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The subjective-objective deficit paradox in schizotypy extends to emotion regulation and awareness

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ABSTRACT

There is an emerging subjective-objective deficit paradox in schizotypy. Individuals with schizotypy report severe subjective complaints in several key functional domains commensurate with that of individuals with schizophrenia. However, objective assessments of the same domains show relatively intact performance. We examined whether this subjective-objective deficit paradox extends to two closely linked affective processes: emotion regulation and awareness. Individuals with elevated social anhedonia (SocAnh; $n = 61$) and elevated perceptual aberration/magical ideation (PerMag; $n = 73$) were compared to control participants ($n = 81$) on subjective and objective measures of emotion regulation and awareness. Subjective measures included self-report questionnaires assessing regulatory ability, attention to emotion, and emotional clarity. Implicit emotion regulation was assessed by the Emotion Regulation-Implicit Association Test (ER-IAT) while objective emotional awareness was assessed by the Levels of Emotional Awareness Scale (LEAS), a performance-based test. Results showed that both SocAnh and PerMag groups reported notable deficits in almost all subjective measures relative to controls (composite $ds > 0.55$). In contrast, performance on ER-IAT and LEAS was very similar to controls (composite $ds < 0.11$). The current study suggests that the subjective-objective deficit paradox extends to emotion regulation and awareness, highlighting the importance of higher-order cognitive bias in understanding emotional abnormalities in schizotypy.

1. Introduction

Affective disturbances are cardinal features of schizotypy – the multidimensional organization reflecting liability for schizophrenia (Kwapil and Barrantes-Vidal, 2015, 2012; Lenzenweger, 2006; Meehl, 1990). Specifically, emotional experience abnormalities figure prominently in the two core dimensions of schizotypy, namely positive (e.g., perceptual aberration and magical ideation) and negative (e.g., anhedonia) schizotypy. These emotional experience abnormalities adversely impact functioning (Geng et al., 2013; Horan et al., 2007) and are poorly treated by existing interventions (Blanchard et al., 2011b; Sarkar et al., 2015). It has been suggested that experiential abnormalities in schizotypy might be due to disruptions in emotion regulatory processes (Cohen et al., 2011b; Horan et al., 2008). Yet, our understanding of emotion regulation processing in schizotypy is limited, especially in light of an emerging deficit paradox, such that severe subjective complaints are sometimes not supported by objective assessments across affective, cognitive, and other key functional domains (Cohen et al., 2017). Thus, the present study employed a multi-method assessment strategy to investigate subjective and objective emotion regulation processing in positive and negative schizotypy individuals.

Emotion regulation has been conceptualized as families of regulatory strategies recruited to modulate one's emotional experiences (Gross, 2013, 1998). A prototypical regulation strategy is cognitive reappraisal, which refers to reinterpreting the meaning of a situation/stimulus so as to modify its emotional impact. Importantly, besides the deliberate deployment of regulatory efforts, people can initiate different regulation strategies implicitly, regulating their emotions without a conscious, explicit goal to do so (Braunstein et al., 2017). At the same time, a necessary first step to adaptive emotion regulation is emotional awareness (Gross and Jazaieri, 2014). Emotional awareness involves attending to emotional information and emotional clarity (i.e., the ability to identify, understand, and distinguish between distinct emotions). Thus, emotional awareness underlies one's ability to select appropriate regulation strategies and constitutes a critical prerequisite for flexibly executing any regulatory processes (Gross and Jazaieri,

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2014; Peña-Sarrionandia et al., 2015). Given the relationship between emotion regulation and awareness, the current study examined both processes in individuals with schizotypy to provide a more holistic understanding of affective abnormalities in schizotypy.

Individuals with schizotypy report disruptions in emotion regulation and awareness on subjective measures of these constructs (i.e. self-reports), and these deficits are reported to be as severe as those with psychotic illnesses. For example, there is evidence showing that schizotypy is associated with greater use of generally maladaptive emotion regulation strategies, including suppression (Henry et al., 2009) and avoidant coping, with severity sometimes exceeding that of individuals with schizophrenia (MacAulay and Cohen, 2013). Similarly, regarding emotional awareness, both positive and negative schizotypy individuals report increased attention to negative emotions (Martin et al., 2011), decreased emotional clarity (Kerns, 2006, 2005) as well as increased alexithymia (Fung et al., 2017; Martin et al., 2016). In addition, negative, but not positive, schizotypy individuals report decreased attention to positive emotions (Martin et al., 2011). The magnitude of these emotional awareness abnormalities in schizotypy compared to healthy individuals are generally in the medium to large range, which is similar to the magnitude of the effect found when comparing individuals with schizophrenia or schizoaffective disorder to healthy controls (Kimhy et al., 2012; Kubota et al., 2012; Martin et al., 2013). Hence, robust subjective abnormalities have been observed in emotion regulation and awareness, with severity rivaling those seen in schizophrenia and schizoaffective disorder.

In contrast, findings are much more mixed when emotion regulation and awareness are assessed objectively. Individuals with schizotypy were found to display relatively intact performance when engaging in effortful emotion regulation (e.g., reappraise a negative image; Henry et al., 2009; Modinos et al., 2010). Similarly, behavioral expressions in response to affective stimuli, which reflect automatic regulatory processes (Drabant et al., 2009; Hooker et al., 2014), are generally unremarkable (Cohen et al., 2009; Cohen and Hong, 2011). Studies that examined affective interference on information processing as an index of attention to emotion (e.g., emotional Stroop task) also produced conflicting results. Individuals with schizotypy, particularly positive schizotypy, were found to display interference caused by negative stimuli, and hence attentional bias for negative emotions, in some studies (Brown and Cohen, 2010; Coy and Hutton, 2012; Green et al., 2001; Mohanty et al., 2008; Van Strien and Van Kampen, 2009), but others failed to observe any interference effect (Mohanty et al., 2005; van 't Wout et al., 2004). Conflicting findings about affective interference were also observed for negative schizotypy (Coy and Hutton, 2012; Martin et al., 2012; Martin and Kerns, 2010; Mohanty et al., 2008). Of note, behavioral paradigms designed to assess either emotion regulation or awareness likely involve both processes. For example, some researchers argue that attentional bias observed in the emotional Stroop task serves as an automatic regulatory function (Kappes and Bermeitinger, 2016; Schwager and Rothermund, 2013), while effective regulation, whether implicit or explicit, necessarily depends on the awareness of emotional response (Barrett et al., 2001; Gross and Jazaieri, 2014; Subic-Wrana et al., 2014). Overall, subjective emotion regulation and awareness abnormalities often fail to manifest behaviorally on objective measures among individuals with schizotypy.

The disjunction between subjective and objective assessments of emotion regulation and awareness seems to parallel an emerging deficit paradox observed in other functional domains in schizotypy (Cohen et al., 2017). For example, individuals with schizotypy often endorse severe and broad concerns about their cognitive functioning (e.g., memory, attention), but a recent meta-analysis on the objective measures across ten cognitive abilities only showed negligible to small effect sizes (Chun et al., 2013). Nevertheless, methodological and conceptual heterogeneity in prior studies of emotion regulation and awareness makes it difficult to integrate research findings across studies. In particular, studies vary in their dimensional definition (i.e., through the use of correlational methodology; Henry et al., 2009; Kerns, 2006; Mohanty et al., 2008) versus taxonic/categorical definition (i.e., through the use of extreme-groups approach; Brown and Cohen, 2010; Henry et al., 2009; Martin et al., 2012, 2011) of schizotypy. Variability exists even for studies relying on the same theoretical conceptualization, such that some studies selected participants based on their total schizotypy scores (Brown and Cohen, 2010; Henry et al., 2009), while others considered a particular facet (e.g., positive or negative schizotypy; Martin et al., 2012, 2011).

To broaden our understanding of the schizotypy deficit paradox and address the limitations of prior research, the present study examined emotional awareness and regulation in schizotypy using both subjective/explicit and objective/implicit measures. Considering that positive and negative features of schizotypy are associated with distinct etiologies, symptom presentations, and treatment responses (Kwapil and Barrantes-Vidal, 2015), we employed an extreme-groups approach that separately compared people with elevated positive schizotypy (perceptual aberration and magical ideation or PerMag) and people with elevated negative schizotypy (social anhedonia or SocAnh) to healthy controls. Subjective emotion regulation and awareness were measured by relevant self-report questionnaires. Implicit emotion regulation was assessed by the Emotion Regulation-Implicit Association Test (ER-IAT; Mauss et al., 2006), while objective emotional awareness was assessed by a performance-based test, the Levels of Emotional Awareness Scale (LEAS; Lane et al., 1990). If the schizotypy deficit paradox applies, we would expect abnormalities in emotion regulation and awareness assessed through self-report measures, but not on the corresponding implicit and objective tasks (i.e., ER-IAT and LEAS).

2. Method

2.1. Participants and measures

Participants were largely the same as reported in Fung et al., (2017; please see Fung et al., for recruitment details). Briefly, as in our previous investigations, undergraduate students at a large Midwestern university were recruited using a psychometric high-risk approach combined with psychotic-like experience semi-structured interview (Cicero et al., 2014; Karcher et al., 2015; Martin et al., 2017). In the current study, there were 61 people in the SocAnh group who scored 1.96 *SD* above the same-sex mean on the Revised Social Anhedonia Scale (RSAS; Eckblad et al., 1982), which is designed to assess lack of relationships and lack of pleasure from relationships. There were 73 people in the PerMag group who scored 1.96 *SD* above the same-sex mean on the Perceptual Aberration Scale (PerAb; Chapman et al., 1978) or Magical Ideation Scale (MagId; Eckblad and Chapman, 1983) or had a summed, standardized score from the PerAb and MagId scales above 3.0. The PerAb scale and the MagId scale are designed to assess psychotic-like distortions and unusual beliefs, respectively. There were 81 people in the control group who scored less than 0.5 *SD* above the mean on the RSAS, PerAb, and MagId scales. In addition, lifetime and current psychotic-like symptoms were assessed by the Structured Interview for Prodromal Syndromes (SIPS; Miller et al., 2003). All the SIPS interviews were conducted by extensively trained graduate students blind to the group membership (EAM and NRK; inter-rater reliability > .93). Five participants in the SocAnh group, all participants in the PerMag group, and none in the control group had lifetime and current ratings ≥2 (2 = "mild") on Unusual Thought Content/Delusional Ideation and Perceptual Abnormalities/Hallucinations subscales of the SIPS.

2.2. Materials

2.2.1. Subjective measures[1]

2.2.1.1. Subjective emotion regulation. Subjective emotion regulation was assessed by two self-report questionnaires: the Emotion

[1] See Table 1 for example items and Cronbach's αs

Regulation Questionnaire (ERQ; Gross and John, 2003) and Nonacceptance, Strategies, Goals, and Impulse subscales of the Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer, 2004). The 10-item ERQ assesses the extent to which individuals use two emotion regulation strategies: cognitive reappraisal and expressive suppression, which are generally considered adaptive and maladaptive forms of emotion regulation, respectively (Gross, 2013). Participants rated on a 7-point scale (1 = strongly disagree; 7 = strongly agree), with higher scores indicating greater use of reappraisal and suppression. The ERQ has received considerable support for its validity, with self-reported scores associated with physiological and neural correlates of emotion regulation (Cutuli, 2014).

The four subscales of the DERS assess the degree to which, in the presence of negative emotions, individuals are able to accept their feelings (Nonacceptance), engage in effective emotion regulatory strategies (Strategies) and goal-directed behaviors (Goals), and refrain from impulsive behaviors (Impulse). Participants rated how often each item applied to themselves on a 5-point scale (1 = almost never (0–10%); 5 = almost always (91–100%)). Higher scores indicate greater dysfunction, which have been found to be associated with physiological measures of emotion dysregulation (Vasilev et al., 2009) as well as various forms of psychopathology, including anxiety disorders (Salters-Pedneault et al., 2006; Tull et al., 2007), eating disorders (Harrison et al., 2010), and addictive disorders (Fox et al., 2008).

2.2.1.2. Subjective emotional awareness. Attention to emotion and emotional clarity were measured by the Awareness and Clarity subscales of the DERS. The Awareness subscale assesses the degree to which individuals attend to and acknowledge their feelings. The Clarity subscale assesses the degree to which individuals can identify and understand their feelings. Higher scores indicate greater difficulties in emotion regulation or emotion dysregulation.

To measure attention to positive and negative emotions separately, participants completed the 16-item Following Affective States Test (FAST; Gasper and Bramesfeld, 2006). The FAST is comprised of four subscales: Focus on Positive Feelings, Ignore Positive Feelings, Focus on Negative Feelings, and Ignore Negative Feelings. Participants rated on a 7-point scale (1 = strongly disagree; 7 = strongly agree). FAST subscale scores have been shown to predict behavioral measures of affective responsiveness in both healthy individuals (Gasper and Bramesfeld, 2006; Marroquín et al., 2016) and patients with schizophrenia (Martin et al., 2013). As in previous research (Martin et al., 2011), two composite scores were calculated by subtracting the standardized scores from the Ignore subscales from the Focus subscales, yielding an "attention to positive emotion" score and an "attention to negative emotion" score. Higher scores thus indicate greater attention to positive and negative emotions.

2.2.2. Objective measures

2.2.2.1. Implicit emotion regulation. Implicit emotion regulation was measured by the ER-IAT (Mauss et al., 2006). Participants were instructed to respond as quickly and accurately as possible in categorizing each stimulus word, which was selected from the categories of emotion regulation (e.g., Controlled), emotion expression (e.g., Expressive), positive (e.g., Good), and negative (e.g., Bad). The ER-IAT consisted of 5 blocks, with 20 trials per block. Blocks 1, 2, and 4 were practice trials, in which participant categorized stimulus words into emotion regulation vs. expression or into positive vs. negative. In the critical Block 3, participants categorized stimulus words into two combined categories: emotion regulation and positive vs. emotion expression and negative. In the second critical Block 5, participants again categorized stimulus words into two combined categories with switched key assignments: emotion expression and positive vs. emotion regulation and negative. If participants gave an incorrect answer at first, the program waited for the correct answer, leading to a built-in error penalty (Greenwald et al., 2003). The final IAT score characterizes the difference in reaction time between Block 3 and Block 5 using the *D* method as recommended by Greenwald et al., (2003; see supplementary material for detailed scoring). Higher ER-IAT scores indicate more implicit valuing of emotion regulation relative to emotion expression, which have been shown to be associated with implicit and adaptive down-regulation of negative affect in response to a lab induction procedure (Mauss et al., 2006).

2.2.2.2. Objective emotional awareness. Objective emotional awareness was measured by the 20-item LEAS (Lane et al., 1990). Each item is comprised of an emotionally evocative scenario followed by two open-ended questions that ask the participants to describe their anticipated feelings and that of another person. The scenarios were designed to elicit a wide range of emotional reactions, including happiness, sadness, anger, and fear. Past research has demonstrated substantial validity for the LEAS, showing lower LEAS scores among patients with clinical disorders relative to healthy controls (e.g., borderline personality disorder and depression; Donges et al., 2005; Levine et al., 1997) and higher LEAS scores associated with greater emotional functioning (e.g., emotion perception and empathy; Barchard and Hakstian, 2004; Lane et al., 1996).

Each item was scored on a 6-point scale, corresponding to the six levels of emotional awareness proposed by Lane and Schwartz's (1987) cognitive-developmental model: 0 = cognitions, 1 = bodily sensations, 2 = action tendencies, 3 = single emotions, 4 = blends of emotion, and 5 = combination of blends. The total summed score across the 20 scenarios was used as an index for emotional awareness ($\alpha = 0.84$). In addition, two novel emotional awareness scores were computed: (a) emotional range, which was computed by summing all unique scorable words (i.e., having a score of at least 1); and (b) multi-level response, which was computed by counting the number of items with scorable words spanning more than one level ($\alpha = 0.79$; see supplementary material for detailed scoring). Higher scores thus indicate greater emotional awareness.

As LEAS scoring does not allow the examination of positive and negative words separately, and there is reason to believe that individuals with schizotypy might display differential abnormalities in positive vs. negative emotional words (Fung et al., 2017; Martin et al., 2011), we conducted a text analysis using participants' LEAS responses to test whether the groups differed in their positive and negative word usage (i.e., sentiment analysis). We followed the standard approach to data preprocessing (Silge and Robinson, 2017), which involves removing punctuations, numbers, and common English "stop" words (e.g., a, the, or). Then, we extracted positive and negative words based on the Bing lexicon, which is an open-sourced, domain-independent dictionary containing thousands of valenced words (Hu and Liu, 2004). Raw counts of positive and negative words were then converted to percentages of total words to account for differences in the total number of words used.

2.3. Procedure

The current study was carried out in accordance with the Declaration of Helsinki and was approved by the university Institutional Review Board. After receiving a complete description of the study, participants provided informed consent and completed the above tasks and questionnaires in one session. The LEAS was completed using Microsoft Word, while the ER-IAT and all questionnaires were administered through E-prime software (Psychology Software Tools, 2006).

2.4. Statistical analyses

We first examined potential demographic differences (i.e., gender, age, and ethnicity) between SocAnh, PerMag, and control groups by computing Chi-squared test for gender, one-way ANOVA for age, and,

due to the small sample sizes for certain ethnicities, Fisher's exact test for ethnicity. Then, to examine group differences in objective and subjective measures of emotional awareness and regulation, we computed one-way ANOVAs without adjustment of the *p* value (Feise, 2002; Perneger, 1998). Significant comparisons were followed up with post-hoc analyses using Tukey's HSD.[2] Pearson correlations between subjective and objective measures were also conducted for each group and results are reported in the supplementary material. Last, composite effect sizes comparing the SocAnh and PerMag groups to the control group were computed by aggregating respective effect sizes across each process (emotion regulation and awareness) and assessment strategy (subjective and objective) using the method detailed by Borenstein et al. (2009).[3]

3. Results

As shown in Table 2, the groups did not differ in any of the demographic variables, including gender, $\chi^2(2, N = 215) = 0.26$, $p = .88$, $V = 0.025$, age, $F(2, 212) = 2.31$, $p = .10$, $\eta^2 = 0.021$, and ethnicity, $p = .83$, two-tailed Fisher's exact test, $V = 0.051$.

3.1. SocAnh and PerMag groups reported medium-to-large deficits in subjective emotion regulation and awareness

Significant group differences were observed in almost all of the subjective variables assessed (see Table 3), and these effects were slightly more pronounced for the SocAnh group. Regarding emotion regulation, the groups differed significantly in the use of reappraisal, the use of suppression, and subscales of emotion dysregulation ($Fs > 10.59$, $ps < .001$, $\eta^2s > 0.03$), except for Goals, $F(2, 210) = 1.22$, $p = .30$, $\eta^2 = 0.01$. Specifically, relative to the control group, both SocAnh and PerMag reported equally greater use of suppression ($ps < .001$, $ds > 0.64$), greater emotional nonacceptance ($ps < .004$, $ds > 0.58$), greater difficulties accessing effective emotion regulation strategies ($ps < .001$, $ds > 0.94$), and greater impulse control difficulties ($ps < .002$, $ds > 0.65$). Only the SocAnh group reported significantly lower use of reappraisal, $p < .001$, $d = 0.78$. Overall, both schizotypy groups reported medium to large abnormalities in emotion regulation compared to the control group, with the SocAnh group showing greater abnormalities.

With respect to emotional awareness, the groups differed significantly in lack of awareness (i.e., attention to emotion), lack of clarity, attention to positive emotion, and attention to negative emotion ($Fs > 3.69$, $ps < .03$, $\eta^2s > 0.03$). Specifically, relative to the control group, both SocAnh and PerMag reported greater lack of emotional clarity ($ps < .001$, $ds > 0.92$), lower attention to positive emotion ($ps < .05$, $ds > 0.42$), and greater attention to negative emotion ($ps < .029$, $ds > 0.43$). Only the SocAnh group reported significantly greater lack of attention to emotion generally, $p = .02$, $d = 0.46$. In addition, the SocAnh group reported lower attention to positive emotion compared to the PerMag group ($p = .04$, $d = 0.41$), while the two groups did not differ significantly in other subjective emotional awareness variables. Overall, both schizotypy groups reported medium to large abnormalities in emotional awareness compared to the control group, with the SocAnh group showing greater abnormalities.

3.2. No group differences in objective emotion regulation and awareness

All groups showed a significant IAT effect (one-sample *t*-test difference from 0: $t(59) = -4.93$, $p < .001$ for SocAnh; $t(70) = -3.95$, $p < .001$ for PerMag; $t(79) = -4.89$, $p < .001$ for controls). This indicates that participants, on average, displayed greater valuing of emotional expression relative to regulation, which is consistent with prior studies using this task (Hopp et al., 2011; Krans et al., 2014; Mauss et al., 2006). The groups did not differ significantly in ER-IAT, $F(2, 208) = 0.22$, $p = .80$, $\eta^2 = 0.002$ (see Table 3). Additionally, the groups did not differ significantly in LEAS emotional awareness scores, $F(2, 212) = 0.37$, $p = .69$, $\eta^2 = 0.003$. The average LEAS score from our university sample ($M = 67.60$, $SD = 8.34$) was significantly higher than the established norm from a community sample ($M = 61.9$, $SD = 10.7$; Lane et al., 1996), $t(593) = 6.74$, $p < .001$, but was comparable to other studies using university students (e.g., $M = 68.3$, $SD = 9.0$; Lundh et al., 2002). We also did not find any significant differences between groups in other LEAS variables assessed, including emotional range, multi-level response, and the percentage of positive and negative emotion words used ($Fs < 0.71$, $ps > .49$, $\eta^2s < 0.007$).

Overall, there is limited evidence of group differences in objective measures of emotion regulation and awareness. In addition, the effect sizes for the above comparisons were in the negligible range. Subsequent power analysis using the observed effect sizes ($\eta^2s < 0.007$) suggested that a sample size of 457 per group would be needed for any statistical significance to be observed ($\alpha = .05$, $\beta = 0.80$). Thus, it is unlikely that the non-significant results were due to insufficient power.

3.3. Larger deficits for subjective than for objective measures

As shown in Fig. 1, composite effect sizes for subjective measures were within medium-to-large range ($ds > 0.55$). Conversely, the composite effect sizes for objective measures were negligible ($ds < 0.11$). To further examine the group differences in subjective vs. objective measures, we ran a linear mixed model of Group (Control vs. SocAnh vs. PerMag) X Assessment (Subjective vs. Objective) X Process (Regulation vs. Awareness), with random intercepts of subject. Results showed that both SocAnh and PerMag groups reported significant deficits in subjective measures (both $ps < .001$), but were statistically similar to the control group on objective measures (both $ps = .83$; see supplementary material for details regarding this analysis). Taken together, the differences between the schizotypy and control groups were much larger for subjective measures than for objective measures. In addition, the SocAnh group displayed a relatively larger impairment than the PerMag group, although no significant difference was observed.

4. Discussion

The present study examined emotion regulation and awareness in schizotypy using a multi-method assessment strategy. We found that SocAnh and PerMag groups exhibited severe subjective abnormalities in emotion regulatory processes, yet objective performances for both schizotypy groups were statistically similar to healthy controls. Notably, the null findings were unlikely the result of a limited statistical power, as we have achieved adequate power to detect small effects and the effect sizes for objective measures were in the negligible range. Overall, our findings suggest that the subjective-objective deficit

[2] Consistent with standard practice for effect size estimates, we reported Cramer's *V* (*V*) for the Chi-square test and Fisher's exact test, eta-squared (η^2) for ANOVAs, and Cohen's *d* for comparisons of two means. Following conventions, an eta-squared value of 0.01, 0.06, and 0.14 represents small, medium, and large effect size, respectively; a Cohen's *d* value of 0.2, 0.5, and 0.8 represents small, medium, and large effect size, respectively (Cohen, 1988). The interpretation for Cramer's *V* depends on its degree of freedom (*df*), with 0.1/sqrt(*df*), 0.3/sqrt(*df*), and 0.5/sqrt(*df*) considered small, medium, and large effect size, respectively (Cohen, 1988).

[3] The following variables were aggregated to compute composite effect sizes: (a) the four DERS subscales and the ERQ for subjective emotion regulation, (b) FAST attention to positive and attention to negative emotion scores, and DERS awareness and clarity subscales for subjective emotional awareness, and (c) LEAS emotional awareness, emotional range, and multi-level response for objective emotional awareness. We did not compute a composite effect size for objective emotion regulation, as ER-IAT was the only variable.

Table 1
Example items and Cronbach's alphas for subjective measures.

	Cronbach's alpha	Example item
ERQ		
Reappraisal	.85	I control my emotions by changing the way I think about the situation I'm in
Suppression	.83	I control my emotions by not expressing them
DERS		
Nonacceptance	.90	When I'm upset, I feel guilty for feeling that way
Strategies	.91	When I'm upset, I believe that I'll remain that way for a long time
Goals	.89	When I'm upset, I have difficulty getting work done
Impulse	.90	When I'm upset, I lose control over my behaviors
Awareness	.89	I am attentive to my feelings
Clarity	.86	I have difficulty making sense out of my feelings
FAST		
Focus on Positive Feelings	.80	I often pay a lot of attention to my positive feelings
Ignore Positive Feelings	.80	One should never be guided by positive emotions
Focus on Negative Feelings	.80	I tend to dwell more on my negative feelings than others do
Ignore Negative Feelings	.77	It is usually a waste of time to think about your negative emotions

Note. ERQ = Emotion Regulation Questionnaire, DERS = Difficulties in Emotion Regulation Scale, FAST = Following Affective States Test, ER-IAT = Emotion regulation-IAT, and LEAS = Levels of Emotional Awareness Scale.

Table 2
Demographic characteristics for SocAnh, PerMag, and control groups.

	SocAnh $n = 61$	PerMag $n = 73$	Control $n = 81$	Tests statistic and effect size
Female *n* (%)	43 (70.5)	49 (67.1)	54 (66.7)	$\chi^2(2, N = 215) = 0.26$, $p = .88$, $V = .025$
Age *Mean* (*SD*)	18.8 (0.90)	18.8 (0.91)	19.1 (1.17)	$F(2, 212) = 2.31$, $p = .10$, $\eta^2 = .021$
Race *n* (%)				$p = .83$ (two-tailed Fisher's exact test), $V = .051$
Asian	2 (3.3)	2 (2.8)	1 (1.2)	
African American	12 (19.7)	11 (15.5)	9 (11.1)	
Caucasian	39 (63.9)	46 (64.8)	62 (76.5)	
Latino/a	3 (4.9)	4 (5.6)	2 (2.5)	
Biracial	2 (3.3)	2 (2.8)	3 (3.7)	
Other	3 (4.9)	6 (8.6)	4 (4.9)	

Table 3
Comparison of SocAnh, PerMag, and control groups on affect measures.

	SocAnh $n = 61$	PerMag $n = 73$	Control $n = 81$	*F* statistic and effect size	Post-hoc comparisons	Cohen's *d* (vs. control)	
						SocAnh	PerMag
Subjective measures							
ERQ							
Reappraisal	4.75 (1.47)	5.30 (1.06)	5.59 (0.64)	10.64***, $\eta^2 = .09$	S < P; S < C	0.78	0.34
Suppression	3.99 (1.57)	3.74 (1.54)	2.82 (1.35)	12.65***, $\eta^2 = .11$	C < S,P	0.81	0.64
DERS							
Nonacceptance	2.56 (1.06)	2.72 (1.07)	2.02 (0.83)	10.59***, $\eta^2 = .09$	C < S,P	0.58	0.73
Strategies	2.55 (1.05)	2.57 (0.90)	1.74 (0.66)	21.98***, $\eta^2 = .17$	C < S,P	0.94	1.05
Goals	3.50 (1.07)	3.48 (0.95)	3.28 (0.85)	1.22, $\eta^2 = .01$	NA	0.23	0.22
Impulse	2.01 (1.03)	2.18 (0.99)	1.49 (0.54)	13.13***, $\eta^2 = .11$	C < S,P	0.65	0.88
Awareness	2.52 (0.96)	2.29 (0.89)	2.10 (0.84)	3.69*, $\eta^2 = .03$	C < S	0.46	0.21
Clarity	2.52 (1.02)	2.67 (0.93)	1.77 (0.62)	23.88***, $\eta^2 = .19$	C < S,P	0.92	1.15
FAST							
Positive composite score	−0.77 (1.92)	−0.04 (1.65)	0.60 (1.44)	11.7***, $\eta^2 = .10$	S < P < [a] C	0.83	0.42
Negative composite score	0.38 (1.59)	0.20 (1.52)	−0.46 (1.54)	5.91**, $\eta^2 = .05$	C < S,P	0.54	0.43
Objective measures							
ER-IAT	−0.23 (0.36)	−0.18 (0.39)	−0.20 (0.38)	0.22, $\eta^2 = .002$	NA	0.06	0.05
LEAS							
Emotional awareness	67.8 (8.72)	66.9 (8.22)	68.1 (8.23)	0.37, $\eta^2 = .003$	NA	0.03	0.14
Emotional range	96.2 (29.7)	97.3 (23.8)	95.6 (25.0)	0.079, $\eta^2 = .001$	NA	0.02	0.07
ulti-level response	8.98 (4.33)	9.85 (3.91)	9.28 (4.62)	0.71, $\eta^2 = .007$	NA	0.07	0.13
% Positive emotion words	12.4 (2.92)	12.3 (3.03)	12.8 (2.84)	0.54, $\eta^2 = .005$	NA	0.13	0.16
% Negative emotion words	19.3 (5.50)	19.8 (4.32)	20.1 (3.85)	0.50, $\eta^2 = .005$	NA	0.17	0.08

Note. ERQ = Emotion Regulation Questionnaire, DERS = Difficulties in Emotion Regulation Scale, FAST = Following Affective States Test, ER-IAT = Emotion regulation-IAT, and LEAS = Levels of Emotional Awareness Scale. Abbreviations: S = SocAnh, P = PerMag, C = Control. ***$p < .001$; **$p < .01$; *$p < .05$; [a] $p = .05$.

paradox in schizotypy extends to emotion regulation and awareness regardless of specific schizotypy traits.

Consistent with the extant literature, we found that both SocAnh and PerMag groups reported broad and severe subjective abnormalities in emotion regulation and awareness. More important, the SocAnh group was found to report greater affective impairments relative to the PerMag group, and this was particularly pronounced for emotional awareness. This finding is in line with prior work showing unique

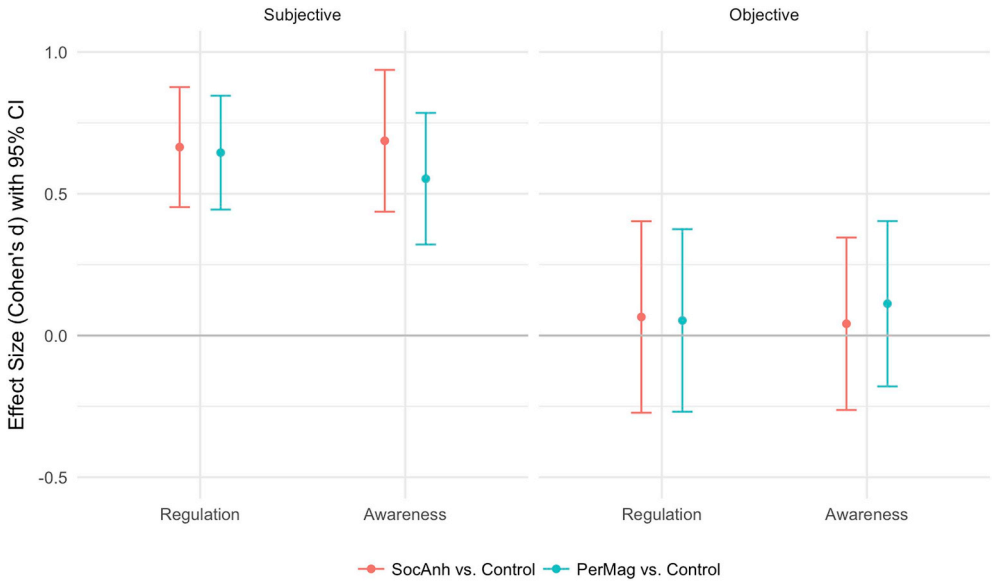

Fig. 1. Composite effect size estimates (Cohen's *d*) comparing the SocAnh and PerMag groups to the control group for objective and subjective emotion regulation and awareness.

emotional abnormalities associated with the negative, but not positive, schizotypy. Specifically, while both positive and negative schizotypy are associated with elevated attention to and experience of negative emotions, only negative schizotypy is associated with reduced attention to and experience of positive emotions (Fung et al., 2017; Li et al., in press; Martin et al., 2011). Given that the construct of negative schizotypy itself is characterized by emotion-related abnormalities (e.g., anhedonia, affective flattening), this finding of greater emotional impairments in negative schizotypy is consistent with its conceptualization. Interestingly, impairments were observed for all self-reported measures except for the Goals subscale of the DERS, that is, the ability to engage in goal-directed behaviors when faced with negative emotions. A closer examination of the items revealed that the questions were anchored with concrete behavioral outcomes that possibly allow for relatively more objective assessments of one's own activity (e.g., "When I'm upset, I have difficulty getting work done"; "When I'm upset, I can still get things done [R]"). Therefore, this result lends more credibility to our findings of the subjective-objective deficit paradox as they are not a function of measurement bias (e.g., self-report vs. behavioral tasks).

Our finding that individuals with schizotypy are impaired in subjective, but not objective, emotion regulation and awareness is largely consistent with previous research. With respect to implicit emotion regulation, our null result is in line with past findings of automatic emotion regulation (Cohen et al., 2009; Cohen and Hong, 2011) as well as implicit response to affective stimuli (Cohen et al., 2011a). At the same time, our null result regarding objective emotional awareness is not inconsistent with prior mixed findings generated by studies examining behavioral indices of attention to emotion in schizotypy (Brown and Cohen, 2010; Mohanty et al., 2005). In particular, LEAS findings are consistent with previous studies utilizing text-based analysis in response to affective or neutral stimuli (Cohen et al., 2011a; Cohen and Hong, 2011). However, there is some evidence that schizotypy is associated with objective emotional awareness deficits. For example, Fung et al. (2017) found that compared to healthy controls, schizotypy participants used fewer positive and greater negative emotional words in a free writing paradigm. Schizotypy group was also found to produce fewer positive and greater negative emotional words in response to affective images (Najolia et al., 2011), as well as less emotional content in response to emotion-eliciting scenarios (Kerns et al., 2008). One important distinction from prior paradigms is that the LEAS specifically asks participants to describe their feelings. In contrast, the instructions for the above tasks were either unstructured (in the case of the free-writing paradigm) or ambiguously broad (e.g., "write down a description that would inform another person who has never had the experience before what it is like"; Kerns et al., 2008). Thus, it is possible that, while individuals with schizotypy do not naturally focus on their feelings, they have the capacity to do so when explicitly asked to.

Our results add to a growing literature of subjective-objective deficit paradox in schizotypy. While accumulating evidence has demonstrated a deficit paradox in affective experience (Cohen et al., 2017), we extended prior research by showing that such disjunction is not limited to basic affective processes. High-level processes such as emotion regulation and awareness may also suffer from this disjunction. Moreover, our results, and that of others, reveal that individuals with schizotypy may lack insight into their affective processes. This poor insight might contribute to the experiences of ambivalence (MacAulay et al., 2014), which is a prominent feature of schizotypy characterized by contradictory feelings and attitudes toward a common object (Meehl, 1962). For example, limited insight into one's implicit desire to regulate emotions coupled with a perceived inability to do so might engender opposing, emotionally charged ideas. As a result, this heightened level of ambivalence could exacerbate social and emotional disengagement in schizotypy, which has been observed in the literature (Burgin et al., 2015; Kwapil et al., 2002; MacAulay et al., 2014). Thus, elucidating how insight and ambivalence relate to the subjective-objective disjunction in emotion regulation and awareness will be an important topic for the future.

Overall, findings of the present study imply that emotion regulation and awareness deficits associated with schizotypy might be the result of higher-order processes, rather than abnormalities in basic functioning. Considering that subjective measures tap into one's perceptions and beliefs that have less of an impact on objective assessments (Keefer, 2015), higher-order cognitive bias might be at play in contributing the deficit paradox (Cohen et al., 2017). From a clinical standpoint, the findings of the current study closely align with the cognitive conceptualization of schizophrenia, which places dysfunctional beliefs at the heart of the etiological framework and treatment target (Beck et al., 2009; Beck and Rector, 2005). Consequently, our findings imply that abnormalities in emotion regulation and awareness among at-risk individuals might be more amenable to cognitive therapeutic approaches

that specifically address cognitive bias and provide insights into their discrepant subjective-objective processes, compared to treatments focused on skill acquisition.

One potential candidate for cognitive bias is defeatist performance beliefs (DPB), which refers to global and overgeneralized negative thoughts about one's ability to perform tasks. Relative to controls, elevated levels of DPB have been observed in individuals with schizophrenia and schizotypy, which have been linked to negative symptoms and functional outcomes in both groups (Campellone et al., 2016; Luther et al., 2018, 2016; Mitchell and Cohen, 2017). There is also evidence showing that DPB mediates the relationship between cognitive impairment and both negative symptoms and functioning in schizophrenia patients (Grant and Beck, 2009). Together, recent research suggests that DPB might be a potential mechanism linking cognitive impairments, negative symptoms, and poor functioning. Future studies are needed to elucidate the relationship between DPB and affective abnormalities.

While the current study offers intriguing insights into affective abnormalities in schizotypy and provides compelling directions for future research, it is not without limitations. Chiefly, our results and the generalizability of our findings are limited by the use of a college sample. Given that college students tend to have greater functioning than the general population (Ross and Mirowsky, 1999), it is possible that they might have used compensation strategies to ameliorate the performance deficits. Nevertheless, some evidence suggests that individuals with schizotypy recruited from the community display similar patterns of subjective-objective deficit paradox in affective and cognitive functioning (Blanchard et al., 2011a; Cohen et al., 2006; Germine et al., 2011; Hooker et al., 2014). Examining whether or to what extent this subjective-objective deficit paradox applies to schizotypy community samples and relatives of individuals with schizophrenia will help clarify the boundary conditions and explain the progression of subjective deficits to objective impairments.

In conclusion, the present study extended the boundary of subjective-objective deficit paradox in schizotypy to emotion regulation and awareness. Our findings highlight the role of cognitive bias in contributing to abnormalities in emotion regulation and awareness. As such, further investigation of cognitive bias (e.g. DPB) and emotion regulatory processes may not only improve our understanding of affective disturbances more generally, but also be a critical step in improving intervention outcomes.

Conflicts of interest

None of the authors had a conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2019.01.026.

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