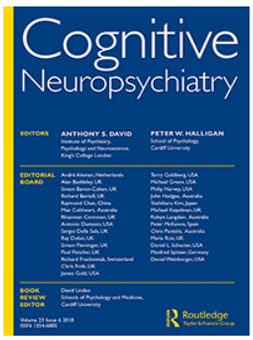

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Attribution of intentions and context processing in psychometric schizotypy

Romina Rinaldi[a,b], Laurent Lefebvre[b], Wivine Blekic[b], Frank Laroi[c,d,e] and Julien Laloyaux[c,d,e]

[a]Grand Hôpital de Charleroi, Hôpital Notre-Dame, Charleroi, Belgium; [b]Cognitive psychology and Neuropsychology Department, University of Mons, Mons, Belgium; [c]Department of Biological and Medical Psychology, University of Bergen, Bergen, Norway; [d]NORMENT – Norwegian Center of Excellence for Mental Disorders Research, University of Oslo, Oslo, Norway; [e]Psychology and Neuroscience of Cognition Research Unit, University of Liège, Liège, Belgium

ABSTRACT

Introduction: Impairment in Theory of mind (TOM) has frequently been associated with schizophrenia and with schizotypy. Studies have found that a tendency to over-attribute intentions and special meaning to events and to people is related to positive psychotic symptoms. Further, it has been suggested that this intentionality bias may be due to a broader deficit in context processing (CP). The aim of the present study was thus to investigate the relationship between positive schizotypy and both over-attribution of intentions and contextual processing.

Methods: One-hundred and nineteen healthy individuals completed the Schizotypal Personality Questionnaire and were assessed with tasks measuring contextual treatment and ToM.

Results: Results revealed that positive schizotypy was significantly related to an over-attribution of intentions on the ToM task and with a faster processing of implicit context. Partial correlational analyses indicated that the association between the attribution of intentions and positive schizotypy was not explained by a deficit of CP. In contrast, stepwise multiple regression analyses showed that both an over-attribution of intentions and a faster processing of implicit context significantly predicted positive schizotypy.

Conclusions: These results show that an over-attribution of intention is independent from a broader deficit in context information processing and that they both possibly contribute to the development and maintenance of positive psychotic symptoms.

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Psychotic symptoms; theory of mind; intentionality; psychosis; cognitive bias

Introduction

Theory of Mind (ToM) is a multi-faceted construct defined as a set of cognitive and emotional abilities that help infer other persons' mental states and intentions (Frith & Frith, 2006). In general, studies have reported ToM impairments in persons diagnosed with schizophrenia (Brüne, 2005). Studies have demonstrated that specific aspects of ToM are related to positive psychotic symptoms. For example, a hyper-intentionality bias (a tendency to over-attribute intentions to the actions of others) has been related

CONTACT Romina Rinaldi romina.rinaldi@umons.ac.be

to positive psychotic symptoms (Ciaramidaro et al., 2014) and especially to paranoid delusions (Blakemore, Sarfati, Bazin, & Decety, 1999).

Recent findings have also observed a similar association in schizotypy. Schizotypy is a set of trait-like expressions of attenuated schizophrenia symptoms that are supposed to reflect a putative liability for psychosis. To date, large multi-national and multi-cultural studies (Fonseca-Pedrero et al., 2018, Fonseca-Pedrero et al., 2018) have shown that schizotypy is a multi-faceted construct composed of three main dimensions: positive symptoms (cognitive-perceptual), negative symptoms (interpersonal) and disorganisation.

Studies have shown that individuals with higher levels of schizotypy—and in particular higher levels of positive schizotypy—present a tendency to over-attribute intentions and purpose to random events and to individuals (Combs, Penn, Wicher, & Waldheter, 2007; Fyfe, Williams, Mason, & Pickup, 2008; Moore & Pope, 2014). In addition, some results suggest that this effect might be driven by specific delusional symptoms rather than by positive schizotypy in general (Fyfe et al., 2008). It is possible to hypothesise that such an over-attribution bias may be one of the cognitive processes underpinning positive symptoms in schizotypy and in schizophrenia as individuals may be more likely to attribute special meaning to random events and to people. This over-attribution is considered to be the manifestation of a broader cognitive bias known as the "intentionality bias" (Rosset, 2008). During childhood, this cognitive bias is believed to be automatic and unconscious when evaluating other's actions (Moore & Pope, 2014; Rosset, 2008) but becomes more controlled with age, when individuals become more able to inhibit this bias with the help of integrated social norms, alternative causal relationships, and with cues such as contextual information (Rosset, 2008).

Over the past decade, context processing (CP) has drawn much attention as being one of the cognitive processes that underpins ToM. CP is defined as a component of working memory that enables the extraction of relevant information from the environment to select an appropriate response. This process can be explicit or implicit depending on whether it leads to verbal awareness of the subject or not (Fogelson & Fernandez-Del-Olmo, 2013). It is thus a key feature for the interpretation of social and non-social events and influences the response to a target event, such as the representation of oneself and other's mental state (Bazin, Perruchet, Hardy-Bayle, & Feline, 2000; Blakemore et al., 1999). It has been demonstrated that both schizophrenia (Cohen, Barch, Carter, & Servan-Schreiber, 1999; Elvevåg, Duncan, & McKenna, 2000; Fogelson et al., 2011, 2013) and schizotypy (Haddon et al., 2011; Steel, Hemsley, & Pickering, 2007; Uhlhaas, Silverstein, Phillips, & Lovell, 2004) are related to difficulties in CP. To date, a number of studies (Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001; Champagne-Lavau, Charest, Anselmo, Rodriguez, & Blouin, 2012; Green et al., 2008; Silverstein, Kovács, Corry, & Valone, 2000; Schenkel, Spaulding, & Silverstein, 2005; Servan-Schreiber, Cohen, & Steingard, 1997) have proposed that the ToM impairments observed in psychosis may be—at least partially—sustained by CP impairments. Context is indeed of crucial importance when it comes to understanding the meaning of a situation, a sentence or a facial expression (Achim, Guitton, Jackson, Boutin, & Monetta, 2013), notably because contextual information helps integrate information into a coherent whole. Silverstein and Schenkel (1997) have suggested that disturbance in the integration of contextually-related information would result in disorganisation on several levels such as disorganisation in thought, language, perception and social cognition—and that this

disturbance underpins various features of schizophrenia symptomatology. In addition, some studies (e.g. Schenkel et al., 2005) have demonstrated that this disturbance is independent from ToM and other neurocognitive functions such as executive functioning, verbal IQ, verbal fluency and memory. These results suggest that ToM abilities are specifically related to CP impairments and not to broader cognitive and information processing deficits. These results are, however, partially contradicted by those reported in Champagne-Lavau et al. (2012), which showed that cognitive flexibility impairment (as assessed with the Trail Making Test) was the best predictor of irony perception (related to ToM abilities) in people with schizophrenia.

To the best of our knowledge, the relationship between both CP and TOM in schizotypy has never been examined previously in the literature. The aim of the present study was thus to investigate whether psychometric schizotypy, and in particular positive schizotypy, is related to both the over-attribution of intentions and contextual processing efficacy. We hypothesised that participants with a higher level of positive schizotypy would tend to over-attribute intentions to people or events and that this specific association would be related to CP.

Materials and method

Participants

One-hundred and nineteen participants (76 men and 43 women) were included in the present study. Exclusion criteria were: the presence of a current or past neurological or psychiatric diagnosis including substance abuse, having ever consulted a mental health professional, having even been treated with psychopharmacological medication, and being younger than 18 years of age and older than 60 years. Descriptive statistics are reported in Table 1. Participant recruitment was conducted with the help of ads on different social networks, direct contact, and e-mails. This included social network websites, and polls of volunteers registered at the University of Mons and who were willing to participate in psychological studies. They were invited to participate in a study that was aimed at revealing the links between personality, information processing and social interactions. The study was approved by the local ethics committee.

Instruments

Schizotypal Personality Questionnaire

The Schizotypal Personality Questionnaire (SPQ) is a 74-item (yes/no) questionnaire designed to assess schizotypal personality traits in the general population (Dumas et al., 2000; Raine, 1991). The questionnaire contains 3 factors (Fonseca-Pedrero et al., 2018; Raine, 1991): cognitive-perceptual (positive symptoms), interpersonal (negative symptoms) and disorganisation. Higher scores indicate a higher proneness to schizotypy.

Triangle task

TOM was assessed using a computerised task developed by Abell, Happé, and Frith (2000). This task was shown by the authors to be a valid and ecological measure of mental state attribution. It is composed of 12 short-animations showing a large blue triangle and a small pink one. There are three different conditions with 4 videos in each:

Table 1. Demographic and clinical characteristics of participants and performance on the tasks.

	Participants ($N = 119$)		
	Mean (SD)	Min–max	Cronbach's α
Age	28.18 (11.33)	18–60	
Sex (F/M)		76/43	
Education (years)	14.11 (1.90)	9–19	
SPQ			
Total	20.52 (10.96)	0–56	0.895
Cognitive-perceptual	8.53 (5.91)	0–25	0.846
Disorganisation	3.90 (2.55)	0–9	0.766
Interpersonal	6.60 (4.55)	0–20	0.796
Intentionality (INT)			
Random	1.29 (1.85)	0–8	
Goal directed	7.90 (1.72)	4–12	
Theory of mind	13.38 (3.40)	4–20	
Context processing (CP)			
Implicit (RTs in ms)	22.61 (29.50)	−57.81–106.52	
Explicit (RTs in ms)	105.68 (99.82)	−62.26–466.34	
Accuracy implicit task	0.97 (0.04)	0.74–1	
Accuracy explicit task	0.93 (0.08)	0.39–1	
Omission implicit task	0.21 (0.59)	0–3	
Omission explicit task	0.66 (1.19)	0–7	
Anticipation implicit task	1.38 (2.51)	0–21	
Anticipation explicit task	4.33 (3.49)	0–16	
Mean RTs of random sequences implicit task	594.44 (87.37)	398.82–834.65	
Mean RTs of predictive sequences implicit task	571.83 (91.86)	383.24–843.91	
Mean RTs of random sequences explicit task	614.05 (76.90)	432.13–781.92	
Mean RTs of predictive sequences explicit task	508.38 (134.32)	154.73–800.92	

random, goal-directed and *theory of mind (TOM).* In the *random* condition, both triangles are moving around purposelessly and without interacting (e.g. bouncing off, moving around). In the *goal-directed* animations, both triangles are interacting purposefully but there are no cues of a triangle reading the other's mind (e.g. dancing, fighting). Finally, in the *TOM* condition, one triangle is responding to the other's mental state and animations are purposely made to evoke mental states and intentions (e.g. one triangle is mocking the other one). Participants are shown one practice trial per condition followed by the animations presented in a random order. After each animation, participants are asked to describe what happened. Responses were recorded and transcribed and were scored by an experimenter who was blind for the schizotypy score (SPQ) of each participant.

A second blind rater scored a sub-set of one third the data sets ($N = 39$). Intraclass correlational analyses revealed a value of 0.71 for the random sequences, 0.69 for the goal-directed sequences and 0.72 for the ToM sequences. According to several guidelines (see Cicchetti, 1994), such intraclass correlation values reveal a good agreement between raters.

For the present study, a score of intentionality was calculated for each condition based on standard criteria provided by the authors of the task (Abell et al., 2000). The intentionality score reflects the use of mental state terms. The score is based on the content of each description provided by each participant. The scoring method was designed to be as objective as possible. In particular, the analysis is only based on the verbs contained in each description of the actions of the triangles provided by the participants. Each verb is scored from 0 (non-deliberate action) to 5 (deliberate action with an explicit goal of

affecting mental state). A score of 0 was attributed to non-deliberate action verbs (i.e. "bouncing off", "moving around"); 1 to deliberate action verbs without interactions (i.e. "swimming", "ice skating"); 2 to deliberate action verbs with the other triangle (e i.e. "fighting", "following", "dancing"); 3 to deliberate action verbs in response to the action of the other triangle (i.e. "chasing", "guarding"); 4 to deliberate action verbs with reference to the mental state of the other triangle (i.e. "mocking", "mimicking", "arguing"); and 5 for deliberate action verbs with the explicit goal of affecting the mental state of the other triangles (i.e. "surprising", "pretending", "convincing"). For each type of sequence (random, goal-directed and ToM), a score was calculated by adding the score of the corresponding verbs. A higher intentionality score thus indicates a tendency to interpret actions as being more intentional.

CP task

The task used in the present study was adapted from the one developed by Fogelson and Fernandez-Del-Olmo (2013). In this computerised task, participants are presented with a series of triangles (facing left, right, upwards, or downwards) on the left or right side of a fixation cross. Participants are asked to press a key on a keyboard as soon as they see a target stimulus (either a downward- or upward-facing triangle depending on the version of the task). The stimuli appear for 500 ms with a 1000 ms interval. The target stimulus is preceded by sequences of non-target events (other triangles) of variable length (4 to 7 triangles). Participants were asked to realise two different versions of the task (see Figure 1): first an implicit version, in which participants were not informed about the presence of a predictive sequence; then an explicit version, in which participants were told about the presence and nature of the predictive sequence (i.e. triangles facing right, left and then down). Each part of the task was composed of 10 blocks of 8 sequences (50% predictive and 50% random) comprising a total of 80 trials and lasting 15 minutes. The software automatically recorded reaction times in milliseconds for each trial. For the present study, a CP score was calculated by subtracting the mean RTs of the predictive trials from the mean RTs of the random trials. The aim was to establish a global score representing the benefit from the presence of predictive sequences. In particular, the more one would benefit from contextual information (predictive sequences), the larger the difference between RTs in random and predictive sequences. For example, a participant with similar RTs in both conditions would have a small difference score, whereas a participant reacting faster in the predicting condition compared to the random condition, would have a large difference score, representing a larger benefit from the predictive sequence.

A CP score was calculated for each version of the task (one for the explicit version and one for the implicit—CP-explicit and CP-implicit, respectively). Anticipations (when the button was pressed 150 ms before the target appeared on the screen) and omissions (when the button was pressed after the target disappeared from the screen) were not taken into account when calculating the CP scores. Statistics for accuracy rate, anticipations and omissions are reported in Table 1.

Statistical analysis

Correlational analyses (Pearson) were carried out between the three SPQ factors (cognitive-perceptual, interpersonal and disorganisation), the Intentionality scores of the

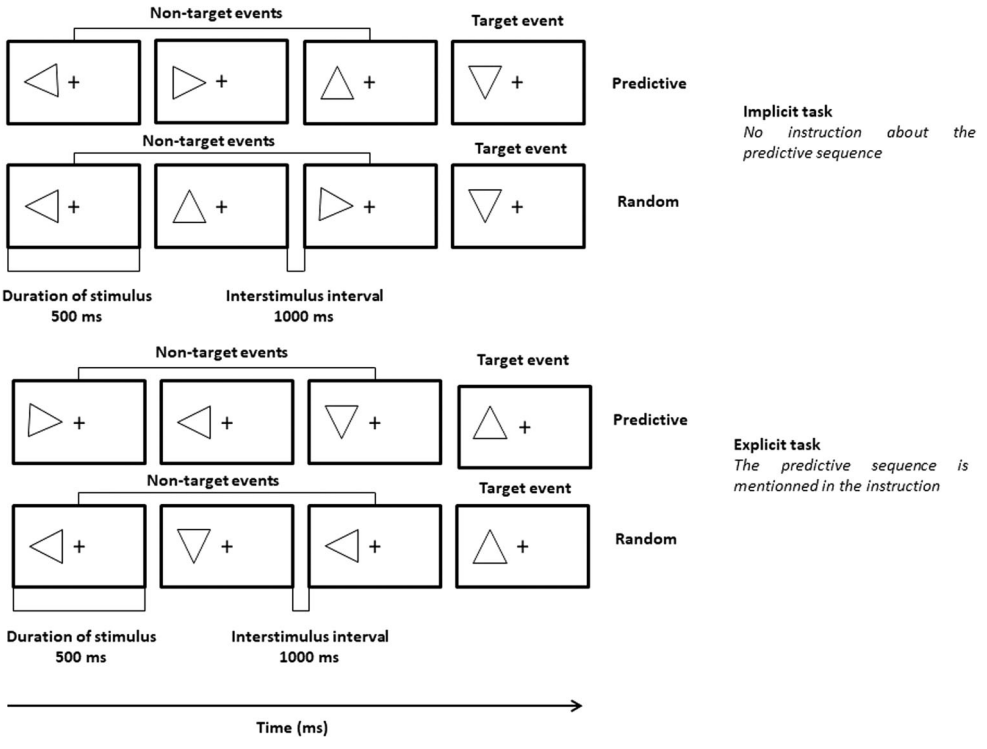

Figure 1. Context processing task.

Triangle Task (intentionality in random, *goal*-directed, and TOM sequences) and the CP scores (implicit and explicit). Thereafter, partial correlational analyses were conducted to examine whether the observed relations between the SPQ and the Intentionality task (Triangle Task) were due to general difficulties in CP (CP Score). The initial alpha was set at 0.05 and corrected for multiple testing (Hommel, 1986, 1988). Stepwise regression analyses with backward elimination ($p > .05$) were then conducted to examine which set of intentionality and contextual variables best predict each SPQ factor.

Results

Correlational analyses

Using a corrected alpha of 0.015, correlational analyses (Table 2) revealed that the SPQ-Cognitive-perceptual score significantly correlated with the Intentionality in ToM sequences. Before statistical correction, the SPQ-Cognitive-perceptual score was also related to the CP-Implicit score and the SPQ-Disorganisation score was related to the Intentionality score in the ToM sequences. The other correlations were not significant.

Partial correlational analyses controlling for CP-Implicit and/or CP Explicit revealed no change in the significance of the initial correlations between the SPQ and Intentionality scores—ToM (CP-Implicit: $r = 0.29$, $p < .001$; CP Explicit: $r = 0.27$, $p < .001$).

Table 2. Correlations between the Schizotypal Personality Questionnaire and performance on the tasks.

	SPQ-Cognitive-perceptual	SPQ-Disorganisation	SPQ-Interpersonal
INT—Random	0.03	−0.04	0.04
INT—Goal directed	0.02	0.07	0.10
INT—Theory of mind	0.29**	0.20*	0.11
CP—Implicit	0.18*	0.04	0.04
CP—Explicit	0.10	−0.02	−0.04

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

Regression analyses

Stepwise regression analyses (Tables 3 and 4) demonstrated, after 4 steps, that both the Intentionality in ToM sequences and the CP-Implicit significantly predicted 10% of the variance in the SPQ-Cognitive-perceptual score [$F(2,116) = 7.44$, $p < .001$, $R^2 = 0.11$, Adjusted $R^2 = 0.10$]. No sign of multicollinearity was detected for any of the variables included in the model [INT-ToM (Tolerance = 0.99; Variance Inflation Factor = 1.00) and CP-Implicit (Tolerance = 0.99, Variance Inflation Factor = 1.00)] nor for those not included in the model [INT-Random (Tolerance = 0.99; Variance Inflation Factor = 1.00), INT-Goal Directed (Tolerance = 0.89; Variance Inflation Factor = 1.11), CP-Explicit (Tolerance = 0.92; Variance Inflation Factor = 1.09)]. Similarly, stepwise regression analyses showed, after 5 steps, that the Intentionality in ToM sequences significantly predicted 3% of the variance in the SPQ-Disorganisation score [$F(1,117) = 4.85$, $p < .05$, $R^2 = 0.04$, Adjusted $R^2 = 0.03$]. No sign of multicollinearity was detected for INT-ToM (Tolerance = 1; Variance Inflation Factor = 1) nor for the variables not included in the model [INT-Random (Tolerance = 0.99; Variance Inflation Factor = 1.00), INT-Goal Directed (Tolerance = 0.91; Variance Inflation Factor = 1.09), CP-Implicit (Tolerance = 0.99, Variance Inflation Factor = 1.00), CP-Explicit (Tolerance = 0.93; Variance Inflation Factor = 1.08)]. Finally, no model was found to significantly predict any variance in the SPQ-Interpersonal score, and thus all the variables were excluded after 6 steps.

Thereafter, hierarchical regression analyses with block-wise entry were conducted in order to examine whether controlling for age and sex affected the results of the stepwise regression analyses. In order to do so, age and sex were first forced to enter the model (first model) followed by the variables that were significant in the stepwise regression analyses (second model).

Concerning the SPQ-Cognitive-perceptual score (Table 5), the first model revealed that both age and sex significantly predicted 10% of the variance [$F(1,116) = 7.60$, $p < .001$, $R^2 = 0.12$, Adjusted $R^2 = 0.10$] (Table 6) with younger age and male being associated with a higher SPQ score. Further, inspection revealed that only age significantly explained any

Table 3. Stepwise regressions analysis of intentionality and contextual processing on SPQ-Cognitive perceptual score.

	B	SE *B*	*β*
Step 4			
Constant	1.12	2.12	
INT—Theory of mind	0.50	0.15	0.29***
CT—Implicit	0.03	0.02	0.17*

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

Table 4. Stepwise regressions analysis of intentionality and contextual processing on SPQ-Disorganisation.

	B	SE *B*	*β*
Step 5			
Constant	1.90	0.94	
INT—Theory of mind	0.15	0.07	0.20*

* = $p < .05$.

part of the variance of the SPQ-Cognitive-perceptual score apart from the variance already explained by sex.

The second model including Intentionality in ToM sequences and CP-Implicit predicted 16% of the variance of the SPQ-Cognitive perceptual score [$F(4,114) = 6.79$, $p < .001$, $R^2 = 0.19$, Adjusted $R^2 = 0.16$]. These results showed that Intentionality in ToM sequences and CP-Implicit together predicted 8% (R^2 change = 0.08) of the SPQ-Cognitive perceptual score apart from the variance already explained by age and sex.

Finally, the same analyses were conducted on the SPQ-Disorganisation score. Results revealed that the first model including age and sex did not reach significance [$F(2,116) = 1.02$, $p > .05$, $R^2 = 0.02$, Adjusted $R^2 < 0.001$] suggesting that neither sex nor age had a significant effect on the SPQ-Disorganisation score and that the previous model that only included Intentionality in ToM sequences was better (Table 4).

Supplementary analysis

Supplementary analyses were then conducted by splitting the sample into sub-groups of low and high proneness to positive schizotypy (based on the SPQ-Cognitive perceptual score). Two different methods were used to split the sample: a median split and a quartile split (1st VS 4th quartile). For both methods, those participants who obtained a score equal to the fixed cutoff score were excluded. For the median split, the cutoff was fixed at 7 and 110 participants were included in the analyses (low = 51, high = 59). For the quartile split, the cutoff was fixed at 4 (Q1) and 12 (Q4) and 49 participants were included in the analyses (Q1 = 24 and Q4 = 25). Thereafter, Student's *t*-tests were conducted to compare both sub-groups on the intentionality and CP scores. The results (Tables 6 and 7) showed that both high groups (above the median and Q4) had a significantly

Table 5. Hierarchical regression analyses with block-wise entry of demographic variables, intentionality and contextual treatment on SPQ-Cognitive perceptual score.

	B	SE *B*	*β*
Model 1			
Constant	13.29	1.39	
Age	−0.16	0.05	−0.31***
Sex	−0.88	0.53	−0.14
Model 2			
Constant	6.32	2.66	
Age	−0.12	0.04	−0.24**
Sex	−0.98	0.54	−0.16
INT—Theory of mind	0.39	0.15	0.22**
CT—Implicit	0.03	0.02	0.17*

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

Table 6. *t*-tests comparing subgroups — median split (SPQ-Cognitive perceptual).

	Mean (SD)			
	Low	High	*t*	*p*
INT—Random	1.47 (1.92)	1.19 (1.81)	0.797	.427
INT—Goal-directed	7.82 (1.96)	7.92 (1.61)	−0.270	.788
INT-—Theory of Mind	12.55 (3.82)	13.97 (3.41)	−2.208	.029
CP—Implicit	14.35 (26.61)	29.91 (29.06)	−2.923	.004
CP—Explicit	85.65 (96.90)	117.24 (93.30)	−1.739	.085

worse performance than both low groups (below the median and Q1) for the intentionality in ToM sequences [median split: $t(1,109) = -2.208$, $p = .029$; quartile split: $t(1,48) = -3.424$, $p = .001$), as well as for the implicit CP score median split: $t(1,109) = -2.923$, $p = .004$; quartile split: $t[1,48) = -2.492$, $p = .016$].

Discussion

The present study explored the relationships between schizotypy, TOM and CP in a sample of individuals from the general population. Based on the existing literature, it was hypothesised that an over-attribution of intentions would be found in individuals with a higher level of positive schizotypy (cognitive-perceptual factor). Correlational analysis and stepwise regressions partially confirmed this hypothesis. In fact, analyses revealed a significant relation between positive schizotypy and the intentionality score on the triangle task. These results suggest that when confronted with a sequence of interactions, participants with a higher proneness to positive schizotypy tend to attribute more intentions to the behaviours of protagonists (i.e. the small and big triangles). These results are consistent with previous studies showing that positive schizotypy is associated with a tendency to over-attribute intentions (Combs et al., 2007; Fyfe et al., 2008; Moore & Pope, 2014). Such results suggest that an over-intentionality bias may play a role in the development and maintenance of positive psychotic symptoms as people are more likely to quickly attribute special meaning to events and to people, which may be the first step towards the development of odd beliefs or delusions. Stepwise regression analyses also revealed a significant association between disorganised schizotypy and an over-intentionality score which may suggest that difficulties in organising thoughts may be a factor promoting an over interpretation of environmental cues.

The present study failed to find a link between positive schizotypy and the attribution of intentions to random events on the Triangle Task. This absence of results was unexpected considering the results reported in Fyfe et al. (2008). Using a similar task, they found that

Table 7. *t*-tests comparing subgroups — quartile split (SPQ-Cognitive perceptual).

	Mean (SD)			
	Low	High	*t*	*p*
INT—Random	1.17 (1.74)	1.08 (1.82)	0.170	.866
INT—Goal-directed	7.46 (1.98)	7.84 (1.52)	−0.160	.451
INT—Theory of Mind	11.58 (2.86)	14.72 (3.51)	−3.424	.001
CP—Implicit	9.39 (27.68)	30.95 (32.59)	−2.492	.016
CP—Explicit	77.58 (91.68)	111/05 (80.21)	−1.362	.180

healthy participants with a higher proneness to delusions were particularly more likely to perceive a greater number of associations in random conditions than those with a lower proneness. Such results suggest that a tendency to attribute intentionality to random events may be more specifically related to delusion proneness than to positive schizotypy in general. There is a need for future studies to explore this issue further.

We also propose that positive schizotypy could be linked to the quality of information processing, and to CP in particular. Stepwise regression analyses revealed a significant association between schizotypy and CP in the implicit condition. Correlational analyses also revealed a statistical tendency between these two variables. To date, only a small number of studies have focused on contextually cued responses in relation to schizotypy (Barch et al., 2004; Haddon et al., 2011; Uhlhaas et al., 2004)—and in particular in an implicit setting as only one study (Steel et al., 2007) explored this issue. However, our results are congruent with those reported by Steel et al. (2007) who found a positive association between higher positive and disorganised schizotypy and a tendency to more quickly process implicit cues. Taken together, such results suggest that people with a higher proneness to positive schizotypy tend to quickly detect and extract implicit information from the environment, which may facilitate an over-interpretation of the environment.

Some authors have suggested that the ToM impairments observed in psychosis may be sustained by CP impairments (Bentall et al., 2001; Servan-Schreiber et al., 1997; Silverstein et al., 2000). Indeed, contextual information—and mostly implicit contextual information such as the vocal pitch, facial expressions, and previous knowledge about the relations between protagonists—is needed to accurately interpret the content of a social event and the intentions of the protagonists (see Achim et al., 2013 for a review). This hypothesis was examined, for the first time in the literature, with the help of partial correlational and stepwise regression analyses. Results from the partial correlational analyses suggest that the association between positive schizotypy and intentionality in ToM sequences is not due to a deficit in CP (implicit and explicit); which implies that this specific relation exists independently of a broader deficit of contextual information processing. In addition, stepwise regression analyses indicate that implicit CP and intentionality both significantly predict a part of the variance of positive schizotypy. It should be noted, however, that the predicted variance is limited and should, therefore, be interpreted with caution. Schizotypy is indeed a complex and multidimensional construct that is potentially influenced by a large set of cognitive, emotional, and social factors that should be taken into account in both research and clinical practice (see Ettinger et al., 2015 and Giakoumaki, 2016 for reviews).

Taken together, these data suggest that both CP and intentionality contribute to positive schizotypy, but that an over-attribution of intention is a specific feature that is independent of a broader deficit in contextual information processing. In other words, the present results show that people with a higher proneness to positive schizotypy have both (1) a hypervigilance bias towards detecting and extracting information from the environment (e.g. vocal pitch, facial expression), which may lead to the perception of information that are incomplete or absent and (2) a tendency to over-attribute and interpret such information. These two mechanisms may play a role, among other factors, in the development and maintenance of positive psychotic symptoms. For example, one may rapidly perceive the angry eyes of someone in a crowd (implicit contextual information)

and over-interpret it as being a threat towards him/her. As for another example, one may perceive a slight change in the environment that nobody around noticed and interpret this event as being clairvoyance.

Such a hypothesis is also coherent with cognitive models of positive symptomatology in schizophrenia—and delusions in particular. For example, Frith (1992) has suggested that delusions arise because people with schizophrenia have difficulties in both the understanding and the attribution of intentions, which rely on a broader deficit of cognitive control and an inability for this system to integrate environmental stimuli. More recent models of positive symptomatology (e.g. Bentall et al., 2001; Freeman, 2007; Green & Phillips, 2004) do not seem to include these components and therefore perhaps they need to be integrated into them.

From a clinical point of view, the present results suggest that there is a need for evaluating and for remediating both of these aspects in clinical practice in order to improve positive psychotic symptoms.

There are some limitations of the present study that deserve mentioning. To begin with, schizotypy was only measured using a self-report questionnaire (SPQ) and therefore response biases might have occurred, especially as such symptoms are highly stigmatised (Gerlinger et al., 2013). Nevertheless, the SPQ has demonstrated excellent psychometric properties in many studies (e.g. Fonseca-Pedrero et al., 2018). Another limit is related to the use of only one measure of intentionality and one measure of CP, and including certain types of artificial stimuli (i.e. triangles). It could be argued that the triangle task lacks ecological validity, which makes it difficult to generalise the present findings. Future studies are needed to replicate the present results using more ecological tasks such as involving real persons and dynamic/real-life settings (i.e. a situation in which the participant can acquire "real-time" information about the environment or the characters) (see Achim et al., 2013 for a review).

Although these results should be considered as exploratory and need replication, they represent the first attempt to systematically investigate the relationship between an over-attribution of intentions and context processing in psychotic-like symptoms and give theoretical insight concerning their possible implication in the development and maintenance of positive symptoms.

Disclosure statement

No potential conflict of interest was reported by the authors.

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