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Impaired fear recognition and social anxiety symptoms in adolescence

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Abstract

This study represents the first examination of adolescent anxiety in relation to peer emotion recognition, rather than adult emotion recognition. Additionally, we examine potential mechanisms for the development of Social Anxiety in females. Facial emotion recognition (FER) is important for accurate social cognition, which is impaired in individuals with various disorders, including anxiety disorders. Social anxiety often onsets during adolescence, is observed more commonly in females, and is often associated with FER difficulties. Given the importance of peer interaction during adolescence, and some evidence that FER may differ as a function of the stimuli (adolescent or adult faces), we sought to study FER in relation to social anxiety symptoms using stimuli portraying adolescent faces. Male and female adolescents (N=64) completed an online survey in which they rated 257 child and adolescent emotional faces and completed a self-report measure of social anxiety symptoms. We examined differences in emotion recognition (e.g., fear, anger, sadness) between individuals with high and low levels of social anxiety symptoms. Adolescents with high social anxiety symptoms were more likely to have problems correctly identifying fearful expressions (90.55% accuracy) compared to adolescents with low social anxiety symptoms (96.00% accuracy; $t = 2.375$, $p = .021$, $d = 0.594$), and this effect was observed exclusively in female adolescents. The observed sex difference in accurate identification of fearful faces in relation to social anxiety could suggest a potential mechanism for social anxiety development in adolescent females.

Keywords

facial emotion recognition; sex differences; fear recognition; adolescents; social anxiety

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Compliance with Ethical Standards

Conflict of Interest

The authors declare that they have no conflict of interest.

Research Involving Human Participants

This study was approved by the University Institutional Review Board.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Introduction

Between 7.3% and 12.1% of adolescents meet diagnostic criteria for social anxiety disorder (Kessler et al., 2005; Wittchen, Stein, & Kessler, 1999). Although increased socio-evaluative fears during adolescence are developmentally normative, they can become clinically impairing for some adolescents when they lead to emotional distress and social avoidance (Ollendick & Hirshfeld-Becker, 2002). The processes underlying the increase in clinically impairing social anxiety during adolescence, and the conditions under which these fears develop into a psychiatric disorder for some adolescents but not others, are not well-understood (cf, Haller, Kadosh, & Lau, 2014). In order to inform prevention and treatment research, it is important to investigate such potential processes, or precipitant mechanisms. Several studies have shown that females are more commonly affected by social anxiety than males (e.g., Weinstock, 1999), and there is evidence for distinctive emotion recognition vulnerabilities for females with anxiety. For example, it has been found that sex moderates attention toward threat cues, such that females with high trait anxiety display enhanced attention towards threatening faces (Waters et al., 2007), illustrating a potential mechanism behind impairment that might differ between males and females.

Facial emotion recognition (FER) is important for social cognition (Adolphs, 2002). Impairments in FER have been observed in many psychiatric disorders (Donno, Parker, Gilmour, & Skuse, 2010), and impairments in fear recognition specifically have been linked to psychopathology (Gross & Jazaieri, 2014). Williams et al. (2009) studied FER across sex and age, both implicitly and explicitly, in order to study normative facial processing. When using an explicit emotion recognition task, they found that responses were fastest for happy emotions and slowest for fearful ones. Further, they found that accuracy in the identification of fear increased rapidly with age over the first two decades, with peak accuracy rates in middle adulthood. Accuracy in recognizing fear is also positively correlated with a metric of social competency, perspective-taking, in non-clinical samples (Trubanova et al., 2015), highlighting the important role of fear identification in social engagement.

Cognitive biases – in particular, attention to threat, have been proposed to affect social information processing and contribute to the etiology and maintenance of anxiety (Eysenck & Calvo, 1992). Female, but not male children, with anxiety demonstrate impairments in recognizing some negative emotions, mainly disgust (Lee, Herbert, & Manassis, 2014). Conversely, adults with high trait anxiety have been found to have faster response times to recognizing dynamic fear faces (Richards et al., 2002), and greater recognition of fear in static faces (Surcinelli, Codispoti, Montebarocci, Rossi, & Baldaro, 2006). Adults with high-trait anxiety have also been found to have a negative response bias, such that they are more likely to state that a briefly presented stimulus is negative (Winton, Clark, & Edelmann, 1995). It has been hypothesized that failure to recognize fear, presented as video clips morphing from neutral to full-blown expression, may predict psychopathology more strongly than any other emotion in university students (Montagne, Kessels, Frigerio, de Haan, & Perrett, 2005). Due to the established sex differences in rates of anxiety and recognition abilities, we sought to evaluate emotion recognition abilities within sex. Given differences in FER and anxiety across gender and development, individual rates of FER deficits for negative emotions, such as fear faces, we hypothesized that fear recognition in

adolescents would be correlated with symptoms of social anxiety. We further hypothesized that these differences would also be observed differentially in males compared to females.

Method

Participants

Participants included 64 adolescents aged 12 to 17 years (43 females, 21 males; Table 1). Participants were recruited through flyers in the community and existing research registry databases. Participants were chosen at random to receive a $20 cash prize. Before beginning the online survey, all participants gave consent to participate by entering their name at the end of a consent information page, acknowledging that they had read the document and voluntarily consented to participate in the study. All study procedures were reviewed and approved by the local Institutional Review Board.

Procedure

Interested participants were provided with a link to the survey. After providing consent, the participant accessed the survey which included the stimulus images in addition to the study measures (i.e., LSAS, demographic form). The images of pictures were presented randomly such that no emotion and no actor was presented more than twice in a row. Raters were asked two questions: (1) which emotion does this image represent? (forced choice: afraid, angry, happy, neutral, sad), and (2) how accurately does the picture represent the emotion you selected in response to the first question? (likert scale, from poorly to very well).

Given that adolescents spend much of their time with same-age peers, we examined FER with stimuli designed to specifically portray adolescent faces, addressing one of the major limitations in the current literature – namely a reliance on adult faces. Our stimuli consisted of 257 images of 59 children and adolescents aged 10 to 17 years (20 males). These images displayed one of five emotions (happiness (n=50), anger (n=52), sadness (n=48), fear (n=51), and neutral (n=56)) with direct gaze (Egger et al., 2011; Coffman et al., 2015). Figure 1 depicts a sample fear stimulus. All of the images were standardized, such that the faces were approximately the same size and visual properties such as brightness and luminance were controlled for (see Coffman et al., 2015). The total image set was randomly split into 2 separate surveys, in order to keep the surveys brief and to avoid fatigue. The surveys were identical in format and differed only on the specific faces that were portrayed, and, as such, the results for both surveys were combined for analytic purposes. Each participant responded only to one of the surveys.

Measures

Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987)—The LSAS is comprised of 24 items concerning performance anxiety and social situations. Items are scored on a Likert scale from 0 to 3 on the extent of fear experienced during a given situation and the extent of avoidance regarding the situation. The self-report version of LSAS has excellent internal consistency (alpha = 0.95; Baker, Heinrichs, Kim, & Hofmann, 2002). The internal consistency for the current sample was also high (alpha = .96).

Data Analyses

For preliminary analyses, descriptive statistics were computed for all demographic variables (i.e., sex, age, race/ethnicity). Data were analyzed with IBM Statistical Package for Social Sciences (SPSS 23). To examine potential sex differences in social anxiety and emotion accuracy for each emotion, we conducted a series of *t*-tests comparing means between the two sex groups for each variable. In order to examine the differences in recognition accuracy between males and females with low and high social anxiety symptoms, we first tested the sex by LSAS score interaction. We then split the male and female participants based on median-split within sex on the LSAS measure and conducted a series of *t*-tests for each group of interest (i.e., adolescents, adolescent females, adolescent males). An α level of .05 was used for all statistical tests. As a post-hoc examination, we investigated potential patterns of misattribution by LSAS median split by calculating the percentage of times each incorrect emotion was chosen.

Results

In order to test whether differences found were not due to general differences between males and females, we first performed preliminary analyses looking at sex differences. Male and female adolescents did not differ on the total LSAS score ($t = -0.853$, $p = .397$). Further, there were no sex differences for recognition of any of the emotions, aside from anger ($t = -2.537$, $p = .014$, $d = 0.645$) for which adolescent females were more accurate (92.58%) than adolescent males (88.28%).

Adolescents who scored high on LSAS, compared to those who scored low on LSAS, showed a significant difference in recognition of fearful stimuli ($t = 2.375$, $p = .021$, $d = 0.594$). Consistent with our hypothesis, those adolescents with greater social anxiety symptoms were significantly worse at identifying fearful stimuli (90.55% accuracy) compared to less anxious peers (96.00% accuracy). There were no significant differences between adolescents who scored low and high on the LSAS for any of the other emotions (all $t < 1.507$, $p > .16$). Given our finding that adolescents with high LSAS scores were worse at identifying fearful faces compared to adolescents with low LSAS scores, we sought to examine possible patterns of emotion misattributions. As seen in Table 2, adolescents with high LSAS scores most often misattributed fear to neutral faces (30.65%) or to sad faces (16.13%). By comparison, when adolescents with low social anxiety misattributed fear, they ascribed fear to neutral faces only about 12% of the time, and to sad faces about 38% of the time.

To analyze whether these patterns held for males and females separately, we first explored the interaction between sex and LSAS score, which was found to not be significant for any of the emotions (all $F < .95$, $p > .50$). This lack of an interaction effect might be due to lack of power associated with the small sample size of male participants. Accordingly, we decided to look at males and females separately in order to examine possible sex differences. For females, similar results to the entire sample were found. For males, the pattern of results was not supported. More socially anxious females were significantly worse at recognizing fearful stimuli (88.61%) compared to less anxious females (95.51%; $t = 2.161$, $p = .037$, $d = 0.652$). However, adolescent females did not show significant differences based on LSAS

scores for any other emotion (all $t < 1.370$, $p > .18$). For males, no differences were found for any emotions (all $t < 1.365$, $p > .188$, $d < 0.587$). Next, we sought to examine misattributions for females specifically, given our finding that adolescent females with high LSAS scores were worse at identifying fearful faces compared to adolescent females with low LSAS scores. For females with high LSAS scores, fear was significantly more likely to be attributed to neutral faces (32.65%), and those with low LSAS scores were more likely to misattribute fear to sad faces (40.91%; see Table 3).

Discussion

The present study sought to investigate whether adolescents' FER is related to self-reported symptoms of social anxiety. Our main findings indicate that female adolescents who report higher social anxiety are worse at identifying fearful expressions compared to female adolescents who report lower levels of social anxiety. Notably however, both groups showed relatively high recognition rates of fearful stimuli, above 90%, suggesting overall the adolescents did not show impairment in fear recognition but rather a relative difference that was associated with self-reported social anxiety symptoms. In addition, these findings appear to be specific only to fearful stimuli, and particularly in females, suggesting that sex may play a role in the mechanistic influence of FER, specifically to fear, on the possible development of social anxiety.

Female adolescents were more accurate in identification of angry facial expressions than their male counterparts. Although we cannot determine whether sex moderates developmental effects on FER because data were collected at a single time point, these results suggest there may be a developmental difference between adolescents and adults, given reports of no sex differences in identification of anger stimuli in adults (e.g., Montagne et al., 2005). However, these results should be interpreted with caution, as only 21 male adolescents participated in the survey. Therefore, while the results for female adolescents confirm our hypothesis regarding differences in recognition of fear based on level of social anxiety, the non-significant findings for male adolescents does not necessarily confirm that the effect is not there for males. While the effect sizes were similar between males ($d < 0.587$) and females ($d = 0.652$) for fear recognition, the effect of fear recognition based on level of anxiety was not significant among males, likely due to the small sample size. Additionally, the non-significant interaction between sex and LSAS scores indicate that data cannot verify whether the LSAS effects meaningfully differ between male and female adolescents for the reasons noted above (i.e., small sample size for males). Therefore, our findings for male adolescents should be viewed as preliminary.

Our finding that adolescent females with high anxiety symptoms are less accurate at identifying fearful stimuli, may represent a divergence from extant literature in adults, which suggests that adults with high trait anxiety display a bias towards fearful stimuli (Winton et al., 1995). We believe that this seemingly discrepant finding could be attributable to at least two reasons. First, much of the existing literature examines emotional misattribution in adults, and our findings may be reflective of a developmental difference. Second, prior studies have predominantly utilized adult or animated stimuli with adolescents, which may lack generalizability to peer emotion recognition.

We also examined how adolescents misattribute fear stimuli (i.e., when fear is shown but not perceived, what emotion is recognized). As noted above, the majority of the extant literature on facial emotion recognition has utilized adult face stimuli, or age appropriate cartoon stimuli; therefore, the current literature leaves a gap in understanding how adolescents view facial expressions of their peers. Our results suggest that there may be a difference in how adolescent females misattribute the fearful stimuli based on degree of social anxiety, with females who report lower levels of social anxiety attributing the fearful faces to sadness, versus female adolescents who report high social anxiety attributing the fearful facial stimuli to neutral expressions. Emotion recognition has been hypothesized to inform reciprocal social responses (Keltner & Haidt, 1999). Given our observed pattern of misattribution, the functional response to fear and sadness seen in a stranger would be the same (i.e., leaving them alone), whereas the social response to either a neutral expression or a fearful one might differ significantly (it is socially acceptable to approach a person with a neutral expression). This difference in how adolescent females view the fearful stimuli based on their self-report of social anxiety could suggest a potential mechanism for how social anxiety develops in adolescents. For example, a potential mechanism for the development of social anxiety in females may involve misperception of stimuli that typically would lead to avoidance in early adolescence. Acting on this misperception may elicit negative responses (e.g., approaching a peer who is feeling distressed, but without awareness of this distress). This in turn could lead to negative social interactions, and increased fear and avoidance in social situations (e.g., Heuer, Rinck, & Becker, 2007).

These findings should be considered in light of the study's limitations, which provide guidance for future directions. First, we enlisted a measure of social anxiety (LSAS; Liebowitz, 1987) that has not been used routinely with adolescents. Nonetheless, our internal consistencies were high, suggesting that it was a reliable measure with this sample. In addition, given that the sample was drawn from the community and we did not specifically recruit for adolescents diagnosed with social anxiety, current findings can only be applied to adolescents who show symptoms of social anxiety based on their self-report, and cannot be generalized to individuals who are diagnosed with social anxiety. In order to follow up on the results presented in this study, it is recommended that future studies use clinically socially anxious adolescent samples. Another limitation in this study is the relatively small number of male adolescents. Lastly, the current study used static images of faces in order to explore facial emotion recognition ability in adolescents. Recent research has shown that type of stimuli might have an effect on individual's ability to recognize facial emotions (e.g., Wehrle, Kaiser, Schmidt, & Scherer, 2000).

Despite these limitations, this study is the first to explore adolescents' ability to recognize adolescent facial expressions using standardized images where size and all visual properties are controlled. The findings suggest a potential developmental difference in social anxiety that has not been well documented in female adolescents. Further research needs to explore these trends using adolescents who struggle with social anxiety and evaluate the impact and potential treatment targets considering this specific facial emotion recognition impairment.

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Figure 1.
Sample stimulus depicting fear.

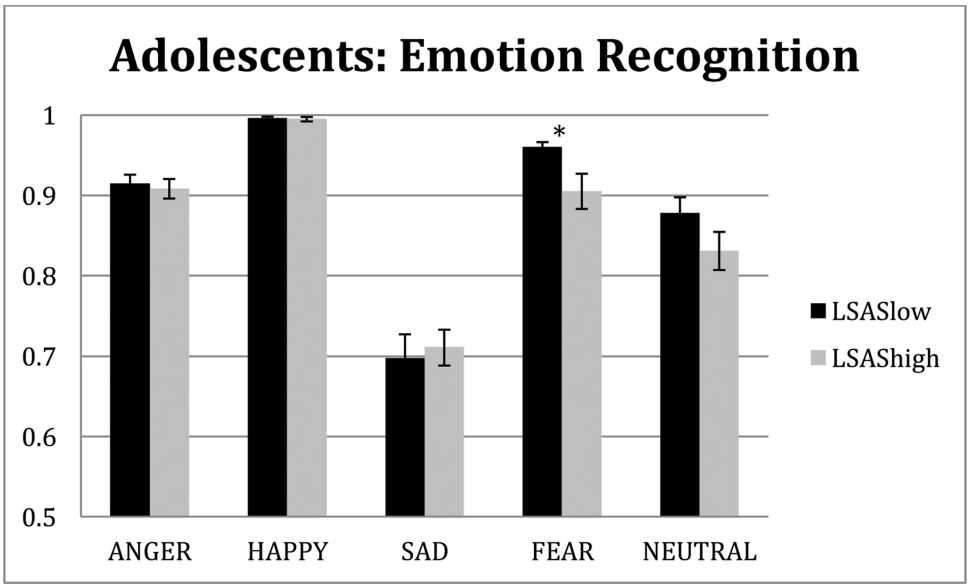

Figure 2.
Recognition accuracy for adolescents for each emotion type split by low and high LSAS.

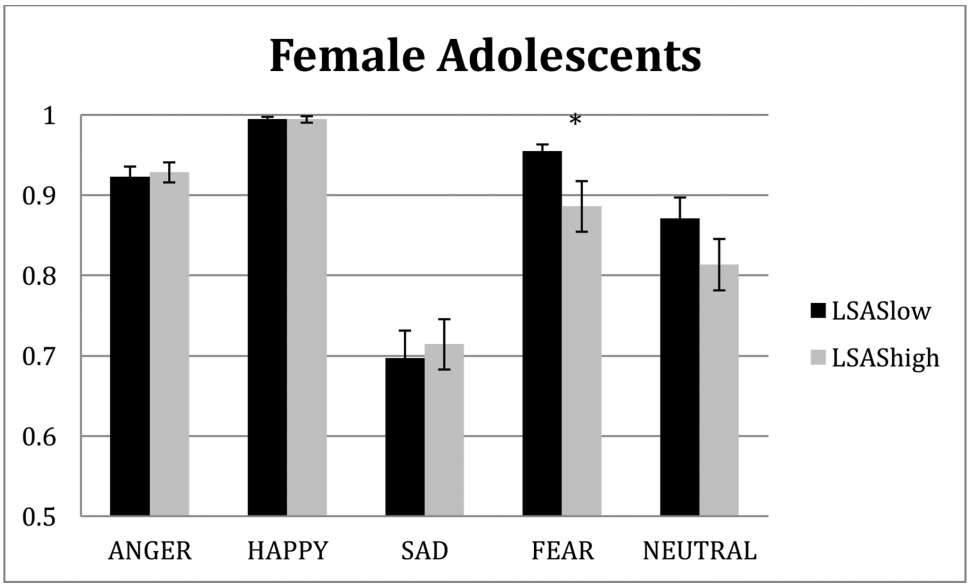

Figure 3.
Recognition accuracy for adolescent females for each emotion type split by low and high LSAS.

Table 1

Demographic Characteristics

	Mean (SD)	Range
Age (in years)	14.56 (1.72)	12-17
LSAS		
Avoid	21.63 (12.76)	1-55
Fear	21.16 (13.18)	0-59
Total	42.78 (25.36)	1-114
	n (% of total)	
Sex		
Male	21 (32.81)	
Female	43 (67.19)	
Race		
Caucasian	59 (92.19)	
Non-Caucasian	3 (4.68)	
Asian-American	1 (1.56)	
African-American	1 (1.56)	
Hispanic	1 (1.56)	
Not provided	2 (3.13)	
Diagnoses		
Anxiety	6 (9.38)	
ADHD	6 (9.38)	
ASD	0	
Depression	5 (7.81)	
LD	3 (4.69)	
Eating Disorder	1 (1.56)	

Table 2

Misattribution percent (%) to emotions in overall adolescents

Fear misattribution %		
emotion chosen	**Low**	**High**
Anger	34.62%	30.65%
Happy	15.38%	22.58%
Neutral	11.54%	30.65%
Sad	38.46%	16.13%
Total	100.00%	100.00%

Table 3

Misattribution percent (%) to emotions in female adolescents

Fear misattribution %		
emotion chosen	**Low**	**High**
Anger	22.73%	26.53%
Happy	13.64%	22.45%
Neutral	22.73%	32.65%
Sad	40.91%	18.37%
Total	100.00%	100.00%