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Social anxiety and sensitivity to social-rank features in male faces

Virginie Peschard[*,1], Sivan Ben-Moshe[**,1], Hadar Keshet, Hannah Restle, Daphna Dollberg, Eva Gilboa-Schechtman[***]

Psychology Department, Bar Ilan University, Israel

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ABSTRACT

Background and objectives: Evolutionary theories propose that socially anxious individuals are especially sensitive to social-rank signals, presumably at the expense of the attunement to signals of affiliation. Despite this theoretical claim, few empirical attempts examined the association between social anxiety (SA) and sensitivity to specific features of social-rank and affiliation. This study aims to fill this gap.

Method: Participants ($N = 67$) completed two tasks in which two emotionally neutral computer-generated male faces of the same character were presented side-by-side. In the Social-Rank-Sensitivity Task, the faces within each pair differed in their level of dominance and, in the Affiliation-Sensitivity Task, the faces differed in their level of trustworthiness. The participants' task was to decide which of the two faces looked more dominant or friendly.

Results: There were no differences in accuracy between high- and low-SA participants in the Affiliation-Sensitivity Task. In contrast, high-SA participants were more accurate than low-SA participants in the Social-Rank-Sensitivity Task. No group differences were found in decision latencies in either task.

Limitations: Limitations of the study are that a non-clinical sample was used and that only computer-generated male faces were considered.

Conclusions: Our findings suggest that SA is related to an enhanced ability to discriminate faces based on social-rank features. Examining sensitivity to facial cues signaling social-rank and affiliation may help to specify the nature of social threat sensitivity in SA.

1. Introduction

Social Anxiety Disorder (SAD) is a condition involving marked anxiety about social or performance situations in which an individual is exposed to possible scrutiny by others. Individuals with SAD fear acting in ways that will be humiliating, embarrassing, or will lead to rejection (American Psychiatric Association, 2013). Social anxiety (SA) ranges in severity (Crome, Baillie, Slade, & Ruscio, 2010), and even below-diagnostic levels, SA is associated with adverse outcomes, including significant functional impairments in several life areas, reduced quality of life and greater risk for comorbidity (e.g., Filho et al., 2010).

Two major biopsychosocial systems – of social-rank (aka hierarchical, power or dominance) and affiliation (aka belongingness, trustworthiness) – are postulated to govern our social lives (Baumeister & Leary, 1995; Sapolsky, 2005). The social-rank system is hypothesized to consistently monitor one's social standing with respect to conspecifics to maximize access to resources and to minimize the potential costs of losing a confrontation. The affiliation system, on the other hand, continuously monitors inclusionary status to satisfy the need to affiliate with or belong to a given social group. Evolutionary models of SAD (Gilboa-Schechtman, Shachar, & Helpman, 2014; Gilboa-Schechtman & Shachar-Lavie, 2013; van Honk, Bos, Terburg, Heany, & Stein, 2015) posit that over-utilization of the social-rank system, and under-utilization of the affiliation system, may contribute to the development and maintenance of SAD. Accordingly, individuals with SAD were found to exhibit biased impression formation when provided with social-rank and affiliation information (Aderka, Haker, Marom, Hermesh, & Gilboa-Schechtman, 2013; Haker, Aderka, Marom,

[*] Corresponding author. Emotional Processing Laboratory, Department of Psychology and the Gonda Brain Science Center, Bar-Ilan University, Ramat-Gan, 52900, Israel.

[**] Corresponding author. School of Behavioral Sciences, Academic College of Tel Aviv-Yaffo, Yaffo, 6818211, Israel.

[***] Corresponding author. Laboratory of Emotion processing, Department of Psychology and the Gonda Brain Science Center, Bar-Ilan University, Ramat-Gan, 52900, Israel.

E-mail addresses: peschardv@gmail.com (V. Peschard), bnmsivan@gmail.com (S. Ben-Moshe), evagilboa@gmail.com (E. Gilboa-Schechtman).

[1] Virginie Peschard and Sivan Ben-Moshe contributed equally to this work.

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Hermesh, & Gilboa-Schechtman, 2013). In particular, SAD individuals, who were given descriptions of protagonists, rated those described as behaving assertively (i.e., as high in social-rank), as more dominant than did control individuals. Conversely, results regarding the effect of SA on impression formation based on affiliation information are mixed. Haker et al. (2013) reported that SAD individuals, relative to controls, tended to view others as less friendly whereas Aderka et al. (2013) found that SAD individuals were more prone to formulate impressions of others as friendlier.

Research examining the relation between SA and the processing of nonverbal cues of social-rank and affiliation is scarce. Most of the literature on SA and the processing of social cues has focused on emotional facial expressions (EFEs), especially expressions conveying social threat (Staugaard, 2010). However, one limitation of this endeavor is that socially-threatening EFEs, such as angry faces, may connote threat to the social-rank system (by signaling high dominance and readiness to engage in confrontation) as well as to the affiliation system (by signaling low affiliation and readiness for exclusion or ostracism) (e.g., Knutson, 1996), thus confounding threats from the two domains.

Existing research investigating the processing of threatening EFEs has examined attentional as well as interpretative biases and their relation to SA. High-compared to low-SA individuals exhibit heightened attention to faces depicting anger or disgust (for a review see Bantin, Stevens, Gerlach, & Hermann, 2016). In contrast, the literature on the interpretation of prototypical EFEs, or of morphed or blended EFEs is rather mixed, with some studies finding no difference between high- and low-SA groups (e.g., Jusyte & Schönenberg, 2014; Philippot & Douilliez, 2005), some finding the expected enhanced response bias and/or enhanced sensitivity to threatening expressions (e.g., Gutiérrez-García & Calvo, 2014; Gutiérrez-Garcia & Calvo, 2016; Gutiérrez-Garcia, Calvo, Gutiérrez-Garcia, & Calvo, 2017; Maoz et al., 2016; Yoon, Yang, Chong, & Oh, 2014), and some even reporting reduced sensitivity (e.g., Gilboa-Schechtman, Foa, Vaknin, Marom, & Hermesh, 2008; Montagne et al., 2006). Given this lack of consistency, disentangling social-rank and affiliation threats may help to specify the nature of social threat sensitivity in SA (Gilboa-Schechtman & Shachar-Lavie, 2013).

The current study therefore sought to examine whether SA is related to sensitivity (i.e., the ability to discriminate) to facial cues of social-rank and affiliation. To do so, we designed two tasks: The Social-Rank-Sensitivity and the Affiliation-Sensitivity Tasks. In both tasks, two neutral computer-generated faces of the same male character were presented side-by-side. We decided to focus only on male faces, as it has been shown that male stimuli may pose a greater threat than female stimuli (see Kret & De Gelder, 2012). The face stimuli varied in intensity on either dominance (in the Social-Rank-Sensitivity Task) or trustworthiness (in the Affiliation-Sensitivity Task). Participants' task was to decide which face appears to connote more dominance or friendliness. As in Aderka et al. (2013) and Haker et al. (2013), we expected that high-compared to low-SA individuals would exhibit *increased* Social-Rank-Sensitivity by showing greater accuracy and shorter decision latencies in the Social-Rank-Sensitivity Task. Conversely, we predicted that high-compared to low-SA individuals would exhibit *decreased* Affiliation-Sensitivity by showing less accuracy and slower decision latencies in the Affiliation-Sensitivity Task.

2. Method

2.1. Participants

One hundred and eight participants were recruited via an academic subject pool and electronic bulletin boards to take part in the study. Each received payment (equivalent of $5) or course credit in exchange for their participation. Five participants were excluded due to below chance response accuracy (overall) yielding a final sample comprised of 103 participants (see data preparation). From this sample, 36 were classified as high-SA participants (i.e., scoring 50 or more on the Liebowitz Social Anxiety Scale-Self-Report version; LSAS-SR Liebowitz, 1987, for similar cutoff score, see Lazarov et al., 2017) and 31 as low-SA participants (i.e., scoring below 30 on the LSAS-SR, Mennin et al., 2002).

Table 1
Means (Standard Deviations in parentheses) of Participants' Characteristics.

Variables	All (n = 103)	HSA group (n = 36)	LSA group (n = 31)	t or $\chi 2$
Age	24.38 (5.98)	23.42 (4.10)	24.13 (4.12)	.70 [a]
% Females	51.50	58.30	58.10	.00 [b]
LSAS	42.04 (22.77)	66.69 (15.67)	17.29 (8.16)	- 16.50 [a] ***
SPIN	15.60 (12.02)	25.00 (12.76)	5.68 (4.56)	- 8.48 [a] ***
BDI	7.86 (7.03)	12.53 (8.31)	4.74 (4.85)	- 4.76 [a] ***

Note. HSA = High socially anxious individuals; LSA = Low socially anxious individuals; LSAS = Liebowitz Social Anxiety Scale; SPIN = Social Phobia Inventory; BDI = Beck Depression Inventory.
***$p < .001$.
t or $\chi 2$ compared means/proportions between high- and low-SA groups.
[a] Value for $t(65)$.
[b] Value for $\chi^2(1, 67)$.

2.2. Self-report questionnaires

Participants completed the Hebrew versions of the following questionnaires: The LSAS-SR (Liebowitz, 1987), the Social Phobia Inventory (SPIN, Connor et al., 2000), and the Beck Depression Inventory (BDI, Beck, Steer, & Brown, 1996). The LSAS-SR is a 24-item scale assessing anxiety and avoidance in social and performance situations. The SPIN is a 17-item scale of social fears, associated avoidance and physiological symptoms. The BDI is a 21-item measure of the severity of depressive symptoms. The latter measure was included because of the high comorbidity between SA and depression (e.g., Beesdo et al., 2007). In the present study, the internal reliabilities of these measures were 0.95, 0.92, and 0.87, respectively. Participant's characteristics are presented in Table 1.

2.3. Stimuli

Stimuli consisted of computer-generated male faces, which were selected from two databases developed and validated by Oosterhof and Todorov (2008). Each database contains 25 Caucasian facial identities created with Facegen Modeller program, Version 3.1 (http://facegen.com, Singular Inversions, 2006). For each facial identity, Oosterhof and Todorov (2008) manipulated specific facial features shown to influence dominance and trustworthiness perceptions in order to create seven exemplars of faces varying from high to low-intensity features on each specific dimension (for a complete description of the validation procedure see Oosterhof & Todorov, 2008).

The Social-Rank-Sensitivity Task and the Affiliation-Sensitivity Task each included 32 face pairs: 2 Facial identities (Character 1 and Character 2) X 2 Levels of difficulty (2: High vs. Low) X 2 Positions (Left vs. Right) x 4 Sets of pairs. The level of difficulty (high or low) was determined by the distance between two paired faces on the dominance (or trustworthiness) continuum (see Fig. 1). Hence, the faces in the low difficulty pairings differed from one another in regard to dominant (or trustworthy) facial features to a greater extent than the high difficulty pairings. A high difficulty pair included two faces that were 1 level apart on Oosterhof and Todorov's (2008) continuum on the dominance (or trustworthiness) dimension (i.e. pairings of levels 2 and 4, 3 and 5, 4 and 6, 5 and 7). A low difficulty pairing, on the other hand, included two faces 2 levels apart on Oosterhof and Todorov's (2008) continuum on the dominance (or trustworthiness) dimension (i.e. pairings of levels 1 and 4, 2 and 5, 3 and 6, 4 and 7). All the pictures were resized to 400 × 477 pixels bitmap.

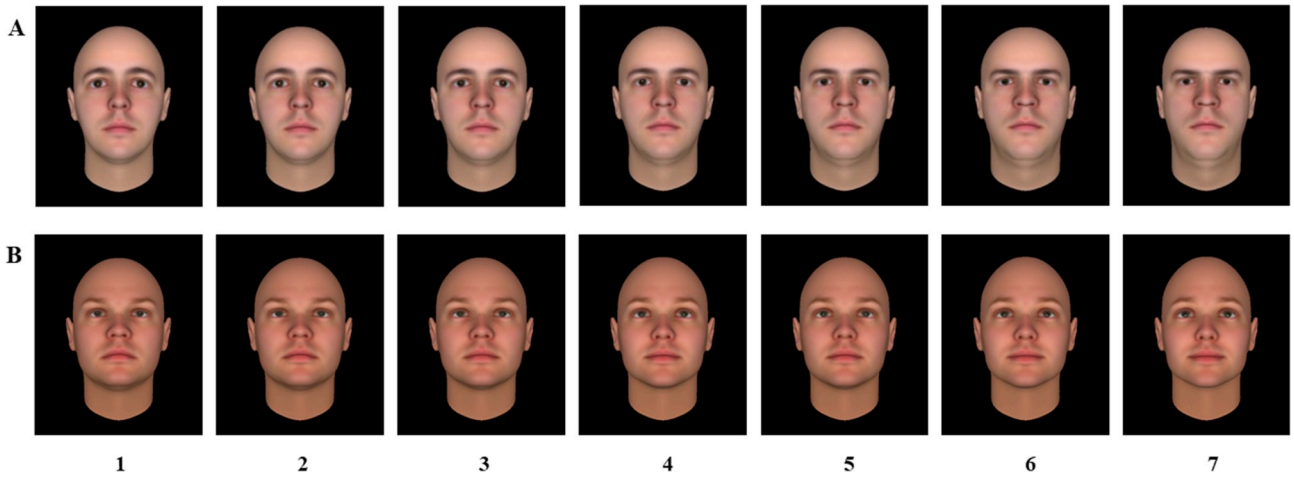

Fig. 1. Example stimuli of the dominance continuum from the Social-Rank-Sensitivity Task (A) and of the trustworthiness continuum from the Affiliation-Sensitivity Task (B). The intensity of dominance or trustworthiness features ranges from 1 to 7.

2.4. Procedure

After providing written consent, participants performed the Social-Rank-Sensitivity Task and the Affiliation-Sensitivity Task. The order of the tasks was counterbalanced across participants. In the Social-Rank-Sensitivity Task, faces within each pair differed in the degree of dominance and participants were requested to identify the more dominant-looking face. In the Affiliation-Sensitivity Task, the two faces differed in the degree of trustworthiness and participants' task was to identify the friendlier-looking one. We decided to ask participants to rate the faces on friendliness while the stimuli were selected on trustworthiness for two reasons. First, as we were interested in the affiliation dimension and its pertinence to SA, we chose a common linguistic term that maps into that dimension. Second, our previous research documented a very high correlation between perceived trustworthiness and friendliness judgments (e.g., Gilboa-Schechtman, Shalom, & Keshet, 2015). Both tasks were run using the E-Prime experimental presentation software (Schneider, Eschman, & Zuccolotto, 2002).

Each of the two tasks contained 5 practice trials followed by 64 experimental trials (two repetitions of the 32 face pairs). The presentation of the trials was randomized. Each trial began with the presentation of a white fixation cross displayed in the middle of a black background, which remained on the screen for the duration of the trial. After 400 msec, the two faces were presented next to each other. Participants were asked to make their decision as quickly as possible by pressing one of two keys ("i" and "e") with their index fingers. Faces disappeared as soon as the participant responded. Following the completion of these tasks, participants filled out the self-report questionnaires online using Qualtrics software and performed other cognitive tasks (e.g., Stroop) which are beyond the scope of the present paper.

3. Results

3.1. Tasks' reliability

Reliability of the tasks was estimated by applying the split-half methodology to decision latencies data of the whole sample. The mean individual scores of the even trials were correlated with the mean individual scores of the odd trials (Davidshofer & Murphy, 2005). Split-half reliability was 0.96 in the Social-Rank-Sensitivity Task and 0.97 in the Affiliation-Sensitivity Task (after Spearman-Brown correction).

3.2. Performances

3.2.1. Data preparation and statistical analyses

Data reduction included the following steps: (1) Incorrect responses were discarded from the analyses of the decision latencies (18.61%) (e.g., Jones et al., 2010); (2) Trials associated with decision latencies shorter than 300 msec or greater than 3 standard deviations (SDs) above the mean of the sample were considered outliers, reflecting anticipatory responding and delayed responding, respectively (2.94% of trials with correct responses); (3) Trials associated with decision latencies more than 3 SDs from participant's mean decision latencies were also eliminated (1.61% of the remaining data) (e.g., Jones et al., 2010). This procedure resulted in a final sample of 103 participants (i.e., 5 participants were excluded due to below chance overall response accuracy, yielding a final sample of 103 participants, their response accuracies were: 10.16%, 29.69%, 32.81%, 43.75, 47.66%), among them 36 were classified as high in SA, and 31 as low in SA.

Speed-accuracy tradeoff analyses were conducted separately for each task and group. There was no significant correlation between accuracy and decision latencies for Social-Rank-Sensitivity Task ($r = -0.00$, $p = .98$; $r = -0.31$, $p = .10$ for high and low SA groups respectively) and Affiliation-Sensitivity Task: ($r = 0.03$, $p = .86$; $r = -0.07$, $p = .72$ for high and low SA groups respectively).

To test our hypotheses, we computed repeated measures ANOVAs with Task (Social-Rank-Sensitivity, Affiliation-Sensitivity) and Levels of difficulty (High, Low) as within-subject factors as well as Group (High-SA, Low-SA) and Task-Order (Social-Rank-Sensitivity first, Affiliation-Sensitivity first) as between-subject factors for both response accuracy and decision latencies. In addition, we complemented these analyses with regression analyses considering the total sample (that is, a sample including the high and the low-SA groups as well as the group of participants with moderate levels of SA severity), i.e., $50 \geq LSAS > 30$, altogether 103 participants.

3.2.2. Response accuracy

The analysis for response accuracy first revealed a significant main effect of Task, $F(1, 63) = 8.88$, $p < .005$, $\eta_p^2 = 0.12$, such that participants were more accurate in the Affiliation-Sensitivity Task than in the Social-Rank-Sensitivity Task (see Table 2). Second, there was also a significant Task × Group interaction, $F(1, 63) = 5.55$, $p < .05$, $\eta_p^2 = 0.08$ (see Fig. 2). Separate ANOVAs for each Task showed that the main effect of Group was significant in the Social-Rank-Sensitivity Task, $F(1, 63) = 4.72$, $p < .05$, $\eta_p^2 = 0.07$, but not in the Affiliation-Sensitivity Task, $F(1, 63) = 0.58$, $p = 0.49$. Consistent with the increased Social-Rank-Sensitivity hypothesis, high-SA participants were more accurate in their decisions than were low-SA participants. Third, and consistently with the design of the task, a significant main effect of Levels of difficulty, $F(1, 63) = 99.12$, $p < .001$, $\eta_p^2 = 0.61$, indicated that participants were more accurate in the (easier) low-difficulty

Table 2
Means (Standard Deviation in Parentheses) of Participants' Response Accuracy and Decision Latencies as a Function of Task, Group and Levels of difficulty.

Variable	Levels of Difficulty	Social-Rank-Sensitivity		Affiliation-Sensitivity	
		HSA	LSA	HSA	LSA
Response accuracy	High-Difficulty	78.65 (15.52)	68.85 (20.10)	80.47 (15.98)	81.05 (11.92)
	Low-Difficulty	85.16 (17.16)	76.51 (18.71)	86.377 (15.24)	91.03 (10.72)
Decision Latencies	High-Difficulty	1873 (640)	1914 (585)	1877 (740)	1817 (674)
	Low-Difficulty	1707 (605)	1769 (579)	1673 (584)	1660 (544)

Note. HSA = High socially anxious individuals; LSA = Low socially anxious individuals. Response accuracy is reported in percentages and decision latencies are reported in msec.

condition than in the high-difficulty condition. Finally, a significant Levels of difficulty X Group X Task-Order interaction, $F(1, 63) = 3.91$, $p = .052$, $\eta_p^2 = 0.61$, was found. However, decomposition of this interaction did not yield significant findings. Other main effects and interactions did not reach significance ($Fs < 2.49$).

We also conducted regression analyses using the total sample with SA severity (computed as the mean z-score of LSAS and SPIN measures) as a continuous variable. These regressions can be thought of as the conceptual counterparts to the repeated measure ANOVAs used in main analyses. In both regression analyses, response accuracy for the one Sensitivity Task (e.g., social-rank) was the dependent variable and SA-severity, depression-severity and response accuracy for the other task (affiliation) were predictors. Due to the skewed distribution of the BDI (Skewness = 1.20, S.E. = 0.29), we used its square-root value in the analyses (as Berger, Keshet, & Gilboa-Schechtman, 2017; Roelofs et al., 2013). The results of the first regression, with social-rank accuracy as the predicted variable, and affiliation accuracy as one of the predictors, indicated that the model explained 11.3% of the variance. SA-severity, and response accuracy in the Affiliation-Sensitivity task, but not depression-severity, were significant predictors ($beta = 0.35$, $t(102) = 3.01$, $p < .005$; $beta = 0.19$, $t(102) = 1.98$, $p = .05$; $beta = -0.18$, $t(102) = -1.54$, $p = .13$). The model of the second regression explained 4.30% of the variance. Response accuracy for the Social-Rank-Sensitivity task, but not SA and depression-severity, were significant predictors ($beta = 0.20$, $t(102) = 1.98$, $p = .05$; $beta = -0.12$, $t(102) = -0.96$, $p = .34$; $beta = 0.01$, $t(102) = 0.08$, $p = .93$).

3.2.3. Decision latencies

An identical ANOVA was conducted on decision latencies. This analysis indicated a significant main effect of Levels of difficulty, $F(1, 63) = 44.53$, $p < .001$, $\eta_p^2 = 0.41$. As expected, decisions in the low-difficulty condition were made faster than in the high-difficulty condition. Other main effects and interactions were not significant ($Fs < 2.43$). Regression analyses using the whole sample yielded qualitatively identical results.

4. Discussion

The present study examined whether individuals with high versus low SA differ in their ability to discriminate social-rank cues in emotionally neutral faces. Consistent with the enhanced Social-Rank-Sensitivity hypothesis, we found that high-compared to low-SA participants were more accurate when discriminating social-rank (i.e., medium-sized effect), but not affiliation, cues in neutral male faces. These differences were also observed when SA was treated as a continuum and when depression-severity was statistically controlled. Importantly, this discrimination advantage came at no apparent cognitive cost, as no differences in decision latencies were observed between the two groups.

Our findings converge with research examining the effects of trait and state dominance on the ability to discriminate signs of facial dominance. Specifically, self-reported trait dominance, as well as traits associated with physical dominance in men (e.g., height), have been found to be *negatively* related to the ability to discriminate facial dominance cues in men (Watkins, Fraccaro, et al., 2010; Watkins, Jones, & DeBruine, 2010). In addition, individuals whose social-rank was temporarily reduced (by imagining the experience of social defeat)

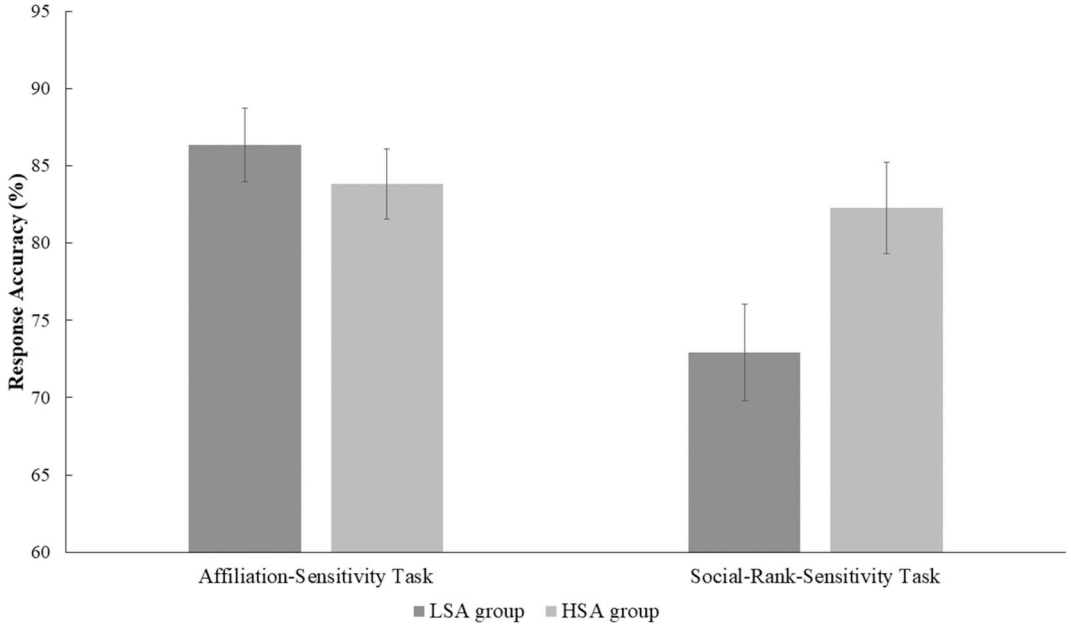

Fig. 2. Mean response accuracy as a function of Task and Group.

were better at discriminating between facial dominance cues (Watkins & Jones, 2012). Thus, higher self-perceived social-rank (as indicated by low SA and high trait and state dominance) is negatively related to sensitivity to facial dominance cues.

Studies examining related processes have also supported that SA is associated with increased attunement to indications of high social-rank. For example, high-compared to low-SA individuals demonstrated a greater increase in their dominance ratings of male faces when exposed to chemo-signals of dominance (i.e., androstadienone; Banner & Shamay-Tsoory, 2018). In addition, SA was also found to be associated with heightened reactivity to chemosensory signals of state dominance, as reflected by increased skin conductance responses (Adolph, Schlösser, Hawighorst, & Pause, 2010). Finally, studies using verbal descriptions of behavior (Aderka et al., 2013; Haker et al., 2013) found that SAD individuals relative to controls rated protagonists, who were described as dominant, as higher on social-rank. Combined, data from a variety of paradigms suggests that SA is positively related to reactivity and sensitivity to verbal and non-verbal social-rank signals.

The enhanced ability to discriminate between social-rank cues in SA individuals converges with evolutionary theories of this condition (e.g., Trower & Gilbert, 1989). According to these theories, high-SA individuals, as compared to low-SA individual, may be more driven by social-rank, than by affiliative, concerns. This particular focus on social hierarchy may lead them to selectively monitor for, and learn to differentiate between, nuanced social-rank cues. In addition to enhanced sensitivity to social-rank cues, high-SA individuals also tend to experience and exhibit involuntary signs of submissiveness. Such signals include gaze avoidance, higher vocal pitch as well as closed posture. Indeed, SA, as well as trait and state dominance, have been related to such behaviors. Gaze avoidance has already been established as an important feature of SA (Enter, Terburg, Harrewijn, Spinhoven, & Roelofs, 2016; Terburg et al., 2016; Weeks, Howell, & Goldin, 2013). Moreover, gaze-aversion was negatively related to trait dominance, and reduced by state dominance (Hortensius, van Honk, de Gelder, & Terburg, 2015; Terburg, Aarts, & van Honk, 2012; Terburg, Hooiveld, Aarts, Kenemans, & van Honk, 2011). Increased vocal pitch has been similarly associated with SA (Galili, Amir, & Gilboa-Schechtman, 2013; Weeks, Heimberg, & Heuer, 2011). Finally, in competitive situations, high-SA men were found to exhibit more closed postures than did low-SA men (Weeks et al., 2011).

Being a keen observer of social-rank cues could be a double-edged sword. On the one hand, it may be useful for high-SA individuals who doubt their own ability to successfully compete, thereby protecting them from costly consequences of misjudging their relative social-rank. On the other hand, a fine-grained discrimination of social-rank cues may lead high-SA individuals to identify others as domineering, judgmental, or critical, potentially resulting in the activation of socially submissive behavioral strategies. Once activated, these submissive strategies may reaffirm the evaluation of the self as inferior, and thereby contribute to the maintenance of SA.

Inconsistent with our predictions, decision latencies in the Social-Rank Sensitivity Task did not vary as a function of SA. This is surprising since higher SA-severity is generally associated with quicker detection of social threat (e.g., Gutiérrez-García & Calvo, 2014). However, these studies have used different designs than ours (e.g., presentation of only one cue at a time), making the comparisons between studies difficult. Our study required quick visual scans and comparisons of two facial cues. It is possible that the two SA groups displayed very different gaze patterns that were masked by similar decision latencies. Eye-tracking studies may elucidate this null finding. Importantly, high-SA individuals were as good as low-SA individuals in discriminating cues of affiliation. Our findings regarding the discrimination of affiliative cues are in line with previous studies documenting weak, or non-existent association of SA-severity and affiliation judgments (Berger et al., 2017; Dijk, van Emmerik, & Grasman, 2018; Gilboa-Schechtman, Friedman, Helpman, & Kananov, 2013).

In closure, several limitations of the present study need to be noted. First, our study was conducted with a young, educated, non-clinical sample consisting mainly of university students. Replications with more representative non-clinical, as well as with clinical samples are needed. Second, we focused on male computer-generated faces. This limitation may reduce the external validity of our findings. Forthcoming studies may examine the effects of SA on the sensitivity to facial dominance in ecological stimuli of both genders (e.g., Watkins, Fraccaro, et al., 2010). Third, our stimuli were neutral facial expressions which may resemble certain emotional expressions (e.g., facial features of dominance resemble that of anger, see Zebrowitz & Montepare, 2015). Indeed, in the present design, we cannot ascertain that the increased sensitivity to social-rank is not due to increased sensitivity to emotional valence. Fourth, it is possible that the increased accuracy of high-SA individuals in discriminating between facial cues of social-rank was driven by instruction-induced focus on dominance, as participants were asked to identify the more “dominant-looking” face. Future studies may address this possible confound by manipulating instructions that highlight submissiveness, rather than dominance. Finally, the interpretation of our findings followed the traditional “feed-forward” approach. This perspective posits that social perceptions are shaped by bottom-up facial cues (e.g. a large jaw). However, recent research challenges this approach by showing that higher-order social cognitive processes (e.g., prior person-knowledge, attitudes, motives; for review see Freeman & Johnson, 2016) can bias visual perception of facial features. Future investigations may therefore benefit from manipulating these cognitive factors (such as participants' beliefs about a character's social-rank, see Gobel, Tufft, & Richardson, 2017) to examine their impacts on the SA-related sensitivity to interpersonal facial cues.

The present study examined the effect of SA on the discrimination of social-rank and affiliation cues. Previous studies documented impairments and biases in the processing of interpersonal cues in SA. Our results suggest that SA is related to an enhanced ability to discriminate between social-rank cues.

Conflicts of interest

The authors disclose any possible financial conflicts of interest and sponsorship or funding arrangements relating to their research.

Authors' note

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbtep.2018.10.005.

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