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Research paper

Obsessive-compulsive symptoms are related to reduced awareness of emotional valence

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ABSTRACT

Background: The Seeking Proxies for Internal States (SPIS) model of OCD asserts that obsessive-compulsive (OC) tendencies are associated with attenuated access to internal states. Here we explore the implications of this model for awareness of emotional valence.

Methods: In Study 1, participants with high and low OC tendencies ($n = 30$ in each group) rated how they felt while viewing different pictures with positive, neutral, or negative valence taken from the International Affective Picture System. Study 2 replicated Study 1 among non-selected participants ($n = 99$) that rated positive and negative pictures chosen from the recently developed Basic-Emotions Nencki Affective Picture System. In both studies, mean deviation from norm ratings (of each picture system) served as the primary outcome measure.

Results: Study 1 showed that high OC participants' mean deviation score was significantly higher, compared with low OC participants, across positive, neutral, and negative pictures ($p=.01$). Follow-up analyses revealed that while no group difference emerged for mean valence rating ($p=.16$), groups differed on the mean standard deviation of ratings within each valence category ($p=.002$). In Study 2, only OC tendencies, not depressive or anxiety symptoms, were positively correlated with mean deviation from norm ratings ($p=.026$). Dividing the sample to high and low OC groups based on an OC cutoff score yielded similar group differences to those observed in Study 1 ($p<.001$).

Limitations: Analog samples and a relative small sample size (Study 1).

Conclusions: This study suggests that OC symptoms are associated with reduced awareness of emotional valence, possibly emanating from a noisier emotional perception.

1. Introduction

Over the past decade we have developed and validated the Seeking Proxies for Internal States (SPIS) model of obsessive-compulsive disorder (OCD; Dar et al., 2019, 2016; Lazarov et al., 2015, 2012a, 2012b; Lazarov et al., 2010, 2014; Liberman and Dar, 2009, 2018). According to this model, OCD is characterized by *attenuated access to internal states,* rendering these states vague and less clearly experienced. Internal states are defined as subjective states that cannot be fully assessed by outside observers or objective measures, and could be, among others, cognitive (e.g., perception, memory), affective (e.g., different emotions), and bodily (e.g., muscle tension, proprioception). This attenuation of internal states, according to the SPIS model, is coupled with, and closely and bi-directionally related to, *obsessive doubts* (regarding these states), a phenomenon considered to be a central feature of OCD in both classic (Janet, 1903; Rapoport, 1989; Reed, 1985; Shapiro, 1965) and more recent accounts of the disorder (Boyer and Lienard, 2006; O'Connor et al., 2005; Summerfeldt, 2004; Szechtman and Woody, 2004; Tolin et al., 2003; Wahl et al., 2008). Put differently, the SPIS model suggests that doubting an internal state can reduce access to that state, and naturally, reduced access to internal states might in turn increase doubt in regard to these states. The SPIS model also postulates that OCD is characterized by a compensatory reliance on and usage of *proxies*, defined as substitutes or indexes for the internal state that the individual perceives as more easily discernible or less ambiguous than the state they index. Importantly, while these proxies may be beneficial in short-term reduction of doubt and anxiety, in the long term they might have detrimental effects as they remove one further from his internal experience (Lazarov et al., 2014) thereby increasing doubt and uncertainty (van den Hout and Kindt, 2003; van den Hout and Kindt, 2008). For example, imagine a person who does not know whether she loves her partner and resorts to counting the number of daily text messages she sends him as a proxy for her affection. While this practice might temporarily reduce her doubts and anxiety, over the long run,

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relying on this proxy will only further erode her confidence in her feelings towards her spouse, and decrease her ability to directly experience this feeling (Lazarov et al., 2014). To use another clinical example to illustrate the SPIS model, a young man with OCD began to worry that he did not fully understand the material he had learned in school. The more he questioned and attempted to monitor his own level of understanding, the more his uncertainty about his understanding grew. He therefore developed the rule that he should be able to recite the material by heart. In terms of the SPIS model, he compensated for attenuated access to his internal state of understanding by developing a more easily discernible and "objective" proxy. Finally, to cite the words of one OCD patient with contamination obsessions and cleaning rituals: "I don't really know that my hands are clean, but I do know that I have completed my ritual."

Initial support for some of the model's assertions was attained via a series of studies examining the bodily internal states of relaxation and muscle tension, using two biofeedback-aided experimental paradigms (Lazarov et al., 2015, 2012a, 2012b; Lazarov et al., 2010, 2014; Zhang et al., 2017). Using muscle tension as an example, in the first paradigm high and low OC participants were asked to produce different levels of muscle tone (i.e., the magnitude production task; Lazarov et al., 2012b), with deviations from the requested target, in absolute value, serving as the outcome of interest. Importantly, deviation scores were chosen as the dependent variable to reflect that the examined internal state is vaguely or less clearly experienced (compared with non-OC participants) signaling attenuated access to that state. The general procedure comprised four phases. During Phase 1 participants were requested to try and achieve the target internal state (i.e., different levels of muscle tone) without viewing the biofeedback monitor. They were subsequently given an explanation about the biofeedback apparatus and then asked to achieve the same internal state as in Phase 1, this time while viewing the biofeedback monitor (Phase 2). Phase 3 repeated Phase 1, while in the fourth and final phase participants were not able to view the biofeedback monitor continuously, but were given several opportunities to do so upon their own request. They were warned, however, that viewing the monitor might also impair their performance. As predicted, high OC participants performed worse (i.e., deviated more than the target internal state) than low OC participants in the absence of biofeedback, but performed equally well when the biofeedback was available. Also as predicted, high OC participants requested to see the biofeedback monitor in Phase 4 more times than did low OC participants, despite the potential cost in performance they had been warned about. In the second paradigm, high and low OC participants were asked to assess their internal state of muscle tone (Lazarov et al., 2012a, Study 1), after receiving relevant but false physiological feedback. The false feedback procedure comprised two counter-balanced phases, during which participants viewed pre-programmed "biofeedback" depicting their physiological state. During one phase, the biofeedback monitor showed a descending line graph indicating a decrease in muscle tone, and during the other, an ascending line graph indicating an increase in muscle tone. Following each phase participants were requested to subjectively rate their physiological state. We examined the extent to which participants' estimations of their internal states were affected by the false feedback. As predicted, high OC participants, compared to low OC participants, were more affected by the false feedback in assessing the relevant internal states, with no differences between phases in the actual physiological measure. These results were replicated, with much larger effect sizes, when participants with clinical OCD were compared to both anxiety disorders and non-clinical control participants (Lazarov et al., 2014). Finally, experimentally inducing doubt and uncertainty among non-selected participants yielded result patterns that were very similar to those observed in high OC participants in both paradigms (Lazarov et al., 2015, 2012a, Study 1).

While providing important initial evidence for the SPIS model, internal bodily states are not particularly relevant to the phenomenology of OCD. In contrast, OC individuals often have doubts regarding their own emotional states. Two lines of research indicate that OCD is indeed associated with reduced emotional awareness (Kang et al., 2012; Robinson and Freeston, 2014). First, deficiencies in emotional awareness in relation to the *emotional states of others*, reflective of empathy, have been implicated in OCD (Kang et al., 2012). Research has shown attenuated amygdala responsivity in OCD patients while viewing faces expressing different emotions (Cannistraro et al., 2004) as well as a deficient ability among OC participants to correctly recognize emotional facial expressions (for review see Daros et al., 2014). However, these studies did not directly assess one's ability to accurately assess his/her own emotional states. Other studies, more directly assessing emotional awareness in relation to *one's own feelings*, reflective of *alexithymia* (i.e., a trait characteristic manifesting in difficulties in identifying and describing one's own emotions; Sifneos, 1973), have also found deficiencies in OCD (for a review see Robinson and Freeston, 2014). Yet, these studies have used self-report measures of alexithymia (i.e., the twenty-item Toronto Alexithymia Scale; TAS-20; Bagby et al., 1994a, 1994b; Taylor et al., 2003), rather than using actual performance on tasks gauging perception of one's own emotions. As self-reports often reflect low confidence rather than deficient ability, the self-reported alexithymia could simply reflect reduced confidence in the ability to identify and describe one's own emotions (Lazarov et al., 2012b). Furthermore, lacking an ability often makes it impossible for people to know, and report, of its absence (Dunning et al., 2003). Thus, additional research is needed to explore awareness of one's own emotional states in OCD.

Three recent studies in our lab tested the prediction that OCD would be related to attenuated access to one's own emotions (Dar et al., 2016). The dependent variable in these studies was performance on the emotional intelligence (EI) test as assessed by the Mayer Salovey Caruso Emotional Intelligence Test (MSCEIT, Mayer and Salovey, 1997; Mayer et al., 2002, 2004), a widely used measure based on strong conceptualization with good reliability and validity (Brackett and Mayer, 2003; Mayer et al., 2004, 2003). The MSCEIT produces two distinct scores of EI, Experiential and Strategic, both expressed as percentiles within the distribution of normative scores, with lower percentile scores reflecting lower emotional intelligence compared with the norm. More specifically, a correct response on the test is scored on the basis of agreement with general consensus, with MSCEIT scores, provided by the test publishers, standardized in relation to a normative sample previously assessed by the MSCEIT (Jacobs et al., 2008; Mayer et al., 2002). Experiential EI reflects the ability to perceive, generate, and feel emotions. In contrast, Strategic EI reflects a more cognitive aspect of EI, comprised of understanding and managing emotions. As the SPIS model postulates an attenuation of emotional states in OCD, it predicts that OC symptoms would be related to deficient performance only on Experiential EI, but not on Strategic EI. Findings were in complete accordance with this prediction. Study 1 demonstrated that high OC participants, compared to low OC participants, had lower Experiential EI, but not lower Strategic EI. Study 2, examining a sample of non-selected participants, found that OC symptoms were correlated with lower Experiential EI but not Strategic EI, and also replicated the results of Study 1 when comparing the top and bottom quartiles of the distribution based on an OCD measure. Finally, in Study 3, experimentally inducing doubt in one's ability to correctly identify his/her emotions among unselected participants yielded similar results to those reported in Study 1.

The present study aims to extend the aforementioned findings in three important ways. First, Experiential EI measures the ability to perceive, generate, and feel emotions by using test items referring to discrete qualitatively different emotions such as happiness, sadness, fear, and surprise. Here we aimed to explore the model's predictions with regard to the more basic dimension of emotional valence, namely, the extent to which an emotion is positive vs. negative. Second, as Experiential EI items require participants to identify the emotions expressed in faces and pictures, these items less directly assess the responder's own emotional state. In the present study we aimed to address this potential limitation by using an emotional task that more directly and explicitly requires participants to identify their own emotions. Third, as the MSCEIT is a multiple choice questionnaire, it might signal to participants that items have correct and erroneous responses. Here we chose a task in which participants are explicitly informed that there are no right or wrong answers.

In the present studies, we adopted the original procedure of the International Affective Picture System (IAPS; Lang et al., 2008), in which participants are asked to rate different pictures in terms of how it made *them* feel, as opposed to the aforementioned EI studies (Dar et al., 2016) in which participants were asked to rate the emotions expressed in presented stimuli. In Study 1, participants with high and low OC symptoms were asked to rate the valence of positive, neutral and negative IAPS pictures (Lang et al., 2008), matched on arousal levels. In Study 2, to generalize obtained results beyond a specific set of pictorial stimuli, non-selected participants rated the valence of positive and negative pictures taken from the more recently developed Basic-Emotions Nencki Affective Picture System (NAPS-BE; Riegel et al., 2016), again matched on arousal levels. While both picture sets offer norm ratings of additional features (e.g., arousal), we decided to focus on valence ratings as the current studies were specifically designed to extend our previous emotional intelligence findings (Dar et al., 2016) in the realm of emotion valence. Based on the SPIS model and our previous findings (Dar et al., 2016; Lazarov et al., 2012b, 2014), we predicted that in Study 1 high OC participants, compared with low OC participants, would deviate more from IAPS norm ratings. We chose deviation from the norm rating as our outcome variable of interest in line with our previous studies in which norm ratings were used (Dar et al., 2016) and deviation scores served as the dependent measure (Lazarov et al., 2012b, 2014). Time to complete the task and subjective rating of task difficulty were also assessed, with the expectation that high OC participants will take longer than low OC participants to complete the task and would rate the task as more difficult. For Study 2 we predicted that OC symptoms will be positively correlated with mean deviation from NAPS-BE norm ratings.

2. Study 1

2.1. Methods

2.1.1. Participants

Three hundred and fifty-three undergraduate psychology students at Tel-Aviv University were screened using the Obsessive-Compulsive Inventory-Revised (OCI-R; (Foa et al., 2002; see Measures). We invited students who scored at the top and bottom of the distribution to participate in this study. Importantly, using "analog" samples of high and low scorers on measures of OCD has been shown to be relevant to the understanding of OCD (for a review see Abramowitz et al., 2014), and was proven useful in previous research conducted in our laboratory, in which results of “analog” participants were successfully replicated in clinical samples (Lazarov et al., 2014).

The final sample included 60 students (17 men, *M*age = 23.57 years, *SD* = 5.75, range = 18–42 years): 30 students (4 men, *M*age = 23.70 years, *SD* = 3.94, range = 18–42) with high OC symptoms (*M* = 41.87, *SD* = 13.63) and 30 students (13 men, *M*age = 23.43 years, *SD* = 2.25, range = 18–28) with low OC symptoms (*M* = 10.90, *SD* = 11.20). For comparison, the mean OCI-R score for OCD patients in Foa et al. (2002) was 28.01 (*SD* = 13.53), with a cutoff score of 21 for differentiating OCD patients from non-anxious controls, and 18 for differentiation from anxious controls.[1] The study protocol was approved by the local Institutional Review Board and participants provided written informed consent and received course credit for participation.

2.1.2. Measures

Obsessive-compulsive symptoms. OC symptoms were measured using the OCI-R (Foa et al., 2002). The OCI-R lists 18 characteristic OCD symptoms. Each symptom is rated regarding its prevalence during the last month on a five-point scale ranging from 0 (Not at all) to 4 (Extremely). The OCI-R has been shown to have good validity, test-retest reliability and internal consistency in both clinical (Foa et al., 2002) and non-clinical samples (Hajcak et al., 2004). Cronbach's alpha in the present sample was 0.96.

Depression and anxiety symptoms. Depression and anxiety symptoms were measured using the Depression, Anxiety and Stress Scales-21 (DASS-21; Lovibond and Lovibond, 1995a). The DASS-21 is a 21-item self-report questionnaire yielding three sub-scales of seven items each, assessing dimensional components of depression, anxiety and stress. Each individual item is rated on a 4-point scale ranging from 0 (*the item does not apply to me at all*) to 3 (*the item applies to me very much or most of the time*), on which participants indicate how much the statement applied to him/her experience over the past week. The DASS-21 has been shown to have high reliability, validity and internal consistency in both clinical and non-clinical groups (Antony et al., 1998; Henry and Crawford, 2005; Lovibond, 1998; Lovibond and Lovibond, 1995b). Cronbach's alpha in the present sample was 0.93, 0.91, and 0.95 for the depression, anxiety, and stress sub-scales, respectively.

Task difficulty. Subjective task difficulty was measured with a 100-mm Visual Analogue Scale (VAS) on which participants were asked to mark the place that best describes how difficult they felt the task was. In the present study we used a computer-administered VAS, anchored with “I did not find the task difficult at all” on the left and “I found the task to be very difficult” on the right. Scores ranged from 0 to 100 with higher scores reflecting more experienced difficulty.

2.1.3. The valence rating task

IAPS pictures. The IAPS is a large set of emotionally-evocative pictures that provides for each picture normative ratings of valence, arousal and dominance (Lang et al., 2008). Here we focused on the valence scale, which ranges from Positive (signaling the participant felt happy, pleased, satisfied, hopeful) to Negative (signaling the participant felt unhappy, annoyed, unsatisfied, melancholic, despaired, bored). We chose 120 pictures for the present study: 40 with positive (high) valence, 40 with neutral valence, and 40 with negative (low) valence (IAPS valence ratings of 6.5–7.5, 4.5–5.5, 2.5–3.5, respectively). These three categories were matched on arousal ratings, with half of the pictures within each category being of high arousal (IAPS arousal ratings of 5.2–7.5) and half of low arousal (IAPS arousal ratings of 2.5–4.8). The chosen pictures did not contain any classic OCD-relevant content.[2] Picture selection was performed in a two-tier process, whereby IAPS pictures were first chosen by one reviewer (AL) and then corroborated by a second reviewer (RD), both with extensive experience in treating, assessing, and conducting research on OCD. Order of picture presentation was randomized per participant. Table 1 depicts the average valence ratings of IAPS pictures in each valence category (i.e., based on the IAPS norm ratings).

Valence rating procedure. The valence rating procedure followed

[1] As participants were assessed using a self-report measure of OC symptoms (i.e., the OCI-R; Foa et al., 2002), rather than on a formal clinical diagnostic interview, those surpassing the clinical cutoff of 21 are still referred to as having high OC symptoms and not clinical OCD, although some, if formally assessed, may would have met criteria for clinical OCD.

[2] As OCD can be idiosyncratic and vary among individuals, is it possible of course that for some participants some pictures may have contained OCD-relevant content.

Table 1
Norm valence ratings of IAPS and NAPS pictures per valence type (Based on the IAPS and NAPS Datasets).

	High Valence		Neutral Valence		Low Valence	
	M	*SD*	*M*	*SD*	*M*	*SD*
IAPS	6.93	0.27	5.03	0.29	3.02	0.30
NAPS	5.95	0.55	–	–	4.04	0.65

Note. IAPS, International Affective Picture System; NAPS BE, Basic-Emotions Nencki Affective Picture System.

closely the original IAPS scoring procedure (Lang et al., 2008). Briefly, participants were told that the task they are about to perform is designed to examine the way people respond to different pictures representing different events in life, and that during the task they would be asked to rate each of them in terms of how it *made them feel.* They were also told that there are no right or wrong answers, and that all that was required of them is to answer as honestly as they can. Next, the valence rating procedure, using a computerized 9-point Self-Assessment Manikin (SAM; Fig. 1), was explained and demonstrated. Specifically, participants were shown the SAM and its two anchors and midpoint, and informed that the happy anchor signals that the participant felt happy, pleased, satisfied, or hopeful while viewing the picture, and that the unhappy anchor signaled the participant felt unhappy, annoyed, unsatisfied, melancholic, despaired, or bored. Participants were also advised that intermediate feelings can be indicated by marking any of the other locations on the SAM and that the SAM midpoint signaled the participant felt completely neutral, neither happy or unhappy. This valence rating of each presented picture using the happy-to-unhappy SAM was later transformed to a corresponding 9-to-1 score. Finally, before starting the actual procedure, participants were told once again that their rating of each picture should reflect how they actually *felt* while watching the picture. They were further instructed that due to time constraints they should not dwell on their ratings and indicate their feelings as quickly as possible following the picture disappearance. The total duration of the task was approximately 35 min.

In line with our previous research in the realm of bodily states (Lazarov et al., 2014) and emotions (Dar et al., 2016), we again focused on deviation score as our outcome measure of interest. For each valence category we derived a rating deviation score per participant, as was done in our previous studies on bodily internal states (Lazarov et al., 2012b, 2014), and based on provided general consensus norms (Dar et al., 2016). Specifically, for each participant, we first computed the absolute difference between the IAPS normed rating of each presented picture and the rating assigned to it by the participant. Next, we computed a mean deviation score per valence category by averaging the deviation scores of the 40 pictures per valence category. Thus, for each participant we derived three deviation scores, one for the positive pictures, one for the neutral pictures, and one for the negative pictures.

2.1.4. Procedure

Participants were tested individually in a quiet room. Upon arriving, they received a detailed explanation about the experiment, a description of the general procedure and the specifics of the rating procedure (see above), and then signed an informed consent form. Next, the IAPS task commenced, following closely the procedure described in Lang et al. (2008). Each trial began with a 5 s preparation slide instructing participants to get ready for the next slide. Then the picture itself was presented for 6 s, and the valence-rating SAM appeared immediately after it. After rating, participants pressed a “NEXT” button, which initiated the next trial. For each picture we recorded participants' rating and the time it took them to rate the picture (i.e., the time that elapsed from the SAM appearance to entering the rating). Upon task completion, participants rated task difficulty and completed the OCI-R (Foa et al., 2002) and DASS-21 questionnaires (Lovibond and Lovibond, 1995a). Finally, participants were debriefed and thanked for participation.

2.1.5. Data analysis

We powered our study to detect group differences in mean deviation score using a 2-tailed $\alpha = 0.05$ and a Power of 0.80, and based on the effect size found in our previous study of group differences on Experiential EI scores, a measure that greatly resemble the current one (Dar et al., 2016; Study 1). This resulted in a required sample of 28 participants per group. Power analysis was performed using G*Power 3.1.9.4 (Faul et al., 2007). All statistical analyses were conducted with SPSS (IBM; version 25).

Independent sample t-tests compared between-group descriptive characteristics, and a chi-square test used to compare groups on gender distribution. To examine group differences on valence deviation scores, we performed a mixed-model ANOVA with group (high OC, low OC) as a between-subjects factor and picture valence (positive, neutral, negative) as a within subject factor. A similar two-by-three mixed-model ANOVA was also performed for response time. As our analysis indicated between group differences in gender distribution, we also performed analysis of covariance (ANCOVA) for significant findings entering gender as a covariate. Finally, an independent sample *t*-test was used to compare groups on subjective ratings of task difficulty. All statistical tests were 2-sided, using α of 0.05. Effect sizes for significant findings are reported using η_p^2 for ANOVAs and *Cohen's d* for mean comparisons, including 90% effect size confidence interval (CI).

2.2. Results

2.2.1. Demographic and clinical characteristics

Demographic and clinical characteristics of the two groups are described in Table 2. While groups did not differ on age, $t(58) = 0.32$, $p = .75$, differences were noted for gender distribution, $\chi^2(1) = 6.65$, $p = .01$. Not surprisingly, the two groups, which were created based on their OCI-R scores, differed significantly on the depression, anxiety, and stress sub-scales of the DASS-21, $t(58) = 3.93$, $t(58) = 4.49$, $t(58) = 6.60$, respectively, all p's < 0.001.

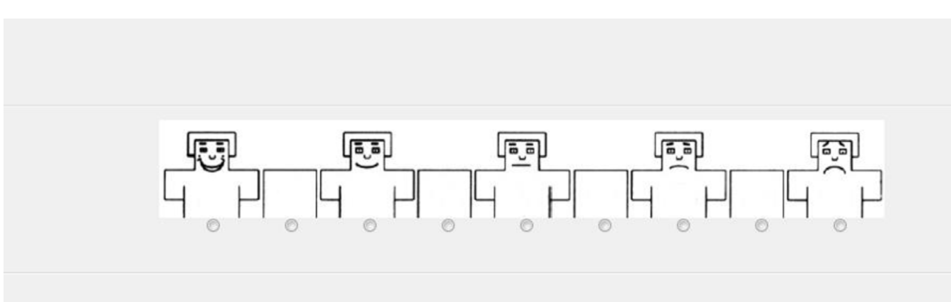

Fig. 1. The computerized 9-point Self-Assessment Manikin (SAM).

Table 2
Demographic and psychopathological characteristics per group – Study 1.

	High OC group		Low OC group		P value
Measure	*M*	*SD*	*M*	*SD*	
Age	23.70	3.94	23.43	2.25	.75
Gender ration (M:W)	4:26	–	13:17	–	.01
OCI-R	41.87	13.63	10.90	11.20	< 0.01
DASS-21					
Depression subscale	8.30	6.22	3.20	3.44	< 0.01
Anxiety subscale	7.87	5.48	2.67	3.21	< 0.01

Note. OC, Obsessive-Compulsive; OCI-R, Obsessive-Compulsive Inventory-Revised; DASS-21, Depression, Anxiety and Stress Scales-21.

2.2.2. IAPS valence ratings

Deviation scores. Mean deviation scores by group and valence category are presented in Fig. 2a. As predicted, there was a main effect of group, $F(1, 58) = 6.60$, $p = .01$, $\eta^2_p = .10$, CI = 0.01–0.23, such that high OC participants had higher deviation scores than low OC participants, across all valence categories (positive, neutral, and negative). No group-by-valence category interaction emerged, $F(2, 58) = 0.68$, $p = .50$. Because groups differed on gender ratio, we repeated this analysis introducing gender as a covariate. The main effect of group remained significant, $F(1, 57) = 5.31$, $p = .02$, $\eta^2 p = .09$, CI = 0.005–0.21. Again, no group-by-valence category interaction emerged, $F(2, 57) = 1.23$, $p = .30$. There was also no gender-by-valence category interaction, $F(2, 57) = 1.81$, $p = .17$.

To better understand the observed group differences in mean deviation scores, we computed for each participant the mean valence ratings of each valence category, and averaged these across participants for each group. We then conducted a similar group-by-valence category mixed-model ANOVA to explore the possibility that group differences in mean deviation scores were due to group differences in the magnitude of the emotional response (for example, systematically lower or higher valence ratings of high OC participants, compared to low OC participants). However, there was no main effect of group, $F(1, 58) = 2.02$, $p = .16$, $\eta^2 p = .03$, nor a group-by-valence category interaction, $F(2, 58) = 2.65$, $p = .07$, $\eta^2 p = .03$ (see Fig. 2b). Introducing gender as a covariate showed no main effect of group, $F(1, 57) = 0.56$, $p = .46$, nor a group-by-valence category interaction, $F(2, 57) = 1.25$, $p = .29$ and there was no gender-by-valence category interaction, $F(2, 57) = 2.21$, $p = .12$.

We also examined with a similar ANOVA the standard deviation of the scores each participant assigned to the 40 pictures in each valence category. The 40 pictures in each valence category were selected to be similar on valence, and thus, their normed ratings had a low standard deviation (see Table 1). We reasoned that a high standard deviation among a participant's ratings would reflect a less calibrated, noisier, emotional experience. Consistent with this reasoning, a significant main effect of group, $F(1, 58) = 10.78$, $p = .002$, $\eta^2 p = .16$, CI = 0.04–0.29, and no group-by-valence category interaction, $F(2, 58) = 0.13$, $p = .88$, $\eta^2 p = .002$, indicated a higher standard deviation among high OC participants, compared with low OC participants, across all valence categories (see Fig. 2c). The main effect of group remained significant after introducing gender as a covariate, $F(1, 57) = 8.74$, $p = .004$, $\eta^2 p = .13$, CI = 0.03–0.27. Again, no group-by-valence category interaction emerged, $F(2, 57) = 0.29$, $p = .75$ and there was no gender-by-valence category interaction, $F(2, 57) = 0.97$, $p = .38$.

Response time and difficulty ratings. We found no main effect of group, $F(1, 58) = 0.15$, $p = .70$, or a group-by-valence category interaction effect, $F(2, 58) = 1.97$, $p = .14$, on response time. Introducing gender as a covariate showed no main effect of group, $F(1, 57) = 0.11$, $p = .74$, and there was no group-by-valence category interaction, $F(2, 57) = 1.72$, $p = .18$, or gender-by-valence category interaction $F(2, 57) = 0.61$, $p = .55$. However, there was a significant group differences on subjective difficulty ratings, $t(58) = 2.24$, $p = .03$, *Cohen's d* = 0.58, CI = 0.06–1.09, such that high OC participants rated the task as more difficult (M = 53.33, $SD = 19.51$) than low OC participants (M = 40.67, $SD = 24.00$). This group differences was still significant after introducing gender as a covariate, $F(1, 59) = 4.34$, $p = .04$, $\eta^2 p = .07$, CI = 0.001–0.18,

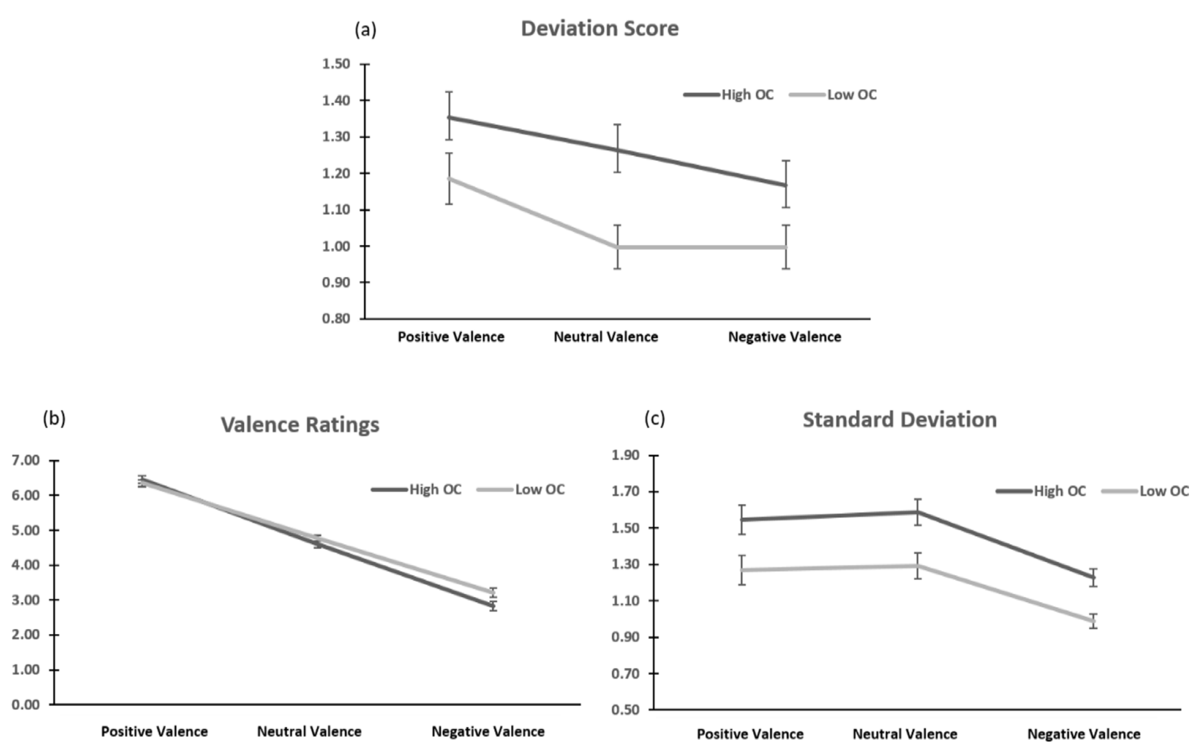

Fig. 2. Results of Study 1. (a) Mean deviation-from-the-norms scores by Group and Valence category; (b) Mean valence ratings (raw scores) by Group and Valence category; (c) Standard deviation of the scores by Group and Valence category. Error Bars denote standard error of the mean (SEM).

3. Study 2

3.1. Methods

3.1.1. Participants

We powered our study to detect a correlation of 0.3 between OC symptoms and mean deviation from NAPS-BE norm ratings using a 2-tailed $\alpha = 0.05$ and a Power of 0.80, and based on the correlation coefficient between OC symptoms and Experiential EI scores found in our previous research (Dar et al., 2016; Study 2). This resulted in a required sample of 84 participants. Power analysis was performed using G*Power 3.1.9.4 (Faul et al., 2007). All statistical analyses were conducted with SPSS (IBM; version 25).

Participants were 99 members of an Israeli internet-based panel (Midgam; https://www.midgampanel.com/) which constitute a fairly representative sample of Israeli society in terms of geographical location, ethnic origin, religiosity, educational level and socio-economic status based on demographic data provided by the Israeli Central Bureau of Statistics (CBS; http:// www.cbs.gov.il/he/publications/doclib/2019/2.shnatonpopulation/st02_03.pdf). Potential participants were contacted via email and asked to participate in a study in psychology for a small fee. The final sample included 39 women (39.4%) and had a mean age of 40.00 years (SD = 11.99, range = 18–64). Mean psychopathological measures were 22.02 (SD = 12.12, range = 0–62) for the OCI-R (Cronbach's alpha of 0.89), and 10.38 (SD = 4.02, range = 7–27) and 9.94 (SD = 3.56, range = 7–23) for the depression and anxiety DASS-21 subscales, respectively (see Measures in Study 1). Cronbach's alpha for the DASS-21 was 0.89 for the depression sub-scale and 0.83 for the anxiety sub-scale. The study protocol was approved by the local Institutional Review Board and participants provided written informed consent.

3.1.2. The valence rating task

NAPS-BE pictures. The NAPS-BE (Riegel et al., 2016) is a subset of 510 images/pictures chosen from the original NAPS set (Marchewka et al., 2014). It provides normative ratings of valence and arousal for each picture on a 1–9 scale, akin to those provided by the IAPS, as well as normative ratings of discrete emotions (happiness, surprise, sadness, anger, disgust, and fear). As in Study 1, we focused on general valence ratings. We chose 60 images, 30 with positive valence (NAPS-BE valence > 5) and 30 with negative valence (NAPS-BE valence rating < 5), matched on arousal levels. Additional image qualifications were: (1) arousal levels < 4, in order to minimize the effect of high arousal on valence ratings; (2) disgust rating < 2, in order to exclude images with potential OCD-relatedness, as disgust was found to be related to obsessions and compulsions (Mancini et al., 2001); and (3) 0.75 < standard deviation (SD) of valence rating < 1.5. This range was chosen to maximize the potential of chosen images to yield OC-related deviations from norm valence ratings. Specifically, high norm variability might mask any variability-increasing effect of OC symptoms; Conversely, low norm variability could yield relatively uniform ratings, suppressing the potential effects of OC symptoms. The 60 chosen images were further split into two blocks of 30 images, by sorting the 60 individual images by valence and then dividing them in a semi-alternating fashion, resulting in two blocks with similar mean valence ratings (5.05 for Block 1 and 5.07 for Block 2). While order of blocks was fixed, order of picture within each block was randomized per participant. Table 1 presents the average valence ratings of NAPS-BE pictures in each valence category (based on the NAPS norm ratings).

Valence rating procedure. The valence rating procedure was similar to Study 1. However, as this procedure was delivered online (see Procedure below), participants were also requested to refrain from any distractions during the task, and specifically not to listen to any kind of music, as music has been shown to affect emotional states (Arjmand et al., 2017; Mas-Herrero et al., 2013). The total time to complete the task was approximately 15 min, with about 6 min to complete each block.

Similar to Study 1, for each participant we computed a mean deviation score by averaging the deviation scores of the 60 presented pictures.

3.1.3. Procedure

The entire procedure was delivered online using the Qualtrics website (http://telaviv.eu.qualtrics.com). Following the instructions described above, the task itself began. Each picture was presented for 5 s, with the valence-rating SAM appearing immediately after picture disappearance. Following the rating, participants pressed a “NEXT” button that appeared on the screen to initiate the next trial. Following 30 trials (i.e., Block 1) participants were given a short break before proceeding with the task. Upon task completion, participants completed the OCI-R (Foa et al., 2002) and the depression and anxiety subscales of the DASS-21 questionnaire (Lovibond and Lovibond, 1995a).

3.2. Results

3.2.1. Correlation analysis

To examine our primary hypothesis, we computed a Pearson partial correlation between mean deviation scores and OCI-R scores, controlling for DASS-21 anxiety and depression scores. We then repeated this analysis, once for DASS-21 anxiety scores, controlling for OCI-R and DASS-21 depression scores, and once for DASS-21 depression scores, controlling for OCI-R and DASS-21 anxiety scores. As predicted, mean deviation scores were positively correlated with OCI-R scores, $r = 0.23$, $p = .026$. Importantly, mean deviation scores did not correlate with either DASS-21 anxiety scores, $r = 0.002$, $p = 0.98$, or DASS-21 depression scores, $r = -0.16$, $p = .12$, suggesting mean deviation scores to be specifically associated with OC symptoms.

3.2.2. Group level analysis

To examine the replicability of results obtained in Study 1, we divided the study sample to a high OC and a low OC group based on the OCI-R cutoff score of 21 (Foa et al., 2002), and then repeated the analyses of Study 1, conducting a group (high OC, low OC) by picture valence (positive, negative) mixed-model ANOVA for mean deviation score, mean valence rating and standard deviation of scores in each valence category (see Fig. 3a, 3b, 3c, respectively). Demographic and clinical characteristics of the two groups are described in Table 3. Groups did not differ on age, $t(97) = 0.08$, $p = .93$, or gender distribution, $\chi^2(1) = 0.16$, $p = .83$. However, not surprisingly, the two groups, which were created based on an OCI-R cutoff score, also differed significantly on the depression and anxiety sub-scales of the DASS-21, $t(97) = 3.60$, $t(97) = 4.02$, respectively (all p's < 0.001).

Fully replicating the findings of Study 1, for mean deviation score, the group (high OC, low OC) by picture valence (positive, negative) mixed-model ANOVA yielded a main effect of group, $F(1, 97) = 7.43$, $p < .001$, $\eta^2 p = .07$, CI = 0.01–0.16, such that high OC participants had higher deviation scores, compared with low OC participants, across both valence categories. Also, while no significant group effect emerged for mean valence rating, $F(1, 97) = 0.17$, $p = .68$, for mean standard deviation, a main effect of group, $F(1, 97) = 6.01$, $p = .01$, $\eta^2 p = .06$, CI = 0.006–0.15, indicated a higher standard deviation among high OC participants, compared with low OC participants, across both valence categories.

4. Discussion

The present study aimed to corroborate the SPIS tenet of attenuated access to internal states in OCD in the realm of emotions. In Study 1, participants with high and low OC symptoms provided valence ratings to emotional IAPS pictures with positive, neutral, or negative valence, matched on arousal levels. As predicted, compared with low OC participants, high OC participants deviated more from valence norm

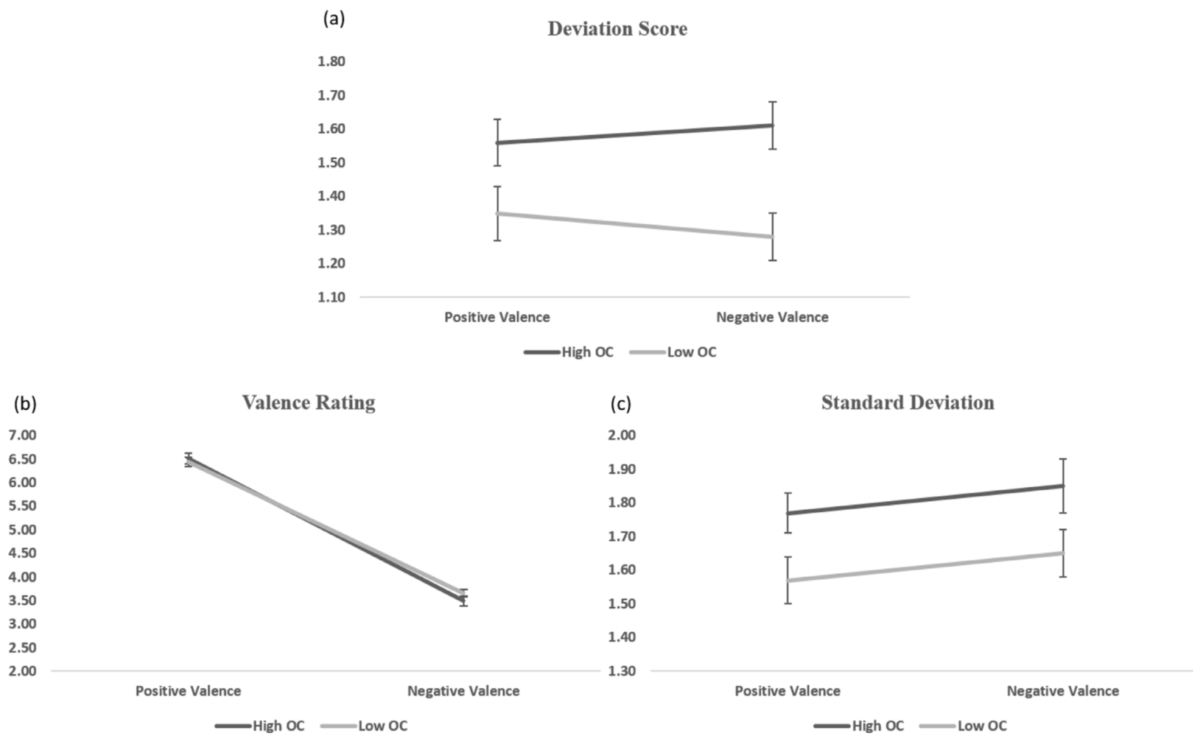

Fig. 3. Results of group-level analysis in Study 2. (a) Mean deviation-from-the-norms scores by Group and Valence category; (b) Mean valence ratings (raw scores) by Group and Valence category; (c) Standard deviation of the scores by Group and Valence category. Error Bars denote standard error of the mean (SEM).

Table 3
Demographic and psychopathological characteristics per group – Study 2.

	High OC group (n = 52)		Low OC group (n = 47)		P value
Measure	M	SD	M	SD	
Age	39.90	12.64	40.11	11.37	.93
Gender ration (M:W)	31:21	–	29:18	–	.83
OCI-R	31.11	8.85	11.96	5.40	< 0.01
DASS-21					
Depression subscale	11.69	4.74	8.94	2.35	< 0.01
Anxiety subscale	11.21	4.17	8.53	1.96	< 0.01

Note. OC, Obsessive-Compulsive; OCI-R, Obsessive-Compulsive Inventory-Revised; DASS-21, Depression, Anxiety and Stress Scales-21.

ratings. Contrary to our predication, groups did not differ in response time. Consistent with our prediction, high OC participants rated the task as more difficult than low OC participants. The procedure of Study 2 followed closely that of Study 1 while using the newly developed NAPS-BE picture dataset in a sample of non-selected participants. Results indicated that only OC symptoms correlated positively with mean deviation scores, while depressive and anxiety symptoms did not. Dividing the sample to high and low OC groups based on the OCI-R cutoff score yielded similar group differences to those observed in Study 1.

The present findings extend previous ones in the realm of emotional awareness in OCD in several important ways. First, while previous findings have shown that OCD is related to a deficiency in accurately identifying the emotions expressed in faces or in pictures (for review see (Daros et al., 2014), here we showed a complementary deficiency also when asking participants to directly assess/rate *their own feeling* while viewing evocative stimuli. Second, previous studies in OCD examining emotional awareness in relation to one's own feelings have used mostly self-report measures of alexithymia (for a review see Robinson and Freeston, 2014). Third, whereas previous studies examined the relationship of OC symptoms to evaluation of specific emotions (e.g., anxiety, surprise, disgust), the present study addressed the more basic and simple axis of emotion valence, namely, the extent to which an emotion is positive vs. negative. Our findings demonstrate that high OC individuals are less calibrated, relative to low OC participants, even on this basic emotional dimension. Finally, previous studies used multiple choice questionnaires, such as the MSCEIT (Mayer et al., 2003), which might suggest to participants the existence of correct and erroneous answers and inadvertently instigate test anxiety or, alternatively, perfectionist symptoms among high OC participants trying to "succeed on the task." Importantly, perfectionism and test anxiety, which tends to be high in OCD (Frost and Steketee, 1997), also impede performance (Mills and Blankstein, 2000; Mor et al., 1995; Stoeber et al., 2009). The present findings were obtained with tasks that had no "right or wrong" answers, possibly mitigating the potential influence of these factors on our results.

We also explored group differences in mean valence rating and in the variance of these ratings per valence category. While we found no group differences for the former, a group difference did emerge for the latter. What could explain this divergence? One possibility is that it is simply easier to distinguish broad valence categories (i.e., positive, neutral, negative) than to be more finely tuned, or calibrated, to minute differences between individual pictures of similar valence. For example, it does not stand to reason that a high OC participant would not feel a picture of playing puppies as positive, whereas a picture of a rotting corpse as negative. However, when presented with several pictures of equivalent (positive/neutral/negative) valence, high OC participants were less calibrated in their ratings of their own feelings of specific images within these valence categories, showing high score variance. Another possibility, not necessarily exclusive of the former, is that high OC participants may have also relied on their semantic knowledge about presented stimuli in judging their valence, assigning the "correct" valence type/category per picture. This interpretation is in accordance with SPIS assertions and aligns with our previous results showing that unlike Experiential EI, no differences between high and low OC participants emerged for Strategic EI, which reflects a more cognitive aspect of EI (Dar et al., 2016). This result also echoes prior research showing that high OC individuals rely on explicit processing to compensate and overcome a deficit in implicit processing (Deckersbach et al., 2002; Rauch et al., 1997; Soref et al., 2018). Future research could address these possibilities more directly by including, in addition to broad valence ratings, also ratings of specific and discrete emotional states.

Regarding the SPIS model more generally, results of the present studies would lead to conceptualizing the proposed attenuation of internal states in OCD as reflecting a noisier perception of these states. Interestingly, this possibility is in line with a previous study examining procedural working memory in OCD (Shahar et al., 2017). Similar to the present findings, no group differences were found between OCD and control participants on actual working memory functioning. However, an evidence accumulation modeling follow-up analysis revealed that compared with controls, the performance of OCD participants was characterized by noisier perceptual processing, which was compensated for by a more cautious response threshold (Shahar et al., 2017).

Further supporting the notion that high OC symptoms might be related to reduced access to emotional experience, high OC participants rated the task as more difficult compared with low OC participants. According to the SPIS model, this finding reflects the difficulty that high OC participants have in accessing their own emotional states. Moreover, our model suggests that the difficulty these participants evidently experienced in rating their emotional response (i.e., obsessing over the act of choosing or obsessive doubting) may in turn have further attenuated their access to these internal states (Lazarov et al., 2015; Shapira et al., 2013) resulting in deficient performance on the task. Notably, task difficulty was assessed as a whole, and not per valence category, and hence we could not compare the different valence categories on subjective difficulty. Future research might examine whether and how the level of difficulty experience by high OC participants might interact with picture valence. Furthermore, we expected that high-OC participants would take longer to rate the pictures, but no such difference emerged. Possibly, this null finding could be attributed to the instructions given to participants, which followed closely the original IAPS guidelines (Lang et al., 2008), namely, not to dwell on picture ratings and to respond as quickly as possible. Still, future studies should replicate the present procedure while dropping the requirement to respond as quickly as possible.

The current results should be considered in light of several limitations. First, the high and low OC groups in Study 1, as well as the two OCI-R-based groups of Study 2, also differed on depression and anxiety measures, possibly serving as alternative explanations for significant findings. Yet, as these features are inherently elevated in participants with high OC symptoms (Brown et al., 2001; Overbeek et al., 2002) we could not include them as additional covariates in our statistical analyses (Miller and Chapman, 2001).[3] However, Study 2 suggests that the obtained results are specifically related to group differences in OC symptoms, as deviation scores were uncorrelated with depression and anxiety measures. Still, additional research could further examine the specificity of the obtained results by controlling for other relevant OC-related traits such as perfectionism, and by comparing the performance of high OC participants to participants high on other psychopathology-related features, such as general distress or broader internalizing or externalizing symptomology. Relatedly, regarding Study 2, while the association between OC symptoms and mean deviation scores remained significant after controlling for depression and anxiety levels as measured in relation to the past week (using the DASS-21; Lovibond and Lovibond, 1995a), the present study did not include a state measure pertaining to participants' concurrent mood. Future research should include such a measure to examine more transient effects of mood on the obtained results.

Second, as Study 1 and 2 were both designed to elaborate our previous findings in the realm of emotion valence (Dar et al., 2016), we did not obtain other relevant ratings such as subjective arousal experienced while viewing the different valanced-pictures. Thus, while the different valence categories were matched on arousal levels based on norm ratings, it remains unclear whether high and low OC participants indeed experienced them as equivalent. The design of our studies was guided by the need to produce, based on norm ratings, discrete emotional-valanced categories matched on arousal, such that results, if obtained, could not be attributed to a-priory differences in the arousing nature of presented pictured. Nevertheless, future research in the realm of emotional awareness should consider this important aspect in order to gain a more complete understanding of emotional awareness in OCD.

Third, while studies using OCD analog samples, as in Study 1, have contributed significantly to the understanding of clinical OCD (for a review see Abramowitz et al., 2014), our results cannot be directly generalized to clinical OCD due to the analog nature of the sample and the assessment methods employed (i.e., self-report measures). At the same time, several encouraging indicators should be considered in this regard. First, the mean OCI-R score of the high OC group in Study 1 was well above the clinical cutoff score of 21 reported to differentiate OCD patients from non-anxious control (Foa et al., 2002). Second, previous studies from our lab have demonstrated that results obtained with clinical samples not only replicate those obtained with analog samples, but actually yield more prominent group differences (see Lazarov et al., 2012a, 2012b; Lazarov et al., 2014). Lastly, as extrapolating from the present results to clinical OCD requires assuming a linear relationship between OC symptoms and the observed behavior (i.e., increased deviation scores), the significant correlation between the two found in Study 2 allude to such a relationship. Thus, based on these indicators, we believe that current results would be replicated when comparing OCD patients and healthy control participants. Still, future studies should employ the present procedures using clinical OCD and both anxiety disorders and healthy control participants in order to address the above-mentioned limitations and strengthen the significance and generalizability of the current findings (Lazarov et al., 2014).

Fourth, while the procedure of Study 2 was delivered online, the current study did not employ any attention check questions or other methods sometimes used to optimize participant attention and quality of data in online research (Chandler et al., 2014). We do not believe this problem is acute, however. There is evidence that online participants may in fact be more attentive to task instructions and requirements compared with college students (Hauser and Schwarz, 2016). Moreover, the fact that similar results emerged in Study 1 (using a student sample) and Study 2 (using online participants) strengthens the validity of data obtained from the online panel. Still, future online research should include attention checks to ascertain data quality. Finally, the samples employed, especially in Study 1, were relatively small.

5. Conclusion

To conclude, this study adds to a growing body of research examining the SPIS model of OCD, while expanding on previous findings in the realm of emotional awareness. The present findings further elucidate the attenuation of internal states component of the model by suggesting that emotional states are experienced more vaguely or less clearly as the internal affective system of individuals with high OC symptoms is characterized by increased noise leading to a less calibrated system. Thus, while for most people introspecting on their feelings in different life situations might be an easy and effortless task, for high OC individuals, according to the SPIS model, this process poses more of a challenge (Dar et al., 2016).

[3] Nevertheless, after introducing depression, anxiety and stress scores as covariates, in addition to gender distribution, Study 1 results remained significant for group main effect on deviation scores, $F(1, 54) = 3.76$, $p = .05$, $\eta_p^2 = .07$, and for group main effect on rating standard deviation, $F(1, 54) = 5.60$, $p = .02$, $\eta_p^2 = .09$. This was also the case in the group-level analysis in Study 2, with the group main effect on mean deviation scores and mean standard deviation remaining significant, $F(1, 95) = 9.67$, $p = .002$, $\eta_p^2 = .09$ and $F(1, 95) = 7.20$, $p = .009$, $\eta_p^2 = .07$, respectively.

Our findings have potential clinical implications. Therapists can use the SPIS framework to discuss with patients the difficulties they experience in trusting their own subjective experiences and feelings. These doubts and uncertainties can be understood in therapy not only as excessive and irrational, but also, in part, as emanating from deficient access to one's own internal signals. An emphasis on excepting and acknowledging doubt and uncertainty as an integral part of human existence can also benefit from using SPIS terminology, as SPIS asserts that no action will ever successfully eliminate the obsessive doubt. Targeting doubt in achieving beneficial treatment outcome has been suggested in previous approaches to OCD (Aardema and O'Connor, 2012; Tolin et al., 2003). The present findings may also encourage using mentalization-based techniques aimed at achieving greater awareness of internal experiences in treating patients with OCD (Fonagy, 2002; Fonagy et al., 1991, 2010). The SPIS model suggests that some of the symptoms displayed by OCD patients may be attempts to manage their difficulties in accessing emotional states, and therapy could use SPIS terminology to offer patients a novel way to conceptualize and interpret their symptoms. This terminology offers an interpretation that is both more functional and more emphatic than the interpretations these patients typically come up with.

Authors declaration

We declare that this manuscript is original and that it has not been published before or has been posted on a web site and that it is not currently being considered for publication elsewhere.

Institutional board review

The authors assert that all procedures contributing to this work comply with APA ethical standards and with the Helsinki Declaration of 1975, as revised in 2008. All procedure were approved by the committees on human experimentation in Tel Aviv University.

Data availability

The data that support the findings of this study are openly available in Open Science Foundation (OSF) at https://osf.io/wb2s7/?view_only=3478fa52dcd34ba6b156bb973e1d22bb.

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Declaration of Competing Interest

We wish to confirm that there are no known conflict of interest associated with this publication.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2020.03.129.

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