Emotion Prediction and Social Consequences in Elevated Schizotypy

Elyssa M. Barrick and Sarah Hope Lincoln

Department of Psychological Sciences, Case Western Reserve University, Cleveland, OH, USA

Author Note

Elyssa M. Barrick: https://orcid.org/0000-0002-6659-0141

Sarah Hope Lincoln: https://orcid.org/0000-0002-2453-060X

We have no conflicts of interest to disclose. All authors meaningfully contributed to the current manuscript and reviewed and approved their individual contributions. The Case Western Reserve University Institutional Review Board approved these studies (20211291). All data, non-proprietary materials, and code from this investigation are freely available on the Open Science Framework (https://osf.io/rbqgy/).

Elyssa Barrick served as lead for conceptualization, data curation, formal analysis, investigation, project administration, validation, visualization, and writing—original draft. Sarah Hope Lincoln served as lead for funding acquisition and supervision. Elyssa Barrick and Sarah Hope Lincoln contributed equally to writing—review and editing.

Correspondence concerning this article should be addressed to Elyssa Barrick, Department of Psychological Sciences, Case Western Reserve University, Mather Memorial Building Room 103, 11220 Bellflower Road, Cleveland, OH 44106-7123, USA. Email: emb261@case.edu.

Abstract

Successfully navigating the social world requires people to make accurate predictions about others. Individual differences in emotion prediction, or the ability to predict someone's subsequent emotion given their current emotional state, can lead to variability in social success. Across three studies (N = 1,024) we find evidence that individuals with heightened schizotypy display worse emotion prediction accuracy. Further, this difficulty with emotion prediction is associated with increased feelings of loneliness, diminished social support, smaller social networks, and partially explains some of these social difficulties in individuals with heightened negative schizotypy. We also found that individuals with heightened schizotypy had disruptions in the ability to use the affective information sources that support emotion prediction: typicality of one's own personal emotion dynamics, understanding of one's emotional experiences, and perceiving others' emotions. These findings highlight the importance of emotion prediction as a social cognitive construct that should be considered in future research for individuals across the schizophrenia spectrum.

Keywords: schizotypy, schizophrenia-spectrum, emotion, social cognition, social functioning

General scientific summary [not counted in word count]

This series of studies provides evidence that individuals who report higher than average unusual perceptual experiences, disorganized thoughts, and interpersonal difficulties also struggle with knowing how other people transitions between emotions (emotion prediction). This difficulty with emotion prediction may be related to how an individual's own emotions transition, how well they understand their emotional experiences, and their ability to recognize others' emotional expressions. Emotion prediction accuracy may be an important new target for social skills training, as more accurate emotion prediction is associated with better social well-being and functioning.

Navigating the social world is a complex process that requires attending to and understanding people around us. Picking up on subtle contextual cues, understanding and expressing one's own emotions, and accurately inferring others' mental states are all crucial skills that allow people to successfully interact with others. Further complicating this process, individuals must also consider the dynamic nature of social interactions. That is, to be socially successful, we must consider the social information currently at our disposal and use that information to make accurate predictions about others. For example, imagine that your partner is up for a promotion and has been stressed about work. Knowing that stressed people are more likely to become irritable than contrite leads you to make them a cup of soothing tea instead of bringing up the mess they left in the kitchen. As this example illustrates, we can predict others' emotional states by considering their current emotional state and what would be a predictable, typical emotional transition (i.e., the change from one emotion to another), and use this information to make socially advantageous decisions.

People make these types of social predictions about others on a daily basis, and fortunately are good at predicting how a person's emotions might change over time (Cunningham et al., 2013). Across multiple samples, people's predictions about others' emotion transitions closely mapped onto people's real-life reports of emotion transitions (Barrick et al., 2024; Thornton & Tamir, 2017; Zhao et al., 2022). This ability to make accurate predictions is in part due to the regularity with which people transition between emotions. Research using experience-sampling data found that people display patterns in their daily emotion transitions, such as shifting between similarly valenced emotions (e.g., amused to joyful) more often than differently valenced emotions (e.g., amused to angry) (Thornton & Tamir, 2017). These types of statistical regularities likely make it easier for people to identify and predict others' emotions.

Although on average people are good at predicting others' emotion transitions, previous studies have found that emotion prediction accuracy—or how well a person's predictions align with the reported true emotion transitions—isn't at ceiling. That is, there are individual differences in people's ability to accurately predict others' transitions, and importantly, these differences may have social benefits and consequences. Zhao et al. (2022) found that people who were more accurate at predicting the emotion transitions of the general population, their personal community, and friends also reported higher relationship quality and lower feelings of loneliness compared to individuals with lower emotion prediction accuracy. A recent series of studies also investigated emotion prediction accuracy in individuals with heightened autistic traits, a population that often reports difficulties with social interactions (Barrick et al., 2024). Across five studies, these individuals also displayed worse emotion prediction accuracy. Additionally, individuals with lower emotion prediction accuracy also reported more feelings of loneliness and smaller social networks and close friends. Together these studies provide compelling evidence that emotion prediction is an important social cognitive construct that may play a role in successful social functioning and social well-being.

Mechanisms Underlying Emotion Prediction Accuracy

Accurate emotion prediction relies on an individual's ability to use different types of affective information: internal and external (Barrick et al., 2024). Internal affective information refers to one's own experiences and understanding of emotions. Specifically, the *typicality* of one's emotion transitions—or how closely one's own emotion transitions align with the general population—and an individual's *ability to understand their own emotional experiences* contribute to their emotion prediction accuracy. These sources likely contribute because people are, in part, using themselves as a template when predicting others' emotions. People often draw

upon self-knowledge when making inferences and judgments about others (Ames, 2004; Dunning & Hayes, 1996; J. Krueger & Clement, 1994; J. I. Krueger & Chen, 2014; Nickerson, 1999), which can lead to drawing incorrect conclusions about certain attributes and preferences (Bauman & Geher, 2002; Birch & Bloom, 2007; Gilovich et al., 2000; Ross et al., 1977). However, in the case of emotion prediction, this egocentrism may be a reasonable strategy.

The first study to investigate this phenomenon found evidence that people use their own personal transitions to make emotion predictions about unfamiliar others; and people employing this strategy tend to be more accurate (Zhao et al., 2023). However, the decision to use this strategy and the level of accuracy depended on two factors: how typical the emotion transitions were of the person making the judgements, and how similar the target person was to the person making the judgements. That is, people who judged the unfamiliar person to be similar to themselves employed the egocentric strategy more often, which led to more accurate predictions. However, understanding interpersonal similarity *and* recognizing that this strategy might not work for a dissimilar other demands considerable insight and social understanding. Consequently, individuals who struggle with insight and social judgements may choose this egocentric strategy, even when it may not be the best choice.

A recent series of studies found that individuals with heightened autistic traits reported less typical personal emotion transitions and displayed worse emotion prediction (Barrick et al., 2024). Further, the typicality of participants' personal emotion transitions partially mediated the relationship between communication difficulties and emotion prediction accuracy, suggesting that individuals with atypical emotion transitions may be using their own experiences as an anchor for predicting others' emotion transitions, to their own detriment. Part of this struggle may be due to difficulty understanding one's own emotional experiences. Individuals that report

alexithymia, or difficulty identifying and describing their emotions, show impairments in mentalizing about others' mental states (Guttman & Laporte, 2002; Moriguchi et al., 2006; Swart et al., 2009), suggesting that understanding one's own internal states may impact the ability to understand others' mental states. This challenge would make accurately predicting others' emotion transitions exceedingly difficult. To this point, research has found that worse emotion understanding partially explained the relationship between communication difficulties and low emotion prediction accuracy (Barrick et al., 2024).

In addition to internal information, people also use external affective information—social cues in the environment—to make accurate emotion predictions. In order to learn about the emotion dynamics of others, people must be able to infer others' emotions and track changes over time. These emotion inferences rely heavily on accurately perceiving social cues, many of which are provided through people's facial expressions (Bar et al., 2006; Guarnera et al., 2015; Martinez et al., 2016), as well as contextual information in the environment such as gestures, body language, prosody, and cultural norms (Cowen et al., 2021; Reschke & Walle, 2021). Failing to use this social information would make emotion prediction nearly impossible; how can a person predict an emotion transition without knowing the current emotion? An initial study provided evidence for this relationship, finding that individuals who struggled with emotion perception also displayed worse emotion prediction (Barrick et al., 2024).

Emotion Prediction in Clinical Populations

Thus far, emotion prediction accuracy has only been examined in individuals with heightened autistic traits. However, individuals along the schizophrenia spectrum may represent another group that encounters difficulty with emotion prediction. There is significant overlap in the social cognitive difficulties reported by individuals with autism spectrum disorder and those

with schizophrenia spectrum disorders (Barlati et al., 2020; Fernandes et al., 2018; Oliver et al., 2021; Pinkham et al., 2020). Specifically, these groups both report difficulties using the internal and external affective information necessary for making accurate emotion predictions: personal affective dynamics, emotion understanding, and emotion cues.

There is some evidence that individuals with schizophrenia spectrum disorders experience less typical emotion dynamics. Studies using ecological momentary assessment methods (EMA) have investigated these dynamics by measuring in-the-moment affect of individuals with varying levels of psychotic experiences. Findings indicate that individuals at-risk for, or diagnosed with, psychotic disorders exhibit high affective instability, which is characterized by momentary fluctuations in mood (Hermans et al., 2021; Nowak et al., 2022; Oorschot et al., 2013; So et al., 2023). When examined within diagnostic group alone, there is no consensus on whether this instability appears for both positive and negative affect. However, research looking at affective instability and symptom clusters found that positive symptoms were associated with higher negative and positive affective instability, while negative symptoms were not associated with instability (Nittel et al., 2018; Oorschot et al., 2013). Findings for these groups regarding affective variability—or how frequently a person experiences emotions that differ from their baseline emotional state—are also inconclusive, with some research indicating increased negative and positive variability, and others finding reduced variability or no relationship (Hermans et al., 2021; Myin-Germeys et al., 2000; Nowak et al., 2022; Westermann et al., 2017).

Studies have also examined emotion dynamics at the subclinical end of the spectrum by focusing on schizotypy, a continuum of latent personality traits reflecting unusual and disorganized thinking patterns. The multidimensional conceptualization of schizotypy consists of

the positive dimension, which includes experiences such as perceptual oddities and paranoia, the negative dimension, which includes experiences such as alogia, avolition, and anhedonia, and the disorganized dimension, which includes experiences such as difficulty organizing and expressing thoughts and behavior. Findings from these studies provide evidence that people who endorsed heightened positive and disorganized schizotypy reported more frequent experiences of negative affect, as well as higher variability in negative affect (Kemp et al., 2022; Kwapil et al., 2012). Individuals that endorse high negative schizotypy, however, report lower intensity and variability of positive affect (Kemp et al., 2018, 2022; Kwapil et al., 2012, 2020). Findings related to negative schizotypy and negative affect have been less consistent, with studies reporting both elevated and diminished experiences of negative emotions. Overall, these findings suggest that individuals with elevated schizotypy profiles exhibit atypical affective variability, with certain dimensions contributing more than others. And while previous studies have not directly investigated whether individuals across the schizophrenia spectrum transition between emotions differently than the general public, the existing literature supports the idea that affective dynamics in this population may be atypical.

Individuals across the schizophrenia spectrum also report challenges with understanding their own emotional experiences. Specifically, research indicates that individuals with schizophrenia display difficulties understanding and describing their emotional state (Kimhy et al., 2012; Kubota et al., 2011, 2012; Yu et al., 2011) and difficulty differentiating between emotions, known as low emotion granularity (Kimhy et al., 2014). Additionally, a recent large-scale study of 689 patients with schizophrenia found a prevalence rate of 31.5% for alexithymia (Huo et al., 2023). Heightened levels of alexithymia are present in individuals with a clinical diagnosis and those at clinical high risk and psychometric risk for psychosis (Aaron et al., 2015;

Kimhy et al., 2016; Seghers et al., 2011; Van Rijn et al., 2011; Yang et al., 2020). These difficulties understanding emotional experiences may contribute to difficulties with emotion prediction.

Additionally, individuals across the schizophrenia spectrum exhibit less accurate perception and interpretation of emotional faces. In those diagnosed with schizophrenia, meta-analyses consistently demonstrate impaired emotion recognition abilities, which are most often associated with negative symptoms (Chan et al., 2010; Kohler et al., 2010; Weinreb et al., 2022). Individuals in early and first-episode psychosis (FEP) stages also display less accurate emotion recognition (Barkl et al., 2014), with FEP individuals struggling more with emotion identification compared to CHR individuals, those at familial high risk, and healthy controls (Tikka et al., 2020). However, findings are mixed within the CHR population, with some studies suggesting worse emotion recognition compared to healthy controls, and others finding no differences (Thompson et al., 2011; Seo et al., 2020). A recent systematic review revealed that individuals with heightened schizotypy also demonstrate less accurate emotion recognition (Zouraraki et al., 2023). However, the specific emotions participants struggled with depended on the heightened dimension of schizotypy they endorsed. Specifically, individuals with heightened disorganized schizotypy only had difficulty with negative emotions, while those with heightened negative schizotypy had difficulty with both positive and negative emotions, and individuals with heightened positive schizotypy had difficulty recognizing positive, negative, and neutral emotions.

These difficulties using internal and external affective information sources observed across the schizophrenia spectrum may present a larger issue collectively than the individual challenges they pose. Personal emotion dynamics, emotion understanding, and emotion

perception all appear to be crucial for accurately predicting others' emotions. Moreover, accurate emotion prediction has been linked to positive social outcomes, while inaccurate emotion prediction is associated with negative social outcomes. Together, this suggests that emotion prediction may not only be an important underexplored social cognitive construct, but also a potential novel mechanism underlying some social functioning difficulties seen in clinical populations, such as those with schizophrenia spectrum disorders.

Overview of Current Studies

Across three studies between 2021-2023, we sought to determine whether 1) emotion predication accuracy varies with schizotypy levels, 2) emotion prediction accuracy explains social satisfaction and functioning in heightened schizotypy, and 3) affective information sources play a role in emotion prediction accuracy in heightened schizotypy (See Table 1 for breakdown of hypotheses by study).

Table 1

Summary of Research Questions, Hypotheses, and Study Information

Research Question	Hypotheses	Studies Testing Hypotheses
1. Does emotion prediction vary with levels of schizotypy?	Higher schizotypy will be associated with less accurate emotion predictions.	Studies 1-3
2. Does emotion prediction accuracy help explain social satisfaction and functioning and in individuals with heightened schizotypy?	2a. Higher schizotypy will be associated with lower social satisfaction and functioning. 2b. Inaccurate emotion prediction will be associated with lower social satisfaction and functioning. 2c. Emotion prediction will mediate the relationship between schizotypy and social satisfaction/functioning.	Social satisfaction: Study 2 Social functioning: Study 3
3. Do the affective information sources underlying emotion	3a. Better emotion prediction accuracy will be associated with more typical	Typicality: Studies 1-3

prediction play a role in emotion prediction accuracy for individuals with heightened schizotypy?	emotion transitions, better emotion understanding and emotion perception. 3b. Higher schizotypy will be associated with less typical emotion transitions, worse emotion understanding and emotion perception. 3c. These affective information sources will mediate the relationship between schizotypy and emotion prediction accuracy.	Emotion understanding: Study 2 Emotion Perception: Study 3

Methods

Transparency and Openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the studies, following JARS (Appelbaum et al., 2018). All data, analysis code, and non-proprietary research materials are available at https://osf.io/rbqgy/. Data were analyzed using RStudio, R version 4.3.1(Posit team, 2023; R Core Team, 2023) and the following packages: psych v2.3.6 (Revelle, 2023), lmerTest v3.1-3 (Kuznetsova et al., 2017), parameters v0.21.3 (Lüdecke et al., 2020), MuMIn v1.45.5 (Bartoń, 2023), and lavaan v0.6-17 (Rosseel, 2012). Figures were created using the packages seaborn v0.11.2 (Waskom, 2021) and matplotlib v3.7.1 (Caswell et al., 2023) in Python v3.9.7 (Van Rossum & Drake, 2009). The studies' design and analysis were not pre-registered.

Participants

Participants (N = 1,024) consisted of community samples recruited through online social media sites (e.g., Facebook, Twitter, Reddit) and online research pools (e.g., ResearchMatch, Prolific). Sample sizes for all studies were determined with an a priori power analysis using the *pwr.r.test()* function from the pwr package (Champely, 2020). Targeted effect sizes and basis, projected power, ideal and final sample sizes for all studies are reported in Table 2. As no prior

studies investigated emotion prediction in individuals with or at risk-for schizophrenia-spectrum disorders, the power analysis for Study 1 was conducted using data from a previously collected, publicly available dataset (Barrick et al., 2024) examining the relationship between autistic traits and participants' emotion prediction ability. To account for any potential differences in these populations, we used the smallest detected effect size from the previous dataset in the current power calculation for Study 1. Participation was restricted to individuals 18 years and older residing in the United States. Participants were excluded based on the a priori criterion of an English comprehension level less than "Good" ($N = 5$). Additionally, in Study 3 we used new Qualtrics fraud detection to flag and exclude participants with duplicate responses and/or received a bot detection score below .40 (N = 105). All participants were compensated $5.00 upon study completion.

Table 2

A priori Power Analysis Values for all Studies

Study	Targeted effect size	Effect size basis	Sig. level	Power	Ideal *N*	Final *N*
1	$r = .21$	Emotion prediction accuracy and heightened autistic traits (Barrick et al., 2024)	.05	.95	288	409
2	$r = .21$	Smallest correlation between emotion prediction accuracy and schizotypy Study 1	.05	.95	288	268
3	$r = .18$	Smallest correlation between emotion prediction accuracy and schizotypy Study 2	.05	.95	394	347

Demographics

Participants completed a demographics form where they reported their age, gender, race, ethnicity, native language and English comprehension level (see SI Table S1 for full characteristics).

Schizotypy

To assess schizotypy, participants completed the Multidimensional Schizotypy Scale – Brief (MSS-B; Gross et al., 2018), a 38-item scale that assesses the positive, negative, and disorganized dimensions of schizotypy. The items on this scale were created to reflect the experiences of individuals across the schizotypy spectrum and are similar to experiences endorsed by individuals with clinical psychotic disorders, though they often present as milder, subclinical symptoms. Participants respond to statements as either true or false. Items were totaled within each dimension; higher scores indicate that more symptoms of the dimension were endorsed.

Emotion Prediction Task

In the emotion prediction task (Thornton & Tamir, 2017), participants rate how likely it is that an average person would transition from one mental state (e.g., "sad") to another mental state (e.g., "happy"). On each trial, participants were presented with two mental states connected by an arrow (Sad → Happy) and informed that the first mental state is the person's hypothetical current state, and the second mental state is a hypothetical mental state the person might experience next. Participants rated the likelihood of the shown transition on a scale from 0 (there is no chance that an average person will transition from the first state to the second state) to 100 (an average person would definitely transition from the first state to the second state). Instructions did not include a specific time interval for the mental state transition; rather participants were instructed "When considering this, think of how people generally would feel.

That is, how do people, on average, transition from one state to the next?" Participants rated the likelihood of all possible transitions between mental states, including transitions of a state back to itself, and transitions in both directions between mental states (See SI Methods for full task instructions). Prior work has demonstrated the discriminant, convergent and incremental validity of this task for measuring individual differences in emotion prediction, as well as test-retest reliability (Barrick et al., 2024; Thornton & Tamir, 2017; Zhao et al., 2022).

The mental states for Study 1 were happy, calm, full of thought, sluggish, sad, anxious, irritable. In Studies 2 and 3, the mental state "full of thought" was replaced with "alert," as we determined the meaning of "full of thought" was too ambiguous. All other emotions remained the same. The mental states included in this study contained both affective mental states (e.g., "happy") and cognitive mental states (e.g., "alert"), however all states are referred to as "emotions" throughout this paper.

Emotion prediction accuracy was calculated by correlating participant likelihood ratings from the emotion prediction task with "ground truth" log odds of real-world transitions between the mental states. The "ground truth" transitional probabilities between different emotions were obtained from a previously published study (Thornton & Tamir, 2017), which used data from a previous experience sampling study (Wilt et al., 2011) to perform the calculations (See SI methods for ground truth calculation procedure). The mental states for the emotion prediction task in the current studies were chosen as approximate matches for states used in this previous study, as there were ground truth transitional probabilities for all mental state pairs from this sample.

Emotion prediction accuracy scores range from -1 to 1. High positive emotion prediction accuracy scores indicate that participants' responses were strongly aligned with the ground truth

transitions. Emotion prediction accuracy scores around zero indicate random patterns of responding, or consistent ratings around 50%. Strong negative emotion prediction accuracy scores indicate that participants' responses were the opposite of what would be expected given the ground truth likelihoods. Taking examples from Study 1, when presented with a transition that has a high ground truth likelihood (Irritable → Irritable), high accuracy individuals (those with a positive accuracy score) rated the likelihood 93% on average, while the low accuracy individuals (those with a negative accuracy score) rated the likelihood 43% on average. When presented with a low likelihood transition (Sad → Happy), high accuracy individuals rated the likelihood 18% on average, while the low accuracy individuals rated the likelihood 69% on average.

Emotion Transition Typicality

To assess the typicality of participants' own personal emotion transitions, participants also completed the emotion transitions task, but were instructed to rate the likelihood that they themselves would transition from a hypothetical current emotional state to another hypothetical emotional state. We assessed the typicality of these personal emotion transitions by correlating them with the ground truth likelihoods also used in the emotion transition task. The order participants answered the emotion prediction task for others and self was randomized.

Emotion Understanding

To assess participants' understanding of emotions, participants in Study 2 completed the Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994), a 20-item self-report scale that measures difficulty describing one's own feelings, difficulty identifying feelings, and externally oriented thinking. Participants answered each item on a 5-point scale anchored at "Strongly

Disagree" to "Strongly Agree." Scores were summed, with higher scores reflecting more difficulty understanding one's emotions.

Emotion Perception

To measure participants' emotion perception ability, participants in Study 3 completed the Multiracial version of the Reading the Mind in the Eyes Task (Kim et al., 2024). In the task, participants were presented with a picture of the eye-region of a face, and asked to choose which emotion is being expressed from a set of four choices. Correct responses received a score of 1, and incorrect a score of 0. Responses were summed for each participant, with higher scores reflecting more accurate emotion perception.

Social Satisfaction

To measure social satisfaction, participants in Study 2 completed two self-report measures. First, the UCLA Loneliness Scale (D. W. Russell, 1996), which is a 20-item scale designed to measure self-reported loneliness. The survey consisted of a series of first-person statements regarding companionship and feelings of belonging, rated on a Likert-scale of O = often (1), S = sometimes (2), R = rarely (3), N = never (4). Higher scores reflect that more feelings of loneliness were endorsed. Participants also completed the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988), which is a self-report measure of perceived social support availability from friends, family, and significant others. Answers range from 1 ("Very strongly disagree") to 7 ("Very strongly agree"). Sum scores were calculated for each participant, with higher scores indicating more feelings of social support.

Social Functioning

To assess social functioning, participants in Study 3 completed three self-report measures. Participants completed the social/leisure subscale of the Social Adjustment Scale–

Self-Report (SAS-SR; Weissman et al., 1978), which consisted of 10 questions relating to relationship quality in the past two weeks. Sum scores were computed, with higher scores indicating more difficulty with social functioning. Participants also completed the Social Network Nomination (Cohen et al., 1997), which asked responders to list the people they have been in contact with over the last seven days, and then indicate from this list which individuals they could turn to for emotional support. A "general network" score was calculated by summing the number of people listed as in-contact with over the last seven days. A "close network" score was calculated by summing the number of people listed as emotional supporters. Lastly, participants completed the Social Network Index (Dunbar & Spoors, 1995), which measures how many close friends an individual has (e.g., "people that you feel at ease with, can talk to about private matters, and can call on for help") on a scale of "0" to "7 or more," and how often they're in contact with them ("How many of these friends do you see or talk to at least once every 2 weeks?"). Sum scores for these two questions are calculated, with higher scores indicating larger meaningful social networks (See SI results).

Results

Descriptive Statistics

The means, standard deviations, and range for all variables are reported in Table 3.

Table 3

Sample Size, Means, Standard Deviations and Ranges for All Variables

Variable	*N*	*M*	*SD*	*Min*	*Max*
Emotion prediction accuracy	1024	0.13	0.25	-0.50	0.71
Schizotypy					
Positive	1024	6.23	3.22	0	13
Negative	1024	5.58	2.75	0	12
Disorganized	1024	5.54	3.17	0	12
UCLA loneliness scale	268	47.94	6.49	20	71

Perceived Social Support	268	59.06	11.55	16	84
Social Adjustment Scale	347	2.48	0.59	1.1	4.8
Social Network Index	347	6.33	3.11	1	15
Social Network Nomination					
General network	345	5.64	3.73	1	24
Close network	345	1.97	1.54	0	9
Typicality	1023	0.12	0.25	-0.46	0.72
Emotion understanding	268	60.04	8.16	31	87
Emotion Perception	347	17.46	6.88	2	32

Note: Schizotypy = Multidimensional Schizotypy Scale: Brief. Perceived Social Support = Multidimensional Scale of Perceived Social Support. Social Adjustment Scale = social/leisure subscale only. Emotion understanding = Toronto alexithymia scale. Emotion perception = Multiracial Reading the Mind in the Eyes Task.

Emotion Prediction and Schizotypy

The first goal of these studies was to establish a relationship between emotion prediction accuracy and schizotypy. To test this relationship, we fit three separate linear mixed effects models for each schizotypy dimension (*positive, negative, disorganized*) using a restricted maximum likelihood estimation (REML; using *lmer()* from lmerTest). Models consisted of emotion prediction accuracy score as the dependent variable, a fixed effect of schizotypy score, and a random intercept for study to account for study-level variation. The parameters package was used to obtain standardized coefficients and point estimates for all models and to obtain *p*-values for mixed effects models. The MuMIn package was used to obtain R^2 for mixed effects models. Results revealed that all three dimensions of schizotypy were associated with emotion prediction accuracy (Fig. 1, Table 4). That is, individuals who endorsed more positive, negative, or disorganized schizotypy experiences also displayed less accurate emotion prediction.

Table 4

Linear Model Results of Effects of Schizotypy Dimensions on Emotion Prediction Accuracy, Estimated Separately for Dimension

Fixed Effects															
	Positive					Negative					Disorganized				
	β	*SE*	95% CI	*t*	*p*	β	*SE*	95% CI	*t*	*p*	β	*SE*	95% CI	*t*	*p*
Intercept	.01	0.13	[-.24, .26]	0.08	.933	.007	0.11	[-.20, .21]	0.06	.948	.009	0.14	[-.26, .28]	0.07	.945
Schizotypy	-.15	0.03	[-.21, -.09]	-4.83	< .001	-.26	0.03	[-.32, -.20]	-8.59	< .001	-.10	0.03	[-.16, -.04]	-3.16	.002

Random Effects						
	Positive		Negative		Disorganized	
	Variance	SD	Variance	SD	Variance	SD
Study (Intercept)	0.003	0.05	0.002	0.04	0.003	0.06
Residual	0.06	0.24	0.06	0.24	0.06	0.24

Model Fit						
	Positive		Negative		Disorganized	
	Marginal	Conditional	Marginal	Conditional	Marginal	Conditional
R^2	0.02	0.07	0.07	0.10	0.01	0.06

Note. T-tests used Satterthwaite's method. Uncertainty intervals and p-values for fixed effects were computed using a Wald t-distribution approximation. Model equation: emotion prediction accuracy ~ schizotypy dimension + (1|study)

These initial results indicate that individuals with heightened schizotypy, particularly those high in negative schizotypy, display less accurate emotion predictions. In a previous study examining emotion prediction in individuals with heightened autistic experiences, less accurate emotion predictions were associated with lower social satisfaction and social functioning. Given these relationships, our second goal was to examine whether emotion prediction accuracy helped explain social satisfaction and functioning and in individuals with heightened schizotypy.

Social Satisfaction and Functioning

First, we sought to conceptually replicate previous findings that heightened schizotypy is associated with worse social satisfaction and functioning. To test this hypothesis we conducted linear regressions, with social outcome measures (Study 2: loneliness, social support; Study 3: social adjustment scale, social network nomination) as separate dependent variables and all three schizotypy dimensions as independent variables using the *lm()* function. Results revealed that schizotypy dimensions differentially related to social outcomes (Table 6). Heightened negative schizotypy displayed the most consistent relationship, showing associations with worse social adjustment, smaller general and close social network sizes, greater loneliness, and lower perceived social support. Heightened disorganized schizotypy was also associated with worse social adjustment and more feelings of loneliness, but not network size or perceived social support. Heightened positive schizotypy was associated with worse social adjustment, and higher levels of perceived social support, an unexpected finding. Positive schizotypy was not significantly associated with social network size or feelings of loneliness.

Table 6

Regression Results for the Effects of Schizotypy on Social Satisfaction and Functioning

Outcome variable	Social adjustment scale				General network size				Close network size				Loneliness				Perceived social support			
Predictors	β	*SE*	95% CI	*p*	β	*SE*	95% CI	*p*	β	*SE*	95% CI	*p*	β	*SE*	95% CI	*p*	β	*SE*	95% CI	*p*
Positive schizotypy	.15	0.01	[.02, .28]	.028	-.12	0.07	[-.25, .01]	.068	.01	0.03	[-.13, .14]	.920	-.001	0.14	[-.12, .12]	.982	.21	0.28	[.08, .35]	.002
Negative schizotypy	.18	0.01	[.07, .29]	.001	-.28	0.07	[-.39, -.17]	< .001	-.32	0.03	[-.43, -.21]	< .001	.23	0.14	[.11, .36]	< .001	-.32	0.29	[-.45, -.19]	< .001
Disorganized schizotypy	.16	0.01	[.04, .29]	.012	-.11	0.07	[-.23, .02]	.104	.02	0.03	[-.11, .15]	.771	.38	0.14	[.24, .51]	< .001	-.14	0.28	[-.29, .01]	.062

Note. Model equation: social outcome measure ~ positive + negative + disorganized

Next, we tested if emotion prediction accuracy was associated with social satisfaction and functioning by conducting separate linear regressions predicting the social outcome measures (Study 2: loneliness, social support; Study 3: social adjustment scale, social network index, social network nomination) from participants' emotion prediction accuracy scores using the *lm()* function. Results revealed that both measures of social satisfaction were significantly associated with emotion prediction accuracy, such that as accuracy increased loneliness decreased (β = -.16, *SE* = 1.52, 95% CI: [-.28, -.04], *p* = .008) and perceived social support increased (β = .15, *SE* = 2.72, 95% CI: [.03, .27], *p* = .02). Emotion prediction accuracy's relationship to social functioning was less clear, with higher accuracy being significantly associated with the size of one's general (β = .16, *SE* = 0.77, 95% CI: [.06, .27], *p* = .003) and close social networks (β = .32, *SE* = 0.30, 95% CI: [.21, .42], *p* < .001) as measured by the Social Network Nomination, but was not significantly associated with the Social Adjustment Scale: social and leisure subscale (β = .06, *SE* = 0.12, 95% CI: [-.05, .16], *p* = .278).

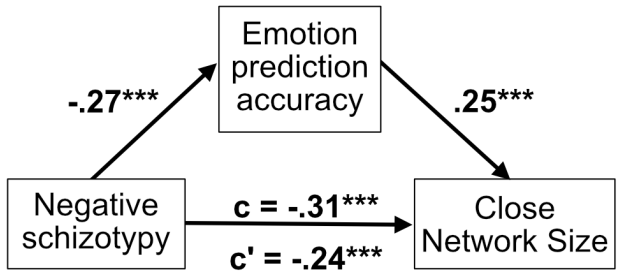
The findings from this study thus far provide evidence for the relationships between 1) emotion prediction accuracy and heightened schizotypy, 2) heightened schizotypy and social satisfaction and functioning, and 3) emotion prediction accuracy and social satisfaction and functioning. Our next goal was to examine the role of emotion prediction accuracy in social satisfaction and functioning for individuals with heightened schizotypy. Unfortunately, a sensitivity analysis indicated that the data for general network size, loneliness, and social support were insufficiently powered to detect the indirect effects of a theoretical model that emotion prediction accuracy mediates the relationship between schizotypy and social outcomes (See Supplementary Results for sensitivity analysis details). However, the analysis indicated that we

had 100% power to detect the indirect effects of emotion prediction accuracy on the relationship between negative schizotypy and close network size.

To test this model, a mediation analysis with bootstrapping method (1,000 iterations) was conducted using the *sem()* function of the lavaan package. Results indicated that emotion prediction partially mediated the relationship between negative schizotypy and close network size, as the indirect pathway was significant (b = -0.04, 95% CI [-0.06, -0.02], p = .001; Figure 1), and the direct effect of negative schizotypy on close network size remained significant when emotion prediction accuracy was included in the model (b =-0.13, 95% CI [-0.20, -0.08], p < .001).

Figure 1

Mediating Role of Emotion Prediction on Negative Schizotypy and Network Size



Note. Significant paths are indicated with bolded black lines and coefficients. Total effect is represented by c and direct effect is represented by c'. ***p < .001.

Affective Information Sources Underlying Emotion Prediction Accuracy

Our final goal for this series of studies was to investigate whether individual differences in the affective information sources previously found to underlie emotion prediction accuracy – typicality of one's own emotion transitions, emotion understanding, and emotion perception – explained differences in emotion prediction accuracy across schizotypy levels.

First, we sought to replicate the relationship between emotion prediction accuracy and the three affective information sources. A linear mixed effects model was conducted with emotion

prediction accuracy as the dependent variable, a fixed effect of typicality (Studies 1-3), and a random intercept for study to account for study-level variation. For emotion understanding and emotion perception, linear regressions were conducted, as we only had data from a single study for each variable. Results revealed that typicality significantly predicted emotion prediction accuracy, such that individuals with more "typical" emotion transitions–or transitions more similar to the general public–made more accurate emotion predictions (Table 7). Individuals with better emotion understanding (β = -.15, *SE* = 0.002, 95% CI: [-.27, -.03], *p* = .014) and emotion perception (β = .60, *SE* = 0.002, 95% CI: [.51, .68], *p* < .001) also made more accurate emotion predictions.

Table 7

Linear Model Results of Effects of Typicality on Emotion Prediction Accuracy

Fixed Effects					
	β	*SE*	95% CI	*t*	*p*
Intercept	.002	0.07	[-.15, 14]	-0.03	.974
typicality	.68	0.02	[.63, .72]	29.63	< .001
Random Effects					
	Variance		SD		
Study (Intercept)	0.001		0.03		
Residual	0.03		0.18		
Model Fit					
	Marginal		Conditional		
R^2	0.46		0.48		

Note. t-tests used Satterthwaite's method. Uncertainty intervals and p-values for fixed effects were computed using a Wald t-distribution approximation. Model equation: emotion prediction accuracy ~ typicality + (1|study)

Next, we tested whether schizotypy was associated with typicality of emotion transitions, emotion understanding, and emotion perception by conducting separate linear regressions predicting the affective information source (typicality, emotion understanding, emotion perception) from each schizotypy dimension. Results revealed that all three dimensions

significantly predicted typicality, such that as positive, negative, and disorganized schizotypy increased, the typicality of participants' own emotion transitions decreased (Table 8). All three dimensions also predicted emotion understanding, with higher positive, negative, and disorganized schizotypy being associated with lower emotion understanding. Positive and negative schizotypy also significantly predicted emotion perception, with higher schizotypy individuals displaying worse emotion perception. Disorganized schizotypy was not significantly associated with emotion perception performance (Table 9).

Table 8

Linear Model Results of Effects of Schizotypy Dimensions on Typicality, Estimated Separately for Dimension

Fixed Effects															
	Positive					Negative					Disorganized				
	β	*SE*	95% CI	*t*	*p*	β	*SE*	95% CI	*t*	*p*	β	*SE*	95% CI	*t*	*p*
Intercept	.02	0.12	[-.22, .26]	0.15	.880	.01	0.09	[-.17, .20]	0.15	.878	.02	0.13	[-.23, .27]	0.14	.889
Schizotypy	-.11	0.03	[-.18, -.05]	-3.62	< .001	-.26	0.03	[-.32, -.20]	-8.58	< .001	-.07	0.03	[-.13, -.01]	-2.27	.023

Random Effects						
	Positive		Negative		Disorganized	
	Variance	SD	Variance	SD	Variance	SD
Study (Intercept)	0.003	0.05	0.001	0.04	0.003	0.05
Residual	0.06	0.24	0.05	0.23	0.06	0.24

Model Fit						
	Positive		Negative		Disorganized	
	Marginal	Conditional	Marginal	Conditional	Marginal	Conditional
R^2	0.01	0.05	0.07	0.09	0.005	0.05

Note. T-tests used Satterthwaite's method. Uncertainty intervals and p-values for fixed effects were computed using a Wald t-distribution approximation. Model equation: typicality ~ schizotypy dimension + (1|study)

Table 9

Regression Results for the Effects of Schizotypy on Emotion Understanding and Perception

Outcome variable	Emotion understanding				Emotion perception			
Predictors	β	*SE*	95% CI	*p*	β	*SE*	95% CI	*p*
Positive schizotypy	.43	0.15	[.32, .54]	< .001	-.14	0.10	[-.25, -.04]	.007
Negative schizotypy	.42	0.16	[.31, .53]	< .001	-.21	0.13	[-.32, -.11]	< .001
Disorganized schizotypy	.50	0.14	[.40, .61]	< .001	-.05	0.10	[-.16, .06]	.347

Note. Model equation: affective information source ~ schizotypy dimension

These findings have indicated significant relationships between 1) affective information processing and emotion prediction accuracy, and 2) schizotypy affective information processing. Our final goal for these series of studies was to examine the role of affective information processing on emotion prediction accuracy in individuals with heightened schizotypy. A sensitivity analysis indicated that the data were sufficiently powered to detect the indirect effects of a theoretical model that typicality mediates the relationship between all dimensions of schizotypy and emotion prediction accuracy, as well as the model that emotion perception mediated the relationship between negative schizotypy and emotion prediction accuracy (See Supplementary Results for sensitivity analysis details).

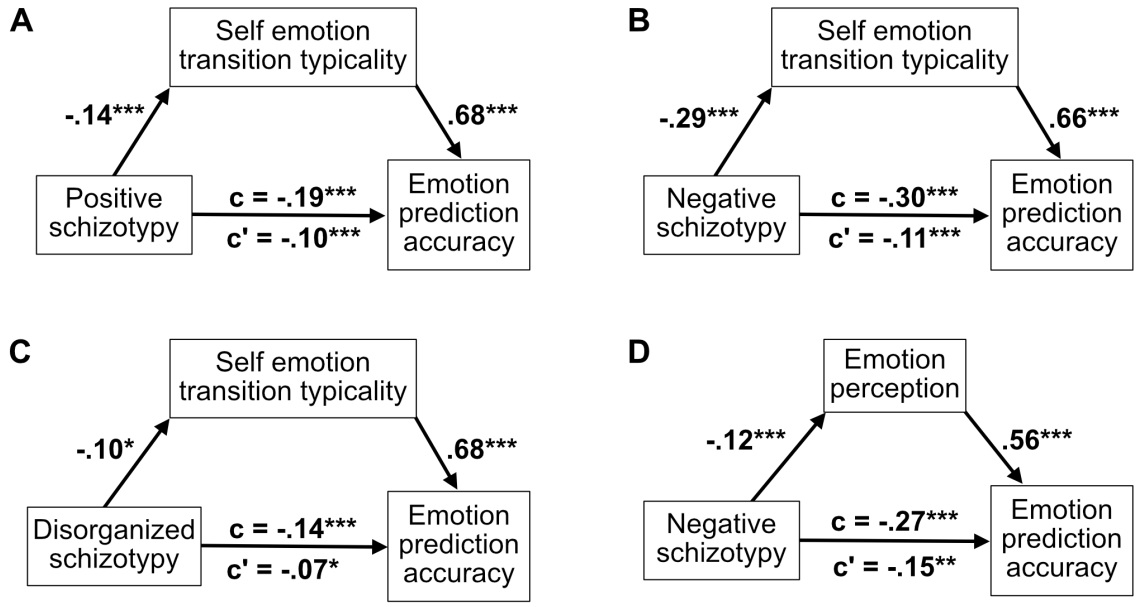
To test these models, four separate mediation analyses with bootstrapping method (1,000 iterations) were conducted using the *sem()* function of the lavaan package. The first three mediations tested how each schizotypy dimension (positive, negative, disorganized) predicted emotion prediction accuracy via an indirect effect of typicality. The last mediation tested how negative schizotypy predicted emotion prediction accuracy via an indirect effect of emotion perception.

Results (Figure 2) indicated that typicality partially mediated the relationship between positive schizotypy and emotion prediction accuracy, as the indirect pathway was significant (*b* =

-0.008, 95% CI [-0.01, -0.004], $p < .001$), and the direct effect of positive schizotypy on emotion prediction accuracy remained significant when typicality was included in the model (b =-0.007, 95% CI [-0.01, -0.004], $p < .001$). Typicality also partially mediated the relationship between negative schizotypy and emotion prediction accuracy (indirect effect: b = -0.02, 95% CI [-0.02, -0.01], $p < .001$; direct effect: b =-0.01, 95% CI [-0.01, -0.005], $p < .001$), as well as disorganized schizotypy and emotion prediction accuracy(indirect effect: b = -0.005, 95% CI [-0.009, -0.002], $p = .002$; direct effect: b = -0.005, 95% CI [-0.009, -0.002], $p = .002$). Emotion perception also partially mediated the relationship between negative schizotypy and emotion prediction accuracy (indirect effect: b = -0.01, 95% CI [-0.02, -0.005], $p < .001$; direct effect: b = -0.01, 95% CI [-0.02, -0.006], $p = .001$).

Figure 2

Mediating Role of Typicality and Emotion Perception on Schizotypy and Emotion Prediction



Note. Significant paths are indicated with bolded black lines and coefficients. Total effect is represented by c and direct effect is represented by c'. * $p < .05$. ***$p < .001$.

General Discussion

Navigating the social world requires making accurate predictions about others, however there is substantial variability in people's ability to predict others' emotions. In three studies, we investigated the ability to predict others' emotion transitions across varying levels of schizotypy, the social consequences of inaccurate emotion prediction, and potential mechanisms underlying this emotion prediction ability. Here we find that higher levels of all schizotypy dimensions were associated with worse emotion prediction ability and lower social satisfaction. We also show that emotion prediction may play a role in social satisfaction for high schizotypy individuals. Specifically, we found that emotion prediction ability partially explained the relationship between heightened negative schizotypy and having smaller networks of close friends. Individuals with higher levels of schizotypy and worse emotion prediction also displayed less typical personal emotion transitions, more difficulty identifying and describing one's own feelings, and worse emotion perception. Further, typicality partially explained the relationship between heightened levels of all schizotypy dimensions and lower emotion prediction accuracy, while emotion perception ability partially explained the relationship between heightened negative schizotypy and lower emotion prediction accuracy.

Emotion Prediction and Social Functioning

A primary goal of these studies was to learn more about the role emotion prediction plays in social functioning difficulties in individuals with heightened schizotypy. Our findings not only revealed a significant negative relationship between emotion prediction and schizotypy, but also a relationship between emotion prediction and measures of social satisfaction. Specifically, individuals that displayed worse emotion prediction also reported more feelings of loneliness, lower feelings of social support from their communities, and smaller network sizes.

These findings that demonstrate emotion prediction's association with social satisfaction replicate previous findings with these measures across samples of college students, community members, and individuals with heightened autistic traits (Barrick et al., 2024; Zhao et al., 2022). So why might emotion prediction impact social functioning and satisfaction? Let's consider the expected social implications of poor emotion prediction. In personal relationships, an individual who consistently misinterprets their partner's current and future emotions might often react inappropriately in the moment. Regularly misjudging a partners' emotion transitions could lead to minor arguments that, over time, strain the relationship. Similarly, in a professional setting, failing to understand a colleague's emotion transitions can result in miscommunications, conflict, or lower team cohesion, which could impact career trajectories. Overall, these misjudgments can lead to significant difficulties in maintaining both personal relationships and professional success. If poor emotion prediction has similar real-world consequences, it likely affects the size of a person's network and the length and quality of their relationships. Our studies support this idea, showing that people with heightened negative schizotypy, who struggle with emotion prediction, report smaller friendship groups and feel less socially supported. This aligns with previous research that found impairments in specific areas of social cognition—areas that facilitate social understanding—are also associated with poorer social relationships across the psychosis spectrum (Cowman et al., 2021; Hooker & Park, 2002; Wang, 2013).

Mechanisms Underlying Emotion Prediction

Previous work found that people with atypical personal emotion transitions, poor emotion understanding, and impaired emotion perception struggled with making accurate emotion predictions (Barrick, et al., 2024). Here we found the same pattern, where individuals heightened on any schizotypy dimension reported difficulty with internal affective information: less typical

emotion transitions and worse emotion understanding. In both this previous work and the current studies, participants' likelihood ratings of their own and others' emotion transitions are strongly associated, which suggests that participants may indeed be employing an egocentric projection strategy–using themselves as a template to make emotion predictions about others. However, as predicted, if one's own emotional experiences are highly dissimilar from the target person, the judgements about the other person will likely be inaccurate. However, it's important to note that the typicality ratings in these studies are based on participants estimates of their general emotion transitions; it will be important to confirm the atypicality of these transitions with methods such as EMA.

Research focused on the affective dynamics of individuals across the schizophrenia spectrum have often examined affective indices such as emotional instability and variability, among others (Kemp et al., 2022; Kuppens et al., 2010; Li et al., 2022; Nowak et al., 2022; So et al., 2023; Westermann et al., 2017). These indices are derived from affective frameworks based on the idea that people conceptualize and experience emotions along two dimensions: valence and arousal (Kuppens et al., 2010; J. A. Russell, 1980, 2003). However, recent social psychology literature offers more comprehensive accounts of emotions that explain not only the ways in which people mentally represent emotions, but *how* people relate emotions to each other and use this information to make predictions about others' emotion transitions. The 3D Mind Model provides evidence that emotions are represented in a 3-D 'mental state space' along the dimensions of valence, rationality, and social impact (Tamir et al., 2016)—and that these dimensions account for over 80% of the variance in how our brains represent emotions (Thornton & Tamir, 2020). This model suggests that the location of emotions in this 3D space reflect their conceptual content, and emotions that are close in space are more similar and more

likely to transition between each other. People then use the information about transition likelihoods, informed by the 3D space, to make predictions about others (Thornton & Tamir, 2017). As would be expected, individuals who represent emotions differently along these dimensions compared to the general public display worse emotion prediction (Barrick et al., 2024). Some research suggests that individuals with schizophrenia spectrum disorder generally represent emotions differently than their neurotypical counterparts, as evidenced by low emotion granularity (Kimhy et al., 2014), however this area of research is relatively unexplored in this population. Investigating the complexity of these affective representations and their relationship to emotion transitions in schizophrenia spectrum disorders may help further illuminate impairments in emotion prediction and provide important information about affective dynamics in this population.

We also found evidence that high schizotypy individuals have difficulty understanding their own emotional experiences— elevated alexithymia—and that higher alexithymia individuals made less accurate emotion predictions. This adds an additional layer of complexity to the findings regarding the relationship between emotion prediction and internal affective information: is it that individuals are transitioning differently between emotions, or is it that they're uncertain about their emotional experiences and thus have difficulty accurately reporting them? Contrary to previous findings that elevated alexithymia partially explained the relationship between elevated autistic traits and worse emotion prediction (Barrick et al., 2024), the relationships between emotion prediction and alexithymia in the current studies were quite weak. Thus, despite the results showing that heightened schizotypy was moderately to strongly associated with higher alexithymia, the current results suggest that this difficulty understanding one's emotions is likely not driving the emotion prediction inaccuracies in this group.

In addition to these difficulties with internal affective information, people with heightened positive and negative schizotypy also showed difficulty with external affective information, displaying worse emotion perception performance. Individuals across the schizophrenia spectrum consistently report difficulties using external affective information during social interactions (Kohler et al., 2010; Tikka et al., 2020; Zouraraki et al., 2023), and findings suggest that this difficulty may impact functional outcomes for these individuals (Irani et al., 2012). Here, individuals with heightened negative schizotypy specifically displayed impaired emotion perception, which partially explained their worse emotion prediction, which in turn partially explained their lack of strong social networks. Though our studies were underpowered to formally test this path model, the individual paths provide compelling evidence that emotion perception difficulties may impact functional outcomes in a more dynamic way than originally thought.

Another possible way to explore emotion prediction ability in individuals with schizophrenia spectrum disorders is to decompose the construct of emotion prediction into lower order cognitive skills and examine these individual pieces. Emotion prediction as a social cognitive skill likely requires some level of complex thinking that relies on intact foundational processes such as memory and learning. Research on schizophrenia spectrum disorders has provided robust evidence that many of these cognitive skills, such as attention, processing speed, and working memory (Green et al., 2019; Heinrichs & Zakzanis, 1998; McCleery & Nuechterlein, 2019; Mesholam-Gately et al., 2009) are impaired in this population. Similarly, research on these domains in heightened schizotypy has found evidence of milder impairments in memory and cognition (Ettinger et al., 2015; Sahakyan & Kwapil, 2016, 2019), and that schizotypy levels predicted neuropsychological performance in a longitudinal study

(Karamaouna et al., 2021). One specific cognitive ability that may plausibly underlie emotion prediction ability is statistical learning. Specifically, the ability to learn statistical regularities and patterns that occur in one's environment. Here, that refers to the statistical regularities with which people change from experiencing one emotion to another. If individuals across the schizophrenia spectrum have an impaired ability to detect the statistical regularities necessary to learn the transitional probabilities between emotional states, they will not be able to construct an accurate representation of how the states relate to each other in a dynamic way. Given the evidence that this population displays learning and memory difficulties, future studies may want to examine their statistical learning abilities in the context of emotional information and see whether this plays a role in emotion prediction difficulties.

The relationships between schizotypy, emotion prediction, and social outcomes reveals a new possible target that may be beneficial to incorporate into social skills training (SST) for psychosis spectrum. Traditional SSTs target skills such as identifying emotional expressions, understanding nonverbal cues, and instrumental skills, which are often taught using behavioral role-play. However, more recent extensions of traditional SST, such as cognitive-behavioral social skills training (CBSST ; McQuaid et al., 2000) and social-cognitive training (SCT; Horan & Green, 2019) include additional targets such as problematic thinking patterns, theory of mind, and social attribution, often using computerized training programs to teach these skills. While SSTs in general appear to have a positive impact on functional outcomes (Kurtz & Mueser, 2008), there is some evidence that SCT may have the largest impact (Turner et al., 2018). However, broad-based SCT, which targets all domains of social cognition rather than focusing on a single skill, has shown to be the most effective (Nijman et al., 2020). Considering our results suggest an important role for emotion prediction in social functioning, it may be fruitful to

incorporate teaching the transitional probabilities between emotions into a broad-based social cognition focused SST.

Limitations

The current studies are cross-sectional in nature, which allowed us to begin examining the relationships between these constructs but does not allow us to draw causal conclusions about the results. Though our mediations were conducted based on clear theoretical concepts, it is possible that the directional relationships between variables are reversed. Future studies should further examine the directionality of the relationships established in these studies. Additionally, the sample sizes for Studies 2 and 3 did not provide us with sufficient power to fully examine our hypotheses regarding the role of emotion prediction in social satisfaction or the mechanisms underlying poor emotion prediction in individuals with heightened schizotypy.

The current study design investigated emotion prediction accuracy for the "average person," and though individuals with heightened schizotypy displayed lower emotion prediction for this target, we do not know if this finding would extend to other potentially more relevant social targets. Neurotypical individuals initially use their general person-knowledge to make emotion predictions about unfamiliar others, and then tailor their predictions to the specific person as they spend more time with them (Zhao et al., 2022). Though their accuracy for the person at baseline was still high, it increased over time as they began to personalize their predictions. It is possible that individuals with heightened schizotypy may display this ability to tailor predictions to specific others, and their emotion prediction accuracy for familiar others may be better than for a generic other. Alternatively, it may be that emotion prediction accuracy is not better for all familiar others, but only for familiar others that are similar to themselves. This is an important extension of the current work that should be investigated in the future.

Constraints on generality

The sample for the current studies consisted of community members that self-reported levels of schizotypy. Although research into schizophrenia spectrum disorders suggests that the experiences of those with heightened schizotypy may reflect experiences that are similar, albeit milder, to those with clinical symptoms, it's possible that emotion prediction may look different in individuals with full-threshold psychotic experiences. Future work should expand the current findings by examining this ability across the entire schizophrenia spectrum.

Our samples were also collected using online platforms. While this method does allow for a diverse range of ages and racial and ethnic identities (as indicated in Table S1) compared to other convenience sampling methods, it may not fully represent the general population. Further, the current sample, as well as the ground-truth calculations, were obtained from United States residents, and thus the results cannot be generalized to residents of other countries or cultural groups.

It is also important to note that the task employed to measure emotion perception focused specifically on the eye region of the face. Though facial expressions are one way that we convey social information to others (Bar et al., 2006; Guarnera et al., 2015; Hess et al., 2016; Martinez et al., 2016), other contextual information such as tone of voice and prosody, gestures, environmental situation, and cultural norms play important roles in accurate emotion perception (Cowen et al., 2021; Le Mau et al., 2021; Reschke & Walle, 2021). Therefore, it's possible that the focus on facial expressions in this study may not generalize to real-world emotion perception abilities. To address this, future studies should use naturalistic and dynamic tasks to more comprehensively understand the role of emotion perception in emotion prediction ability.

One design element that was kept mostly constant across studies were the emotions chosen for the emotion prediction and typicality tasks (happy, calm, full of thought/alert, sluggish, sad, anxious, irritable). However, we believe the results will generalize to other sets of emotion words. Previous studies have replicated the relationship between emotion prediction and multiple constructs (typicality, emotion understanding, communication difficulties, social satisfaction and functioning) using the same set of emotions as the current study and a larger set of emotions that were more complex and cognitive in nature (assertive, confident, grouchy, sad, unrestrained, bold, irritable, lively, nervous, talkative, contempt, disgust, embarrassment, love, satisfaction; (Barrick et al., 2024; Zhao et al., 2022).

Conclusion

Previous research highlights the significance of accurately predicting others' emotions for social well-being. Our findings offer initial evidence that this crucial social ability is impaired in individuals with heightened levels of schizotypy. These individuals exhibit challenges in processing affective information, particularly in their own emotional dynamics and in interpreting others' emotions, leading to inaccuracies in emotion prediction. This inaccuracy is associated with increased loneliness, diminished social support, and smaller social networks, underscoring its significance. Targeting improvements in emotion prediction accuracy in individuals with heightened schizotypy presents a promising direction for future social interventions.

References

Aaron, R. V., Benson, T. L., & Park, S. (2015). Investigating the role of alexithymia on the empathic deficits found in schizotypy and autism spectrum traits. *Personality and Individual Differences*, *77*, 215–220. https://doi.org/10.1016/j.paid.2014.12.032

Ames, D. R. (2004). Strategies for Social Inference: A Similarity Contingency Model of Projection and Stereotyping in Attribute Prevalence Estimates. *Journal of Personality and Social Psychology*, *87*(5), 573–585. https://doi.org/10.1037/0022-3514.87.5.573

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia scale—I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research*, *38*(1), 23–32. https://doi.org/10.1016/0022-3999(94)90005-1

Bar, M., Neta, M., & Linz, H. (2006). Very first impressions. *Emotion*, *6*(2), 269–278. https://doi.org/10.1037/1528-3542.6.2.269

Barlati, S., Minelli, A., Ceraso, A., Nibbio, G., Carvalho Silva, R., Deste, G., Turrina, C., & Vita, A. (2020). Social Cognition in a Research Domain Criteria Perspective: A Bridge Between Schizophrenia and Autism Spectra Disorders. *Frontiers in Psychiatry*, *11*, 806. https://doi.org/10.3389/fpsyt.2020.00806

Barrick, E. M., Thornton, M. A., Zhao, Z., & Tamir, D. I. (2024). Individual differences in emotion prediction and implications for social success. *Emotion*. https://doi.org/10.1037/emo0001386

Bartoń, K. (2023). *MuMIn: Multi-Model Inference* (R package version 1.47.5) [Computer software]. https://CRAN.R-project.org/package=MuMIn

Bauman, K. P., & Geher, G. (2002). We think you agree: The detrimental impact of the false consensus effect on behavior. *Current Psychology*, *21*(4), 293–318. https://doi.org/10.1007/s12144-002-1020-0

Birch, S. A. J., & Bloom, P. (2007). The Curse of Knowledge in Reasoning About False Beliefs. *Psychological Science*, *18*(5), 382–386. https://doi.org/10.1111/j.1467-9280.2007.01909.x

Caswell, T. A., Lee, A., De Andrade, E. S., Droettboom, M., Hoffmann, T., Klymak, J., Hunter, J., Firing, E., Stansby, D., Varoquaux, N., Nielsen, J. H., Root, B., May, R., Gustafsson, O., Elson, P., Seppänen, J. K., Jae-Joon Lee, Dale, D., Hannah, … Moad, C. (2023). *matplotlib/matplotlib: REL: v3.7.1* (v3.7.1) [Computer software]. [object Object]. https://doi.org/10.5281/ZENODO.7697899

Champely, S. (2020). *pwr: Basic Functions for Power Analysis.* (1.3-0) [Computer software]. https://CRAN.R-project.org/package=pwr

Chan, R. C. K., Li, H., Cheung, E. F. C., & Gong, Q. (2010). Impaired facial emotion perception in schizophrenia: A meta-analysis. *Psychiatry Research*, *178*(2), 381–390. https://doi.org/10.1016/j.psychres.2009.03.035

Cohen, S., Doyle, W. J., Skoner, D. P., Rabin, B. S., & Gwaltney, J. M. (1997). Social ties and susceptibility to the common cold. *JAMA*, *277*(24), 1940–1944.

Cowen, A. S., Keltner, D., Schroff, F., Jou, B., Adam, H., & Prasad, G. (2021). Sixteen facial expressions occur in similar contexts worldwide. *Nature*, *589*(7841), 251–257. https://doi.org/10.1038/s41586-020-3037-7

Cowman, M., Holleran, L., Lonergan, E., O'Connor, K., Birchwood, M., & Donohoe, G. (2021). Cognitive Predictors of Social and Occupational Functioning in Early Psychosis: A

Systematic Review and Meta-analysis of Cross-Sectional and Longitudinal Data. *Schizophrenia Bulletin*, *47*(5), 1243–1253. https://doi.org/10.1093/schbul/sbab033

Cunningham, W. A., Dunfield, K. A., & Stillman, P. E. (2013). Emotional States from Affective Dynamics: *Emotion Review*. https://doi.org/10.1177/1754073913489749

Dunbar, R. I. M., & Spoors, M. (1995). Social networks, support cliques, and kinship. *Human Nature*, *6*(3), 273–290. https://doi.org/10.1007/BF02734142

Dunning, D., & Hayes, A. F. (1996). Evidence for egocentric comparison in social judgment. *Journal of Personality and Social Psychology*, *71*(2), 213–229. https://doi.org/10.1037/0022-3514.71.2.213

Ettinger, U., Mohr, C., Gooding, D. C., Cohen, A. S., Rapp, A., Haenschel, C., & Park, S. (2015). Cognition and Brain Function in Schizotypy: A Selective Review. *Schizophrenia Bulletin*, *41*(suppl 2), S417–S426. https://doi.org/10.1093/schbul/sbu190

Fernandes, J. M., Cajão, R., Lopes, R., Jerónimo, R., & Barahona-Corrêa, J. B. (2018). Social Cognition in Schizophrenia and Autism Spectrum Disorders: A Systematic Review and Meta-Analysis of Direct Comparisons. *Frontiers in Psychiatry*, *9*, 504. https://doi.org/10.3389/fpsyt.2018.00504

Gilovich, T., Medvec, V. H., & Savitsky, K. (2000). The spotlight effect in social judgment: An egocentric bias in estimates of the salience of one's own actions and appearance. *Journal of Personality and Social Psychology*, *78*(2), 211–222. https://doi.org/10.1037/0022-3514.78.2.211

Green, M. F., Horan, W. P., & Lee, J. (2019). Nonsocial and social cognition in schizophrenia: Current evidence and future directions. *World Psychiatry*, *18*(2), 146–161. https://doi.org/10.1002/wps.20624

Gross, G. M., Kwapil, T. R., Raulin, M. L., Silvia, P. J., & Barrantes-Vidal, N. (2018). The multidimensional schizotypy scale-brief: Scale development and psychometric properties. *Psychiatry Research*, *261*, 7–13. https://doi.org/10.1016/j.psychres.2017.12.033

Guarnera, M., Hichy, Z., Cascio, M. I., & Carrubba, S. (2015). Facial Expressions and Ability to Recognize Emotions From Eyes or Mouth in Children. *Europe's Journal of Psychology*, *11*(2), 183–196. https://doi.org/10.5964/ejop.v11i2.890

Guttman, H., & Laporte, L. (2002). Alexithymia, empathy, and psychological symptoms in a family context. *Comprehensive Psychiatry*, *43*(6), 448–455. https://doi.org/10.1053/comp.2002.35905

Heinrichs, R. W., & Zakzanis, K. K. (1998). Neurocognitive deficit in schizophrenia: A quantitative review of the evidence. *Neuropsychology*, *12*(3), 426–445. https://doi.org/10.1037/0894-4105.12.3.426

Hermans, K. S. F. M., Myin-Germeys, I., Gayer-Anderson, C., Kempton, M. J., Valmaggia, L., McGuire, P., Murray, R. M., Garety, P., Wykes, T., Morgan, C., Kasanova, Z., & Reininghaus, U. (2021). Elucidating negative symptoms in the daily life of individuals in the early stages of psychosis. *Psychological Medicine*, *51*(15), 2599–2609. https://doi.org/10.1017/S0033291720001154

Hess, U., Kafetsios, K., Mauersberger, H., Blaison, C., & Kessler, C.-L. (2016). Signal and Noise in the Perception of Facial Emotion Expressions: From Labs to Life. *Personality and Social Psychology Bulletin*, *42*(8), 1092–1110. https://doi.org/10.1177/0146167216651851

Hooker, C., & Park, S. (2002). Emotion processing and its relationship to social functioning in schizophrenia patients. *Psychiatry Research*, *112*(1), 41–50. https://doi.org/10.1016/S0165-1781(02)00177-4

Horan, W. P., & Green, M. F. (2019). Treatment of social cognition in schizophrenia: Current status and future directions. *Schizophrenia Research*, *203*, 3–11. https://doi.org/10.1016/j.schres.2017.07.013

Irani, F., Seligman, S., Kamath, V., Kohler, C., & Gur, R. C. (2012). A meta-analysis of emotion perception and functional outcomes in schizophrenia. *Schizophrenia Research*, *137*(1–3), 203–211. https://doi.org/10.1016/j.schres.2012.01.023

Karamaouna, P., Zouraraki, C., & Giakoumaki, S. G. (2021). Cognitive Functioning and Schizotypy: A Four-Years Study. *Frontiers in Psychiatry*, *11*, 613015. https://doi.org/10.3389/fpsyt.2020.613015

Kemp, K. C., Gross, G. M., Barrantes-Vidal, N., & Kwapil, T. R. (2018). Association of positive, negative, and disorganized schizotypy dimensions with affective symptoms and experiences. *Psychiatry Research*, *270*, 1143–1149. https://doi.org/10.1016/j.psychres.2018.10.031

Kemp, K. C., Sperry, S. H., Hernández, L., Barrantes-Vidal, N., & Kwapil, T. R. (2022). Affective dynamics in daily life are differentially expressed in positive, negative, and disorganized schizotypy. *Journal of Psychopathology and Clinical Science*. https://doi.org/10.1037/abn0000799

Kim, H. A., Kaduthodil, J., Strong, R. W., Germine, L. T., Cohan, S., & Wilmer, J. B. (2024). Multiracial Reading the Mind in the Eyes Test (MRMET): An inclusive version of an

influential measure. *Behavior Research Methods*. https://doi.org/10.3758/s13428-023-02323-x

Kimhy, D., Gill, K. E., Brucato, G., Vakhrusheva, J., Arndt, L., Gross, J. J., & Girgis, R. R. (2016). The impact of emotion awareness and regulation on social functioning in individuals at clinical high risk for psychosis. *Psychological Medicine*, *46*(14), 2907–2918. https://doi.org/10.1017/S0033291716000490

Kimhy, D., Vakhrusheva, J., Jobson-Ahmed, L., Tarrier, N., Malaspina, D., & Gross, J. J. (2012). Emotion awareness and regulation in individuals with schizophrenia: Implications for social functioning. *Psychiatry Research*, *200*(2–3), 193–201. https://doi.org/10.1016/j.psychres.2012.05.029

Kimhy, D., Vakhrusheva, J., Khan, S., Chang, R. W., Hansen, M. C., Ballon, J. S., Malaspina, D., & Gross, J. J. (2014). Emotional granularity and social functioning in individuals with schizophrenia: An experience sampling study. *Journal of Psychiatric Research*, *53*, 141–148. https://doi.org/10.1016/j.jpsychires.2014.01.020

Kohler, C. G., Walker, J. B., Martin, E. A., Healey, K. M., & Moberg, P. J. (2010). Facial Emotion Perception in Schizophrenia: A Meta-analytic Review. *Schizophrenia Bulletin*, *36*(5), 1009–1019. https://doi.org/10.1093/schbul/sbn192

Krueger, J., & Clement, R. W. (1994). The truly false consensus effect: An ineradicable and egocentric bias in social perception. *Journal of Personality and Social Psychology*, *67*(4), 596–610. https://doi.org/10.1037/0022-3514.67.4.596

Krueger, J. I., & Chen, L. J. (2014). The First Cut is the Deepest: Effects of Social Projection and Dialectical Bootstrapping on Judgmental Accuracy. *Social Cognition*, *32*(4), 315–336. https://doi.org/10.1521/soco.2014.32.4.315

Kubota, M., Miyata, J., Hirao, K., Fujiwara, H., Kawada, R., Fujimoto, S., Tanaka, Y., Sasamoto, A., Sawamoto, N., Fukuyama, H., Takahashi, H., & Murai, T. (2011). Alexithymia and regional gray matter alterations in schizophrenia. *Neuroscience Research*, *70*(2), 206–213. https://doi.org/10.1016/j.neures.2011.01.019

Kubota, M., Miyata, J., Sasamoto, A., Kawada, R., Fujimoto, S., Tanaka, Y., Sawamoto, N., Fukuyama, H., Takahashi, H., & Murai, T. (2012). Alexithymia and reduced white matter integrity in schizophrenia: A diffusion tensor imaging study on impaired emotional self-awareness. *Schizophrenia Research*, *141*(2–3), 137–143. https://doi.org/10.1016/j.schres.2012.08.026

Kuppens, P., Oravecz, Z., & Tuerlinckx, F. (2010). Feelings Change: Accounting for Individual Differences in the Temporal Dynamics of Affect. *Journal of Personality and Social Psychology*, *99*(6), 1042–1060. https://doi.org/10.1037/a0020962

Kurtz, M. M., & Mueser, K. T. (2008). A meta-analysis of controlled research on social skills training for schizophrenia. *Journal of Consulting and Clinical Psychology*, *76*(3), 491–504. https://doi.org/10.1037/0022-006X.76.3.491

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). **lmerTest** Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software*, *82*(13). https://doi.org/10.18637/jss.v082.i13

Kwapil, T. R., Brown, L. H., Silvia, P. J., Myin-Germeys, I., & Barrantes-Vidal, N. (2012). The expression of positive and negative schizotypy in daily life: An experience sampling study. *Psychological Medicine*, *42*(12), 2555–2566. https://doi.org/10.1017/S0033291712000827

Kwapil, T. R., Kemp, K. C., Mielock, A., Sperry, S. H., Chun, C. A., Gross, G. M., & Barrantes-Vidal, N. (2020). Association of multidimensional schizotypy with psychotic-like experiences, affect, and social functioning in daily life: Comparable findings across samples and schizotypy measures. *Journal of Abnormal Psychology*, *129*(5), 492–504. https://doi.org/10.1037/abn0000522

Le Mau, T., Hoemann, K., Lyons, S. H., Fugate, J. M. B., Brown, E. N., Gendron, M., & Barrett, L. F. (2021). Professional actors demonstrate variability, not stereotypical expressions, when portraying emotional states in photographs. *Nature Communications*, *12*(1), 5037. https://doi.org/10.1038/s41467-021-25352-6

Li, L. Y., Schiffman, J., & Martin, E. A. (2022). Affect-Dynamic Signatures of Psychosis Risk Across Multiple Time Scales and Contexts. *Clinical Psychological Science*, *10*(5), 960–980. https://doi.org/doi.org/10.1177/21677026211070794

Lüdecke, D., Ben-Shachar, M., Patil, I., & Makowski, D. (2020). Extracting, Computing and Exploring the Parameters of Statistical Models using R. *Journal of Open Source Software*, *5*(53), 2445. https://doi.org/10.21105/joss.02445

Martinez, L., Falvello, V. B., Aviezer, H., & Todorov, A. (2016). Contributions of facial expressions and body language to the rapid perception of dynamic emotions. *Cognition and Emotion*, *30*(5), 939–952. https://doi.org/10.1080/02699931.2015.1035229

McCleery, A., & Nuechterlein, K. H. (2019). Cognitive impairment in psychotic illness: Prevalence, profile of impairment, developmental course, and treatment considerations. *Dialogues in Clinical Neuroscience*, *21*(3), 239–248. https://doi.org/10.31887/DCNS.2019.21.3/amccleery

McQuaid, J. R., Granholm, E., McClure, F. S., Roepke, S., Pedrelli, P., Patterson, T. L., & Jeste, D. V. (2000). Development of an Integrated Cognitive-Behavioral and Social Skills Training Intervention for Older Patients With Schizophrenia. *The Journal of Psychotherapy Practice and Research*, *9*(3), 149–156.

Mesholam-Gately, R. I., Giuliano, A. J., Goff, K. P., Faraone, S. V., & Seidman, L. J. (2009). Neurocognition in first-episode schizophrenia: A meta-analytic review. *Neuropsychology*, *23*(3), 315–336. https://doi.org/10.1037/a0014708

Moriguchi, Y., Ohnishi, T., Lane, R. D., Maeda, M., Mori, T., Nemoto, K., Matsuda, H., & Komaki, G. (2006). Impaired self-awareness and theory of mind: An fMRI study of mentalizing in alexithymia. *NeuroImage*, *32*(3), 1472–1482. https://doi.org/10.1016/j.neuroimage.2006.04.186

Myin-Germeys, I., Delespaul, P. A. E. G., & deVries, M. W. (2000). Schizophrenia Patients Are More Emotionally Active Than Is Assumed Based on Their Behavior. *Schizophrenia Bulletin*, *26*(4), 847–854. https://doi.org/10.1093/oxfordjournals.schbul.a033499

Nickerson, R. S. (1999). How we know—and sometimes misjudge—what others know: Imputing one's own knowledge to others. *Psychological Bulletin*, *125*(6), 737–759. https://doi.org/10.1037/0033-2909.125.6.737

Nijman, S. A., Veling, W., Van Der Stouwe, E. C. D., & Pijnenborg, G. H. M. (2020). Social Cognition Training for People With a Psychotic Disorder: A Network Meta-analysis. *Schizophrenia Bulletin*, *46*(5), 1086–1103. https://doi.org/10.1093/schbul/sbaa023

Nittel, C. M., Lincoln, T. M., Lamster, F., Leube, D., Rief, W., Kircher, T., & Mehl, S. (2018). Expressive suppression is associated with state paranoia in psychosis: An experience sampling study on the association between adaptive and maladaptive emotion regulation

strategies and paranoia. *British Journal of Clinical Psychology*, *57*(3), 291–312. https://doi.org/10.1111/bjc.12174

Nowak, U., Krkovic, K., Kammerer, M. K., & Lincoln, T. M. (2022). Pinpointing affective disturbances in psychosis: A comparison of temporal affect dynamics in individuals with psychotic disorders, individuals with attenuated psychotic symptoms, and clinical and healthy controls. *Journal of Psychiatric Research*, *153*, 260–268. https://doi.org/10.1016/j.jpsychires.2022.06.047

Oliver, L. D., Moxon-Emre, I., Lai, M.-C., Grennan, L., Voineskos, A. N., & Ameis, S. H. (2021). Social Cognitive Performance in Schizophrenia Spectrum Disorders Compared With Autism Spectrum Disorder: A Systematic Review, Meta-analysis, and Meta-regression. *JAMA Psychiatry*, *78*(3), 281. https://doi.org/10.1001/jamapsychiatry.2020.3908

Oorschot, M., Lataster, T., Thewissen, V., Lardinois, M., Wichers, M., van Os, J., Delespaul, P., & Myin-Germeys, I. (2013). Emotional Experience in Negative Symptoms of Schizophrenia—No Evidence for a Generalized Hedonic Deficit. *Schizophrenia Bulletin*, *39*(1), 217–225. https://doi.org/10.1093/schbul/sbr137

Pinkham, A. E., Morrison, K. E., Penn, D. L., Harvey, P. D., Kelsven, S., Ludwig, K., & Sasson, N. J. (2020). Comprehensive comparison of social cognitive performance in autism spectrum disorder and schizophrenia. *Psychological Medicine*, *50*(15), 2557–2565. https://doi.org/10.1017/S0033291719002708

Posit team. (2023). *RStudio: Integrated Development Environment for R* [Computer software]. Posit Software, PBC. http://www.posit.co/

Reschke, P. J., & Walle, E. A. (2021). The Unique and Interactive Effects of Faces, Postures, and Scenes on Emotion Categorization. *Affective Science*, *2*(4), 468–483. https://doi.org/10.1007/s42761-021-00061-x

Revelle, W. (2023). *psych: Procedures for Psychological, Psychometric, and Personality Research.* (2.3.6) [Computer software]. R package. https://CRAN.R-project.org/package=psych.

Ross, L., Greene, D., & House, P. (1977). The "false consensus effect": An egocentric bias in social perception and attribution processes. *Journal of Experimental Social Psychology*, *13*(3), 279–301. https://doi.org/10.1016/0022-1031(77)90049-X

Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of Personality Assessment*, *66*(1), 20–40. https://doi.org/10.1207/s15327752jpa6601_2

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*(6), 1161–1178. https://doi.org/10.1037/h0077714

Russell, J. A. (2003). Core Affect and the Psychological Construction of Emotion. *Psychological Review*, *110*(1), 145–172. https://doi.org/10.1037/0033-295X.110.1.145

Sahakyan, L., & Kwapil, T. R. (2016). Positive schizotypy and negative schizotypy are associated with differential patterns of episodic memory impairment. *Schizophrenia Research: Cognition*, *5*, 35–40. https://doi.org/10.1016/j.scog.2016.07.001

Sahakyan, L., & Kwapil, T. R. (2019). Hits and false alarms in recognition memory show differential impairment in positive and negative schizotypy. *Journal of Abnormal Psychology*, *128*(6), 633–643. https://doi.org/10.1037/abn0000441

Seghers, J. P., McCleery, A., & Docherty, N. M. (2011). Schizotypy, Alexithymia, and Socioemotional Outcomes. *Journal of Nervous & Mental Disease*, *199*(2), 117–121. https://doi.org/10.1097/NMD.0b013e3182083bc4

So, S. H., Chau, A. K. C., Chung, L. K., Leung, C., Chong, G. H. C., Chang, W. C., Mak, A. D. P., Chan, S. S. M., Lee, S., & Sommer, I. E. (2023). Moment-to-moment affective dynamics in schizophrenia and bipolar disorder. *European Psychiatry*, *66*(1), e67. https://doi.org/10.1192/j.eurpsy.2023.2438

Swart, M., Kortekaas, R., & Aleman, A. (2009). Dealing with Feelings: Characterization of Trait Alexithymia on Emotion Regulation Strategies and Cognitive-Emotional Processing. *PLoS ONE*, *4*(6), e5751. https://doi.org/10.1371/journal.pone.0005751

Tamir, D. I., Thornton, M. A., Contreras, J. M., & Mitchell, J. P. (2016). Neural evidence that three dimensions organize mental state representation: Rationality, social impact, and valence. *Proceedings of the National Academy of Sciences*, *113*(1), 194–199. https://doi.org/10.1073/pnas.1511905112

Thornton, M. A., & Tamir, D. I. (2017). Mental models accurately predict emotion transitions. *Proceedings of the National Academy of Sciences*, *114*(23), 5982–5987. https://doi.org/10.1073/pnas.1616056114

Thornton, M. A., & Tamir, D. I. (2020). People represent mental states in terms of rationality, social impact, and valence: Validating the 3d Mind Model. *Cortex*, *125*, 44–59. https://doi.org/10.1016/j.cortex.2019.12.012

Tikka, D. L., Singh, A. R., & Tikka, S. K. (2020). Social cognitive endophenotypes in schizophrenia: A study comparing first episode schizophrenia patients and, individuals at

clinical- and familial- ‘at-risk’ for psychosis. *Schizophrenia Research*, *215*, 157–166. https://doi.org/10.1016/j.schres.2019.10.053

Turner, D. T., McGlanaghy, E., Cuijpers, P., van der Gaag, M., Karyotaki, E., & MacBeth, A. (2018). A Meta-Analysis of Social Skills Training and Related Interventions for Psychosis. *Schizophrenia Bulletin*, *44*(3), 475–491. https://doi.org/10.1093/schbul/sbx146

Van Rijn, S., Schothorst, P., Wout, M. V. ’T, Sprong, M., Ziermans, T., Van Engeland, H., Aleman, A., & Swaab, H. (2011). Affective dysfunctions in adolescents at risk for psychosis: Emotion awareness and social functioning. *Psychiatry Research*, *187*(1–2), 100–105. https://doi.org/10.1016/j.psychres.2010.10.007

Van Rossum, G., & Drake, F. L. (2009). *Python 3 Reference Manual*. CreateSpace.

Wang, Y. (2013). Cognitive empathy partially mediates the association between negative schizotypy traits and social functioning. *Psychiatry Research*, *210*, 62–68. http://dx.doi.org/10.1016/j.psychres.2013.03.015

Waskom, M. (2021). seaborn: Statistical data visualization. *Journal of Open Source Software*, *6*(60), 3021. https://doi.org/10.21105/joss.03021

Weinreb, S., Li, F., & Kurtz, M. M. (2022). A meta-analysis of social cognitive deficits in schizophrenia: Does world region matter? *Schizophrenia Research*, *243*, 206–213. https://doi.org/10.1016/j.schres.2022.04.002

Weissman, M. M., Prusoff, B. A., Thompson, W. D., Harding, P. S., & Myers, J. K. (1978). Social adjustment by self-report in a community sample and in psychiatric outpatients. *The Journal of Nervous and Mental Disease*, *166*(5), 317–326. https://doi.org/10.1097/00005053-197805000-00002

Westermann, S., Grezellschak, S., Oravecz, Z., Moritz, S., Lüdtke, T., & Jansen, A. (2017). Untangling the complex relationships between symptoms of schizophrenia and emotion dynamics in daily life: Findings from an experience sampling pilot study. *Psychiatry Research*, *257*, 514–518. https://doi.org/10.1016/j.psychres.2017.08.023

Wilt, J., Funkhouser, K., & Revelle, W. (2011). The dynamic relationships of affective synchrony to perceptions of situations. *Journal of Research in Personality*, *45*(3), 309–321. https://doi.org/10.1016/j.jrp.2011.03.005

Yang, H., Shi, H., Ni, K., Wang, Y., Cheung, E. F. C., & Chan, R. C. K. (2020). Exploring the links between alexithymia, empathy and schizotypy in college students using network analysis. *Cognitive Neuropsychiatry*, *25*(4), 245–253. https://doi.org/10.1080/13546805.2020.1749039

Yu, S., Li, H., Liu, W., Zheng, L., Ma, Y., Chen, Q., Chen, Y., Yu, H., Lu, Y., Pan, B., & Wang, W. (2011). Alexithymia and Personality Disorder Functioning Styles in Paranoid Schizophrenia. *Psychopathology*, *44*(6), 371–378. https://doi.org/10.1159/000325168

Zhao, Z., Sened, H., & Tamir, D. I. (2023). Egocentric projection is a rational strategy for accurate emotion prediction. *Journal of Experimental Social Psychology*, *109*, 104521. https://doi.org/10.1016/j.jesp.2023.104521

Zhao, Z., Thornton, M. A., & Tamir, D. I. (2022). Accurate Emotion Prediction in Dyads and Groups and Its Potential Social Benefits. *Emotion*, *22*(5), 1030–1043. https://doi.org/10.1037/emo0000890

Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The Multidimensional Scale of Perceived Social Support. *Journal of Personality Assessment*, *52*(1), 30–41. https://doi.org/10.1207/s15327752jpa5201_2

Zouraraki, C., Karamaouna, P., & Giakoumaki, S. G. (2023). Facial emotion recognition and schizotypal traits: A systematic review of behavioural studies. *Early Intervention in Psychiatry*, *17*(2), 121–140. https://doi.org/10.1111/eip.13328