Universidade de Aveiro
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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Psicologia da Saúde e Reabilitação Neuropsicológica, realizada sob a orientação científica da Doutora Sandra Cristina de Oliveira Soares, Professora Auxiliar do Departamento de Educação e Psicologia da Universidade de Aveiro, e Doutor Nuno de Sá Teixeira, Professor Auxiliar Convidado do Departamento de Educação e Psicologia da Universidade de Aveiro

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Acknowledgement

À professora Sandra pela partilha de conhecimentos e ajuda ao longo deste último ano, foi um privilégio ser orientada por si.

Ao professor Nuno, por toda a disponibilidade e ajuda. Mas principalmente pela tranquilidade que conseguia sempre transparecer, e claro, pelo humor à mistura.

À Joana, por todo o apoio e toda a paciência ao longo de todo o processo, mas especialmente por toda a compreensão, é bom sentir que não estamos sozinhos.

A toda a minha família que tornou isto possível e sempre me apoiou, em especial à minha mãe, ao André, à avó Conceição e à Madrinha.

Às meninas de sempre, Adriana, Eunice e Ramalho obrigada por ouvirem todas as reclamações ao longo destes anos e pelas visitas míticas a Aveiro.

E porque o que fez destes os melhores cinco anos foram as pessoas que por sorte ou por obra do destino tive o privilégio de me cruzar, a todos os que me receberam nesta casa e me acompanharam, em especial à Tânia, à Valadares e à Sarmento.

Aos que partilharam as dores desta etapa que agora termina, mas também fizeram a proeza de as tornar menores, agora partilhamos a vitória, ao Sérgio, à Bia e à Eva.

Aos meus três meninos, Afonso, Gusta e Sosá, o meu percurso não seria tão completo e feliz sem vocês.

Ao João, a pessoa que mais paciência teve de ter durante este processo longo, prometo que daqui para a frente não falo mais da tese.

Por fim, a todos os colegas e professores que se cruzaram comigo e de alguma forma contribuíram para este percurso maravilhoso.

palavras-chave

Traços de Esquizotipia; Momento Representacional; Faces Dinamicas; Esquizofrenia; Processamento de Emoções.

Resumo

A perceção de faces emocionais é crucial nas nossas interações sociais quotidianas. Alguns estudos demostraram uma associação entre a perceção de faces emocionais e traços esquizotípicos, uma estrutura de personalidade que se assemelha aos sintomas positivos, negativos e desorganizados da esquizofrenia. No entanto, apesar das faces estarem constantemente em movimento no mundo real, a maioria dos estudos ainda utiliza faces emocionais sem movimento. Além disso, existem evidências de que é possível antecipar o estado emocional imediato dos outros com base na história preceptiva das suas expressões faciais. Essa "antecipação emocional" pode ser explicada por um fenômeno percetual denominado de Momento Representacional (MR), no qual o deslocamento de um evento dinâmico é sistematicamente deslocado para frente, para o futuro imediato. Neste estudo, o nosso objetivo foi investigar o efeito dos traços esquizotípicos na antecipação emocional em faces emocionais dinâmicas, tendo por base a literatura sobre o RM. Indivíduos saudáveis realizaram uma tarefa de julgamento de um conjunto de faces dinâmicas de avatares, que começavam com uma expressão totalmente raivosa ou alegre para uma expressão ambígua. Cada face dinâmica foi seguida por uma sonda representando a mesma expressão da imagem final da sequência (ambígua) ou uma levemente alterada para maior alegria/raiva. Os participantes indicaram se a sonda era igual ou diferente da imagem final da sequência. Os participantes foram divididos em dois grupos pela mediana do Questionário de Personalidade Esquizotípica (QPE). A variável dependente foi a direção do viés, calculada como a média ponderada da proporção de respostas iguais, com valores positivos indicando viés positivo (ou MR). Nós hipotetizámos que o grupo com pontuações superiores no QPE mostraria um MR maior do que o grupo com pontuações menores no QPE, particularmente para faces que variavam de alegres para ambíguas, sugerindo uma perceção enviesada de ameaça em estímulos ambuíguos no contínuo psicótico. Os resultados não mostraram efeito do QPE e, portanto, a nossa hipótese não foi suportada. Isso pode indicar que os traços esquizotípicos não estão associados a uma antecipação emocional exagerada. Ainda assim, os nossos resultados devem ser interpretados com cautela devido à amostra recrutada e ao uso de medidas de autorrelato. Estudos futuros são necessários para entender se o MR para faces emocionais dinâmicas está intacto em todo o continuum psicótico (inclusive na esquizofrenia) ou apenas a um nível subclínico.

keywords

Schizotypal Traits; Representational Momentum; Dynamic Faces; Squizophrenia; Emotional Processing;

Abstract

The perception of emotional faces is crucial in our everyday social interactions. Some studies have shown an association between the perception of emotional faces and schizotypal traits, a personality structure that resembles the positive, negative, and disorganized symptoms of schizophrenia. However, despite faces being constantly in motion in the real world, most studies still use static emotional faces. Additionally, there is evidence that it is possible to anticipate the immediate emotional state of others based on the perceptual history of their facial expressions. This “emotional anticipation” can be explained by a perceptual phenomenon named *representational momentum* (RM), in which the offset of a dynamic event is systematically displaced forward, into the immediate future. In this study, we aimed to investigate the effects of schizotypal traits on emotional anticipation for dynamic emotional faces, by taking advantage of the RM framework. Healthy individuals performed a probe judgment task with a set of avatar faces changing from a fully angry or happy expression towards an ambiguous expression. Each dynamic face was followed by a probe depicting the same expression as the final picture of the sequence (ambiguous) or one slightly changed to greater happiness/anger. Participants indicated if the probe was equal to, or different from, the final picture of the sequence. Participants were divided into two groups by median split of the Schizotypal Personality Questionnaire (SPQ). Dependent variable was the direction of bias, calculated as the weighted mean of the proportion of equal responses, with positive values indicating forward bias (or RM). We hypothesized that high SPQ group would show a stronger RM than low SPQ, particularly for Happy-to-Ambiguous faces, in line with an increased tendency to perceived threat in ambiguous stimuli in the psychotic-continuum. Results showed no effect of SPQ and, therefore, our hypothesis was not supported. This may indicate that schizotypal traits are not associated with an exaggerated emotional anticipation. Still, our results should be interpreted with caution due to the recruited sample and use of self-report measures. Future studies are needed to understand if RM for dynamic emotional faces is intact across the psychotic-continuum (including in schizophrenia) or solely at a subclinical level.

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Introduction

Schizophrenia (SZ) is a severe psychiatric disorder, marked by cognitive impairments (Tripathi et al., 2018) and a complex network of disorganized, positive (e.g., hallucinations, delusions), and negative symptoms (e.g., avolition, anhedonia) (American Psychiatric Association, 2013). Moreover, social cognitive impairments have been considered a core feature of SZ (Green et al., 2015). These are correlated with poor functioning outcomes (Halverson et al., 2019), are presented in the early stages of the disorder (Healey et al., 2016), and are resistant to antipsychotic medication (Kucharska-Pietura & Mortimer, 2013). Hence, a broader comprehension of social cognitive deficits in SZ is critical for developing psychological interventions (Green et al., 2015).

Social cognition is defined as "the psychological processes that are involved in the perception, encoding, storage, retrieval and regulation of information about other people and ourselves" (Green et al., 2015, p. 1). Four major social cognitive domains are established in the SZ literature: emotion processing, social perception, theory of mind, and attributional style/bias (Pinkham, 2014). Emotion processing is the perception of emotional information, such as emotional facial expressions, and the management and regulation of emotions. Social perception refers to the integration of social and contextual knowledge to decode and interpret social cues. Theory of mind (also known as mentalizing, mental state attribution, or cognitive empathy) is the ability to infer about the intentions, dispositions, emotions, and/or beliefs of others. Lastly, attentional style/bias is defined as the way individuals interpret, explain, and/or make sense of the positive and negative social experiences they came across in life.

Of foremost relevance to the present study, SZ patients exhibit large and consistent deficits in emotion processing, particularly in recognizing and discriminating emotional facial expressions (Kohler et al., 2010; Savla et al., 2013). For instance, behavioural studies showed that SZ patients tend to misattribute anger or fear to neutral faces (Habel et al., 2010; Kohler et al., 2003; Pinkham et al., 2011; Premkumar et al., 2008). This aligns with the predominant threat appraisal experienced in psychosis (Underwood et al., 2016), especially in social context (Veling et al., 2016). Since being able to perceive others' emotional state is critical for an emotional communication, an aberrant processing of emotional faces can negatively affect patients' social behaviour, thus contributing to a cascade of socioemotional difficulties (Hooker & Park, 2002). In addition, deficits in emotion processing have been considered a potential

endophenotype of SZ, as they can be observed (although less severely) in unaffected first-degree relatives (Allott et al., 2015), clinical high-risk for SZ (Allott et al., 2014) and schizotypy (Zouraraki et al., 2022).

Schizotypy was first described as a manifestation of genetic risk of SZ and is defined as a personality structure characterized by psychological factors that resemble positive, negative, and disorganized symptoms of SZ (Ettinger et al., 2014; Meehl, 1989; Nelson et al., 2013). Literature seems to acknowledge a 3-factor structure for schizotypy, similarly to SZ: 'cognitive-perceptual' (or 'positive schizotypy'), which involves experiences like perceptual alterations and unusual thoughts, corresponding to hallucinations and delusions in SZ, respectively; 'interpersonal' (or 'negative schizotypy'), characterized by difficulties in emotional and social functions, such as loss of pleasure and lack of desire to engage in social contacts; and 'disorganized', which consists of deficits in thought process and behaviour issues (Ettinger et al., 2014). Importantly, there is evidence that SZ and schizotypy overlap on some genetic, cognitive, neurobiological, and psychosocial levels, thus supporting the assumption of a continuum of psychosis, ranging from low schizotypal traits in the general population to the clinical manifestation of SZ (in some extreme cases or under adverse environmental factors) (Nelson et al., 2013). In fact, although schizotypy alone does not equal a SZ diagnosis, some studies showed that healthy individuals with high schizotypal traits have an increased risk of developing a psychotic disorder (Debbané et al., 2015). Hence, the study of schizotypy in the general population has gained increased attention because it can provide critical knowledge into the mechanisms underlying the clinical manifestation of SZ while eliminating clinical cofounders, namely medication side-effects, comorbidities, chronical hospitalization, and psychomotor slowing (Barrantes-Vidal et al., 2015; Ettinger et al., 2014).

Despite few authors reporting no effect of schizotypal traits (van't Wout et al., 2004; Toomey & Schuldberg, 1995; Waldeck & Miller, 2000), most studies seem to suggest a significant association between schizotypal traits and emotion processing (e.g., Dawes et al., 2021; Fusar-Poli et al., 2022; Yan et al., 2020). For instance, individuals with high schizotypal traits experience more difficulties in emotion recognition paradigms than individuals with low schizotypal traits (Brown & Cohen, 2010; Morrison et al., 2013). In a recent study, Uono et al. (2021) asked healthy individuals to detect, among a crowd of static neutral faces, normal facial expressions of happiness/anger or their anti-expressions (i.e., facial expressions in which the facial

feature displacement is similar in magnitude but opposite in direction in relation to their corresponding expressions). They found that schizotypal traits – evaluated with the Schizotypal Personality Questionnaire (SPQ; Raine, 1991) – were negatively correlated with the effectiveness for detecting normal *versus* anti facial expressions. The authors proposed that individuals with high schizotypal traits failed to detect emotional faces in a privileged manner, which can be explained by an exaggerated attribution of (emotional) salience to non-salient stimuli (Uono et al., 2021). This also aligns with the study by Yan et al. (2020) demonstrating a positive correlation between schizotypal traits and right posterior superior temporal sulcus activation during neutral face processing, but not emotion recognition or affective theory of mind. Having this in mind, it is possible that, as in SZ, schizotypy is associated with a vulnerability to put emotional meaning into non-salient stimuli, such as neutral or ambiguous facial expressions, but further studies are needed. Moreover, little is known about the effects of schizotypal traits in the perception of dynamic emotional faces (Zouraraki et al., 2022).

In the real world, human faces are constantly in motion, displaying dynamic cues of verbal and non-verbal communication, gaze, and emotional state (Dobs et al., 2018; Krumhuber et al., 2013). Remarkably, however, most studies on emotion processing only use static faces, which decreases their ecological validity. Additionally, there is evidence that humans can anticipate others' emotional state based of subtle changes in their facial expression (Jellema et al., 2011; Marian & Shimamura, 2013; Palumbo & Jellema, 2013). For instance, a series of studies showed that neutral faces that began with a happy or angry expression are rated as slightly angry or happy, respectively, which suggests a bias towards the most likely future emotional expression (Jellema et al., 2011; Palumbo et al., 2015, 2018; Palumbo & Jellema, 2013). According to the authors, their findings reflect emotional anticipation mechanisms, i.e., anticipation of others' emotional state based on the immediate perceptual history of their facial expression. Nevertheless, this effect can also be explained by *representational momentum* (RM).

RM is a perceptual phenomenon related to motion, in which the offset of a moving target is systematically displaced further into the immediate future, in the direction of anticipated motion (Freyd, 1987; Freyd & Finke, 1984; see Hubbard, 2010, 2014). Freyd (1983) provided the first description of RM. In this study, participants were briefly presented to a frame of an action sequence (e.g., person jumping). After a

retention interval, a second frame of the same action sequence was shown, either representing a before (backward) or an after (forward) timepoint. Participants were asked to discriminate if the second frame was 'equal to' or 'different from' the first frame (Probe Judgement Task). When the pair was given in forward than backward temporal order, participants took significantly longer to accurately discriminate that the second frame differed from the first frame. According to the authors, these findings represented an increased difficulty to reject director stimuli in forward condition (Freyd, 1983).

Since this first study, several theoretical models of RM have been proposed. These cover a range of possible explanations, including mental representations of physical properties related to motion (as the case of *momentum* or 'mass in motion', defined as the product of the object's mass and velocity), low-level factors (mostly related to vision, such as oculomotor behavior, aftereffect, and perceptual adaptation), beliefs regarding physical systems and objects in motion (such as extrapolation and implicit knowledge), and a combination of all (see Hubbard, 2010). In spite of the lack of consensus on the 'best' theoretical model, RM is believed to compensate for the delays in sensory and motor systems (Hogendoorn, 2020).

It has been demonstrated that RM is influenced by characteristics of the target (e.g., velocity, distance, eccentricity, mass, modality), display (e.g., target's surface, retention interval, contrast between target and background, prior probabilities), context (e.g., nontarget stimuli, visual scenes, cross model information, gravity), and even observer (e.g., expertise, psychopathology) (for a theoretical review see Hubbard, 2014). With respect to the observer's characteristics, only a few studies looked at the psychotic-continuum. Jarrett et al. (2002) showed that RM for SZ patients and healthy individuals with high schizotypal traits tended to be exaggerated in contrast to healthy individuals with low schizotypal traits (although no statistical significance was reached). In this study, a static image implying motion (freeze-frame) was shown, followed by a probe. The probe could be representing the same, a future, or a past instant of the first image. Participants were asked to provide an equal/different judgment. Although caution is needed due to small sample size, the authors suggested this potential exaggerated RM in SZ and high schizotypal traits may be explained by a failure to inhibit the automatic process of motion extrapolation. In another study, Vettise (2012) found a positive correlation between RM magnitude and SPQ score for disorganized factor in healthy individuals, but not for perceptual-cognitive factor (in

opposition to their hypothesis). Later, De Sá Teixeira et al., (2013) found that target's velocity had no effect on RM for SZ patients, contrary to healthy individuals. In this study, participants were shown a moving square (target) which suddenly disappeared and were asked to indicate the final location by displacing a cursor with a mouse. A wide gamut of velocities was used to estimate the slopes of the individual psychophysical functions for RM magnitude. For SZ patients, the slopes were not significantly different from 0, contrary to those found for the control group, which may reflect abnormal motion processing in SZ, with a possible link to eye tracking abnormalities. Since these studies are scarce and utterly different in terms of response modality, stimuli type, and population, a direct comparison between them is difficult. Furthermore, these studies do not address RM for socioemotional events.

There is strong evidence that RM also occurs for socially relevant events (Dozolme et al., 2018; Greenstein et al., 2016; Hudson et al., 2009; Hudson & Jellema, 2011; Jellema et al., 2011; Palumbo et al., 2018; Palumbo & Jellema, 2013; Prigent et al., 2018; Senior et al., 2018; Uono et al., 2014; Yoshikawa & Sato, 2008). For instance, Greenstein et al. (2016) found that the final position of a ring moving toward a stationary dot was strongly displaced forward in the direction of motion when stimuli were preceded by a threatening vignette (e.g., the ring was an assailant holding a weapon and moving toward the victim) than a neutral vignette (e.g., the ring was a person holding a sandwich). This suggests that RM is stronger for threatening stimuli, which may be related to an evolutionary relevance of anticipating a potential hazard in the environment. Concerning emotional faces, Yoshikawa & Sato (2008) presented human faces gradually changing from neutral to emotional expressions, followed by static probes, and asked participants to adjust probes' facial expression to match the final facial expression of the dynamic sequences. The authors found that probes were systematically adjusted to more intense facial expressions, regardless of the emotional category, and that this was proportional to velocity – an effect typically observed in RM (e.g., Hubbard, 2005; Hubbard & Bharucha, 1988). A similar forward bias was reported by Courgeon et al. (2010) using a probe judgment task with neutral-to-emotional avatar faces; however, this effect was only reported in sequences ending with lower emotional intensity, whereas higher intensity resulted in a backward bias (an effect opposite to RM). Additionally, the authors showed that the amplitude of perceptual bias dependent on the emotional category, with anger, disgust, fear, and surprise producing an 'emotional momentum'.

To our knowledge, RM for emotional faces has not yet been investigated in SZ. Moreover, studies focusing of the perception of dynamic emotional faces in schizotypal traits are still insufficient (Abbott & Byrne, 2013; Huang et al., 2013; Uono et al., 2015). In a study by Uono et al. (2015), healthy individuals were presented to neutral-to-happy and neutral-to-fearful human faces ending with 52%, 80% or 108% intensity. The authors found that schizotypal traits – also measured with SPQ – were positively correlated with an increased tendency to exaggerate the intensity of the final facial expression of dynamic sequences, irrespective of the emotional category. Similarly, this effect was observed for static faces, which seem to indicate that schizotypy is associated with exaggerated emotion processing in general, rather than exaggerated RM for socioemotional events. Still, given that RM seems to be stronger for dynamic emotional faces ending in lower intensity (Courgeon et al., 2010), it could be that showing dynamic emotional faces changing towards a neutral or ambiguous expression will magnify the difference between 'high' and 'low' schizotypal traits in terms of emotional anticipation.

Having this in mind, in the present study (part of a preregistered project) we aimed to investigate RM for dynamic emotional faces in schizotypal traits. For that, we created a probe judgment task with dynamic ambiguous faces (depicting 50% of happiness and 50% of anger) of male and female avatars that began with a fully angry expression (henceforth Angry-to-Ambiguous) and happy expression (henceforth Happy-to-Ambiguous). Ambiguous faces were used as endpoint instead of neutral faces to generate a more ecologically valid transition between anger and happiness, as 'real' faces typically portrait features of multiple emotions rather than a single emotion or 'blank' neutral expression (Aviezer et al., 2008; Hassin et al., 2013). After each dynamic sequence, a 250 ms mask was exhibited, followed by a probe of the same avatar, depicting either the same facial expression (i.e., ambiguous facial expression) or one slightly displaced towards an angry/happy expression by one, two or three frames. Participants were asked to indicate whether the probe's facial expression was 'equal to' or 'different from' the final facial expression of the dynamic sequence. On the one hand, if participants show a tendency to make 'equal' judgments in probes that depict an emotional state after the endpoint of the dynamic sequence, in the direction of anticipated motion (e.g., a slightly angrier probe in happy-to-ambiguous condition), there is a forward bias, consistent with RM. On the other hand, if this tendency occurs

for probes showing a previous emotional state (i.e., a slightly happier probe in Happy-to-Ambiguous condition), there is a backward bias, opposite to RM.

Schizotypal traits were assessed with SPQ and participants were divided into high SPQ and low SPQ by a median split of the total score to investigate group differences (Ahn et al., 2020). Firstly, we hypothesized a main effect of Emotion, demonstrating a stronger RM in Happy-to-Ambiguous (i.e., facial expressions changing toward anger) than Angry-to-Ambiguous conditions (i.e., facial expressions changing toward happiness). This is consistent with a biological advantage to anticipate the location or action of a potential threat (Greenstein et al., 2016). Secondly, we expected to find a significant interaction between Group and Emotion, such that the high SPQ group (compared to the low SPQ group) would show a stronger RM in Happy-to-Ambiguous conditions, which could be explained by an increased tendency to anticipate threat in ambiguous social events in psychosis-proneness (Underwood et al., 2016; Veling et al., 2016). Hypotheses were preregistered and can be found at OSF (https://osf.io/pbacf).

Methods

Sample Size Justification

Sample size was preregistered using a simulated power analysis in ANOVA_Power Shiny App (Lakens & Caldwell, 2021), with 2000 simulations and an alpha-level of .05. We defined a mixed 2 × 2 design with Group (high SPQ, low SPQ) as between-subjects factor and Emotion (Happy-to-Ambiguous, Angry-to-Ambiguous) as within-subjects factor. We were interested in the group × emotion interaction. Assuming the high SPQ group would have a mean of 0.45 in Happy-to-Ambiguous and -0.1 in Angry-to-Ambiguous, while the low SPQ group would have a mean of 0.2 in Happy-to-Ambiguous and 0.1 in Angry-to-Ambiguous, we would need 52 participants per group (N = 104) to achieve 81.05 power for the three-way interaction.

Participants

Participants were recruited from the University of Aveiro and nearby community. Recruitment was made through social media platforms. Participants were all Portuguese speakers, aged between 18 and 40 years, and with normal or corrected-

to-normal vision. Exclusion criteria were a) failure to understand instructions and procedures, b) self-report of medical or neurological disorders that may affect brain function (e.g., history of seizures, head trauma with unconsciousness for > 15 min), c) formal diagnosis of mental disorders, d) formal diagnosis of psychotic disorders in biological first-degree relatives, e) and current psychotropic medication intake. A total of 114 participants (81 women, 71.05%) were recruited. Of those, 5 were excluded for having a diagnosis of mental disorder, 3 for not completing the questionnaires, 1 for not understanding the instructions, and 1 due to software errors. Final sample included 104 participants (73 women, 70.19%), aged between 17 and 39 (M = 21.48, SD = 4.18). Sociodemographic, psychological, and cognitive characterization is described in Table 1 (Attachment A).

All procedures were approved by the Ethics Committee of the University of Aveiro (03-CED/2020) and conducted in accordance with the guidelines of the Declaration of Helsinki and the American Psychological Association. Participants received either course credits (Psychology students) or a stamp for a 5€ voucher in return for participation.

Materials

Lab Equipment

Experimental tasks were programmed in, and displayed with, PsychoPy3 (Peirce et al., 2018), and stimuli were presented on an LG 24GL650-B monitor (1920 × 1080 pixels resolution, 100 Hz refresh rate). Behavioral responses were given through a standard QWERTY keyboard. Data from self-report instruments were collected in Limesurvey (forms.ua).

Psychological Assessment

Schizotypal Personality Questionnaire (SPQ). The SPQ is a self-report questionnaire developed by Raine (1991) to screen community populations for schizotypal traits. It contains 74 items with dichotomous response format (yes/no), distributed across nine dimensions that can be merged into three factors based on the three-factor model of schizotypy (Raine et al., 1994): cognitive-perceptual (ideas of reference, odd beliefs or magical thinking, unusual perceptual experiences, and suspiciousness), interpersonal (social anxiety, no friends, constricted affect, and suspiciousness), and disorganized (odd or eccentric behavior, and odd speech). Total,

dimension, and factor scores are the sum of 'yes' responses. Total score ranges from 0 to 74, with higher scores indicating higher schizotypal traits. In the present study, we applied the Portuguese version of the SPQ (Santos & Paixão, 2013) and used median total score to slip our sample into high SPQ (i.e., individuals scoring ≥ than median) and low SPQ (i.e., individuals scoring < than median). The Portuguese version demonstrated good internal consistency and temporal stability (Santos & Paixão, 2013). Similarly, our sample showed acceptable levels of internal consistency, with Cronbach's alpha of 0.90 for total score and between 0.63 and 0.81 for the nine dimensions.

Launay-Slade Hallucination Scale-Revision (LSHS-R). Besides schizotypal traits, we also included measures of psychotic-like experiences that can occur in the general population, namely hallucinations and delusional ideation. This allowed a more detailed assessment of psychosis-proneness. The LSHS-R (Launay & Slade, 1981) is a self-report scale to evaluate different forms of hallucinations, namely auditory, visual, olfactory, tactile, hypnagogic, and hypnopompic. It contains 16 items, measured using a 5-point Likert scale from 0 ("*definitely does not apply to me*") to 4 ("*definitely applies to me*"). Total score ranges from 0 to 64, with higher scores indicating higher hallucination predisposition. We used the Portuguese version of the LSHS-R (Castiajo & Pinheiro, 2017), which showed to have good internal consistency (Cronbach's alpha of 0.87 for total score) and item-total correlation above 0.30 for all items. In our sample, Cronbach's Alpha for the total score was 0.88, also suggesting good internal consistency.

Peters et al. Delusional Inventory (PDI-21). The PDI-21, developed by Peters et al., (2004) is a self-report inventory that assesses the multidimensionality of delusional ideation. It contains 21 items with a dichotomous response format (yes/no). Each 'yes' response is scored 1. For each item answered 'yes', participants are asked to rate the degree of distress, preoccupation, and conviction on a 5-point Likert scale from 1 to 5. Total score ranges from 0 to 21, with higher scores indicating higher delusional ideation. It is also possible to compute scores for distress, preoccupation, and conviction, by summing up the 'yes' responses in each dimension ('no' responses are automatically scored 0). The Portuguese version showed good internal consistently and item-total correlations greater than 0.30 (Pimentel et al., 2017). Cronbach's Alpha in our sample was 0.76, suggesting acceptable internal consistency.

State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA). To control for the effects of anxiety, we used the self-report STICSA, developed by Ree et al. (2008). The STICSA consists of two scales of 21 items each: a state-anxiety scale (STICSA-1), which asks for the evaluation of how the individual "*feels at this moment*"; and a trait-anxiety scale (STICSA-2), referring to "*how often, in general, the sentence is true for you*". Each scale contains two subscales that independently assess symptoms of cognitive anxiety (10 items) and somatic anxiety (11 items). All items are measured in a 4-point frequency response scale, ranging from 1 ("*nothing*") to 4 ("*very*"). Total score varies between 21 and 84, with higher scores indicating higher anxiety. The Portuguese version demonstrates very good internal consistency for all subscales and item-total correlations of at least 0.35 (Barros et al., 2022). In our sample, we found a Cronbach's alpha of 0.85 for STICSA-1 and 0.90 for STICSA-2, indicating good internal consistency.

Stimuli

Two male and two female avatar faces (front view) with neutral facial expressions were created with FaceGen Modeler 3.5.3 (Singular Inversions Inc.), using the following setup: a) European race, b) 30 years of age, c) average shape and texture on the caricature scale, d) full symmetry, and e) gender shape to 'very male' or 'very female' (Figure 1). Avatar faces were saved as FaceGen files (extension .fg), and imported into FacsGen (Krumhuber et al., 2012).

For each avatar identity, a 100% angry facial expression (AU4 Brow lowerer = 100%, AU5 Upper lid raiser = 100%, AU7 Lids tightener = 50%, AU9 Nose wrinkle = 30%, AU23 Lip tightener = 100%) and a 100% happy facial expression (AU6 Cheek raiser = 100%, AU12 Lip corner puller = 100%) were created (all with closed mouth), as well as 19 gradual transitions between them (Figure 1). The intermediate emotion was an ambiguous facial expression, corresponding to an intensity of 50% anger and 50% happiness. All emotional changes were made based on the Facial Action Coding System (FACS; Ekman et al., 2002) by a certified FACS coder, using FacsGen. For similar procedures, see Korb et al. (2022). The resulting 21 pictures per avatar identity (84 in total) were saved as .png.

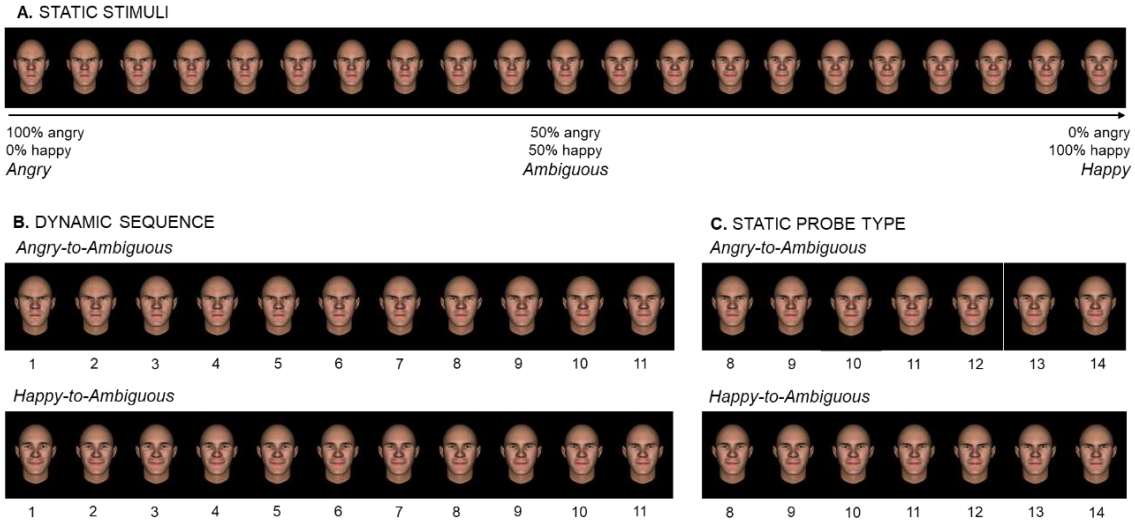

Figure 1: Example of stimuli for a male avatar face.

Probe Judgement Task

Each trial started with a white fixation cross, for a random duration of 800 to 1200 ms, followed by a dynamic sequence of avatar faces, gradually changing from a fully angry to an ambiguous expression (Angry-to-Ambiguous) or from a fully happy to an ambiguous expression (Happy-to-Ambiguous). Each dynamic sequence contained eleven pictures, all belonging to the same avatar identify (Figure 1). The first picture of the dynamic sequence (i.e., fully angry/angry expression) was shown for 200 ms, followed by nine intermediate pictures presented for 80 ms each and the final picture for 200 ms (Figure 2). The final picture always corresponded to an ambiguous expression, irrespective of the dynamic sequence. The dynamic sequence was followed by a mask (a pixelated picture of the final expression of the dynamic sequence) for 250 ms, followed by a probe until participants' response. The probe was a static face of the same avatar identify depicting the same expression as the final picture of the dynamic sequence (i.e., ambiguous expression) or one slightly displaced towards an angry/happy expression by one, two, or three pictures, thus producing seven possible probe types per dynamic sequence (Figure 1). For similar procedures, see Dozolme et al. (2018), Hudson et al. (2016) and Prigent et al. (2018).

All stimuli were presented at 13º of visual angle, corresponding to the perceived dimension of a human face at about 100 cm distance – the averaged personal space during social interactions with an unfamiliar person (Hecht et al., 2019). Participants were instructed to indicate whether the facial expression depicted by the probe was 'equal to' or 'different from' the facial expression of the final picture of the dynamic

sequence, by pressing the ‘up’ or ‘down’ keys on the keyboard, respectively (Figure 2). No feedback was provided.

The Probe Judgement Task contained 168 trials (2 emotions × 2 sexes × 2 identities × 7 probes × 3 repetitions) and was preceded by 5 training trials, all in a randomized order. None of the stimuli used in the training trials was shown in the experimental task.

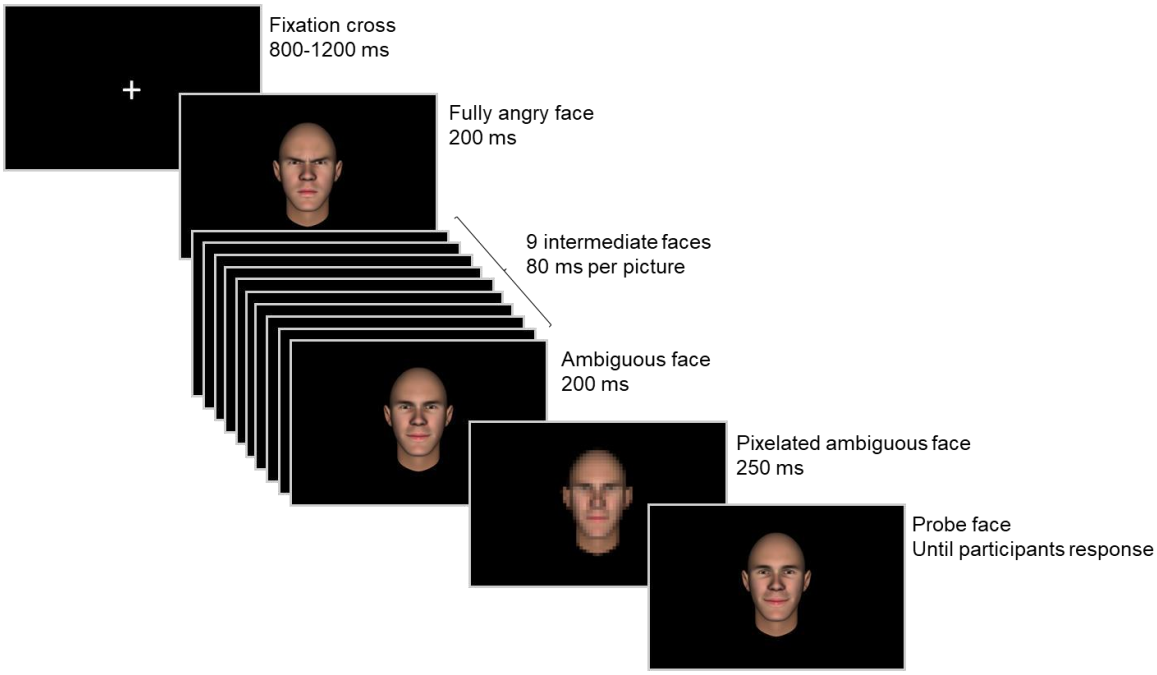

Figure 2: Schematic representation of a trial of the Probe Judgement Task.

Ambiguity Threshold Task

Participants completed an interleaved staircase task to obtain the ambiguity threshold for each avatar identity, using static stimuli. In each trial, a white fixation cross was shown at the center of the screen, for a random duration of 800 to 1200 ms, followed by one randomly chosen stair, in which the static pictures used to create the dynamic sequences in the probe judgment task were shown. As for the Probe Judgment Task, all stimuli were presented at 13º of visual angle. Participants were instructed to indicate whether the avatar face depicted anger or happiness, by pressing the ‘l’ or ‘a’ key on the keyboard, respectively. No feedback was provided. The facial expression (21 pictures per avatar identity) gradually changed towards happy or angry, based on the last response for each stair, following a 2-up, 2-down rule: after two successive angry/happy responses, the intensity of facial expression changed towards a fully

happy/angry expression. Two randomly interleaved stairs per avatar identity were used, one starting with a fully angry and one from a fully happy expression. Furthermore, the size of the intensity steps each time a stair is presented was 3 pictures before the first reversal and 1 picture afterwards. Each stair ended after a minimum of four reversals (constrained to a minimum of 5 presentations per stair).

Procedures

After signing the consent form (Attachment B), participants completed a sociodemographic questionnaire (Attachment C) and the STICSA-1. Then, participants were seated upright, as comfortably as possible, in front of a computer screen, with its center located 60 cm from the participants' cyclopean eye. They were asked to keep their gaze at the fixation cross before stimuli presentation. Next, participants performed the Probe Judgment Task, followed by the Ambiguity Threshold Task. The tasks lasted about 20 min and 10 min, respectively. Response time and response key were collected. After the Ambiguity Threshold Task, participants completed the SPQ, LSHS-R, PDI-21, and STICSA-2. Lastly, all participants were fully debriefed about the purposes of the study and rewarded for their participation.

Main Statistical Analysis

Trials with response time < 250 ms were excluded from the analysis. Data was analyzed in Jamovi (Version 2.3; The Jamovi Project, 2022). As preregistered, our main analysis consisted of a 2 × 2 repeated-measures ANOVA with one between-subjects factor (Group: high SPQ, low SPQ), one within-subjects factor (Emotion: Happy-to-Ambiguous, Angry-to-Ambiguous), and the averaged mean of the bias as dependent variable. Greenhouse-Geisser correction was performed in case of violation of sphericity, assessed via the Mauchly's test. Post-hoc analyses with Tukey correction for multiple comparisons were computed. Alpha-level was set to 0.05 and partial eta-squared (η^2_p) was reported.

The bias was calculated as the sum of the products of probe levels (8, 9, 10, 11, 12, 13, 14) with the percentage of 'equal' responses in each probe level, divided by the sum of the percentage of 'equal' responses in each probe level, subtracted by 11 (final

picture of the dynamic sequence).[1] Null values indicate no bias, while positive values indicate a forward bias (or RM), and negative values a backward bias (opposite to RM).

Secondary Analysis Plan

Secondary analyses were conducted to explore the effects of both Avatar Sex (female, male) and Participant Sex (female, male). These variables were added as within-subject factors. Moreover, the effects of total SPQ score and the three SPQ factors were statistically controlled, using these variables as covariates in separated repeated-measures ANOVA with Emotion as within-subjects factor. Concerning other variables related to psychosis-proneness, namely hallucination and delusional ideation, secondary analyses were conducted with total PDI-21 and LSHS-R scores as covariate in separated analyses. Lastly, we also used total STICSA-1 and STICSA-2 scores as covariates to control the effects of state-anxiety and trait-anxiety, respectively.

Results

Both the Happy-to-Ambiguous (M = 0.14; SD = 0.66) and the Angry-to-Ambiguous faces (M = 0.0538; SD = 0.619) showed an average bias above 0 (Figure 3). In addition to the preregistered analyses, preliminary tests with one sample t-test demonstrated that bias was significantly higher than 0 in Happy-to-Ambiguous faces, $t(103) = 2.16$, $p = 0.017$ but not in Angry-to-Ambiguous faces, $t(103) = 0.89$, $p = 0.189$, which means that RM was only statistically significant in Happy-to-Ambiguous faces.

[1] In the preregistration, we defined probe levels as -3, -2, -1, 0, +1, +2, and +3. However, to match the number of pictures within the dynamic sequence (composed by eleven static pictures), we replaced the probe levels by 8, 9, 10, 11, 12, 13, and 14. Therefore, level 11 is similar to the final picture of the inducing sequence; levels 8, 9, and 10 are the three immediate pictures before the end of the sequence; and levels 12, 13, and 14 are the three immediate pictures after the end of the sequence (in case the movement continued as expected).

Figure 3: Mean RM, in pictures, as a function of the emotional content of the animations (Angry-to-Ambiguous or Happy-to-Ambiguous). The error bars depict the standard errors of the means. * $p < 0.050$.

Since we used both female and male avatars, we also conducted separated analysis for each Avatar Sex. In this case, significance level was adjusted to .025 to correct for multiple comparisons. For the female avatar faces, RM was not significantly higher than 0 in Angry-to-Ambiguous, $t(103) = 0.960$, $p = 0.170$, and Happy-to-Ambiguous faces, $t(103) = 0.640$, $p = 0.262$. For the male faces, there was no significant RM for the Angry-to-Ambiguous condition, $t(103) = 0.725$, $p = 0.235$, but there was a significant RM effect for the Happy-to-Ambiguous condition, $t(103) = 3.297$, $p < 0.001$ (Figure 4).

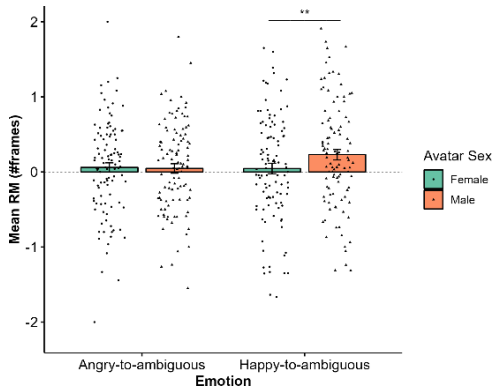

Figure 4: Mean RM, in pictures, as a function of the emotional content of the animations (abscissa; Angry-to-Ambiguous or Happy-to-Ambiguous) and avatar's sex: green bars - female avatar; orange bars - male avatar. The error bars depict the standard errors of the means. ** $p < 0.010$.

Considering the distinct pattern of response between female and male avatar faces, we decided to add Avatar Sex to preregistered analysis (preliminary analyses showed no effect of Participant Sex, so this variable was not considered in the analysis). Therefore, we used repeated-measures ANOVA with one between-subject factor (Group) and two within-subject factors (Avatar Sex, Emotion). We found a main effect of Avatar Sex, F (1, 102) = 8.71, p = 0.004, η^2p = 0.079, and a significant interaction between Emotion and Avatar Sex, F (1, 102) = 8.990, p = 0.003, η^2p = 0.002. In female faces, post-hoc comparisons showed no significant difference between Happy-to-Ambiguous faces (M = 0.045; SE = 0.071, CI 95% [-0.095, 0.185]) and Angry-to-Ambiguous faces (M = 0.060; SE = 0.063, CI 95% [-0.064, 0.184], p = 0.998). In contrast, in male faces, we found marginally higher RM in Happy-to-Ambiguous (M = 0.230; SE = 0.070, CI 95% [0.091, 0.369]) than Angry-to-Ambiguous faces (M = 0.046; SE = 0.064, CI 95% [-0.081, 0.173], p = 0.060). Moreover, while there was no significant difference between Angry-to-Ambiguous female and male faces (p = 0.978), RM was significantly higher in Happy-to-Ambiguous male than female faces (p = 0.003). No main effect of Group , F (1, 102) = 0.253, p = 0.616, η^2p = 0.002, and Emotion, F (1, 102) = 1.530, p = 0.219, η^2p = 0.015; and no significant interaction between Group and Emotion, F (1, 102) = 0.419, p = 0.519, η^2p = 0.004, Group and Avatar Sex, F (1, 102) = 0.343, p = 0.559, η^2p = 0.003, and Group, Emotion, and Avatar Sex were reported, F (1, 102) = 0.224, p = 0.637, η^2p = 0.002.

To further investigate if the lack of group effect was due to the method of group division, we repeated the previous analysis using two groups split by SPQ tertile (non-preregistered analysis): high SPQ (i.e., individuals with SPQ total score ≥ 23, n = 36) and low SPQ (i.e., individuals with SPQ total score ≤ 12, n = 37). This analysis was data driven and thus not preregistered. Individuals with medium SPQ were excluded from the analysis (n = 31), as in the study by (Laycock et al., 2019). Results were similar, showing a main effect of Avatar Sex, F(1, 71) = 5.15, p = 0.026, η^2p = 0.068, and a significant interaction between Emotion and Avatar Sex, F(1, 102) = 5.16, p = 0.026, η^2p = 0.068, with no effect of (and significant interaction with) Group (all p > 0.050) (Figure 5).

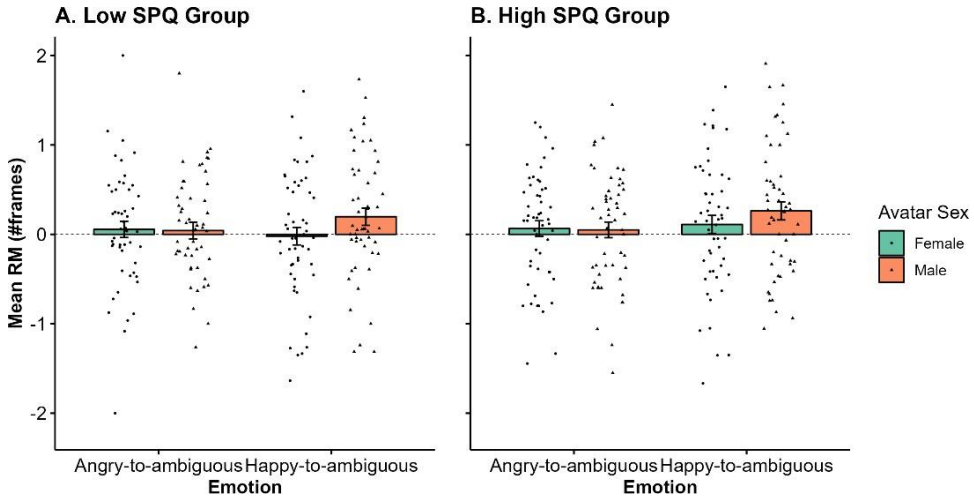

Figure 5: Mean RM, in pictures, as a function of the emotional content of the animations (abscissa; Angry-to-Ambiguous or Happy-to-Ambiguous) and avatar's sex (green bars - female avatar; orange bars - male avatar) for the Low SPQ Group (Panel A) and the High SPQ Group (Panel B). The error bars depict the standard errors of the means.

Separated repeated-measures ANOVA were performed with Avatar Sex and Emotion as within-subjects, and SPQ total score, SPQ cognitive-perceptual, SPQ interpersonal, and SPQ disorganized factors as covariates. All analysis showed no effect of covariates (all $p > 0.050$). This procedure was then repeated for the LSHS-R, PDI-21, STICSA-1, and STICSA-2, all showing no effect of covariates (all $p > 0.050$). Lastly, we divided the full sample by the median total scores of LSHS-R and PDI-21 to look for differences between high and low psychotic-like experiences (non-preregistered analysis). Two separated repeated-measures ANOVA were conducted with Group (high LSHS-R, low LSHS-R; or high PDI-21, low PDI-21) as between-subjects factor and Emotion and Avatar Sex as within-subjects factor. Similar to the SPQ, there were no effects of both groups' division (all $p > .050$).

Regarding the Ambiguity Threshold Task, we investigated the effect of Avatar Sex and Group. The ambiguity threshold was calculated as the level of facial expression of the trials where reversals (with a size intensity set of 1) took place. Values lower than 11 indicate that the faces with more angry than happy cues were perceived as being ambiguous, while values higher than 11 indicate that the faces with more happy than angry cues are perceived as being ambiguous. Both the slightly angry female faces (M = 10.1; SD = 1.46) and slightly angry male faces (M = 10.3; SD = 1.51) were perceived as being ambiguous, with one sample t-test showing an ambiguity score statistically

different than 11 in both female, $t(103) = -6.28$, $p < 0.001$ and male faces $t(103) = -4.68$, $p < 0.001$. Repeated-measures ANOVA with Group as between-subject factor and Avatar Sex as within-subject factor showed no main effect of Group, $F(1, 102) = 1.33$, $p = 0.251$, $\eta^2p = 0.013$, Avatar Sex, $F(1, 102) = 2.55$, $p = 0.113$, $\eta^2p = 0.024$, and no significant interaction between Group and Avatar Sex, $F(1, 102) = 0.32$, $p = 0.574$, $\eta^2p = 0.003$.

Discussion

The purpose of the present study was to investigate emotional anticipation for dynamic emotional faces and its putative links with schizotypal traits, by taking advantage of the framework on RM. Based upon the extant literature, it was expected that higher RM would emerge for Happy-to-Ambiguous than Angry-to-Ambiguous conditions, disclosing a higher anticipatory bias for threatening facial expressions. Additionally, it was hypothesized that either or both of those trends to be amplified for those participants rating higher on schizotypal traits, as assessed with SPQ.

The found outcomes only partially supported the hypothesized trends. The last shown image of the sequences, depicting an ambiguous facial expression, was misperceived as more happy or angrier when the animations implied a change from angry to ambiguous or happy to ambiguous, respectively. Stated differently, the implied emotional dynamics were extrapolated beyond the actual shown sequences, in congruence with the RM literature for emotional faces (Kaufman & Johnston, 2014; Jellema et al., 2011; Palumbo & Jellema, 2013; Palumbo et al., 2018). Importantly enough, this emotional extrapolation was only significantly higher than 0 for those sequences unfolding from a clearly happy face towards an ambiguous one, disclosing a higher bias to anticipate facial expression dynamics compatible with the emergence of a threatening emotional expression. The latter result conforms neatly with published reports disclosing a tendency for people to more likely anticipate and swiftly process stimuli signaling a presumable danger (Greenstein et al., 2016).

Interestingly, further analyses revealed that the increased RM for Happy-to-Ambiguous sequences was mainly found for male avatars, with female avatars leading to similar magnitudes of RM for both emotional conditions. At this point one cannot exclude that this difference does not reflect specificities of the stimuli used, being artificially generated. Notwithstanding, the disclosed effect of the avatar's sex might well reveal internalized cultural or social statistical regularities, with male conspecifics

being perceived as either more aggressive or observers being more prone to further anticipate angry and threatening states in males (see, e.g., Korb et al, 2022). Be it as it may, it is worth noticing that when the same face stimuli were shown in a static pose, with participants indicating if each face conveyed a happy or angry facial expression (ambiguity task), slightly angrier faces (both of female and male avatars) were actually perceived as more ambiguous – that is, for a facial expression to be perceived to lie midway between the clearly angry/happy expressions, it had to display slight cues of anger. This outcome runs contrary to our preliminary hypothesis that emotional faces slightly biased towards the happy could be perceived as ambiguous, disclosing a higher bias to easily detect angry cues in a facial expression (consistent with a presumed heightened sensitivity to threatening cues). While it is not possible, in the current thesis, to clearly account for this result (further replications of the effect, with other more realistic stimuli, are required), it strongly suggests that disparate processes are involved in the perception of static facial expressions and dynamic ones. In other words, the anticipation bias for angry facial expressions found for dynamic faces, but not static ones, might suggest that threat detection mechanisms are future oriented.

Regarding the links between RM for perceived emotional states and schizotypal traits, we hypothesized a significant interaction between group (low vs high on the SPQ scores) and conveyed emotion, expecting individuals with high schizotypal traits to show a stronger forward displacement when compared to the low schizotypal group, particularly for the Happy-to-Ambiguous sequences. However, the obtained results failed to substantiate that hypothesis, with no differences emerging between high and low schizotypal groups in the perception of emotional faces, nor any relationship between the SPQ scores and RM magnitude. Similarly, a lack of effects of hallucinatory experiences and delusion ideation (as assessed with the LSHS-R and PDI-21, respectively) was also found. Although several published studies report some differences between individuals with high and low schizotypal traits on some tasks, it is far from being a general and robust finding, with some authors reporting no differences between those groups (see Zouraraki et al., 2022). For example, van't Wout and collaborators (2004) did not find significant differences between individuals with high ‘positive schizotypy’ and low ‘positive schizotypy’ (evaluated with the LSHS) on emotional processing tasks. Likely of more relevance to the present findings, Jarret and collaborators (2012) found no statistical evidence for different RM magnitudes (with non-social stimuli) between groups of participants with high or low schizotypal traits.

In the present results, albeit the statistical significance criterion was not achieved, visual inspection shows a trend for larger RM in the high schizotypal group in the Happy-to-Ambiguous conditions. Therefore, it is possible that this effect is more extreme for SZ patients, perhaps leading to a significant difference between clinical and non-clinical population solely. This would suggest that exaggerated emotional anticipation is only observed in the clinical manifestation of SZ. Future studies are needed to test this assumption. Furthermore, it is worth to emphasize that our use of the terms 'high' and 'low' refers to the distribution of scores collected for the current sample which lack the desired variability, specially in higher end of the scale, to derive stronger conclusions. Tentatively, thus, it might be the case that a significant difference would emerge for a sample of participants with higher scores on the SPQ, closer to the higher end of the psychotic-continuum. Until the present experiment is replicated, in the future, with observers displaying a wider amplitude of schizotypal traits, our hypothesis remains, at best, inconclusive or, at worst and taking at face values the found outcomes, disproven.

Although our study did not confirm all of our hypothesis, it gave interesting results that could be further explored in the future. In what follows, and as a conclusion, we highlight some future directions that stem from the present work. Forthcoming studies should attempt to generalize our results for realistic dynamic human faces – this is of particular importance to clarify if and which of the trends reported in the present work are due to the stimuli employed (particularly the difference between male and female avatars). A major limitation of the present study refers to the relatively narrow distribution of schizotypal scores which, as highlighted above, hinders the strength of our conclusions pertaining to the relation between schizotypy and RM magnitude for Happy-to-Ambiguous facial expressions. A straightforward replication of the present experiment recruiting participants with higher scores on the SPQ and, ideally, patients with SZ, emerges as a particularly relevant future direction. Additionally, caution is needed when interpreting our findings due to the use of a self-report questionnaire to evaluate schizotypal traits (Ladea et al., 2020). Self-report questionnaires are often susceptible to social desirability bias, which means that participants might manipulate their response to please the examiner or to conform to social norms or expectations (Holtgraves, 2004). Therefore, it is possible that this social desirability bias led to attenuated scores of the SPQ, as well as the LSHS-R and PDI-21, thus affecting our results. Although no reliable method has been developed to measure schizotypal traits, a

previous study successfully used a machine learning technique to classify individuals with schizotypy based on electroencephalography data collected during an audiovisual emotion perception task (Jeong et al., 2017). Hence, future studies would benefit from the use of more objective measures for discriminating individuals with high schizotypal traits from individuals with low schizotypal traits.

Finally, the present experiment quite convincingly revealed the usefulness and promising value of RM as a tool to explore the perception of social-emotional dynamic stimuli, mirroring the relevance of dynamic information and time-unfolding events in social interactions in our ever-changing real world.

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Attachments

Attachment A: Sample Characterization

		Total sample (*n* = 104)	*High schizotypal traits* (*n* = 52)	*Low schizotypal traits* (*n* = 52)
Age, *M (SD)*		21.48 (4.18)	20.73 (3.97)	22.23 (4.29)
Nationality, *n (%)*	Portuguese	97 (93.26)	47 (90.38)	50 (96.15)
	Brazilian	6 (6.19)	4 (7.69)	2 (3.85)
	Equatorian	1 (1.03)	1 (1.92)	0 (0.00)
Education, *n (%)*	≤ 12 years	64	38	26
	Graduation	28	10	18
	Master	10	4	6
	≥ PhD	2	0	2
SPQ, *M (SD)*	Total score	18.53 (9.50)	26.88 (5.96)	10.17 (4.69)
	Disorganized	3.29 (2.63)	4.81 (2.40)	1.77 (1.89)
	Interpersonal	10.99 (5.73)	15.37 (4.13)	6.62 (3.19)
	Cognitive-perceptual	6.73 (5.50)	10.37 (5.19)	3.10 (2.69)
PDI-21, *M (SD)*	Total score	4.13 (3.26)	5.71 (3.50)	2.56 (2.02)
	Distress	11.85 (10.92)	17.71 (11.87)	5.98 (5.44)
	Precupation	9.50 (9.52)	14.56 (10.44)	4.44 (4.68)
	Conviction	12.12 (10.74)	17.75 (11.76)	6.50 (5.48)
LSHS-R, *M (SD)*	Total score	14.82 (10.57)	21.38 (10.33)	8.25 (5.59)
	Factor I	3.96 (5.01)	6.77 (5.55)	1.15 (1.97)
	Factor II	2.31 (2.46)	3.19 (2.54)	1.42 (2.04)
	Factor III	8.55 (4.83)	11.42 (4.24)	5.67 (3.43)
STICSA-1, *M (SD)*		30.00 (6.53)	32.35 6.99)	27.65 (5.10)
STICSA-2, *M (SD)*		32.61 (8.26)	36.79 (8.18)	28.44 (5.95)

Notes. LSHS-R, Launay-Slade Hallucination Scale-Revision; SPQ, Schizotypal Personality Questionnaire; STICSA-1; Inventory for Cognitive and Somatic Anxiety-State, STICSA-2; Inventory for Cognitive and Somatic Anxiety-Trait; PDI-21, Peters et al. Delusional Inventory.

Attachment B: Informed Consent

Consentimento informado

Caro(a) participante,

Antes de iniciar a sua participação, leia com atenção a seguinte informação

Informações sobre o estudo: O estudo está a decorrer no Emo|Senses Lab no Departamento de Educação e Psicologia da Universidade de Aveiro (DEP-UA) pela Doutoranda Joana Grave e Mestranda Sara Cordeiro, sob a orientação da Prof. Doutora Sandra C. Soares e coorientação do Prof. Nuno de Sá Teixeira, e está a ser financiado pela FCT através de uma Bolsa de Doutoramento.

Objetivo do estudo: O objetivo deste estudo é avaliar fenómenos relacionados com a perceção de faces de avatares. De momento, não podemos explicar com mais detalhe os nossos objetivos, mas será totalmente esclarecido no final da sessão.

Procedimento específico: Este estudo está dividido em duas fases. A primeira fase engloba uma o preenchimento de um questionário e a realização de uma tarefa computorizada. Na tarefa serão apresentados vídeos de faces cuja expressão facial se vai alterando, de forma gradual. Após os vídeos, será apresentada uma imagem da mesma face. A sua tarefa consistirá em indicar se a expressão facial da face apresentada nesta imagem é igual à (ou diferente da) última expressão facial da face apresentada no vídeo, assim como o quão confiante se sente com a sua resposta. Terá oportunidade para treinar e esclarecer todas as suas dúvidas. Na segunda fase, será solicitado que complete um questionário sociodemográfico (idade, sexo, escolaridade, nacionalidade, língua materna, lateralidade, consumo de substâncias, problemas de visão, diagnóstico de perturbação mental e/ou neurológica, medicação), alguns instrumentos para avaliar, por exemplo, a forma como é habitualmente, e duas tarefas breves para avaliar as funções cognitivas. Os dados desta fase serão usados para controlar a influência destes fatores nos resultados da tarefa experimental, assim como para fins de caracterização da amostra.

Riscos e benefícios: Não existem riscos ou desconfortos expectáveis. A participação neste estudo vale um carimbo no cartão Emo|Senses. A cada dois carimbos (ou seja, a cada duas participações em estudos elegíveis do Emo|Senses Lab) receberá um voucher

SONAE no valor de 5€. Se for estudante de Psicologia da UA, deverá optar entre usufruir da sua participação neste estudo para o preenchimento do cartão OU para a atribuição de créditos em Unidades Curriculares, mediante as condições estipuladas pelo(a) docente responsável.

Confidencialidade, anonimização e encriptação: Toda a informação recolhida é confidencial. Não serão recolhidos quaisquer dados pessoais que permitam a sua identificação direta. Em vez do seu nome ou outros dados pessoais identificativos, será usado um código para emparelhar os dados comportamentais provenientes da tarefa computorizada (tempos de resposta e taxas de acerto) com os dados pessoais e sensíveis provenientes do questionário sociodemográfico, dados psicométricos provenientes dos questionários psicométricos e dados comportamentais provenientes das tarefas cognitivas (tempos de resposta e taxas de acerto). Este código será gerado, de forma aleatória, através de um software e nunca estará associado a quaisquer dados pessoais que permitam a sua identificação direta.

Os dados pessoais, sensíveis e psicométricos serão recolhidos na plataforma forms.ua e descarregados para um ficheiro Excel, protegido por palavra-passe. Este ficheiro estará alojado no ARCA da UA atribuído à responsável pelo tratamento de dados, também protegido por palavra-passe a que apenas a mesma terá acesso. Após o download dos dados da plataforma forms.ua, estes serão apagados da mesma. Os dados comportamentais provenientes da tarefa computorizada serão recolhidos através de um software alojado nos computadores do laboratório e armazenados num ficheiro Excel, protegido por palavra-passe e alojado no ARCA. Os dados comportamentais provenientes da avaliação cognitiva serão recolhidos em papel, armazenados num armário fechado à chave no DEP-UA, apenas acessível à responsável pelo tratamento de dados, e posteriormente armazenado num ficheiro Excel, protegido por palavra-passe e alojado no ARCA.

Todos os dados serão processados em grupo e nunca individualmente, e apenas após o término da recolha de dados. Neste momento, os dados comportamentais, pessoais e sensíveis, e psicométricos de cada participante serão emparelhados através do código de participação, num ficheiro Excel único, protegido por palavra-passe e alojado no ARCA. Os dados pessoais e sensíveis serão mantidos durante um prazo de cinco anos, sendo posteriormente eliminados. Após este período, os restantes dados serão mantidos no seu formato anónimo.

Responsável pelo tratamento: A responsável pelo tratamento de dados é a Doutoranda Joana Grave.

Acesso e partilha dos dados: Os resultados deste estudo, sempre analisados em grupo, serão usados para fins académicos e para apresentações em revistas e congressos científicos, nacionais e/ou internacionais. A base de dados, sempre anonimizada e sem os dados pessoais ou sensíveis, poderá ser partilhada para dar cumprimento ao movimento Open Science.

Natureza voluntária da sua participação: É livre de aceitar ou recusar participar neste estudo. Se concordar em participar, poderá desistir a qualquer momento, sem qualquer prejuízo para si. Tem o direito de acesso, retificação, eliminação, limitação e/ou oposição ao tratamento dos seus dados até ao momento de eliminação dos seus dados pessoais e sensíveis (cinco anos).

Contactos/esclarecimentos: Caso deseje obter mais informações sobre este estudo, poderá contactar a Doutoranda Joana Grave (joanagrave@ua.pt), a mestranda Sara Cordeiro (sarascordeiro@ua.pt) ou a Prof. Sandra C. Soares (sandra.soares@ua.pt).

O estudo dá cumprimento ao estipulado no Regulamento Geral de Proteção de Dados (RGPD), garantindo a segurança, anonimato e confidencialidade de todos os dados facultados pelos(as) participantes, em todas as fases do processo. Neste sentido, foi auscultada a equipa RGPD da UA (edp@ua.pt), que deu o seu aval relativamente à recolha e tratamento de dados pessoais aqui envolvidos, em cumprimento do Regulamento. Adicionalmente, este estudo segue as recomendações da Declaração de Helsínquia para a investigação científica, tendo sido aprovado pelo Conselho de Ética e Deontologia da UA.

Declaração de consentimento informado:

Ao selecionar SIM na caixa abaixo, declara que:

- É adulto, falante de língua portuguesa e possui visão normal ou corrigida para o normal.

- Teve oportunidade de ler, na íntegra, o consentimento informado, que o considera explícito e que, por lhe ter sido garantido que foi elaborado de acordo com as recomendações da Declaração de Helsínquia e por ter compreendido os procedimentos e o que tem de fazer, concorda com o seu conteúdo e aceita participar livremente neste estudo.
- Foi-lhe garantido o direito de desistir a qualquer momento do estudo, sem qualquer prejuízo.
- Foi-lhe garantido que todos os dados recolhidos serão tratados de forma confidencial, dando cumprimento ao estipulado no Regulamento Europeu de Proteção de Dados (EU; 2016/679, Lei 58/2019 [LPDP]), no Regulamento Geral de Proteção de Dados (RGPD), e na sua lei de execução nacional, garantindo a segurança e confidencialidade dos dados facultados pelos(as) participantes, em todas as fases do processo, dando o seu consentimento para o tratamento dos dados pessoais em referência.

Caso não pretenda dar o seu consentimento para o tratamento dos seus dados pessoais, ou não pretenda participar no estudo, escolha a opção NÃO e a sua participação terminará por aqui.

SIM ☐ NÃO ☐

Primeiro e último nome do(a) participante:

_____Data: ____/ ____/

Assinatura do(a) participante: _____

Assinatura do(a) investigador(a): _____

Attachment C: Sociodemographic Questionnaire

As respostas às seguintes questões serão usadas apenas para tratamento estatístico no âmbito do estudo de investigação. Não será possível identificá-lo pelas suas respostas. Por favor, responda o mais honestamente possível.

1. Idade:
2. Género:
   - ☐ Masculino
   - ☐ Feminino
   - ☐ Prefiro não responder
3. Nacionalidade:
   - ☐ Portuguesa
   - ☐ Brasileira
   - ☐ Outra:
4. Língua materna:
   - ☐ Português
   - ☐ Outra:
5. Lateralidade:
   - ☐ Destro
   - ☐ Esquerdino
   - ☐ Ambidestro
6. Habilitações literárias:
   - ☐ Nenhum (sem educação/formação formal)
   - ☐ < 2º ciclo (< 6º ano)
   - ☐ 3º ciclo (9º ano)
   - ☐ Ensino secundário, profissional ou vocacional (12º ano)
   - ☐ Bacharelato
   - ☐ Licenciatura
   - ☐ Mestrado
   - ☐ Doutoramento
   - ☐ Outra:
7. Tem algum problema de visão?
   - ☐ Sim

- ☐ Não

7.1. Se respondeu afirmativamente, por favor indique qual o problema de visão e se está corrigido/tratado

8. Consome alguma substância, de forma regular? Por exemplo, álcool e drogas como canábis e derivados, heroína, cocaína, haxixe, entre outras.

- ☐ Sim
- ☐ Não

8.1. Se respondeu afirmativamente, por favor indique qual a substância e a frequência do consumo.

9. Toma alguma medicação com receita médica ou sem receita médica, de forma regular?

- ☐ Sim
- ☐ Não

9.1. Se respondeu afirmativamente, por favor indique qual a medicação.

10. Está, neste momento, diagnosticado com uma doença/problema mental e/ou neurológico por um(a) Psiquiatra, Neurologista, Psicólogo(a) e/ou Médico(a) de Família?

10.1 Se respondeu afirmativamente, por favor indique qual é o diagnóstico e a data do mesmo.

11. Foi diagnosticado com algum problema ou doença mental por um(a) Psiquiatra, Neurologista; Psicólogo(a) ou Médico(a) de Família? Por exemplo, depressão, perturbação bipolar, esquizofrenia, perturbação do espetro do autismo, perturbação da ansiedade, entre outras.

- ☐ Sim
- ☐ Não

11.1. Se respondeu afirmativamente, por favor indique o diagnóstico e o ano de diagnóstico.

12. Algum dos seus familiares em primeiro grau (pais, irmãos e/ou filhos) foi diagnosticado com Esquizofrenia ou outras Perturbações Psicóticas, ou com Perturbações do Espetro do Autismo?

- ☐ Sim
- ☐ Não

12.1. Se respondeu afirmativamente, por favor indique qual o grau familiar (pai/mãe, irmão/irmã, avô/avó) e o diagnóstico: