Research article

'Feeling' or 'sensing' the future? Testing for anomalous cognitions in clinical versus healthy populations

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ABSTRACT

In the study and treatment of psychosis, emotional intelligence (EI) and thinking styles are important patient characteristics for successful outcomes in clinical intervention. Anticipation of unpredictable stimuli (AUS) may be understood as an anomalous perception and anomalous cognition in which an individual supposedly senses and recognizes future stimuli in an unexpected way, also referred to as "hunches or premonitions." This examined the roles of EI and thinking styles in AUSs in convenience samples of healthy participants ($n = 237$) versus patients diagnosed with psychosis ($n = 118$). We adjusted several quadratic and exponential regression models according to the obtained functions. Group means were also compared to examine differences in EI scores for participants with psychosis compared to healthy participants. In the healthy group, EI predicted AUSs with a weight between 42% and 58%. Thinking styles were not correlated with AUSs. However, EI was not correlated with AUSs in the clinical group. Patients with psychosis tended to score higher on AUSs and lower on EI and thinking styles compared to participants in the healthy group. We discuss EI as a variable that can contextualize some anomalous perceptions which are otherwise difficult to classify or measure within the classic psychosis continuum model.

1. Introduction

Anomalous perceptions are clinically defined as perceptual disturbances present in individuals with or without psychiatric histories (Bell et al., 2006; Davies et al., 2017; Shapiro et al., 2019). The terms "psychotic-like-experiences" and "anomalous experiences" are synonymous with this description (see Brett et al., 2013). According to the continuum model of psychosis, anomalous perceptions fluctuate within a quantitative and qualitative symptomatic gradient that belongs to the field of psychotic disorders (Chapman and Chapman, 1980; Capra et al., 2013; Kwapil et al., 2020; Escolà-Gascón, 2022a). Along these lines, the most severe anomalous perceptions would be present in patients with schizophrenia or other psychotic disorders (Wright et al., 2018). In contrast, less intense anomalous perceptions are shown to be present in participants in the general population (see also van Os et al., 2009). Having attenuated anomalous perceptions would imply a potential risk for mental health challenges, given that they predispose the individual to

future psychotic disorders (Shapiro et al., 2019). The continuum model is valid, clinically useful, and widely accepted, but some of its disadvantages have not yet been resolved (David, 2010; Sommer, 2010; Feyaerts et al., 2021). Particularly, a major limitation is that not all types of anomalous experiences can be included or are represented within this framework (Hinterbuchinger and Mossaheb, 2021; Laythe et al., 2021; Woollacott et al., 2021).

A notable example of such perceptions or experiences is the *anticipation of unpredictable stimuli* (AUS) (Radin et al., 2011; Mossbridge et al., 2014; Duggan and Tressoldi, 2018). These are behaviors whereby an individual predicts or identifies future-state stimuli (i.e., have not yet happened) accurately without employing conventional psychological, biological, or perceptual mechanisms recognized by current scientific theories (Mossbridge and Radin, 2018). Informally, AUSs are referred to as "premonitions" or "hunches" (see Radin and Borges, 2009). But actually, AUSs can be viewed as delusional ideations that are consistent with the continuum model of psychosis (Grillon et al., 2008). However, some

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scientific literature suggests that AUSs or premonitions might have an ontological reality (see Bem, 2011; Radin et al., 2011; Storm et al., 2013; Mossbridge et al., 2012; Bem et al., 2016; Cardeña, 2018; Utts, 2018). These studies involved experimentally-blinded participants who guessed the random sequence of a set of images depicting pleasant or unpleasant scenes. Such publications have generated much controversy and criticism that still remains today (see Rabeyron, 2020; Reber and Alcock, 2020). On one hand, if these premonitions were legitimate then there should be active debate about the limits of human perception or consciousness. On the other hand, if premonitions were perceptual aberrations or artifacts, then they should be studied as potential expressions of the continuum model of psychosis (Escolà-Gascón, 2020a, 2022b). In fact, one can also find research that attempted to replicate such significant results and failed (see Robinson, 2011). Despite these unsuccessful replications, research continues to be published with statistical results in favor of AUSs and similar insights (see Sarraf et al., 2021; Watt et al., 2020).

Accordingly, this situation generates a loop between publications in favor or against AUSs but lacking practical application to clinical psychology and psychiatry (see also Escolà-Gascón, 2020b, 2021, 2022b). This issue raises the challenge regarding the value and importance that "AUSs" should have within the context of the psychosis spectrum (see Escolà-Gascón, 2021, 2022b). Thus, the priority is not to check whether or not the results of the AUSs overcame statistical chance in the experimental tests; the essential goal is to investigate and contrast which psychological mechanisms would explain or predict the AUSs (Franklin et al., 2014). In other words, the important goal lies in knowing the clinical variables involved in AUSs and how they affect people (Escolà-Gascón et al., 2021). This research focuses on theories of cognitive reasoning relative to the role of emotions or emotional intelligence.

1.1. Dual process theory (DPT)

DPT is an applied model that allows explaining and distinguishing different thinking styles (see Evans and Stanovich, 2013). There are two types of thinking according to the most general classification of DPT (De Neys, 2021): (a) the intuitive style and (b) the analytical style (or rational style) (see also Pennycook et al., 2015). First, the intuitive style describes a type of reasoning that is defined by being automatic, fast, spontaneous, and efficient (see Evans, 2019). This style is related to instinctive and unintentional behaviors (Alaybek et al., 2021); for this reason, it is also considered as a reasoning that is not controllable (Ross et al., 2017; Pennycook et al., 2018). In contrast, the analytical style is a fundamentally deliberate type of reasoning, which is strategic, slow, logical, and based on working memory (see Raoelison et al., 2020). This way of thinking requires the individual to be aware of the information they perceive and their own behavioral responses, which means that it is a manipulable and controllable style (De Neys and Pennycook, 2019; Escolà-Gascón, 2021).

DPT has been applied and used in the study of psychosis (see the review of Bronstein et al., 2019a,b). Indeed, clinical evidence advocates that intuitive style is positively correlated with and effectively predicts magical ideation (Pennycook et al., 2012; Bronstein et al., 2019a,b). Similarly, patients with psychotic symptoms are known to have deficits in the development of analytic and intuitive thinking (see Green et al., 2000; Nemoto et al., 2009; Haining et al., 2021). Along these lines, other studies also observed that people with high levels of the intuitive style tended to develop more anomalous perceptions versus people using the analytical style (Wolfradt et al., 1999; Zawadzki et al., 2012; Rogers et al., 2018; Pienkos et al., 2019). However, other lines of research contradict the above evidence and posit that thinking styles do not necessarily predict anomalous perceptions per se (Irwin, 2009; Ross et al., 2016, 2017; Evans, 2018). In fact, some evidence suggests that the performance of intuitive and analytical types may be modulated by motivated cognition (see Kahan, 2012; Martel et al., 2020). Motivated cognitions are categories, beliefs, or meanings that influence and bias the performance of different types of reasoning (Mather and Carstensen,

2005; Sood, 2013). For example, people who believe in the existence of paranormal phenomena (as an example of magical ideation) would execute analytical and intuitive reasoning influenced by these acquired beliefs (Rogers et al., 2019; Ross et al., 2019). Therefore, following Irwin's (2009) review between intuitive style and motivated cognition, it is still to be to understood which of the two variables constitutes the antecedent (cause) and the consequence (effects) in the context of anomalous perceptions.

1.2. Emotional intelligence (EI)

A different and alternative perspective was offered by Epstein (1998), who proposed to relate EI to thinking styles (see also Herbst and Maree, 2008). EI is a psychological construct that explains the processes by which people produce, identify, share, and understand emotions related to themselves and others (Salovey and Mayer, 1990). The explanation supporting the association between EI and reasoning styles is based on the assumption that emotions underlie certain automatic responses or behaviors and, thus, may have effects on intuitive reasoning about information (see Epstein, 1998; Murphy and Janeke, 2009; Chaffey et al., 2011; Moore et al., 2012; Li et al., 2021).

However, the relationship between EI and thinking styles is also contested (Megreya, 2013; Murphy, 2013). For example, Locke (2005) does not question that emotions are related to thinking, but emotion itself must be differentiated from the individual's use of emotions (see Mayer and Salovey, 1993 for a revision of the "intelligence" term). Another related problem is that EI can be understood as both a cognitive ability and a psychological trait (Mayer et al., 2008; Fiori, 2009). In fact, depending on how EI is measured, its relationship with thinking styles may be affected (Conte, 2005). For this reason, some studies observed that positive correlations between EI and types of reasoning are significantly reduced when controlling for the mediating effects of the degree of psychological empathy (Korkman and Tekel, 2020). Other research found very low correlations between EI measured as a trait and thinking styles (<0.2) (Baczyńska and Thornton, 2017; Jokić and Purić, 2019; Turan et al., 2019; Sk and Halder, 2020); other publications directly obtained no significant correlations (Hasanpour et al., 2018). The main debate generated by the above findings questions what effects EI and thinking styles (as possible independent variables) have on the production of anomalous perceptions.

1.3. The present study

This research study had two main aims. First, we wanted to determine whether EI levels and thinking styles predict scores on a test of unpredictable stimulus anticipation. This analysis involves differentiating individuals from the general population (without psychiatric history) and individuals with a diagnosis of psychosis. Second, we wanted to examine whether there were significant differences in the levels of EI, thinking styles, and scores on the test of unpredictable stimuli anticipation between individuals with no psychiatric history and patients with a diagnosis of psychosis.

This differentiation was crucial, as typically AUS or anomalous experiences are measured in the clinical setting as self-reported experiences and not as outcomes derived from formal cognitive tests that would assess anomalous experiences as elements of human "cognitions" (see May, 1996; Puthoff, 1996; Utts, 2018). Therefore, we wanted to test the that anomalous experiences, as measured by anomalous cognitions versus self-reported perceptions, would show the same pattern and responses as conventional perceptions or psychotic-like experiences between psychotic participants and healthy participants (as suggested by the continuum model of psychosis). This approach represents a key methodological innovation that motivated this research.

Thus, we conducted two studies. Study 1 addressed the first objective using participants with no psychiatric history. Study 2 addressed our

second objective using participants with no psychiatric history (healthy group) and participants with a psychosis diagnosis (clinical group).

2. Methods

2.1. Participants

2.1.1. Study 1

Our sample consisted of 237 Spanish participants who declared no prior psychiatric history (M_{age} = 25.40, SD = 4.397, range = 18–37 yrs, 50.2% female). Although self-report is a widely used method of collecting information on health status (e.g., Arias-de la Torre et al., 2020), we acknowledge that it was not possible for us to independently confirm the participants' classifications as we lacked access to their medical records, as well as deemed it overly intrusive to request such access or information for our purposes. Participants agreed to participate voluntarily in this study and their personal data were anonymized. Prior to answering the questionnaires, participants signed an informed consent form in which the purposes and conditions of this study were explained.

2.1.2. Study 2

The second study included both clinical and healthy groups. All participants signed an informed consent form and agreed to collaborate completely voluntarily and anonymously. The former (n = 118) comprised 57 males and 61 females (M_{age} = 31.54, SD = 4.314, range = 22–39 yrs) with a diagnosis of paranoid schizophrenia, whom we recruited from four private mental health clinics. These clinics were located in Barcelona and Madrid but remained anonymous to avoid interfering with the flow of new patients or first visits. The patients were in a stable phase of their illness, receiving psychiatric treatment, and had been formally diagnosed with paranoid schizophrenia. The healthy group consisted of 121 participants (corresponding to 51% of 237) randomly selected from the entire Study 1 sample. This group had no previous psychiatric history, and 66 were males and 55 were females (M_{age} = 25.75, SD = 4.43, range = 18–37 yrs) The sample size of this group was leveled with the size of the clinical group to avoid heterogeneous variances of the scores.

2.1.3. Sample collection procedures and inclusion/exclusion criteria

Participants with no self-reported psychiatric history were drawn from the general population and were contacted through social networks (e.g., Whatsapp and Facebook). If the participant indicated on the form that s/he had a psychiatric history, the individual could not start the questionnaire process and was automatically discarded from the data matrix. Therefore, the selection of these participants was non-probabilistic and was performed exclusively online.

In contrast, the sampling used in the non-healthy patients was also non-probabilistic and was based on the collaboration of several hospitals and anonymous clinical centers. In this case, each clinical center had a responsible professional (clinical psychologist or psychiatrist) assigned to perform the data collection. The person in charge at each center made a prior selection of the patients who could be included in this study.

The inclusion criteria for the clinical group were: (a) to have a formal diagnosis of schizophrenia with a margin of seniority and medical follow-up of more than one year and 6 months. (b) to be in a stable phase of his or her illness (with absence of acute psychotic episodes at the time of data collection). (c) to be under continuous psychiatric treatment and supervised by the clinical center s/he was attending. (d) have no cognitive deficits and no formally diagnosed physical disability (e.g., hearing loss). (e) have had no active suicidal ideation and self-harm attempts. (f) have previously presented hallucinatory symptoms (of any sensory modality) either in an attenuated or intense form. For this purpose, we accounted for whether the evaluator specified the type of schizophrenia in the diagnosis and whether the history specified presence/absence of positive symptoms (including magical ideation). (g) to voluntarily consent to participate in this research after being informed of the procedures and conditions.

2.2. General procedures for studies 1 and 2

2.2.1. Design and measurement of premonitory decisions

This research had a *correlational* design. Measurements regarding AUSs were performed using several quasi-experimental trials for each subject. The protocol and procedure for these trials is explained below.

Premonitory decisions data were obtained from the performance of 30 experimental tests for each participant. All trials were conducted online and followed Escolà-Gascón's (2022b) protocol as follows:

(1) *Anticipatory decision* (20 s): the subject had to make a cognitive decision based on two response options (option a) negative content and (option b) positive content. Participants had 20 s to complete this task.
(2) *Transition and image random choice* (15 s): this phase started when the subject had made the anticipatory decision. This transition consisted of the random selection of one of the 20 images by means of the conventional pseudo-randomization command of Microsoft Excel. The selected image was not shown to the subject until the end of the 30 tests.
(3) *Trial end and restart of the procedure*: Before repeating each trial, the participant was asked if s/he was ready for the repetition of the exercise. The participant could leave the experiment whenever desired.

The participants did not have prior access to the information from the *Geneva Affective Picture Database* (GAPED) images and the researcher did not know *a priori* the sequence order of the 30 images, as each one was chosen randomly after the participant's decision. Results were coded as follows: if the content type chosen by the subject coincided with the content type of the randomly selected image, the answer was considered "correct" and +1 point was added. On the contrary, when the contents did not match, +0 points were added. The total score was the sum of the correct answers, which fluctuated between 0 and 30 points.

2.2.2. Development of the procedures

Although the applications were online, the clinics were developed in the company of a professional who guided the patient. The procedure involved six phases: (a) explanation of the conditions and procedures of the investigation; (b) Signing of the informed consent. The participant was informed that s/he could withdraw from participation whenever desired; (c) Explanation of the complete instructions about the AUS-related tests. Participants did not view the images until all data collection protocols were completed. In this way, potential conditioning was avoided and individual responses were independent of each other; (d) Application of the AUS tests; (e) Explanation of the instructions for the participant to answer the two online questionnaires; (f) Application of the questionnaires; and (g) Thank you message once all the tests had been answered. At this point the participant was given the option of viewing the correct images randomly selected by the program. No incidences or problems were found in the execution of these procedures during the development of the research.

2.3. Materials for studies 1 and 2

2.3.1. Geneva Affective Picture Database (GAPED)

Twenty images were randomly selected from The Geneva Affective Picture Database (hereinafter GAPED) (see Dan-Glauser and Scherer, 2011). This is a photographic base that has the same psychometric properties as the IAPS (International Affective Picture System) database, with the difference that the GAPED has an open access license. 10 images showed negative or aversive contents and 10 images presented positive or pleasant contents. The selected positive images were: P018, P052,

P025, P104, P099, P098, P075, P128, P100 and P072 (where P = positives contents). The chosen negative images were: H005, H036, H112, H054, H012, H098, H061, H010, H079 and H102 (where H = negatives contents concerning humans).

2.3.2. Rational-experiential inventory (REI)

Pacini and Epstein (1999) developed this measure to assess both rational (or analytical) and experiential (or intuitive) thinking styles. The REI consists of a total of 40 items distributed in two groups of 20 questions. Each group examines one style of thinking (the rational type and the experiential type). Participants must respond by indicating the degree of agreement on each item using a Likert scale from 1 ("strongly disagree") to 5 ("means "strongly agree"). The two styles of thinking evaluated fit and are based on the dual process theory. It is important to note that in the REI the rational and experiential styles are evaluated as tendencies or psychological traits of the individual and not as cognitive abilities. In this research, the Spanish validation developed by Peñarroja et al. (2016) was used. In relation to the psychometric properties, both the original version and the Spanish version present adequate validity and have reliability indices (based on internal consistency measures) higher than 0.7 (see also Sánchez et al., 2012).

2.3.3. Trait meta-mood scale (TMMS-24)

This self-report questionnaire initially developed by Salovey et al. (1995) for the purpose of examining emotional intelligence. The TMMS-24 considers emotional intelligence as a psychological trait and not as a cognitive ability or skill. Therefore, this test has no right or wrong answers. This questionnaire consists of 24 items that allow measuring emotional intelligence in 3 dimensions: (1) emotional attention, (2) emotional clarity and (3) emotional repair. Each dimension is made up of 8 items in which the participant must indicate his/her degree of agreement with a Likert scale that fluctuates between 1 ("completely disagree") and 5 ("completely agree"). The TMMS-24 has excellent psychometric properties including reliability indices above 0.8 (see Delhom et al., 2017). The Spanish validation developed by Pedrosa et al. (2014) was used in this research.

2.4. Statistical analysis of study 1

In Study 1, the data were computerized and processed with the SPSS® statistical package. The dependent variable was the number of correct scores in the unpredictable stimulus anticipation tests (hereafter hits). The predictor variables were the three dimensions of the TMMS-24 scale: emotional attention (EA), emotional clarity (EC), emotional repair (ER), analytical thinking (AT) and intuitive thinking (IT).

Two types of functions were fitted to estimate the hits: the *quadratic model* and the *exponential model*. The parameter estimation method was the method of *least-squares residual*. Multiple linear regression was not applied for three main reasons: (1) the residuals associated with the dependent variable were not distributed according to the properties of the normal distribution (see Figure 1); (2) the residuals did not present homogeneous variances (see Figure 2); and (3) the forecasts estimated from the linear function yielded negative and inconsistent values.

To test the adequacy of the non-linear functions, the fit of the recounts was tested according to the Poisson probability model (since it belongs to the group of exponential distributions) (see Figure 3; cf. Gardner et al., 1995).

According to the Kolmogorov-Smirnov statistic (= 5.910), the probability that the values of the dependent variable were distributed according to the characteristics of the Poisson distribution was 0.877. The simplest expressions for modeling quadratic and exponential functions are the following:

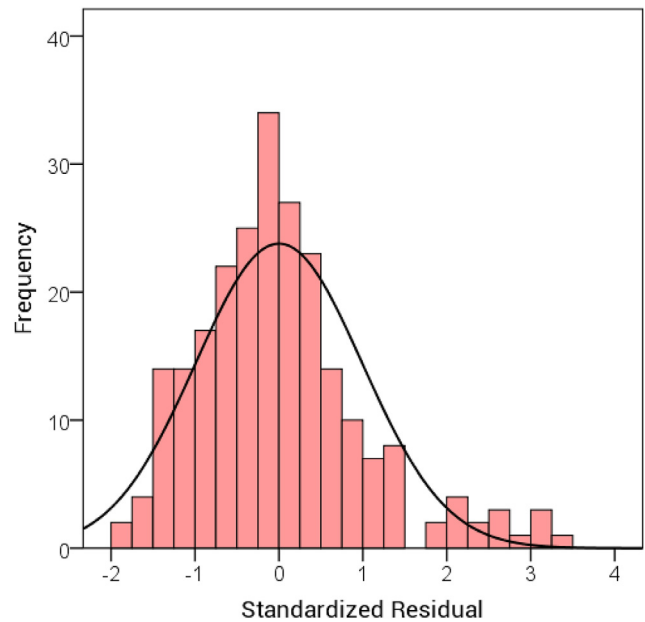$$\widehat{y} = e^{\beta_0 + \beta_1 X_p} \tag{1}$$

Figure 1. Distribution of standardized residuals associated with the dependent variable (the three dimensions of the TMMS-24 were used as predictor variables).

$$\widehat{y} = \beta_0 + \beta_1 X_p + \beta_2 X_p^2 \tag{2}$$

Equation [1] represents the exponential function and [2] is the quadratic. The β_0 are the model constants or intercepts; the β_1 and β_2 are the regression coefficients and represent the model parameters.

2.5. Statistical analysis of study 1

In Study 2, the data were processed using the R programming language and the JASP program (see The Jamovi Project, 2021). We based the statistical analyses on comparisons of scores between the group with no psychiatric history and the group of patients with a diagnosis of
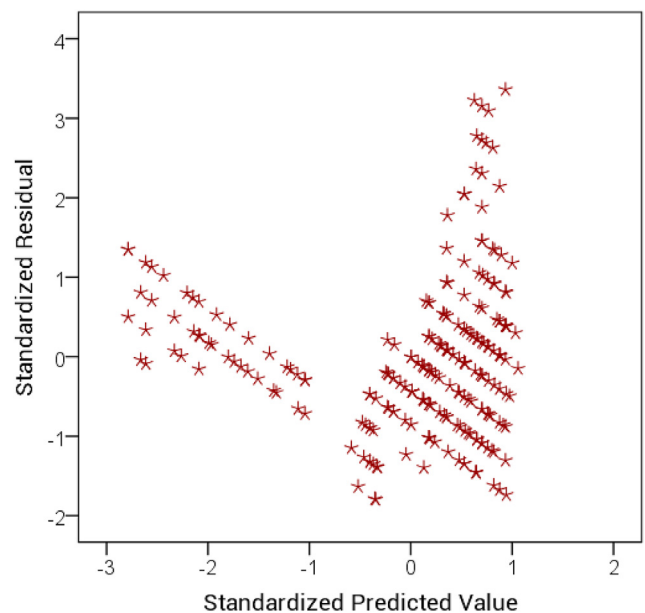

Figure 2. Dispersion plot between the Standardized Residuals and Standardized Predictive Values. As can be seen in this graph, the residuals do not have homogeneous variances.
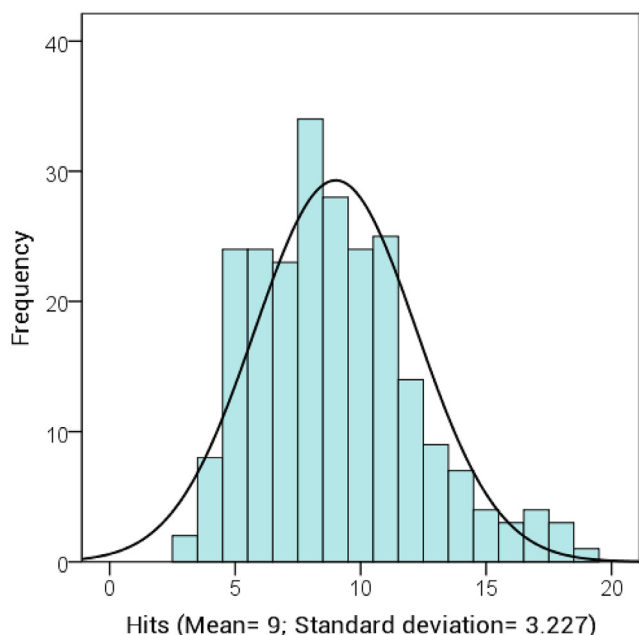
Figure 3. The observed distribution of hits regarding. unpredictable stimulus anticipation tests.

psychosis. Covariances were also calculated between the variables specified in study 1 and exclusively for the group of patients with schizophrenia. This was done to explore whether multiple regression models could be fitted (as was done in study 1 but this time applied only to the group of patients). Student's t-test for independent samples, Mann-Whitney U-test and Bayes Factor (hereafter *BFs*) were applied. The a posteriori probability was estimated for each contrast and the effect size. can be estimated from the *BFs* in favor of the alternative hypothesis (BF_{10}) when the a priori probabilities are adjusted to 50%. The equations are represented mathematically as follows:

$$BF_{10} = \frac{P(D|H_1)}{P(D|H_0)} \propto \frac{BF_{10}}{BF_{10}+1} = P(H_1|D) \qquad (3)$$

where is interpreted as the probability that the distribution associated with the alternative hypothesis reproduces the observed data. In contrast, the BF_{10} in equation [3] is a likelihood ratio and is interpreted as the number of times the data fit the distribution related to the alternative hypothesis for every time the data fit the null hypothesis. When the BF_{10} is greater than 10, it means that evidence in favor of the alternative hypothesis was obtained.

3. Results of study 1 (participants with no psychiatric history, n = 237)

3.1. Descriptive statistics and variance-covariance matrix

Table 1 presents the variance-covariance matrix between the variables included in the model and the descriptive statistics.

According to the covariances obtained, we found that the variables EA, EC and ER were most closely related to the experimental hits. In fact, the TMMS-24 total score should be highlighted, which was the variable with the highest covariance in relation to the hits.

The average value obtained on the hits variable indicated that the results could be obtained by expected chance ($9 < 15_{\text{Average cut-off point}}$; $15 \approx$ 95th percentile). Therefore, the null hypothesis stating the following was maintained: the hits on unpredictable stimulus anticipation tests are adjusted to the mathematical expectation estimated from the 95th percentile ($P_{95} = 15$). However, the observed covariances indicated that

the dimensions of emotional intelligence were positively correlated with the hits. This enabled the application of other nonlinear models to adjust and maximize more precisely the proportion of variance explained (R^2).

3.2. Nonlinear regression models: quadratic and exponential estimations

Quadratic and exponential functions were adjusted and the corrected explained variance of the hits in the stimulus anticipation tests was cleared. The explained variance was obtained by transforming the R^2 statistic adapted to the quadratic and exponential functions. Table 2 summarizes the estimated parameters for each dependent variable.

Following the results in Table 2, both quadratic and exponential functions predicted hits in stimulus anticipation tests more consistently than the linear function. Considering the linear correlation coefficients in Table 1, between 14% and 17% of the explained variance of the hits increased using the exponential and quadratic functions versus the classical linear models. Figures 4, 5, 6, and 7 represent the adjustment of these functions.

The nonlinear functions fitted with these data predicted hits in the unpredictable stimulus anticipation tests between 50.5% and 58.7%. Then, it is possible to infer a quadratic and exponential relationship between the hits and the variables characterizing EI. Thinking styles were not included in the adjusted models, because they did not present high covariances with respect to the hits. Thus, we also concluded that thinking style is neither related to hits nor EI.

4. Results of study 2 (participants with and without schizophrenia, n = 239)

4.1. Descriptive statistics and variance-covariance matrix

Table 3 shows the descriptive statistics for the group of patients with and without schizophrenia. Likewise, in Table 4 the variances-covariances between the variables related to thinking style and emotional intelligence were calculated only for the group of patients with psychosis (n = 118).

As seen in Table 4, the linear correlations in the group of patients with schizophrenia (n = 118) were not significant between the hits and the variables related to emotional intelligence and thinking styles. It is striking that the correlations are significant when the sample used does not present psychiatric antecedents and are not significant when working with patients with a formal diagnosis of psychosis. This point will be assessed in the discussion.

However, if the covariances were different between the clinical and healthy groups, there could also be differences between the means of each of the groups. Therefore, it was decided to perform a comparison of means, which is explained in the following subsection.

4.2. Comparisons between groups of participants with no psychiatric history and participants with a diagnosis of schizophrenia

Table 5 presents the statistical inference on the mean difference. Several measures of effect size were provided.

We found significant differences for all variables except for the measures of intuitive thinking and rational thinking. Considering the averages in Table 3, we thus conclude that participants with a diagnosis of psychosis tend to present lower levels of EI than healthy participants. However, this trend does not hold for hits in the stimulus anticipation tests. In this case, hits tend to be higher in patients with a diagnosis of psychosis. The biserial correlations reinforce these results, i.e., as the participant is healthy (i.e., does not have a psychiatric history), the levels of EI tend to increase. In the case of hits, as the participant is healthy, the number of hits tends to decrease. Therefore, the null hypothesis that EI levels and stimulus anticipation test scores are the same in participants with and without a clinical diagnosis is rejected.

Table 1. Variance-covariance matrix and descriptive statistics for the variables analyzed (n = 237).

	Hits	EA	EC	ER	IT	RT	TMMS-24 total scores
Hits	**10.411**[a]						
EA	12.265 (0.68*)	**30.859**[a]					
EC	12.045 (0.65*)	30.628 (0.961*)	**32.934**[a]				
ER	10.942 (0.63*)	28.437 (0.952*)	28.852	**28.921**[a]			
IT	1.948 (N.S.)	1.885 (N.S.)	1.079 (N.S.)	1.558 (N.S.)	**126.081**[a]		
RT	6.37 (N.S.)	4.025 (N.S.)	0.795 (N.S.)	1.37 (N.S.)	-2.631 (N.S.)	**246.874**[a]	
TMMS-24 total scores	35.252 (0.67*)	89.924 (0.988*)	92.415 (0.983*)	86.210 (0.978*)	4.522 (N.S.)	6.190 (N.S.)	**268.549**[a]
Mean	9	12.26	12.04	10.94	1.95	6.37	83.41
Standard deviation	3.227	5.555	5.739	5.378	11.229	15.712	16.387

Note: EA = emotional attention; EC = emotional clarity; ER = emotional repair.
IT = intuitive thinking; RT = rational thinking; and N.S. = not significant.
a. The variances of the variables are highlighted in bold.
*The parameter differs significantly from "0" (p < 0.01).
Warning: The linear correlation coefficient is given in parentheses for guidance (even if the preconditions are not met). The standardized parameters in Table 2 show that the quadratic and exponential models have a better fit than the linear functions.

Table 2. Regression coefficients and estimated parameters of quadratic and exponential functions (dependent variable = hits).

IV	Adjusted functions	Estimated parameters					Adjusted Explained Variance	Standardized error of estimation	Significance of explained variance
		Constant	Unstandardized		Standardized				
		β_0	β_1	β_2	β_{Z1}	β_{Z2}	R^2	S.E.E.	Fisher's test (p-values)
EA	Quadratic	17.438 (2.746)	-1.379 (0.240)	0.037 (0.005)	-2.374*	3.074*	0.566	2.125	155.101 (p < 0.001)
	Exponential	2.012 (0.160)	0.050 (0.003)	-	0.767*	-	0.587	0.235	336.762 (p < 0.001)
EC	Quadratic	8.196 (2.407)	-0.496 (0.216)	0.018 (0.005)	-0.883	1.546*	0.456	2.380	99.859 (p < 0.001)
	Exponential	2.388 (0.191)	0.046 (0.003)	-	0.725*	-	0.523	0.252	259.788 (p < 0.001)
ER	Quadratic	9.624 (3.010)	-0.636 (0.266)	0.021	-1.060*	1.701*	0.428	2.440	89.424 (p < 0.001)
	Exponential	2.214 (0.194)	0.048 (0.003)	-	0.712*	-	0.505	0.257	241.635 (p < 0.001)
TS	Quadratic	16.335 (2.782)	-0.433 (0.083)	0.004 (0.001)	-2.201*	2.884*	0.533	2.206	135.484 (p < 0.001)
	Exponential	2.101 (0.173)	0.017 (0.001)	-	0.748*	-	0.557	0.243	297.708 (p < 0.001)

Note: IV = independent variable; EA = emotional attention; EC = emotional clarity; ER = emotional repair; and.
TS = TMMS-24 total score.
*The parameter differs significantly from "0" (p < 0.001).
Warning: standardized errors are given in parentheses.

5. General discussion

Our two-part research examined EI, thinking styles, scores on a test of putative premonition, and their relation to stimulus anticipation in participants with and without a psychiatric history. Study 1 found that EI predicted greater than 40% of the variance in premonition scores for healthy participants. Study 2 likewise found some significant differences in EI levels and premonition scores between the participants with and without a psychiatric history. These results suggest several conceptual and practical implications.

5.1. EI, psychoses, and premonitions

Emotional intelligence predicted AUSs in healthy participants, and although these are not necessarily disruptive or intrusive, they may be precursors to psychotic symptoms per the psychosis-continuum model. Indeed, AUSs were more likely to be reported by those with schizophrenia who were likely experiencing other psychotic-related symptoms. These individuals were also more likely to report lower EI and poorer

thinking styles, consistent with the current literature. As such, we would expect a negative correlation between AUSs and EI. However, we observed more AUSs in those with schizophrenia. Evidentially, there could be different predictors, mediators, or pathways for AUSs in those with schizophrenia versus for healthy individuals.

As such, research has identified several important correlates of altered and anomalous experiences, including ambiguity tolerance, aberrant salience, mood, self-esteem, and cognitive processes (Irwin, 2009; Irwin and Watt, 2007); all of which might interact to produce and sustain these experiences in individuals with schizophrenia. Thus, we suspect that EI and thinking skills may be more closely associated with positive symptoms of psychosis (e.g., hallucinations and delusions) compared to more subtle anomalous experiences. Since healthy individuals report fewer AUSs, it is important to identify both significant predictors of these experiences and corresponding methods for intervention.

Our conclusions are consistent with Ross et al. (2017) who found that paranormal attributions for anomalous experiences were related to a low "analytic cognitive style," i.e., the willingness or disposition to critically
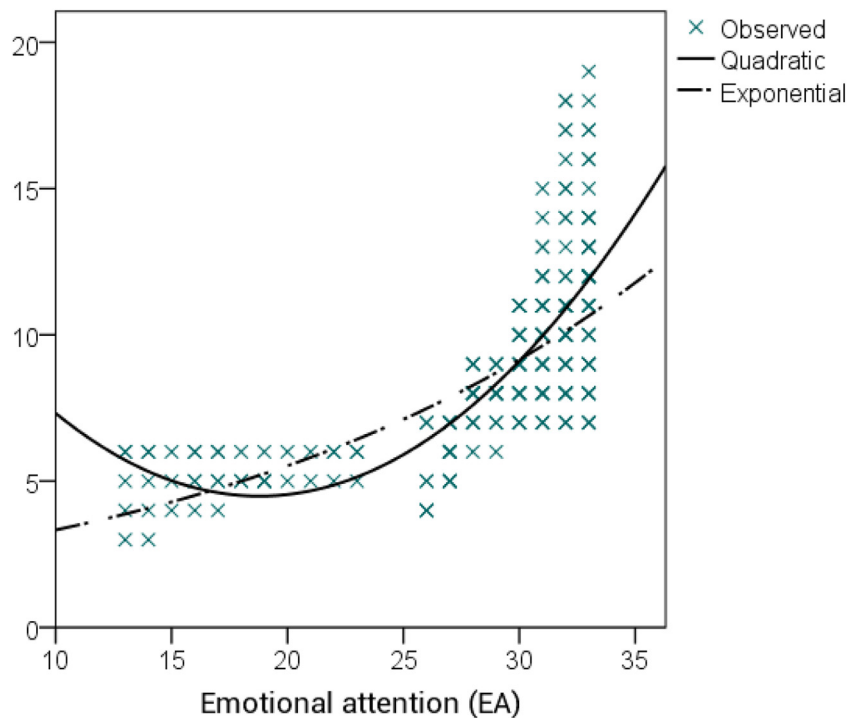
Figure 4. Quadratic and exponential functions for the predictor variable emotional attention.
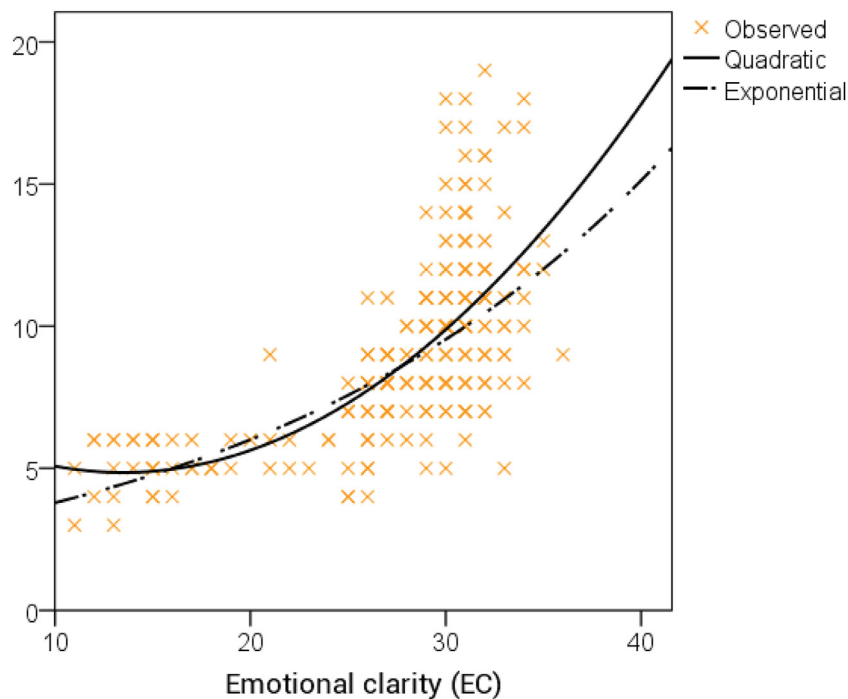

Figure 5. Quadratic and exponential functions for the predictor variable emotional clarity.

evaluate outputs from intuitive processing and engage in effortful analytic processing. Furthermore, these findings help to explain the efficacy of SlowMo digital therapy that aims to reduce automatic thinking and encourage slower, rational thinking styles when coping with paranoia (Garety et al., 2021). Likewise, EI interventions might be useful in the present context. These can include cognitive remediation with emotional intelligence (Eack et al., 2008), combined cognitive remediation with training in emotion perception (Lindenmayer et al., 2013; Peyroux and Franck, 2016), or with broader training in social cognitive skills (Eack

et al., 2007; Eack et al., 2011;Vidarsdottir et al., 2019), recently applied to a youth sample (Burke et al., 2020).

5.2. Anomalous perceptions vs. anomalous cognitions

EI might be a useful and positive variable for modeling psychotic-type experiences and could even be used to discriminate between the altered-anomalous experiences of psychotic vs. nonpsychotic populations. This distinction is important because there are two main ways to measure such
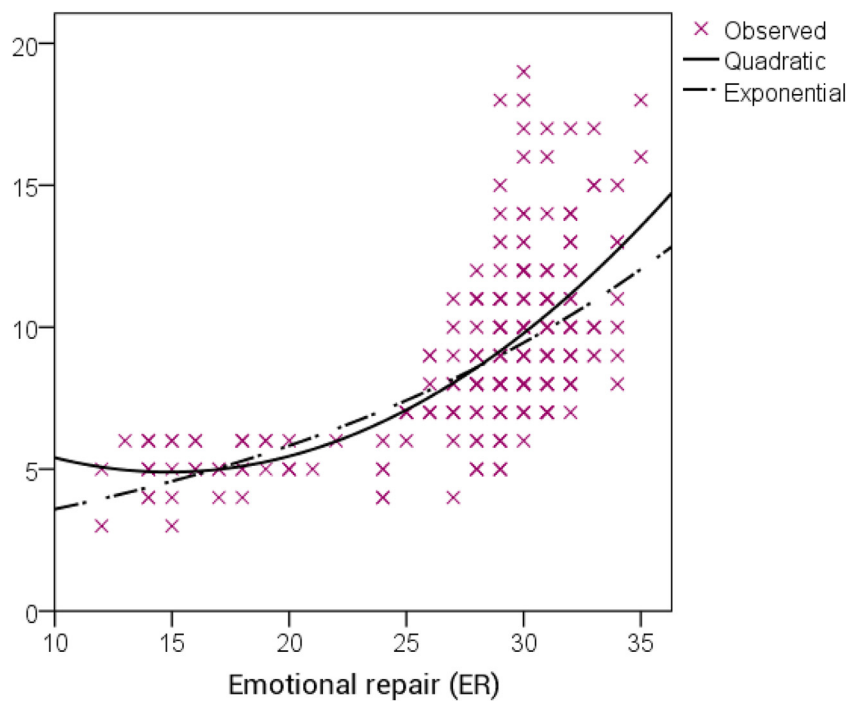
Figure 6. Quadratic and exponential functions for the predictor variable emotional repair.
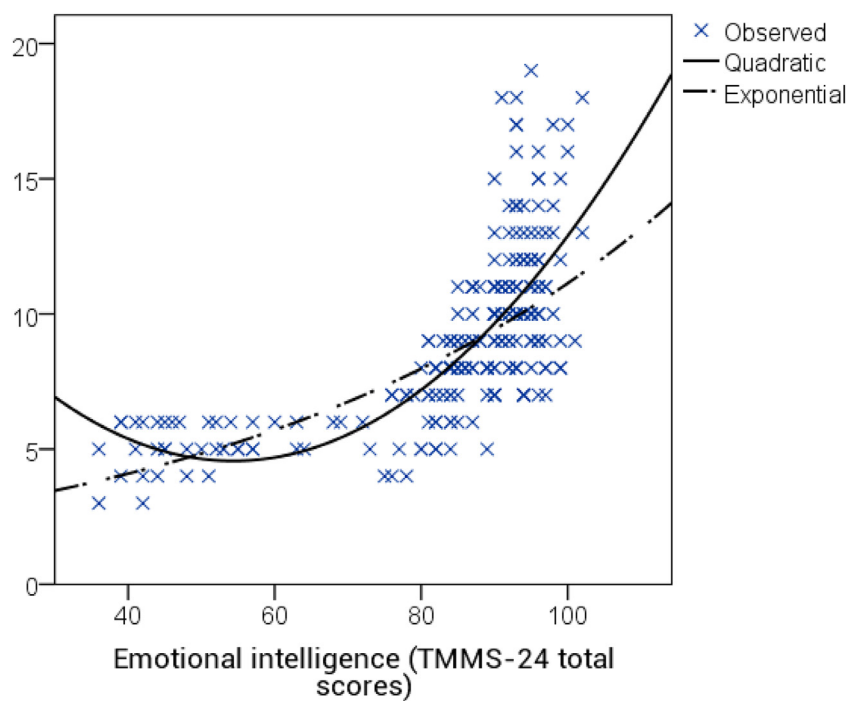

Figure 7. Quadratic and exponential functions for the predictor variable TMMS-24 total scores.

experiences: On the one hand, they can be measured as anomalous cognitions (which would require an experimental or hit-and-miss test; that is the assessment protocol used in this study). Some authors are in favor of excluding anomalous cognitions from clinical models because they consider them phenomena with a different ontology than the classic anomalous experiences or perceptions of psychosis (e.g., Escolà-Gascón et al., 2021). We understand that this is a possibility that should be considered in detail. In this study we wanted to test whether a measure of psychic or anomalous experiences (specifically based on precognition or

AUS), could be present in patients with a psychotic profile and diagnosis in the same way as they are in the general healthy population. The evidence obtained allows us to conclude that anomalous perceptions, measured as anomalous cognitions centered on precognition, are also present in a more intense form in the clinical population as compared to the healthy population. This is a novelty that should be considered in future research that wishes to study the use of anomalous cognitions in the clinical field.

On the other hand, we know that altered-anomalous experiences are measurable and may be understood as perceptions reported from the

Table 3. Descriptive statistics differentiated by groups with and without a diagnosis of psychosis.

	Participants with no psychiatric history (n = 121)		Patients with a diagnosis of psychosis (n = 118)	
	Mean	Standard deviation	Mean	Standard deviation
Hits	9.23	3.492	11.10	3.526
Emotional attention	28.27	5.786	21.81	3.247
Emotional clarity	27.24	5.941	20.65	2.499
Emotional repair	27.55	5.577	20.48	2.349
Intuitive thinking	66.31	11.185	60.58	18.833
Rational thinking	64.26	15.314	61.33	19.037
TMMS-24 total scores	83.07	17.030	62.95	6.271

subjective experience of each participant (self-reported assessment). This is the most frequent typology used in the scientific study of psychotic-type anomalous symptoms. However, we want to point out the difference between anomalous experiences and anomalous cognitions. Specifically, this research strived to innovate in the measurement of anomalous perceptions as possible cognitions, following the logic and original findings of Puthoff (1996), Targ (1996), and May (1996) in their experiments on anomalous cognitions for the Central Intelligence Agency (USA). If anomalous cognitions are more prevalent in psychotic versus healthy individuals, it implies in a clinical sense that anomalous perceptions and anomalous cognitions are related and might even have a similar etiology. However, as mentioned above, future research must test this hypothesis. In addition, the results for anomalous cognitions did not

exceed chance-expectations, and this outcome gives further caution with this hypothesis.

This subsection also underscores the importance of the present study. Namely, anomalous experiences (as a general concept) has been traditionally measured via self-reported anomalous perceptions or symptoms of psychosis. Our research instead provides a cognitive measurement that is a novel way to better understand psychosis. What is innovative is not the precognition experiment itself that has been used for years as an experiment independent of clinic settings (e.g., Bem, 2011; Bem et al., 2016), but rather to apply this approach to the assessment of self-reported anomalous experiences associated with psychotic-type symptomatology. We assert that is the main value of our research, along with the hypothesized relationship between anomalous cognitions and anomalous perceptions.

5.3. An alternative interpretation of prospection and thin boundary functioning

We acknowledge that our findings may perhaps be accounted for by other models. For example, AUSs might be related to prospection-related phenomena that are facilitated via thin (or permeable) boundary functioning (Evans et al., 2019; Houran and Lynn, 2018). Such functioning has been conceptualized in various ways, including (a) Hartmann's (1991) notion of mental boundaries, (b) schizotypy (Claridge, 1997), (c) sensory-processing sensitivity (Aron and Aron, 1997), (d) temporal lobe lability (Persinger and Makarec, 1993), or a general hybrid view exemplified by (e) transliminality (Lange et al., 2019). This latter construct is currently defined as a "hypersensitivity to psychological material originating in (a) the unconscious, and/or (b) the external environment"

Table 4. Variance-covariance matrix of the group of Patients with a diagnosis of psychosis (n = 118).

	Hits	EA	EC	ER	IT	RT	TMMS-24 total scores
Hits	**12.434**						
EA	0.934 (N.S.)	**10.546**					
EC	0.839 (N.S.)	2.747 (0.338*)	**6.246**				
ER	-0.4 (N.S.)	2.732 (0.358*)	3.033 (0.517*)	**5.517**			
IT	2.427 (N.S.)	11.315 (N.S.)	-1.308 (N.S.)	9.459 (0.254*)	**354.689**		
RT	3.923 (N.S.)	-3.365 (N.S.)	-4.363 (N.S.)	-8.332 (N.S.)	-29.477 (N.S.)	**362.411**	
TMMS-24 total scores	1.373 (N.S.)	16.025 (0.787*)	12.025 (0.767)	11.281 (0.766*)	19.466 (N.S.)	-16.06 (N.S.)	**39.331**

Note: EA = emotional attention; EC = emotional clarity; ER = emotional repair.
IT = intuitive thinking; RT = rational thinking; and N.S. = not significant.
a. The variances of the variables are highlighted in bold.
*The parameter differs significantly from "0" (p < 0.01).
Warming: The linear correlation coefficient is given in parentheses for guidance (even if the preconditions are not met).

Table 5. Comparisons between groups of participants with and without a diagnosis of psychosis.

	Student's t test (Frequentist inference)		Bayesian inference		Hedges' g[a]	Rank-biserial correlation	Confidence interval for Rank-biserial Correlation (99%)	
	Welch's t	U test	BF₁₀ (% error)	P(H₁|D)			Lower	Upper
Hits	-4.119* (236.712)	4,724*	351.895 (1.797)	≈1	0.531	-0.338*	-0.497	-0.158
Emotional attention	10.675* (189.732)	11,928*	27.987 (0.381)	0.9655	1.372	0.671*	0.551	0.764
Emotional clarity	11.220* (162.023)	12,085.5*	23.969 (≈0)	0.9599	1.441	0.693*	0.579	0.780
Emotional repair	12.829* (162.125)	12,138.5*	29.792 (≈0)	0.9675	1.647	0.700*	0.588	0.786
Intuitive thinking	2.846 (189.479)	8,708	6.524 (≈0)	0.8670	0.368	0.220	0.031	0.394
Rational thinking	1.307 (224.208)	7,712.5	0.318 (≈0)	0.2412	0.169	0.080	-0.112	0.267
TMMS-24 total scores	12.175* (152.668)	12,113*	26.662 (≈0)	0.9638	1.563	0.697*	0.584	0.783

Note: *p < 0.001.
a. These results are in absolute values.
Note: The biserial correlation is a transformation of Pearson's linear correlation coefficient based on the ranks of the dependent variables. This index indicates the degree of relationship between having or not having a psychotic disorder and the dependent variables of the model.

(Thalbourne and Maltby, 2008, p. 1618). As such, heightened transliminality has been linked to many anomalous or altered experiences (Evans et al., 2019), including future-oriented perceptions like premonitions (Lange and Houran, 2013) and intuitive thinking (or "sudden knowing," e.g., Lange and Houran, 2010).

Accordingly, a psychosis model might be less relevant to AUSs than the notion of mental boundary functioning and its associated continuum within the general population along which normal and extraordinary forms of perception and cognition can be mapped (Cardeña and Alvarado, 2014; Claridge, 1990, 1997; Hewitt and Claridge, 1989; Johns et al., 2002; Peters et al., 1999, 2000; Posey & Losch, 1983–1984; Prentky, 1989). To be sure, healthy individuals with higher EI (or greater emotional sensitivity) can be construed as having more permeable mental and social boundaries (Hartmann, 1991; Houran et al., 2003), which could help to account for their AUSs. On the other hand, our sample of individuals with schizophrenic might have scored lower on EI due to compromised social acuity from substantially looser boundary functioning (Evans et al., 2019). Thus, a ripe area for future research would be to explore AUSs using other measures of thin boundary functioning (e.g., Chapman and Chapman, 1980; Houran et al., 2003; Lange et al., 2000) rather than assessments or diagnoses of psychopathology per the disease model.

5.4. Limitations

Our findings and conclusions are tempered by several limitations. First, there is the nature of the samples used here. We adopted a cross-sectional design that narrowly focused on EI and thinking styles versus a wider array of perceptual-personality variables. Moreover, our clinical sample ostensibly was in a stable phase of illness, and their treatment protocols or inherent coping mechanisms may be confounding factors here. Lastly, we did not assess other psychotic experiences. Future studies should, therefore, aim to incorporate all aspects of altered-anomalous experiences to identify specific predictors across sub-groups.

Second, there are methodological constraints that limit the validity and generalizability of the results. Our correlational and quasi-experimental approach (i.e., we used participants with no psychiatric history as a reference control group) means that the inferences and conclusions of the study do not have causal value and are exclusively focused on statistical associations, which would recommend new studies involving strict experiments. Therefore, valid evidence is provided here but only in terms of statistical effects. The generalizability of our results is also another important point related to external validity. The sample size was sufficient for the analyses applied, but replications are needed to confirm the provocative conclusions and implications of this research. Scientific innovation is necessary, but process models also require replicable results that provide consistent, cumulative scientific evidence (see the statistics manual published by McGraw-Hill by Escolà-Gascón, 2022c). This perspective is especially important when dealing with clinically-oriented research.

5.5. Main conclusions

We substantiated AUSs as anomalous experiences pertinent to cognitive processes of both healthy and psychotic samples. It remains unclear why EI and thinking styles differentially predict AUSs across these two groups, but we expect that premonitions are closely linked to prospection phenomena that are mediated or moderated by thin (permeable) mental boundaries. This hypothesis can work within either (a) the psychosis-continuum model (Chapman and Chapman, 1980; Capra et al., 2013; Kwapil et al., 2020) or (b) outside the disease model of anomalous experience per a transliminality model (Evans et al., 2019; Houran et al., 2003; Lange et al., 2019). Consequently, further research is needed to clarify the cognitive-affective predictors or components of AUSs so that their relationship to altered neurological functioning can be understood and managed on conceptual and clinical levels.

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