technique in which participants are prompted at random intervals to complete brief questionnaires	PA/NA subscale scores	PoS was associated with increased reports of NA (P < 0.001) NeS was associated with decreased reports of PA (P < 0.001)
Shi *et al.* (2012)	NeS: N = 55 (35/20); 18.39 ± 0.85 PoS: N = 62 (32/30); 18.48 ± 0.82 Con: N = 116 (75 /41); 18.56 ± 0.79	Cross-sectional (Between-group comparisons)	SPQ	TEPS	As in Martin *et al.* (2011)	Anticipatory/ Consummatory pleasure scores	Anticipatory pleasure: NeS < Con and PoS > NeS & Con (Ps < 0.05) Consummatory pleasure: PoS > NeS & Con (Ps < 0.001)

(continued)

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Table 1 (continued)

Study	Participants N (males/females); mean age (years) ± SD	Design	Assessment of schizotypy	Assessment of emotion			Results
				Task/scale	Stimuli	Outcome measures	
				EES	As in Leung *et al.* (2010)	Suppression/ Expression of emotions Total score	Suppression of emotions: NeS < PoS < Con (Ps < 0.001) Expression of emotions: PoS > Con; NeS < Con (Ps < 0.05) Total score: NeS < Con & PoS (Ps < 0.001)
Alexithymia							
Prince & Berenbaum (1993)	Undergraduate students: N = 119 (66/53); 119.00 ± 1.10 Community sample: N = 54 (27/27); 33.70 ± 0.30	Cross-sectional (Correlational approach)	RSAS PhysAnh SocAnh	TAS-20	20-item scale assessing alexithymia	Difficulties in identifying/ Communicating Feelings	Identifying feelings: Positive correlation with SocAnh (P < 0.05) in the community sample Communicating feelings: Positive correlations with PhysAnh and SocAnh in both samples (Ps < 0.05)
Gooding & Tallent (2003)	SocAnh: N = 43 (18/25); 18.72 ± 1.03 Con: N = 39 (11/28); 18.69 ± 0.69	Cross-sectional (Between-group comparisons)	Chapman Scales	TAS-20	As in Prince & Berenbaum (1993)	Total score	SocAnh group > Con (P < 0.001)
van 't Wout *et al.* (2004)	High SCT: N = 20 (male/female ratio: 1/4); 21.65 ± 2.43) Low SCT: N = 20 (male/female ratio: 1/1.5); 22.75 ± 3.73)	Cross-sectional (Between-group comparisons)	LSHS SPQ	BVAQ	40-item scale assessing alexithymia	Emotionalizing/ Analyzing/ Verbalizing/ Fantasizing/ Identifying feelings subscale scores	Fantasizing and Emotionalizing: High SCT group < Low SCT group (Ps < 0.05)
Larøi *et al.* (2008)	N = 107 (46% /54%); 22.20 ± 2.40	Cross-sectional (Correlational approach)	SPQ	BVAQ	As in van 't Wout *et al.* (2004)	Emotionalizing/ Analyzing/ Verbalizing/ Fantasizing/ Identifying feelings subscale scores	Fantasizing, Emotionalizing & Analyzing feelings: negative correlations with PoS & DiS (Ps < 0.05) Identifying feelings: positive correlation with NeS (P < 0.01)
Rus-Calafell *et al.* (2013)	N = 98 (34.30% /65.70%); 32.58 ± 9.23	Cross-sectional (Correlational approach)	O-LIFE	TAS-20	As in Prince & Berenbaum (1993)	Total score	Positive correlation with O-LIFE total score (P < 0.01)
Facial Affect Recognition							
Poreh *et al.* (1994)	SCT group: N = 20 (all males); 22.00 ± 0.90) Con: N = 20 (all males); 22.70 ± 1.10)	Cross-sectional (between-group comparisons)	Chapman scales	Facial Affect Recognition	Photographs depicting angry, happy, or surprised faces were presented. Subjects	Errors	SCT group > Con (Ps < 0.005)

(continued)

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Table 1 (continued)

Study	Participants N (males/females); mean age (years) ± SD	Design	Assessment of schizotypy	Assessment of emotion			Results
				Task/scale	Stimuli	Outcome measures	
					were asked to report which affect they detected from a display board containing the stimuli after each presentation		
van 't Wout *et al.* (2004)	N = 200 (79 males/120 females); 20.90 ± 4.50 High SCT: N = 20 (male/female ratio: 1/4); 21.65 ± 2.43) Low SCT: N = 20 (male/female ratio: 1/1.5); 22.75 ± 3.73)	Cross-sectional (Between-group comparisons & Correlational approach)	LSHS SPQ	Degraded facial affect recognition task	64 trials consisting of face photographs with reduced visual contrast by 30% in each of four conditions (angry, happy, fearful, neutral) were presented. Subjects were asked to indicate the expression of each face as accurately as possible.	Errors	High SCT = Low SCT ($P > 0.05$) Positive correlation with PoS in classifying angry faces as happy ($P < 0.001$)
Williams *et al.* (2007)	High SCT: N = 28 (9/19); 18.80 ± 3.01 Low SCT: N = 28 (5/23); 19.60 ± 3.50)	Cross-sectional (Between-group comparisons)	SPQ-B	Ekman 60 Faces Test	60 items were presented in random order and participants were required to choose a label that best described the emotion of each face.	Correct responses	High SCT > Low SCT ($P < 0.05$)
Brown & Cohen (2010)	SCT group: N = 89 (30.30% / 69.70%); 19.19 ± 1.39 Con: N = 27 (48.10% / 51.90%); 19.81 ± 3.25	Cross-sectional (Between-group comparisons)	SPQ	PERT	Items included high and low intensity angry, fearful, happy, sad, and neutral faces. Participants were asked to choose which emotion is being expressed from a list of six choices (happy, sad, disgust, fear, anger, no emotion).	Accuracy	SCT group < Con group in identifying neutral faces ($P < 0.01$)

(continued)

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Table 1 (continued)

Study	Participants N (males/females); mean age (years) ± SD	Design	Assessment of schizotypy	Assessment of emotion			Results
				Task/scale	Stimuli	Outcome measures	
Germine & Hooker (2011)	Experiment 1: N = 2332 (32% /68%); 29.10 ± 11.50 Experiment 2: N = 1514 (38% /62%); 29.30 ± 10.60	Cross-sectional (Regressions approach)	SPQ-B	Experiment 1: Emotion identification Experiment 2: Emotion discrimination	Experiment 1: Stimuli were faces morphed between a neutral and an emotional expression (happy, disgusted, angry, fearful). Participants were required to identify the emotion expressed. Experiment 2: Face pairs were presented sequentially. Participants were required to indicate whether the two faces were expressing the same or different emotion.	Accuracy	Experiment 1: PoS, NeS and DiS predicted identification of happy, angry and fearful faces (Ps < 0.05) Experiment 2: PoS, NeS and DiS predicted correct emotion discrimination (Ps < 0.05)
Abbott & Green (2013)	N = 50 (23/27); 21.76 ± 5.41	Cross-sectional (Correlational approach)	SPQ	Emotion recognition	Colour photographs of face stimuli were presented. Participants were required to select the word most suited (out of seven emotion labels, i.e. happy, sad, anger, fear, disgust, surprise, neutral) to describe the emotion on each face.	Accuracy	Negative correlation with NeS (P < 0.005)
Speech Prosody							
Cohen *et al*. (2009)	SCT group: N = 89 (28/61); 19.11 ± 1.38 Con: N = 26 (12 /14); 19.81 ± 3.31	Cross-sectional (between-group comparisons)	SPQ	CANS	Subjects were asked to discuss their reactions to emotionally valenced pictures (positive, negative and neutral) from the International Affective Picture System	Expressivity score	Schizotypal group = Control group (Ps > 0.05)

(continued)

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Table 1 (continued)

Study	Participants N (males/females); mean age (years) ± SD	Design	Assessment of schizotypy	Assessment of emotion			Results
				Task/scale	Stimuli	Outcome measures	
Cohen & Hong (2011)	SCT group: N = 89 (14/75); 19.19 ± 1.39) Con: N = 26 (12/14); 19.23 ± 1.18)	Cross-sectional (Between group comparisons and correlational approach)	SPQ	CANS	As in Cohen *et al.* (2009)	Fundamental frequency (the lowest harmonic tone in semitones) Inflection (the variability in fundamental frequency) Intensity (the volume in decibels expressed during voiced frames) Total prosody score	No between-group differences ($P > 0.640$) Constricted affect correlated negatively with Fundamental frequency, Inflection and Total prosody scores ($Ps < 0.05$)
Castro & Pearson (2011)	High SCT: N = 64 Low SCT: N = 68	Cross-sectional (Between group comparisons)	SPQ	Dichotic listening stimuli	The words "dower", "tower", "power" and "bower" pronounced in four different emotional tones (happy, sad, angry, neutral).	Sensitivity in detecting prosody	Low SCT > High SCT ($P < 0.005$)
Bedwell *et al.* (2014)	N = 44 (22/22);: 20.00 ± 4.83	Cross-sectional (regressions approach)	SPQ	Autobiographical narratives	Speech samples were obtained from autobiographical narrative prompts.	Intonation (variability in the pitch of speech) Variability in volume of speech (lower values represent more monotonous speech)	Increased ideas of reference predicted lower variability in volume of speech ($P < 0.05$)

Notes: Con: Control group; PerMag: Perceptual Aberration-Magical Thinking group; SocAnh: Social Anhedonia group; SCT: Schizotypy; AIM: Affect Intensity Measure; BEQ: Berkeley Expressivity Questionnaire; BVAQ: Bermond-Vorst Alexithymia Questionnaire; CANS: Computerized Assessment of affect from Natural Speech; DiS: Disorganized schizotypy; DRM: Day reconstruction method; EES: Emotional Expressivity Scale; ESMQ: Experience Sampling Methodology Questionnaire; FAST: Following Affective States Test; GTS: General Temperament Survey; LSHS: Launey–Slade Hallucination Scale; MagicId: Magical Ideation Scale; NA: Negative Affect; NeS: Negative Schizotypy; O-LIFE: Oxford-Liverpool Inventory of Feelings and Experiences; PA: Positive Affect; PANAS: Positive and Negative Affect Schedule; PerAb: Perceptual Aberration Scale; PERT: Penn Emotion Recognition Test; PhysAnh: Physical Anhedonia Scale; PMPI: Perceived Modes of Processing Inventory; PoS: Positive schizotypy; RSAS: Revised Social Anhedonia Scale; SAS: Schizotypal Ambivalence Scale; SCT: Schizotypy; SPQ: Schizotypal Personality Questionnaire; SPQ-B: Schizotypal Personality Questionnaire Brief; TAS-20: Toronto Alexithymia Scale; TEPS: Temporal Experience of Pleasure Scale; TMMS: Trait Meta-Mood Scale.

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

2008) and functional (Berthoz, Artiges, Van De Moortele *et al*., 2002; Jongen, Axmacher, Kremers *et al*., 2014; Karlsson, Näätänen & Stenman, 2008; Reker, Ohrmann, Rauch *et al*., 2010) imaging studies have implicated a disturbed frontotemporal network in alexithymic individuals, encompassing regions also found to dysfunction in schizophrenia (Fahim, Stip, Mancini-Marïe *et al*., 2005; Habel, Klein, Shah *et al*., 2004; Meisenzahl, Koutsouleris, Bottlender *et al*., 2008; Suzuki, Zhou, Takahashi *et al*., 2005; Yamasue, Iwanami, Hirayasu *et al*., 2004), SPD (Goldstein, Hazlett, New *et al*., 2009; Hazlett, Buchsbaum, Haznedar *et al*., 2008; Kawasaki, Suzuki, Nohara *et al*., 2004; Koo, Dickey, Park *et al*., 2006; Suzuki *et al*., 2005; Zhang, Shen, Wu *et al*., 2014) and psychometric schizotypy (DeRosse, Nitzburg, Ikuta, Peters, Malhotra & Szeszko, 2015). However, despite the solid evidence of increased alexithymic traits in schizophrenia patients (Cedro, Kokoszka, Popiel & Narkiewicz-Jodko, 2001; Kubota, Miyata, Sasamoto *et al*., 2012; Kubota, Miyata, Hirao *et al*., 2011; van 't Wout, Aleman, Bermond & Kahn, 2007), their siblings (van 't Wout *et al*., 2007), individuals at clinical high-risk for psychosis (van Rijn, Schothorst, Wout *et al*., 2011) and SPD patients (Dickey, Vu, Voglmaier *et al*., 2012), the relationship between psychometric schizotypy and alexithymia is largely unexplored.

Two scales, the Toronto Alexithymia Scale (TAS-20; Bagby, Parker & Taylor, 1994) and the Bermond-Vorst Alexithymia Questionnaire (BVAQ; Vorst & Bermond, 2001), are the most common instruments for the assessment of alexithymia. Using the TAS-20, Gooding and Tallent (2003) found that individuals scoring high in Social Anhedonia also score higher than controls in the scale. Rus-Calafell, Gutiérrez-Maldonado and Frerich (2013) employed a correlational approach and found positive associations between O-LIFE and TAS-20 score. Prince and Berenbaum (1993) employed a more detailed approach in the TAS-20 scores and reported positive associations between Social Anhedonia and problems in the identification and communication of feelings; increased physical anhedonia also correlated with diminished ability to communicate feelings. Using the BVAQ, van 't Wout, Aleman, Kessels, Larøi and Kahn (2004) found that high scorers in a positive schizotypy scale had lower scores in the capacity to be aroused by emotionally charged events as well as positive correlations between all metrics of the SPQ and difficulties in the identification of emotions. Using the SPQ, Larøi, Van der Linden and Aleman (2008) replicated the aforementioned negative association between the ability to be aroused by events inducing emotions and Positive schizotypy; they also found that this holds true for Disorganized schizotypy as well.

FACIAL EMOTION RECOGNITION

Impaired emotion recognition in schizophrenia was reported quite early and several studies have indicated that this impairment is evident during all phases of the illness (Addington & Addington, 1998; Addington, Penn, Woods, Addington & Perkins, 2008; Kucharska-Pietura, David, Masiak & Phillips, 2005; Lee, Bang, Kim *et al*., 2015; Pinkham, Penn, Perkins, Graham & Siegel, 2007; Wölwer, Streit, Polzer & Gaebel, 1996; Yalcin-Siedentopf, Hoertnagl, Biedermann *et al*., 2014), that it is stable over time (Addington, Saeedi & Addington, 2006; Comparelli, Corigliano, De Carolis *et al*., 2013; Hamm, Renard, Fogley *et al*., 2012), that it is heritable (Gur, Nimgaonkar, Almasy *et al*., 2007) and that it is also evident in individuals at risk for the disorder (Addington *et al*., 2008; Bediou, Asri, Brunelin *et al*., 2007; Corcoran, Keilp, Kayser *et al*., 2015; Kee, Horna, Mintz & Green, 2004) as well as in SPD patients (Dickey, Panych, Voglmaier *et al*., 2011; Waldeck & Miller, 2000). Studies assessing Facial Emotion Recognition (FER) in schizophrenia outnumber those assessing emotion recognition with other paradigms, possibly because FER is closely associated to social cognition (Lee, Koo, Song *et al*., 2014), a key-aspect of the schizophrenic pathology (Green, Olivier, Crawley, Penn & Silverstein, 2005). FER is mediated by a distributed neural network encompassing the orbitofrontal cortex, amygdala, inferior frontal gyri, lateral fusiform gurus and superior temporal sulcus (Adolphs, 2002; Bortolon, Capdevielle & Raffard, 2015). Studies in schizophrenia (Aleman & Kahn, 2005; Habel *et al*., 2010; Mier, Lis, Zygrodnik *et al*., 2014) have identified abnormalities in these brain regions during FER. Interestingly, abnormalities in the activation patterns of these brain regions during FER paradigms have also been reported in psychometric schizotypy (Germine, Garrido, Bruce & Hooker, 2011; Huang, Wang, Jin *et al*., 2013).

Studies in psychometric schizotypy, therefore, have revealed that impaired FER is associated with Positive, Negative as well as Disorganized schizotypal factors (Abbott & Green, 2013; Germine & Hooker, 2011). Group-wise comparisons have also confirmed that controls perform better than high schizotypal individuals both in the identification and discrimination of emotions (Germine & Hooker, 2011; Poreh, Whitman, Weber & Ross, 1994). However, Williams, Henry & Green (2007) used the Ekman Faces test (Young, Perrett, Cabler, Sprengelmeyer & Ekman (2002) to examine FER and reported significant differences only in the identification of positive emotions (controls outperformed the schizotypal group). Although the lack of significant group differences in the other emotional expressions might seem surprising, schizophrenia patients have also been found to present with reduced sensitivity in the recognition of positive emotions when examined with this paradigm (Tsoi *et al*., 2008); we could, therefore, speculate that this findings is at least in part attributed to the properties of the task. Additionally, Brown and Cohen (2010) found that the control group outperformed the schizotypal group in the identification of neutral emotions, as the schizotypals tended to misinterpret neutral facial expressions as expressing an emotion (i.e., disgust). This finding is also consistent with findings in schizophrenia patients (Kohler, Turner, Bilker *et al*., 2003; van 't Wout *et al*., 2007) and is attributed either to the *ambiguity* of neutral compared to emotional expressions or to *a type of cognitive or perceptual bias* in this group (for a detailed discussion see Brown & Cohen, 2010). Finally, van 't Wout *et al*. (2004) reported non-significant differences between schizotypals and controls. However, (a) a degraded FER task was used in this study possibly leading to floor effects in the performance of both groups and (b) a positive schizotypy scale, the Launey–Slade Hallucination Scale (LSHS; Vollema & van den Bosch, 1995), specific for hallucinatory

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

experiences was used for the categorization of subjects into groups; it is therefore possible that the lack of significant findings in this study is also due to the specificity of the scale, which leaves out other aspects of schizotypy.

SPEECH PROSODY

Prosody refers to paralinguistic aspects of utterances and includes pitch, pitch variability, intensity, stress, and duration (Dickey, Morocz, Minney *et al*. 2010). As Dickey *et al*. (2012, p. 20) noted, "Prosody is the vocal expression of one's internal emotional state or intent." Prosodic impairments (both in the expression and recognition of prosody) have been described throughout the course of schizophrenia, starting at the first episode (Allott, Rice, Bartholomeusz *et al*., 2015; Amminger, Schäfer, Klier *et al*., 2012a; Amminger, Schäfer, Papageorgiou *et al*., 2012b) and continuing into the chronic (Bozikas, Kosmidis, Anezoulaki, Giannakou, Andreou & Karavatos, 2006; Hoekert, Kahn, Pijnenborg & Aleman, 2007) phases of the illness. They are also evident in populations at clinical or genetic risk for the disorder (Allott *et al*., 2015; Amminger *et al*., 2012b) as well as in SPD patients (Dickey *et al*., 2012). The neural substrate of prosody includes areas such as the superior and middle temporal gyri, superior temporal sulcus, dorsolateral prefrontal and orbitofrontal cortices and the amygdala (Brück, Kreifelts & Wildgruber, 2011).

Studies in psychometric schizotypy have revealed that high schizotypal individuals perform worse than controls in the detection of prosody (Castro & Pearson, 2011) and that variability of intensity in one's own speech is negatively associated with ideas of reference, a component of paranoid schizotypy (Bedwell, Cohen, Trachik, Deptula & Mitchell, 2014). However, two other studies (Cohen & Hong, 2011; Cohen, Iglesias & Minor, 2009) failed to find significant between-group differences, although in the study by Cohen and Hong (2011) increased negative schizotypy tended to correlate with reduced prosody. Both studies, however, suffer from methodological limitations (e.g., sampling restrictions, lack of statistical corrections) that might have biased the findings.

SUMMARY AND CONCLUSIONS

Untangling the associations between schizotypal traits and emotional processes in psychometric schizotypy is an evolving field as it can significantly aid our understanding of central schizophrenia-related processes and is not affected by confounding factors intrinsic in the study of patient populations (Gruzelier, 2003). As detailed above, current findings indicate that high schizotypal individuals in the general population present with impaired emotional disposition, FER, prosodic expression and identification and increased alexithymia, in accordance to findings in the schizophrenia spectrum.

As regards emotional disposition, the majority of studies so far have examined schizotypy with the Chapman Scales and have associated mainly Social Anhedonia with impaired trait affectivity (e.g., experiencing more negative and at the same time reduced positive emotions). There are currently no studies reporting any associations or effects of other schizotypal facets (e.g., Physical anhedonia) on emotional processing in schizotypy. Also, there are only a couple of group-wise comparison studies (Kerns, 2005, 2006) in which high schizotypal individuals were compared with controls but the schizotypal groups were formed based on their scores on more than one facets (e.g., increased Magical Ideation and Perceptual Aberrations). Studies examining associations between schizotypy as measured with the SPQ and emotional disposition are numerically fewer and suggest an overlap in the associations between the different schizotypal factors and trait affectivity (e.g., experiencing more negative emotions is associated with Positive, Negative and Disorganized schizotypy). On the other hand, studies examining FER and speech prosody have employed mainly the SPQ. In the majority of studies, however, high schizotypal individuals were defined according to either increased total score (Brown & Cohen, 2010; Castro & Pearson, 2011; Germine & Hooker, 2011; Williams *et al*., 2007) or increased score in any schizotypal factor (Cohen & Hong, 2011; Cohen *et al*., 2009; Germine & Hooker, 2011), so that, as with emotional disposition, no distinctions between the different schizotypal factors can be made. As for alexithymia, a variety of schizotypy scales have been used and again almost all aspects of schizotypy have been associated with increased alexithymic traits.

On the basis of the above findings, we could speculate that impaired emotional disposition, FER and prosody along with elevated alexithymia are "central" features of psychometric schizotypy and that is the reason they are evident in all schizotypal facets/dimensions. As regards FER, prosody and alexithymia, this is further supported by their common mediation/regulation by a frontotemporal neural network (Adolphs, 2002; Brück *et al*., 2011; Lieburg *et al*., 2012), which has also been implicated in schizophrenia (Bortolon *et al*., 2015; Yamasue *et al*., 2004*)* and psychometric schizotypy (DeRosse *et al*., 2015; Huang *et al*., 2013).

It is a fact that the studies on psychometric schizotypy and emotion processing are not numerous, they are cross-sectional, the samples in the majority of studies are small (e.g., average 100 participants/study, often divided into two or three groups) and a three-factor model dividing schizotypy into Positive, Negative and Disorganized has so far prevailed. It has been shown, however, that a four-factor model (whereby schizotypy is analysed into Paranoid, Cognitive-Perceptual, Negative and Disorganized factors) provides the best fit (Barron, Swami, Towell, Hutchinson & Morgan, 2015; Compton, Goulding, Bakeman & McClure-Tone, 2009; Fonseca-Pedrero, Compton, Tone *et al*., 2014; Stefanis, Smyrnis, Avramopoulos, Evdokimidis, Ntzoufras & Stefanis, 2004; Stefanis, Vitoratou, Ntzoufras, Smyrnis, Evdokimidis & Stefanis 2006; Tsaousis, Zouraraki, Karamaouna, Karagiannopoulou & Giakoumaki, 2015). Future studies examining the associations of schizotypal dimensions, as defined with the four-factor model, and emotion processing could help clarify the topic further. Genetic studies have also revealed a number of polymorphisms implicated in schizotypy (Roussos *et al*., 2009, 2011, 2013; Stefanis, Trikalinos, Avramopoulos *et al*., 2008; Yasuda, Hashimoto, Ohi *et al*., 2001); however, thus far the effects of these polymorphisms on emotional processing in psychometrically schizotypal individuals have not been studied.

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Finally, longitudinal studies should examine the course of emotional impairments in schizotypy in combination with other factors (e.g., genetic or epigenetic effects, other personality traits, life experiences); this could add in a more holistic approach used to identify individuals who are at increased-risk for converting into psychosis.

REFERENCES

Abbott, G. R. & Green, M. J. (2013). Facial affect recognition and schizotypal personality characteristics. *Early Intervention in Psychiatry*, *7*, 58–63.

Abram, S. V., Karpouzian, T. M., Reilly, J. L., Derntl, B., Habel, U. & Smith, M. J. (2014). Accurate perception of negative emotions predicts functional capacity in schizophrenia. *Psychiatry Research*, *216*, 6–11.

Addington, J. & Addington, D. (1998). Facial affect recognition and information processing in schizophrenia and bipolar disorder. *Schizophrenia Research*, *32*, 171–181.

Addington, J., Penn, D., Woods, S. W., Addington, D. & Perkins, D. O. (2008). Facial affect recognition in individuals at clinical high risk for psychosis. *British Journal of Psychiatry*, *192*, 67–68.

Addington, J., Saeedi, H. & Addington, D. (2006). Facial affect recognition: a mediator between cognitive and social functioning in psychosis? *Schizophrenia Research*, *85*, 142–150.

Adolphs, R. (2002). Neural systems for recognizing emotion. *Current Opinion in Neurobiology*, *12*, 169–177.

Aleman, A. & Kahn, R. (2005). Strange feelings: do amygdale abnormalities dysregulate the emotional brain in schizophrenia? *Progress in Neurobiology*, *77*, 283–298.

Allott, K. A., Rice, S., Bartholomeusz, C. F., Klier, C., Schlögelhofer, M., Schäfer, M. R. & Amminger, G. P. (2015). Emotion recognition in unaffected first-degree relatives of individuals with first-episode schizophrenia. *Schizophrenia Research*, *161*, 322–328.

Amminger, G. P., Schäfer, M. R., Klier, C. M., Schlögelhofer, M., Mossaheb, N., Thompson, A. *et al.* (2012a). Facial and vocal affect perception in people at ultra-high risk of psychosis, first-episode schizophrenia and healthy controls. *Early Intervention in Psychiatry*, *6*, 450–454.

Amminger, G. P., Schäfer, M. R., Papageorgiou, K., Klier, C. M., Schlögelhofer, M., Mossaheb, N. *et al.* (2012b). Emotion recognition in individuals at clinical high-risk for schizophrenia. *Schizophrenia Bulletin*, *38*, 1030–1039.

Arndt, S., Alliger, R. A. & Andreasen, N. C. (1991). The distinction of positive and negative symptoms: The failure of a two-dimensional model. *British Journal of Psychiatry*, *158*, 317–322.

Bagby, R. M., Parker, J. D. A. & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale: I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research*, *38*, 23–32.

Barron, D., Swami, V., Towell, T., Hutchinson, G. & Morgan, K. D. (2015). Examination of the factor structure of the Schizotypal Personality Questionnaire among British and Trinidadian adults. *BioMed Reseach International*, *2015*, 258–275.

Beauchaine, T. P., Lenzenweger, M. F. & Waller, N. G. (2008). Schizotypy, taxometrics, and disconfirming theories in soft science: comment on Rawlings, Williams, Haslam, and Claridge. *Personality and Individual Differences*, *44*, 1652–1662.

Bediou, B., Asri, F., Brunelin, J., Krolak-Salmon, P., D'Amato, T., Saoud, M. & Tazi, I. (2007). Emotion recognition and genetic vulnerability to schizophrenia. *British Journal of Psychiatry*, *191*, 126–130.

Bedwell, J. S., Cohen, A. S., Trachik, B. J., Deptula, A. E. & Mitchell, J. C. (2014). Speech prosody abnormalities and specific dimensional schizotypy features: are relationships limited to male participants? *Journal of Nervous and Mental Disease*, *202*, 745–751.

Berenbaum, H., Boden, M. T., Baker, J. P., Dizen, M., Thompson, R. J. & Abramowitz, A. (2006). Emotional correlates of the different dimensions of schizotypal personality disorder. *Journal of Abnormal Psychology*, *115*, 359–368.

Berthoz, S., Artiges, E., Van De Moortele, P. F., Poline, J. B., Rouquette, S., Consoli, S. M. & Martinot, J. L. (2002). Effect of impaired recognition and expression of emotions on frontocingulate cortices: An fMRI study of men with alexithymia. *American Journal of Psychiatry*, *159*, 961–967.

Blanchard, J. J., Collins, L. M., Aghevli, M., Leung, W. W. & Cohen, A. S. (2011). Social anhedonia and schizotypy in a community sample: The Maryland longitudinal study of schizotypy. *Schizophrenia Bulletin*, *37*, 587–602.

Blanchard, J. J., Mueser, K. T. & Bellack, A. S. (1998). Anhedonia, positive and negative affect, and social functioning in schizophrenia. *Schizophrenia Bulletin*, *24*, 413–424.

Borsci, G., Boccardi, M., Rossi, R., Rossi, G., Perez, J., Bonetti, M. & Frisoni, G. B. (2009). Alexithymia in healthy women: A brain morphology study. *Journal of Affective Disorders*, *114*, 208–215.

Bortolon, C., Capdevielle, D. & Raffard, S. (2015). Face recognition in schizophrenia disorder: A comprehensive review of behavioral, neuroimaging and neurophysiological studies. *Neuroscience and Biobehavioral Reviews*, *53*, 79–107.

Bozikas, V. P., Kosmidis, M. H., Anezoulaki, D., Giannakou, M., Andreou, C. & Karavatos, A. (2006). Impaired perception of affective prosody in schizophrenia. *Journal of Neuropsychiatry and Clinical Neurosciences*, *18*, 81–85.

Brosey, E. & Woodward, N. D. (2015). Schizotypy and clinical symptoms, cognitive function, and quality of life in individuals with a psychotic disorder. *Schizophrenia Research*, *166*, 92–97.

Brown, L. A. & Cohen, A. S. (2010). Facial emotion recognition in schizotypy: The role of accuracy and social cognitive bias. *Journal of the International Neuropsychological Society*, *16*, 474–483.

Brück, C., Kreifelts, B. & Wildgruber, D. (2011). Emotional voices in context: A neurobiological model of multimodal affective information processing. *Physics of Life Reviews*, *8*, 383–403.

Castro, A. & Pearson, R. (2011). Lateralisation of language and emotion in schizotypal personality: Evidence from dichotic listening. *Personality and Individual Differences*, *51*, 726–731.

Cedro, A., Kokoszka, A., Popiel, A. & Narkiewicz-Jodko, W. (2001). Alexithymia in schizophrenia: An exploratory study. *Psychological Reports*, *89*, 95–98.

Chapman, J. P., Chapman, L. J. & Raulin, M. L. (1976). Scales for physical and social anhedonia. *Journal of Abnormal Psychology*, *85*, 374–382.

Chapman, L. J., Chapman, J. P., Kwapil, T. R., Eckblad, M. & Zinser, M. C. (1994). Putatively psychosis-prone subjects 10 years later. *Journal of Abnormal Psychology*, *103*, 171–183.

Chapman, L. J., Chapman, J. P. & Raulin, M. L. (1978). Body-image aberration in schizophrenia. *Journal of Abnormal Psychology*, *87*, 399–407.

Claridge, G. & Broks, P. (1984). Schizotypy and hemisphere function: I. Theoretical considerations and the measurement of schizotypy. *Personality and Individual Differences*, *5*, 633–648.

Cohen, A. S. & Davis, T. E. (2009). Quality of life across the schizotypy spectrum: Findings from a large nonclinical adult sample. *Comprehensive Psychiatry*, *50*, 408–414.

Cohen, A. S. & Hong, S. L. (2011). Understanding constricted affect in schizotypy through computerized prosodic analysis. *Journal of Personality Disorders*, *25*, 478–491.

Cohen, A. S., Iglesias, B. & Minor, K. S. (2009). The neurocognitive underpinnings of diminished expressivity in schizotypy: What the voice reveals. *Schizophrenia Research*, *109*, 38–45.

Comparelli, A., Corigliano, V., De Carolis, A., Mancinelli, I., Trovini, G., Ottavi, G. *et al.* (2013). Emotion recognition impairment is present early and is stable throughout the course of schizophrenia. *Schizophrenia Research*, *143*, 65–69.

Compton, M. T., Goulding, S. M., Bakeman, R. & McClure-Tone, E. B. (2009). Confirmation of a four-factor structure of the Schizotypal Personality Questionnaire among undergraduate students. *Schizophrenia Research*, *111*, 46–52.

Corcoran, C. M., Keilp, J. G., Kayser, J., Klim, C., Butler, P. D., Bruder, G. E. *et al.* (2015). Emotion recognition deficits as predictors of

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

transition in individuals at clinical high risk for schizophrenia: A neurodevelopmental perspective. *Psychological Medicine*, *45*, 2959–2973.

Debbané, M., Eliez, S., Badoud, D., Conus, P., Flückiger, R. & Schultze-Lutter, F. (2015). Developing psychosis and its risk states through the lens of schizotypy. *Schizophrenia Bulletin*, *41*, S396–407.

DeRosse, P., Nitzburg, G. C., Ikuta, T., Peters, B. D., Malhotra, A. K. & Szeszko, P. R. (2015). Evidence from structural and diffusion tensor imaging for frontotemporal deficits in psychometric schizotypy. *Schizophrenia Bulletin*, *41*, 104–114.

Dickey, C. C., Morocz, I. A., Minney, D., Niznikiewicz, M. A., Voglmaier, M. M., Panych, L. P. *et al.* (2010). Factors in sensory processing of prosody in schizotypal personality disorder: An fMRI experiment. *Schizophrenia Research*, *121*, 75–89.

Dickey, C. C., Panych, L. P., Voglmaier, M. M., Niznikiewicz, M. A., Terry, D. P., Murphy, C. *et al.* (2011). Facial emotion recognition and facial affect display in schizotypal personality disorder. *Schizophrenia Research*, *131*, 242–249.

Dickey, C. C., Vu, M. A., Voglmaier, M. M., Niznikiewicz, M. A., McCarley, R. W. & Panych, L. P. (2012). Prosodic abnormalities in schizotypal personality disorder. *Schizophrenia Research*, *142*, 20–30.

Docherty, A. R., Sponheim, S. R. & Kerns, J. G. (2015). Self-reported affective traits and current affective experiences of biological relatives of people with schizophrenia. *Schizophrenia Research*, *161*, 340–344.

Ettinger, U., Meyhöfer, I., Steffens, M., Wagner, M. & Koutsouleris, N. (2014). Genetics, cognition, and neurobiology of schizotypal personality: A review of the overlap with schizophrenia. *Frontiers in Psychiatry*, *5*, 18.

Fahim, C., Stip, E., Mancini-Marïe, A., Mensour, B., Boulay, L. J., Leroux, J. M. *et al.* (2005). Brain activity during emotionally negative pictures in schizophrenia with and without flat affect: An fMRI study. *Psychiatry Research*, *140*, 1–15.

Fonseca-Pedrero, E., Compton, M. T., Tone, E. B., Ortuño-Sierra, J., Paino, M., Fumero, A. & Lemos-Giráldez, S. (2014). Cross-cultural invariance of the factor structure of the Schizotypal Personality Questionnaire across Spanish and American college students. *Psychiatry Research*, *220*, 1071–1076.

Fossati, A., Raine, A., Carretta, I., Leonardi, B. & Maffei, C. (2003). The three-factor model of schizotypal personality: Invariance across age and gender. *Personality and Individual Differences*, *35*, 1007–1019.

Germine, L. T., Garrido, L., Bruce, L. & Hooker, C. (2011). Social anhedonia is associated with neural abnormalities during face emotion processing. *Neuroimage*, *58*, 935–945.

Germine, L. T. & Hooker, C. I. (2011). Face emotion recognition is related to individual differences in psychosis-proneness. *Psychological Medicine*, *41*, 937–947.

Giakoumaki, S. G. (2012). Cognitive and prepulse inhibition deficits in psychometrically high schizotypal subjects in the general population: Relevance to schizophrenia research. *Journal of the International Neuropsychological Society*, *18*, 643–656.

Goldstein, K. E., Hazlett, E. A., New, A. S., Haznedar, M. M., Newmark, R. E., Zelmanova, Y. *et al.* (2009). Smaller superior temporal gyrus volume specificity in schizotypal personality disorder. *Schizophrenia Research*, *112*, 14–23.

Gooding, D. C., Davidson, R. J., Putnam, K. M. & Tallent, K. A. (2002). Normative emotion-modulated startle response in individuals at risk for schizophrenia-spectrum disorders. *Schizophrenia Research*, *57*, 109–120.

Gooding, D. C., Johnson, M. & Peterman, J. S. (2010). Schizotypy and altered digit ratios: A second look. *Psychiatry Research*, *178*, 73–78.

Gooding, D. C. & Tallent, K. A. (2003). Spatial, object, and affective working memory in social anhedonia: An exploratory study. *Schizophr Research*, *63*, 247–260.

Grabe, H. J., Wittfeld, K., Hegenscheid, K., Hosten, N., Lotze, M., Janowitz, D. *et al.* (2014). Alexithymia and brain gray matter volumes in a general population sample. *Human Brain Mapping*, *35*, 5932–5945.

Green, M. F., Olivier, B., Crawley, J. N., Penn, D. L. & Silverstein, S. (2005). Social cognition in schizophrenia: Recommendations from the measurement and treatment research to improve cognition in schizophrenia new approaches conference. *Schizophrenia Bulletin*, *31*, 882–887.

Gruzelier, J. H. (2003). Theory, methods and new directions in the psychophysiology of the schizophrenic process and schizotypy. *International Journal of Psychophysiology*, *48*, 221–245.

Gündel, H., López-Sala, A., Ceballos-Baumann, A. O., Deus, J., Cardoner, N., Marten-Mittag, B. *et al.* (2004). Alexithymia correlates with the size of the right anterior cingulate. *Psychosomatic Medicine*, *66*, 132–140.

Gur, R. E., Nimgaonkar, V. L., Almasy, L., Calkins, M. E., Ragland, J. D., Pogue-Geile, M. F. *et al.* (2007). Neurocognitive endophenotypes in a multiplex multigenerational family study of schizophrenia. *American Journal of Psychiatry*, *164*, 813–819.

Habel, U., Chechko, N., Pauly, K., Koch, K., Backes, V., Seiferth, N. *et al.* (2010). Neural correlates of emotion recognition in schizophrenia. *Schizophrenia Research*, *122*, 113–123.

Habel, U., Klein, M., Shah, N. J., Toni, I., Zilles, K., Falkai, P. & Schneider, F. (2004). Genetic load on amygdala hypofunction during sadness in nonaffected brothers of schizophrenia patients. *American Journal of Psychiatry*, *161*, 1806–1813.

Hamm, J. A., Renard, S. B., Fogley, R. L., Leonhardt, B. L., Dimaggio, G., Buck, K. D. & Lysaker, P. H. (2012). Metacognition and social cognition in schizophrenia: Stability and relationship to concurrent and prospective symptom assessments. *Journal of Clinical Psychology*, *68*, 1303–1312.

Hazlett, E. A., Buchsbaum, M. S., Haznedar, M. M., Newmark, R., Goldstein, K. E., Zelmanova, Y. *et al.* (2008). Cortical gray and white matter volume in unmedicated schizotypal and schizophrenia patients. *Schizophrenia Research*, *101*, 111–123.

Henry, J. D., Bailey, P. E. & Rendell, P. G. (2008). Empathy, social functioning and schizotypy. *Psychiatry Research*, *160*, 15–22.

Hoekert, M., Kahn, R. S., Pijnenborg, M. & Aleman, A. (2007). Impaired recognition and expression of emotional prosody in schizophrenia: Review and meta-analysis. *Schizophrenia Research*, *96*, 135–145.

Horan, W. P. & Blanchard, J. J. (2003). Neurocognitive, social, and emotional dysfunction in deficit syndrome schizophrenia. *Schizophrenia Research*, *65*, 125–137.

Horan, W. P., Blanchard, J. J., Clark, L. A. & Green, M. F. (2008). Affective traits in schizophrenia and schizotypy. *Schizophrenia Bulletin*, *34*, 856–874.

Huang, J., Wang, Y., Jin, Z., Di, X., Yang, T., Gur, R. C. *et al.* (2013). Happy facial expression processing with different social interaction cues: An fMRI study of individuals with schizotypal personality traits. *Progress in Neuropsychopharmacology and Biological Psychiatry*, *44*, 108–117.

Ihme, K., Dannlowski, U., Lichev, V., Stuhrmann, A., Grotegerd, D., Rosenberg, N. *et al.* (2013). Alexithymia is related to differences in gray matter volume: A voxel-based morphometry study. *Brain Research*, *1491*, 60–67.

Jongen, S., Axmacher, N., Kremers, N. A., Hoffmann, H., Limbrecht-Ecklundt, K., Traue, H. C. & Kessler, H. (2014). An investigation of facial emotion recognition impairments in alexithymia and its neural correlates. *Behavioural Brain Research*, *271*, 129–139.

Karlsson, H., Näätänen, P. & Stenman, H. (2008). Cortical activation in alexithymia as a response to emotional stimuli. *British Journal of Psychiatry*, *192*, 32–38.

Kawasaki, Y., Suzuki, M., Nohara, S., Hagino, H., Takahashi, T., Matsui, M. *et al.* (2004). Structural brain differences in patients with schizophrenia and schizotypal disorder demonstrated by voxel-based morphometry. *European Archives of Psychiatry and Clinical Neuroscience*, *254*, 406–414.

Kee, K. S., Horan, W. P., Mintz, J. & Green, M. F. (2004). Do the siblings of schizophrenia patients demonstrate affect perception deficits? *Schizophrenia Research*, *67*, 87–94.

Kendler, K. S., Lieberman, J. A. & Walsh, D. (1989). The Structured Interview for Schizotypy (SIS): A preliminary report. *Schizophrenia Bulletin*, *15*, 559–571.

Kerns, J. G. (2005). Positive schizotypy and emotion processing. *Journal of Abnormal Psychology*, *114*, 392–401.

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Kerns, J. G. (2006). Schizotypy facets, cognitive control, and emotion. *Journal of Abnormal Psychology*, *115*, 418–427.

Kerns, J. G. & Becker, T. M. (2008). Communication disturbances, working memory, and emotion in people with elevated disorganized schizotypy. *Schizophrenia Research*, *100*, 172–180.

Kerns, J. G., Docherty, A. R. & Martin, E. A. (2008). Social and physical anhedonia and valence and arousal aspects of emotional experience. *Journal of Abnormal Psychology*, *117*, 735–746.

Kiwanuka, J. N., Strauss, G. P., McMahon, R. P. & Gold, J. M. (2014). Psychological predictors of functional outcome in people with schizophrenia. *Schizophrenia Research*, *157*, 299–304.

Kohler, C., Turner, T., Bilker, W., Brensinger, C. M., Siegel, S. J., Kanes, S. J. *et al.* (2003). Facial emotion recognition in schizophrenia: Intensity effects and error pattern. *American Journal of Psychiatry*, *160*, 1768–1774.

Koo, M. S., Dickey, C. C., Park, H. J., Kubicki, M., Ji, N. Y., Bouix, S. *et al.* (2006). Smaller neocortical gray matter and larger sulcal cerebrospinal fluid volumes in neuroleptic-naive women with schizotypal personality disorder. *Archives of General Psychiatry*, *63*, 1090–1100.

Kubota, M., Miyata, J., Hirao, K., Fujiwara, H., Kawada, R., Fujimoto, S. *et al.* (2011). Alexithymia and regional gray matter alterations in schizophrenia. *Neuroscience Research*, *70*, 206–213.

Kubota, M., Miyata, J., Sasamoto, A., Kawada, R., Fujimoto, S., Tanaka, Y. *et al.* (2012). Alexithymia and reduced white matter integrity in schizophrenia: A diffusion tensor imaging study on impaired emotional self-awareness. *Schizophrenia Research*, *141*, 137–143.

Kucharska-Pietura, K., David, A. S., Masiak, M. & Phillips, M. L. (2005). Perception of facial and vocal affect by people with schizophrenia in early and late stages of illness. *British Journal of Psychiatry*, *187*, 523–528.

Kwapil, T. R., Brown, L. H., Silvia, P. J., Myin-Germeys, I. & Barrantes-Vidal, N. (2012). The expression of positive and negative schizotypy in daily life: An experience sampling study. *Psychological Medicine*, *42*, 2555–2566.

Kwapil, T. R., Gross, G. M., Silvia, P. J. & Barrantes-Vidal, N. (2013). Prediction of psychopathology and functional impairment by positive and negative schizotypy in the Chapmans' ten-year longitudinal study. *Journal of Abnormal Psychology*, *122*, 807–815.

Larøi, F., Van der Linden, M. & Aleman, A. (2008). Associations between dimensions of alexithymia and psychometric schizotypy in nonclinical participants. *Journal of Nervous and Mental Disease*, *196*, 927–930.

Lee, S. B., Koo, S. J., Song, Y. Y., Lee, M. K., Jeong, Y. J., Kwon, C. *et al.* (2014). Theory of mind as a mediator of reasoning and facial emotion recognition: findings from 200 healthy people. *Psychiatry Investigation*, *11*, 105–111.

Lee, S. Y., Bang, M., Kim, K. R., Lee, M. K., Park, J. Y., Song, Y. Y., Kang, J. I. *et al.* (2015). Impaired facial emotion recognition in individuals at ultra-high risk for psychosis and with first-episode schizophrenia, and their associations with neurocognitive deficits and self-reported schizotypy. *Schizophrenia Research*, *165*, 60–65.

Lenzenweger, M. & Korfine, L. (1995). Tracking the taxon: On the latent structure and base rate of schizotypy. In A. Raine, T. Lencz & S. Mednick (Eds.), *Schizotypal Personality* (pp. 135–167). New York: Cambridge University Press.

Leung, W. W., Couture, S. M., Blanchard, J. J., Lin, S. & Llerena, K. (2010). Is social anhedonia related to emotional responsivity and expressivity? A laboratory study in women. *Schizophrenia Research*, *124*, 66–73.

Li, Z., Lui, S. S., Geng, F. L., Li, Y., Li, W. X., Wang, C. Y. *et al.* (2015). Experiential pleasure deficits in different stages of schizophrenia. *Schizophrenia Research*, *166*, 98–103.

Liddle, P. F. & Barnes, T. R. E. (1990). Syndromes of chronic schizophrenia. *British Journal of Psychiatry*, *157*, 558–561.

Liemburg, E. J., Swart, M., Bruggeman, R., Kortekaas, R., Knegtering, H., Curcić-Blake, B. & Aleman, A. (2012). Altered resting state connectivity of the default mode network in alexithymia. *Social Cognitive and Affective Neuroscience*, *7*, 660–666.

Martin, E. A., Becker, T. M., Cicero, D. C., Docherty, A. R. & Kerns, J. G. (2011). Differential associations between schizotypy facets and emotion traits. *Psychiatry Research*, *187*, 94–99.

Mason, O., Claridge, G. & Jackson, M. (1995). New scales for the assessment of schizotypy. *Personality and Individual Differences*, *18*, 7–13.

Meisenzahl, E. M., Koutsouleris, N., Bottlender, R., Scheuerecker, J., Jäger, M., Teipel, S. J. *et al.* (2008). Structural brain alterations at different stages of schizophrenia: A voxel-based morphometric study. *Schizophrenia Research*, *104*, 44–60.

Mier, D., Lis, S., Zygrodnik, K., Sauer, C., Ulferts, J., Gallhofer, B. & Kirsch, P. (2014). Evidence for altered amygdala activation in schizophrenia in an adaptive emotion recognition task. *Psychiatry Research*, *221*, 195–203.

Mote, J., Minzenberg, M. J., Carter, C. S. & Kring, A. M. (2014). Deficits in anticipatory but not consummatory pleasure in people with recent-onset schizophrenia spectrum disorders. *Schizophrenia Research*, *159*, 76–79.

Myin-Germeys, I., Delespaul, P. A. & deVries, M. W. (2000). Schizophrenia patients are more emotionally active than is assumed based on their behavior. *Schizophrenia Bulletin*, *26*, 847–854.

Nemiah, J. C. & Sifneos, P. C. (1970). Psychosomatic illness: A problem in communication. *Psychotheraoy and Psychosomatics*, *18*, 154–160.

Paradiso, S., Vaidya, J. G., McCormick, L. M., Jones, A. & Robinson, R. G. (2008). Aging and alexithymia: Association with reduced right rostral cingulate volume. *American Journal of Geriatric Psychiatry*, *16*, 760–769.

Phillips, L. K. & Seidman, L. J. (2008). Emotion processing in persons at risk for schizophrenia. *Schizophrenia Bulletin*, *34*, 888–903.

Phillips, M. L., Drevets, W. C., Rauch, S. L. & Lane, R. (2003). Neurobiology of emotion perception I: The neural basis of normal emotion perception. *Biological Psychiatry*, *54*, 504–514.

Pinkham, A. E., Penn, D. L., Perkins, D. O., Graham, K. A. & Siegel, M. (2007). Emotion perception and social skill over the course of psychosis: A comparison of individuals "at-risk" for psychosis and individuals with early and chronic schizophrenia spectrum illness. *Cognitive Neuropsychiatry*, *12*, 198–212.

Poreh, A. M., Whitman, R. D., Weber, M. & Ross, T. (1994). Facial recognition in hypothetically schizotypic college students. The role of generalized poor performance. *Journal of Nervous and Mental Disease*, *182*, 503–507.

Prasad, K. M., Sanders, R., Sweeney, J., Montrose, D., Diwadkar, V., Dworakowski, D. *et al.* (2009). Neurological abnormalities among offspring of persons with schizophrenia: Relation to premorbid psychopathology. *Schizophrenia Research*, *108*, 163–169.

Prince, J. D. & Berenbaum, H. (1993). Alexithymia and hedonic capacity. *Journal of Research in Personality*, *27*, 15–22.

Raine, A. (1991). The SPQ: A scale for the assessment of schizotypal personality based on DSM-III-R criteria. *Schizophrenia Bulletin*, *17*, 555–564.

Raine, A., Reynolds, C., Lencz, T., Scerbo, A., Triphon, N. & Kim, D. (1994). Cognitive, perceptual, interpersonal, and disorganized features of schizotypal personality. *Schizophrenia Bulletin*, *20*, 191–201.

Reker, M., Ohrmann, P., Rauch, A. V., Kugel, H., Bauer, J., Dannlowski, U. *et al.* (2010). Individual differences in alexithymia and brain response to masked emotion faces. *Cortex*, *46*, 658–667.

Reynolds, C. A., Raine, A., Mellingen, K., Venables, P. H. & Sarnoff, A. M. (2000). Three-factor models of schizotypal personality: Invariance across culture, gender, religious affiliation, family adversity, and psychopathology. *Schizophrenia Bulletin*, *26*, 603–618.

Rosell, D. R., Futterman, S. E., McMaster, A. & Siever, L. J. (2014). Schizotypal personality disorder: a current review. *Current Psychiatry Reports*, *16*, 452.

Roussos, P., Bitsios, P., Giakoumaki, S. G., McClure, M. M., Hazlett, E. A., New, A. S. & Siever, L. J. (2013). CACNA1C as a risk factor for schizotypal personality disorder and schizotypy in healthy individuals. *Psychiatry Research*, *206*, 122–123.

Roussos, P., Giakoumaki, S. G. & Bitsios, P. (2009). A risk PRODH haplotype affects sensorimotor gating, memory, schizotypy, and

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

anxiety in healthy male subjects. *Biological Psychiatry*, *65*, 1063–1070.

Roussos, P., Giakoumaki, S. G., Georgakopoulos, A., Robakis, N. K. & Bitsios, P. (2011). The CACNA1C and ANK3 risk alleles impact on affective personality traits and startle reactivity but not on cognition or gating in healthy males. *Bipolar Disorders*, *13*, 250–259.

Rus-Calafell, M., Gutiérrez-Maldonado, J. & Frerich, N. (2013). Schizotypy, alexithymia and affect as predictors of facial emotion recognition capability using static and dynamic images. *Anuario de Psicología/The UB Journal of Psychology*, *43*, 7–21.

Sanchez, A. H., Lavaysse, L. M., Starr, J. N. & Gard, D. E. (2014). Daily life evidence of environment-incongruent emotion in schizophrenia. *Psychiatry Research*, *220*, 89–95.

Shi, Y. F., Wang, Y., Cao, X. Y., Wang, Y., Wang, Y. N., Zong, J. G. *et al.* (2012). Experience of pleasure and emotional expression in individuals with schizotypal personality features. *PLoS One*, *7*, e34147.

Stefanis, N. C., Smyrnis, N., Avramopoulos, D., Evdokimidis, I., Ntzoufras, I. & Stefanis, C. N. (2004). Factorial composition of self-rated schizotypal traits among young males undergoing military training. *Schizophrenia Bulletin*, *30*, 335–350.

Stefanis, N. C., Trikalinos, T. A., Avramopoulos, D., Smyrnis, N., Evdokimidis, I., Ntzani, E. E. *et al.* (2008). Association of RGS4 variants with schizotypy and cognitive endophenotypes at the population level. *Behavioral and Brain. Functions*, *4*, 46.

Stefanis, N. C., Vitoratou, S., Ntzoufras, I., Smyrnis, N., Evdokimidis, I. & Stefanis, C. N. (2006). Psychometric properties of the Greek version of the Schizotypal Personality Questionnaire (SPQ) in young male obligatory conscripts: A two years test–retest study. *Personality and Individual Differences*, *41*, 1275–1286.

Strauss, G. P., Wilbur, R. C., Warren, K. R., August, S. M. & Gold, J. M. (2011). Anticipatory vs. consummatory pleasure: What is the nature of hedonic deficits in schizophrenia? *Psychiatry Research*, *187*, 36–41.

Suzuki, M., Zhou, S. Y., Takahashi, T., Hagino, H., Kawasaki, Y., Niu, L. *et al.* (2005). Differential contributions of prefrontal and temporolimbic pathology to mechanisms of psychosis. *Brain*, *128*(Pt 9), 2109–2122.

Tabak, N. T., Green, M. F., Wynn, J. K., Proudfit, G. H., Altshuler, L. & Horan, W. P. (2015). Perceived emotional intelligence is impaired and associated with poor community functioning in schizophrenia and bipolar disorder. *Schizophrenia Research*, *162*, 189–195.

Tsaousis, I., Zouraraki, C., Karamaouna, P., Karagiannopoulou, L. & Giakoumaki, S. G. (2015). The validity of the Schizotypal Personality Questionnaire in a Greek sample: Tests of measurement invariance and latent mean differences. *Comprehensive Psychiatry*, *62*, 51–62.

Tso, I. F., Grove, T. B. & Taylor, S. F. (2014). Differential hedonic experience and behavioral activation in schizophrenia and bipolar disorder. *Psychiatry Research*, *219*, 470–476.

Tsoi, D. T., Lee, K. H., Khokhar, W. A., Mir, N. U., Swalli, J. S., Gee, K. A. *et al.* (2008). Is facial emotion recognition impairment in schizophrenia identical for different emotions? A signal detection analysis. *Schizophrenia Research*, *99*, 263–269.

van Rijn, S., Schothorst, P., Wout, M., Sprong, M., Ziermans, T., van Engeland, H. *et al.* (2011). Affective dysfunctions in adolescents at risk for psychosis: Emotion awareness and social functioning. *Psychiatry Research*, *187*, 100–105.

van 't Wout, M., Aleman, A., Bermond, B. & Kahn, R. S. (2007). No words for feelings: Alexithymia in schizophrenia patients and first-degree relatives. *Comprehensive Psychiatry*, *48*, 27–33.

van 't Wout, M., Aleman, A., Kessels, R. P., Larøi, F. & Kahn, R. S. (2004). Emotional processing in a non-clinical psychosis–prone sample. *Schizophrenia Research*, *68*, 271–281.

van't Wout, M., van Dijke, A., Aleman, A., Kessels, R. P., Pijpers, W. & Kahn, R. S. (2007). Fearful faces in schizophrenia: the relationship between patient characteristics and facial affect recognition. *Journal of Nervous and Mental Disease*, *195*, 758–764.

Vollema, M. G. & van den Bosch, J. (1995). The multidimensionality of schizotypy. *Schizophrenia Bulletin*, *21*, 19–31.

Vorst, H. C. M. & Bermond, B. (2001). Validity and reliability of the Bermond-Vorst alexithymia questionnaire. *Personality and Individual Differences*, *30*, 413–434.

Waldeck, T. L. & Miller, L. S. (2000). Social skills deficits in schizotypal personality disorder. *Psychiatry Research*, *93*, 237–246.

Wei, J. C., Chuhsing, K. H. & Chaucer, C. H. L. (1997). Schizotypy in community samples: The three-factor structure and correlation with sustained attention. *Journal of Abnormal Psychology*, *106*, 649–654.

Williams, B. T., Henry, J. D. & Green, M. J. (2007). Facial affect recognition and schizotypy. *Early Intervention in Psychiatry*, *1*, 177–182.

Wölwer, W., Streit, M., Polzer, U. & Gaebel, W. (1996). Facial affect recognition in the course of schizophrenia. *European Archives of Psychiatry and Clinical Neuroscience*, *246*, 165–170.

Xavier, S., Best, M. W., Schorr, E. & Bowie, C. R. (2015). Neurocognition, functional competence and self-reported functional impairment in psychometrically defined schizotypy. *Cognitive Neuropsychiatry*, *20*, 53–63.

Yalcin-Siedentopf, N., Hoertnagl, C. M., Biedermann, F., Baumgartner, S., Deisenhammer, E. A., Hausmann, A. *et al.* (2014). Facial affect recognition in symptomatically remitted patients with schizophrenia and bipolar disorder. *Schizophrenia Research*, *152*, 440–445.

Yamasue, H., Iwanami, A., Hirayasu, Y., Yamada, H., Abe, O., Kuroki, N., Fukuda, R., Tsujii, K., Aoki, S., Ohtomo, K., Kato, N. & Kasai, K. (2004). Localized volume reduction in prefrontal, temporolimbic, and paralimbic regions in schizophrenia: An MRI parcellation study. *Psychiatry Research*, *131*, 195–207.

Yasuda, Y., Hashimoto, R., Ohi, K., Fukumoto, M., Umeda-Yano, S., Yamamori, H. *et al.* (2001). Impact on schizotypal personality trait of a genome-wide supported psychosis variant of the ZNF804A gene. *Neuroscience Letters*, *495*, 216–220.

Young, A. W., Perrett, D. I., Cabler, A. J., Sprengelmeyer, R. & Ekman, P. (2002). *Facial expressions of emotion: Stimuli and tests (FEEST)*. Bury St Edmunds: Thames Valley Test Company.

Zhang, Q., Shen, J., Wu, J., Yu, X., Lou, W., Fan, H. *et al.* (2014). Altered default mode network functional connectivity in schizotypal personality disorder. *Schizophrenia Research*, *160*, 51–56.

Received 23 September 2015, accepted 4 March 2016

© 2016 Scandinavian Psychological Associations and John Wiley & Sons Ltd

Copyright of Scandinavian Journal of Psychology is the property of Wiley-Blackwell and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.