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Social inhibition and approach-avoidance tendencies towards facial expressions

Stefanie Duijndam*, Nina Kupper, Johan Denollet[1], Annemiek Karreman

CoRPS – Center of Research on Psychological and Somatic Disorders, Tilburg University, the Netherlands

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ABSTRACT

This study examined how different manifestations of social inhibition (behavioral inhibition, interpersonal sensitivity, and social withdrawal) are related to automatic approach/avoidance behaviors in a social context. A sample of 115 undergraduate students and 20 adults from the general population (M_{age} = 24.8, SD = 11.4; 75% women) were assessed with the 15-item Social Inhibition Questionnaire (SIQ15). During a facial expression version of the Approach-Avoidance Task (AAT), participants reacted to images of emotional facial expressions (angry, happy, and neutral) or to control images (neutral objects) in portrait or landscape formats by pulling a joystick towards themselves (approach) or pushing it away from themselves (avoidance). The superordinate social inhibition construct was not associated with approach/avoidance tendencies. However, individuals high in the interpersonal sensitivity domain of social inhibition showed stronger approach tendencies for happy and neutral facial expressions compared to neutral objects, which may relate to their focus on seeking the approval of others.

1. Introduction

Social inhibition is a broad and stable personality trait that is characterized by decreased conversational behaviors, increased social evaluative concerns, and avoidance of social interaction (Asendorpf, 1993; Denollet and Duijndam, 2019). Findings from developmental studies show that social inhibition may be related to adverse effects on mental health (Dyson et al., 2011; Fox et al., 2005). However, it is largely unexplored how and why social inhibition may affect health and well-being in adults. Hence, a multi-faceted model of adult social inhibition was developed with behavioral (i.e., behavioral inhibition), cognitive (i.e., interpersonal sensitivity), and affective (i.e., social withdrawal) tendencies that may help identify how this disposition in adults is related to specific psychological demands (Denollet and Duijndam, 2019). Previous research shows that socially inhibited individuals perceive social situations as threatening (Kret et al., 2011) because they anticipate criticism or rejection from others. As a consequence, social situations are either avoided (Sheynin et al., 2013), or endured with intense feelings of distress (Duijndam et al., 2019).

Avoidance behaviors prevent individuals to effectively process situations and the emotions related to those situations, and act as an important factor in the maintenance of mental disorders such as social anxiety (Rapee and Heimberg, 1997). Additionally, the use of avoidance strategies in social situations, such as in medical consultations (Schiffer et al., 2007), could be harmful for an individual's health. As socially inhibited individuals are more vigilant towards social threat (Kret et al., 2011), this may result in more automatic avoidance behaviors when social interaction is expected to decrease the level of threat and anxiety in social situations. It is currently unknown whether social inhibition is manifested by threatening social interaction in particular, or by social interaction in general. In this study, we therefore aimed to gain insight in the implicit level of emotional processing of (threatening) social stimuli (i.e., facial expressions) relative to neutral stimuli in socially inhibited individuals, using an approach-avoidance-task (AAT).

The AAT assesses behavioral avoidance tendencies caused by threat, by presenting pleasant and unpleasant stimuli, which have to be pushed away or pulled towards the participant (Solarz, 1960). It has been previously demonstrated that pleasant stimuli are associated with muscle inflexion (approach), whereas unpleasant stimuli are associated with muscle extension (avoidance) (Cacioppo et al., 1993). With respect to facial expressions, avoidance tendencies are usually related to unpleasant facial expressions such as angry faces (Marsh et al., 2005), because expressing anger implies potential social threat (Adams et al., 2003). On the other hand, smiling faces indicate good social intentions and thus larger approach tendencies (Nikitin and Freund, 2019; Ruggiero et al., 2017).

* Corresponding author at: Tilburg University, Department of Medical and Clinical Psychology, CoRPS – Center of Research on Psychological and Somatic Disorders, the Netherlands.
E-mail address: s.n.c.duijndam@tilburguniversity.edu (S. Duijndam).
[1] Prof. Dr. Johan Denollet passed away on October 26, 2019.

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These approach and avoidance responses to facial expressions could be modulated by individual differences in social inhibition. Although previous research observed avoidance tendencies in response to angry and happy facial expressions in socially anxious individuals (Heuer et al., 2007), it is currently unknown how the personality trait social inhibition is related to implicit avoidance tendencies in relation to facial expressions. However, it is expected that socially inhibited individuals may display the same avoidance tendencies, given that social inhibition is associated with social anxiety (Kupper and Denollet, 2014; Schofield et al., 2009). Although related, social inhibition and social anxiety do not share all of the variance (Kupper and Denollet, 2014) suggesting that these are distinct traits. Social inhibition is considered a trait that can vary from normal tendencies in responding to social situations to psychopathological levels of functioning. Because social inhibition reflects a personality trait rather than disordered functioning, high levels are likely more prevalent compared to related mental disorders (i.e., social anxiety disorder, avoidant personality disorder; Schneier et al., 2002; Stein et al., 2004). Gaining insight in the underlying mechanisms of the social inhibition spectrum may therefore offer an opportunity to improve the understanding of the origin of more serious conditions associated with social inhibition.

Additionally, very little is known about how the different manifestations of social inhibition are related to automatic avoidance tendencies in relation to facial expressions. The global social inhibition trait is identified by three related lower-order facets, i.e., behavioral inhibition (e.g., decreased conversational behaviors), interpersonal sensitivity (e.g., fear of negative evaluation) and social withdrawal (e.g., avoiding social interaction; Duijndam and Denollet, 2019). Behaviorally inhibited individuals have difficulty to initiate contact (Asendorpf, 1993), thus this facet may be especially related to an avoidance of happy facial expressions. Individuals with high levels of interpersonal sensitivity are concerned with negative evaluations by others (Marin and Miller, 2013), so an increased avoidance bias for angry faces seems likely. Lastly, the social withdrawal facet is associated with avoiding social interaction altogether, and therefore may show associations with avoidance biases for both angry and happy facial expressions.

The aim of the current study was to investigate implicit approach and avoidance tendencies for facial expressions at different levels of social inhibition, while controlling for the effects of age and sex. Increasing age is associated with more adaptive emotion regulation (Carstensen et al., 2000), and men are more likely to have difficulty distinguishing one emotion from another (e.g., Hall and Matsumoto, 2004). Hence, older adults and men may show less difference in response times for the presented stimuli of the AAT. First, we investigated whether socially inhibited individuals showed stronger avoidance of facial expressions. Next, we examined whether the valence of facial expressions influences avoidance tendencies in socially inhibited individuals. We hypothesized that angry facial expressions in particular, but also happy facial expressions, are associated with avoidance tendencies (reflected by faster pushing than pulling in the AAT) in socially inhibited individuals, just like they were in highly socially anxious individuals (Heuer et al., 2007). As mentioned before, we expected behavioral inhibition to be particularly associated with avoidance of happy facial expressions, interpersonal sensitivity with avoidance of angry facial expressions, and social withdrawal with avoidance of both facial expressions.

2. Material and methods

2.1. Participants and procedure

Participants were 144 undergraduate Psychology students from Tilburg University in the Netherlands who received course credit for participation, and 29 adults from the general population who were paid a small monetary reward for their participation. To recruit participants from the general population, we sent out 1200 flyers to households in Tilburg, explaining the purpose of the study and asking people to participate. Respondents sent an e-mail to demonstrate their interest in the study. Participants above the age of 35 were eligible to participate in the study. Eleven participants dropped out of the study prematurely, and three participants did not agree with the informed consent form and decided not to participate. The final sample thus consisted of 159 participants (M_{age} = 25.9 ± 12.8; 75% women). All participants signed an informed consent form and the study was approved by the institutional ethics review board (EC-2016.26a).

After completion of the online questionnaire, participants were invited to the Behavioral Physiology lab (GO-Lab, Tilburg University), where they performed the Approach Avoidance Task (AAT) in a soundproof and climate-controlled room. The experiment was the first of two separate experiments (i.e., anger recall experiment) in which this sample participated, which were separated from each other by ample resting periods. The other experiment was not relevant for the current paper. Once the questionnaires and the experiment were completed, participants were fully debriefed and thanked for their participation.

2.2. Measures and materials

2.2.1. Demographics

Age, sex, and marital status (partner yes/no) were obtained from self-report questionnaires filled out at home.

2.2.2. Social inhibition

The 15-item Social Inhibition Questionnaire (SIQ15; Denollet and Duijndam, 2019; Duijndam and Denollet, 2019) was used to assess social inhibition and its three underlying facets. *Behavioral inhibition* (BI) refers to difficulties to initiate conversation topics and to get the conversation going (e.g., "*I have difficulty talking to other people*"), *interpersonal sensitivity* (IS) to pervasive social-evaluative concerns (e.g., "*I often worry that others may disapprove of me*"), and *social withdrawal* (SW) to avoiding engagement in intense social or emotional situations (e.g., "*I avoid getting close to other people*"). Items were rated on a 4-item Likert scale ranging from false (0) to true (3), and each facet was represented by a subscale of five items. Cronbach's alpha in the current study yielded 0.93 for the total score, 0.95 for behavioral inhibition, 0.90 for interpersonal sensitivity, and 0.87 for social withdrawal.

2.2.3. Approach Avoidance Task (AAT)

The AAT was adapted from the task used by Wiers et al. (2009) and programmed in Inquisit software (Millisecond Software, Seattle, WA). We used a facial expression version of the AAT with four categories of stimuli: angry expressions, happy expressions, and neutral expressions of five Caucasian males and five Caucasian females from the Radboud Faces Database (Langner et al., 2010), and ten neutral object stimuli (peg, computer mouse, frying pan, hammer, key, light bulb, paperclip, scissors, playing card, clover) from the BOSS database (Brodeur et al., 2010). A joystick (Logitech, Extreme 3D Pro) was used to pull (picture got bigger; approach) or push (picture got smaller; avoidance) the images, to respectively generate the sensation of approach or avoidance. Each category consisted of ten pictures, which were shown in both portrait and landscape format. Participants were instructed (verbally and written) to push the joystick as fast as possible when they saw a picture in portrait format and to pull the joystick when they saw the picture in landscape format, irrespective of the emotional expression. The assignments for format movement were counterbalanced, so that half of the participants (n = 69) pulled pictures that came in landscape and pushed pictures that came in portrait, while the other half (n = 66) pushed landscape pictures and pulled portrait pictures. The images were presented in quasi-random order, such that a maximum of three images of one category or three images of the same format were displayed in a row. All stimuli were shown twice: once in portrait and once in landscape format. Reaction time (RT) was defined as the time from stimulus onset to when the joystick reached its maximal deflection. Before the experimental condition was shown, ten practice trials were presented with a neutral gray rectangle in either portrait or landscape format.

Median response times (RTs) were calculated for each participant per category (facial expressions, and neutral object), and for each facial expression separately (anger, happy, and neutral). As is customary in the AAT literature (e.g., Heuer et al., 2007; Rinck and Becker, 2007; Wiers et al., 2009), AAT difference scores were calculated by subtracting the median pull RT from the median push RT. These scores reflect the relative strength of approach and avoidance tendencies. Positive scores were considered as an approach bias (faster pulling than pushing) and negative scores were considered as an avoidance bias (faster pushing than pulling).

2.3. Data analysis

First, mean error rates and response rates per participant were calculated. Measured with a boxplot, participants with outlier mean error rates (n = 10) and response rates (n = 14) were discarded (e.g., Wiers et al., 2009). If an error was made, values were treated as missing. In addition, the 1% fastest and 1% slowest response times (RTs) were removed.

Second, to examine whether implicit avoidance tendencies were larger for facial expressions compared to neutral object stimuli as a function of individual differences in social inhibition, we performed two repeated measures ANCOVAs. The first repeated measures ANCOVA included the AAT difference scores of the facial expressions combined (as one variable) and the neutral objects as dependent variables, and the total score of social inhibition was entered as a covariate (i.e., continuous), while the categorical variables sex and age group (young adults vs. general population) were entered as factors. For the second repeated measures ANCOVA, the AAT difference scores of the facial expressions were included separately (three variables) with the neutral objects difference score as dependent variables. The total social inhibition score was again entered as a covariate (i.e., continuous), while the categorical variables sex and age group were entered as factors. Based on our hypotheses, we examined several planned comparisons for the second repeated measures ANCOVA. We calculated simple contrasts to gain insight in approach/avoidance differences between all facial expression stimuli and neutral objects stimuli. We then repeated the repeated measures ANCOVA without the neutral object stimuli, to compare differences between the AAT differences scores between all three facial expression stimuli. Above described analyses were repeated for the underlying facets of social inhibition.

A priori power analysis indicated that for performing a repeated measures ANCOVA while expecting a medium effect size (f = 0.25; 95% power, and an alpha of 0.05, 4 repeated measures, correlation of 0.50) we would need 105 participants. We used IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp (2016) for all analyses.

3. Results

3.1. Descriptive statistics

The analyzed sample comprised of 135 participants (M_{age} = 24.8 ± 11.4; 75% women). Demographic characteristics of the sample and response times are presented in Table 1. On average, participants responded faster to pulling than pushing angry facial expressions ($M_{difference}$ = 23 ms; t (133), p = .002), happy facial expressions ($M_{difference}$ = 39 ms; t (134), p < .001); neutral facial expressions ($M_{difference}$ = 20 ms; t (134), p = .007), and neutral objects ($M_{difference}$ = 25 ms; t (134), p = .010).[2]

3.2. Approach avoidance effect

3.2.1. Facial expressions vs. objects

The within-subjects effects of the RM-ANCOVA showed that AAT difference scores for facial expressions (combined as one variable) did not significantly differ from those for objects (F (1,133) = 0.01, p = .936, partial η^2 < 0.001). Additionally, the social inhibition total score was not significantly associated with approach or avoidance bias differences for facial expressions relative to object stimuli (Table 2). The covariates age (F (1,130) = 0.60, p = .440, partial η^2 = 0.005) and sex (F (1, 130) = 1.11, p = .294, partial η^2 = 0.008) were also unrelated to differences in approach and avoidance tendencies. No significant differences were observed for behavioral inhibition or social withdrawal either (Table 2), nor were age (F_{BI} (1, 130) = 0.38, p = .538, partial η^2 = 0.003; F_{SW} (1, 130) = 0.39, p = .535, partial η^2 = 0.003) or sex (F_{BI} (1, 130) = 1.01, p = .318, partial η^2 = 0.008; F_{SW} (1, 130) = 1.27, p = .263, partial η^2 = 0.010) significantly associated. However, results revealed significant differences related to interpersonal sensitivity (F (1, 130) = 5.57, p = .020, partial η^2 = 0.041), with higher levels of interpersonal sensitivity showing stronger approach tendencies for facial expressions relative to neutral objects, while for lower levels of interpersonal sensitivity the opposite was found (Fig. 1). The covariates age (F (1, 130) = 1.08, p = .301, partial η^2 = 0.008) and sex (F (1, 130) = 0.46, p = .499, partial η^2 = 0.004) were not significantly associated with these effects.

Table 1
Overview of demographic variables, social inhibition scores, and median reaction times of total sample.

	Total group N = 135
Demographics	
Age mean (SD)	24.8 (11.4)
Sex (Female)	101 (74.8%)
Marital status (Partner)	42 (31.1%)
Social inhibition	
Total Social Inhibition score mean (SD)	16.09 (9.61)
Behavioral inhibition score mean (SD)	4.98 (4.10)
Interpersonal sensitivity score mean (SD)	6.19 (3.88)
Social withdrawal score mean (SD)	4.93 (3.48)
AAT characteristics	
Anger facial expression difference score in milliseconds mean (SD)	23.04 (82.71)
Happy facial expression difference score in milliseconds mean (SD)	39.05 (93.95)
Neutral facial expression difference score in milliseconds mean (SD)	19.90 (84.23)
Neutral objects difference score in milliseconds mean (SD)	24.54 (108.50)

Note. SD = standard deviation.

Repeated measures ANCOVA revealed no significant within-subjects effect of the stimuli (anger, happy, and neutral (separately), and object) on AAT difference scores either (F (3, 399) = 1.41, p = .239, partial η^2 = 0.011). Also, no significant within-subjects effects of the four stimuli on differences in avoidance or approach bias were observed for the total social inhibition score (F (3, 390) = 1.06, p = .279, partial η^2 = 0.008). Nor were any significant effects observed for age (F (3, 390) = 0.89, p = .447, partial η^2 = 0.007) and sex (F (3, 390) = 0.53, p = .663, partial η^2 = 0.004).

Facet analyses showed similar results for behavioral inhibition (F (3, 390) = 0.39, p = .760, partial η^2 = 0.003), and social withdrawal (F (3, 390) = 0.26, p = .855, partial η^2 = 0.002). Age (F_{BI} (3, 390) = 0.82, p = .482, partial η^2 = 0.006; F_{SW} (3, 390) = 0.77, p = .509, partial η^2 = 0.006) and sex (F_{BI} (3, 390) = 0.478, p = .698, partial η^2 = 0.004; F_{SW} (3, 390) = 0.59, p = .621, partial η^2 = 0.005) were also unrelated to differences in approach and avoidance tendencies. However, repeated measures ANCOVA revealed a significant within-subjects effect of interpersonal sensitivity (F (3, 390) = 2.81, p = .039, partial η^2 = 0.021). The covariates age (F (3, 390) = 1.13, p = .335, partial η^2 = 0.009) and sex (F (3, 390) = 0.22, p = .880, partial η^2 = 0.002) were not significantly associated with these effects.

[2] Although participants were faster in pulling than pushing the joystick, this may have been an artifact of the joystick programming, which means we cannot draw conclusions about the existence of a general approach tendency.

Table 2
Results from the adjusted RM-ANCOVAs of facial expressions vs. objects.

		N = 134		
		F (df)	p	Partial η^2
Facial expressions vs. objects				
A	SIQ15 total	2.18 (1, 130)	0.143	0.016
B	Behavioral Inhibition	0.48 (1, 130)	0.488	0.004
	Interpersonal Sensitivity	5.57 (1, 130)	**0.020**	**0.041**
	Social Withdrawal	0.51 (1, 130)	0.478	0.004
Angry vs. objects				
A	SIQ15 total	1.60 (1, 130)	0.208	0.012
B	Behavioral Inhibition	0.48 (1, 130)	0.492	0.004
	Interpersonal Sensitivity	3.47 (1, 130)	0.065	0.026
	Social Withdrawal	0.44 (1, 130)	0.507	0.003
Happy vs. objects				
A	SIQ15 total	1.92 (1, 130)	0.168	0.015
B	Behavioral Inhibition	0.94 (1, 130)	0.334	0.007
	Interpersonal Sensitivity	5.03 (1, 130)	**0.027**	**0.037**
	Social Withdrawal	0.07 (1, 130)	0.797	0.001
Neutral vs. objects				
A	SIQ15 total	2.17 (1, 130)	0.143	0.016
B	Behavioral Inhibition	0.28 (1, 130)	0.598	0.002
	Interpersonal Sensitivity	6.32 (1, 130)	**0.013**	**0.046**
	Social Withdrawal	0.55 (1, 130)	0.458	0.004

Note. All analyses were corrected for sex and age group. The size of partial η^2 can be interpreted as small (0.01), medium (0.06), and large (0.14) (Miles and Shevlin, 2001). Bold values are statistically significant ($p < .05$).

3.2.2. Angry faces vs. neutral objects

Examining contrast analyses, our results showed that no significant differences in approach or avoidance bias were observed between angry facial expressions and objects for total social inhibition (see Table 2). Nor were any significant effects observed for the underlying facets of social inhibition (Table 2). We found similar results for the covariates age and sex as we did in the main analysis.

3.2.3. Happy faces vs. neutral objects

With respect to approach and avoidance differences between happy facial expressions and objects, no significant effects were found for social inhibition, behavioral inhibition or social withdrawal. The covariates age and sex were not significantly associated either. Higher interpersonal sensitivity levels, however, were associated with a larger approach bias towards happy facial expressions relative to neutral object stimuli (see Table 2; Fig. 1). Age (F (1, 130) = 1.57, p = .212, partial η^2 = 0.012) and sex (F (1, 130) = 0.20, p = .659, partial η^2 = 0.002) were not significantly associated with these effects.

3.2.4. Neutral faces vs. neutral objects

Contrast analyses revealed no significant effects for differences in approach and avoidance tendencies between neutral facial expressions and objects related to social inhibition, nor for behavioral inhibition or social withdrawal (see Table 2). Comparable to the main analysis, the covariates age and sex were also unrelated to these effects. Interpersonal sensitivity was significantly associated with the difference in approach bias between neutral facial expressions and objects (Table 2), with higher levels of interpersonal sensitivity showing larger approach bias towards neutral facial expressions, while for lower levels of interpersonal sensitivity the opposite was found (see Fig. 1). Again, the covariates age (F (1, 130) = 1.00, p = .320, partial η^2 = 0.008) and sex (F (1, 130) = 0.55, p = .460, partial η^2 = 0.004) were not significantly associated with these effects.

3.2.5. Facial expressions

No significant main within-subjects effects between the AAT difference scores of angry, happy, and neutral facial expressions were observed in our sample (F (2, 266) = 2.92, p = .103, partial η^2 = 0.017). Additionally, our results showed that no approach or avoidance bias differences were observed for facial expressions relative to one another in association with social inhibition (Table 3). Nor were any significant differences observed for the covariates age (F (2, 260) = 1.30, p = .275, partial η^2 = 0.010) and sex (F (2, 260) = 0.05, p = .952, partial η^2 < 0.001). Examining the underlying facets revealed no significant effects either (Table 3).

4. Discussion

The current study investigated automatic avoidance tendencies for facial expressions associated with different manifestations of social inhibition. The results showed that higher levels of interpersonal sensitivity were associated with larger approach biases towards facial expressions relative to neutral object stimuli, and that this effect was driven by response differences for happy and neutral facial expressions. There were no individual differences in implicit approach or avoidance tendencies towards facial expressions as a function of global social inhibition, behavioral inhibition, and social withdrawal.

Our findings were not in accordance with our hypothesis that higher levels of interpersonal sensitivity would be associated with increased avoidance bias for facial expressions. Some theories argue that when we are faced with a challenge, the initial response may not be to immediately avoid the situation, but to approach the challenges and overcome obstacles (e.g., Carver and Harmon-Jones, 2009). Although this theory is mostly related to angry facial expressions in people with high levels of reactive aggression (Lobbestael et al., 2016), this idea may help

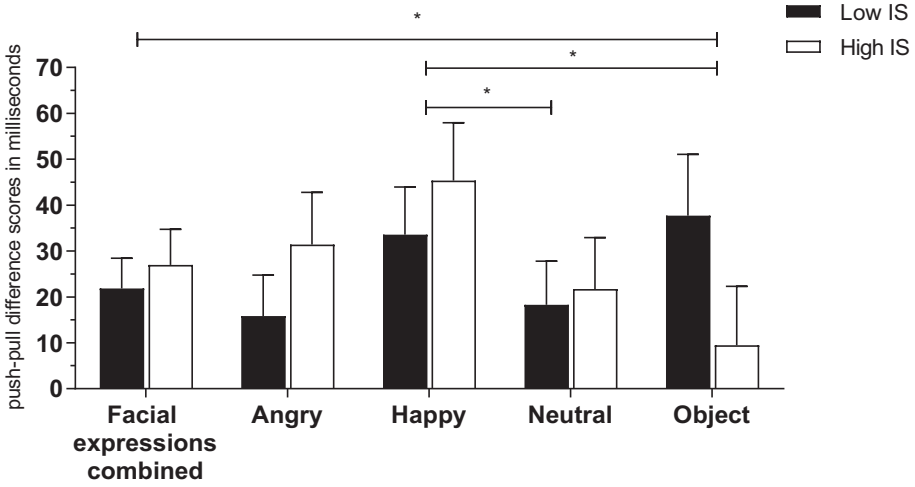

Fig. 1. Mean and Standard Error of Mean (SEM) of difference scores of the AAT per stimulus group (facial expressions combined, angry facial expressions, happy facial expressions, neutral facial expressions, and neutral objects) for high vs. low interpersonal sensitivity (IS). Higher levels of interpersonal sensitivity were associated with a larger approach bias towards facial expressions in general, and happy and neutral facial expressions in particular, as compared with object stimuli. *$p < .05$.

Table 3
Results from the adjusted RM-ANCOVAs of facial expressions.

		$N = 134$		
		F (df)	p	Partial η^2
Angry vs. happy				
A	SIQ15 total	0.05 (1, 130)	0.830	< 0.001
B	Behavioral Inhibition	0.14 (1, 130)	0.714	0.001
	Interpersonal Sensitivity	0.29 (1, 130)	0.590	0.002
	Social Withdrawal	0.19 (1, 130)	0.667	0.001
Angry vs. neutral				
A	SIQ15 total	0.05 (1, 130)	0.828	< 0.001
B	Behavioral Inhibition	0.03 (1, 130)	0.860	< 0.001
	Interpersonal Sensitivity	0.45 (1, 130)	0.505	0.003
	Social Withdrawal	0.01 (1, 130)	0.934	< 0.001
Happy vs. neutral				
A	SIQ15 total	< 0.01 (1, 130)	0.997	< 0.001
B	Behavioral Inhibition	0.30 (1, 130)	0.584	0.002
	Interpersonal Sensitivity	0.02 (1, 130)	0.894	< 0.001
	Social Withdrawal	0.27 (1, 130)	0.605	0.002

Note. All analyses were corrected for sex and age group. The size of partial η^2 can be interpreted as small (0.01), medium (0.06), and large (0.14) (Miles and Shevlin, 2001).

explain our findings. Facial expressions could logically pose as a potential threat for interpersonal sensitive individuals given their worry and fear of being rejected (Duijndam and Denollet, 2019). However, the images used could not have been as threatening as a real-life situation, and therefore interpersonal sensitive individuals were able to challenge their fear resulting in a drive to pull the images faster towards them.

On the other hand, the approach bias towards happy and neutral faces may indicate that individuals high in interpersonal sensitivity are focused on receiving positive feedback. Happy faces communicate an invitation to cooperate (Horstmann, 2003) and previous studies have demonstrated that happiness activates approach tendencies (Nikitin and Freund, 2019; Ruggiero et al., 2017). Thus instead of being interpreted as a threat of social interaction or rejection, interpersonal sensitive individuals may automatically process happy (and neutral) facial expressions as a way of approval of others which also could explain their larger approach tendencies.

The absence of significant differences for behavioral inhibition and social withdrawal facets, as well as the broad social inhibition trait, suggests that there may be no individual differences in automatic processing of facial expressions related to social inhibition. In a sample of highly socially anxious individuals, Heuer et al. (2007) found avoidance tendencies to happy and angry faces in highly socially anxious individuals but not in the non-anxious control group. Given that socially anxious individuals are more likely to be socially inhibited (Kupper and Denollet, 2014), our hypothesis was that we would find the same effects. However, our findings led us to speculate that deviance in automatic processing of threatening stimuli could happen at the clinical level (i.e., social anxiety disorder), but not yet at the (subclinical) personality trait level (i.e., high social inhibition). We might also argue that the images used were not threatening enough for socially inhibited individuals, suggesting that the avoidance tendencies of socially inhibited individuals (Duijndam and Denollet, 2019) are limited to *real* interpersonal settings.

Alternatively, the rejection of our hypotheses may be explained by the design of the AAT. We instructed the participants to react to the format of the images (portrait or landscape) with a push or pull movement (e.g., Wiers et al., 2009), irrespective of the content, which can be referred to as an 'irrelevant feature' task (De Houwer, 2003). The difference scores of the picture categories in such a task are thought to display relatively automatic responses. Though this method has shown to yield a significant effect on approach-avoidance behaviors, it has not always shown significant differences between stimuli (Phaf et al., 2014). In other tasks, where the stimuli have to be explicitly categorized (e.g., push for angry facial expression, pull for happy facial expression (Marsh et al., 2005; Rinck and Becker, 2007)), approach-avoidance tendencies are detected more reliably (Phaf et al., 2014). Some studies found approach-avoidance effects for the explicit AAT, but not for the implicit AAT (Phaf et al., 2014; Rinck and Becker, 2007), which may suggest that full attention towards the affective image heightens its influence on approach or avoidance tendencies. Whether the approach tendencies we observed in interpersonal sensitivity remain in the explicit variant of the AAT, or whether other explicit approach-avoidance tendencies in relation to social inhibition exist remains to be investigated.

4.1. Limitations and implications

The results of this study should be viewed in light of its limitations and strengths. Our sample was female-dominated (75%), and most participants were undergraduate psychology students (84%), suggesting that our results may not generalize to other populations. Additionally, given that women tend to be more accurate than men in judging emotional meaning from nonverbal cues (Elliot et al., 2006; Hall and Matsumoto, 2004) and our sample was female-dominated, this could have influenced the results. Lastly, we only examined the implicit AAT and not the explicit AAT, so we are unable to draw any conclusions on other motives of approach-avoidance behaviors.

A strength of this study is the relatively large sample size, which is larger than most other studies investigating approach-avoidance behaviors (e.g., Heuer et al., 2007; Marsh et al., 2005; Rinck and Becker, 2007). Another strength was the use of the zooming feature in the AAT as programmed in Inquisit, which explicitly reinforces the interpretations of the respective coming closer and going away movements.

Socially inhibited individuals tend to avoid social situations (Sheynin et al., 2013), which is considered a risk for the development of anxiety disorders (Rapee and Heimberg, 1997) and may lead to unsafe situations if it involves for example medical consultations (Schiffer et al., 2007). Current findings indicate that these avoidance tendencies seem unaffected by processing threatening social stimuli at the implicit level of emotional processing. Future research is therefore encouraged to investigate at which level of emotional processing these behaviors happen, to understand when and how to intervene on these avoidance tendencies.

5. Conclusions

The global social inhibition trait and its components behavioral inhibition and social withdrawal did not affect automatic emotional processing as assessed with the implicit AAT. However, higher levels of interpersonal sensitivity were associated with an approach bias towards happy and neutral facial expressions relative to neutral object stimuli. These results may be explained by the drive of interpersonal sensitive individuals to challenge their fear (social interaction), or by their need for approval, which resulted in pulling the images faster towards them.

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CRediT authorship contribution statement

Stefanie Duijndam:Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Validation, Visualization, Writing - original draft.**Nina Kupper**:Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Writing - review & editing.**Johan Denollet**:Conceptualization, Funding acquisition, Resources, Writing - review & editing.**Annemiek Karreman**:Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Writing - review & editing.

Declaration of competing interest

None.

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