Understanding the Interaction of Temperament and Social Skills in the Development of Social Anxiety in Children with Autism Spectrum Disorders

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Abstract

Children with Autism Spectrum Disorders (ASD) often have comorbid psychopathology in addition to social-communication difficulties. Social anxiety is of particular interest because it has been linked to downstream deficits in social functioning. Bellini found a link between social skills, temperament, and the development of social anxiety. The current paper examines whether negative affectivity moderates the relationship between social skills and social anxiety. Twenty-five high-functioning children diagnosed with ASD were administered self and parent report questionnaires measuring pragmatics ability, socialization behaviors, negative affectivity, and social anxiety. High negative affectivity was related to social anxiety, and moderated the relationship between socialization behaviors and social anxiety. Pragmatics ability was not related to social anxiety. Together, these results indicate that negative affectivity is an important factor in the relationship between social skills and social anxiety, and that not all social skills deficits contribute to social anxiety.

Keywords: Autism spectrum disorders; Temperament; Anxiety; Social skills; Socialization

Introduction

There are high rates of comorbid disorders associated with Autism Spectrum Disorders (ASD) including mood disorders, anxiety, and depression [1-5]. Heightened levels of general anxiety are commonly seen in ASD; for example, it has been reported that 49% of the children with ASD had levels of anxiety that were considered clinically high [6], and as many as 42% of individuals with ASD who do not have an intellectual disability meet criteria for an anxiety disorder [5]. It has been suggested that the development of comorbid psychopathologies is a reaction to the core deficits; that is, having ASD causes certain deficits, which are exacerbated by life experiences that occur because of these same deficits [7]. Children with ASD have been shown to have both higher anxiety and more social worries than both typically developing peers and children with communication disorders not resulting from an ASD [8]. However, anxiety does not always predict problems with social functioning. Only when the anxiety is specific to social situations does it correlate with social withdrawal and communication weaknesses [9]. Moreover, this process represents a developmental pathway through which increased social anxiety worsens the core deficits. Therefore, it is important to understand factors that might affect the development of social anxiety.

In typically developing children, social anxiety is related to perceptions of social acceptance and negative evaluation. Research indicates that children with higher fears of negative evaluation, compared to those with lower levels, have lower self-worth and social acceptance [9]. Although it could be argued that children with ASD have difficulties with theory of mind abilities [10], and therefore do not understand social acceptance the same way that typically developing children do, studies suggest that children with ASD actually experience more feelings of loneliness [11]. In a study comparing 22 children with ASD to a group of typically developing children on self-report questionnaires about friendship and loneliness, the children with ASD reported higher scores of loneliness and lower quality friendships [11]. They were also more likely to provide incomplete definitions of loneliness; they were more likely to include the cognitive definition of loneliness and significantly less likely to describe the emotional

experience. This indicates that many children with ASD do want social relationships although they may lack a complete understanding of the concepts, or lack the skills to attain successful relationships. Moreover, they do experience loneliness but may not fully understand how they are making mistakes in social interactions or discouraging friendships from forming. Repeatedly having negative peer interactions without understanding the cause would be extremely frustrating, and may be a factor in the development of social anxiety.

In his 2006 study, Bellini [1] proposed a model for the development of social anxiety in children with ASD that included the element of negative peer interactions. Bellini proposed that those who lack necessary social skills will have negative peer experiences and tend towards social withdrawal, which then allows fewer opportunities to learn and practice social skills, ensuring more negative peer interactions. He also suggested that temperament plays a role. Temperament is defined as the biologically based individual differences in disposition, including susceptibility to arousal and quality of affectivity [12]. This constitutional construct develops over childhood but remains fairly stable and is highly correlated with adult personality [13]. Temperament is important in socialization in that it predicts the development of social skills, such as language abilities, in typically developing children [14,15]. Bellini stated that children who have temperaments that make them easily aroused by stressful stimuli are predisposed to anxiety. In the Bellini model, social skills deficits and temperament interact, making some children, particularly those low in social skills and high in arousal, even more anxious when entering into social situations. Thus, the factors of arousal and skill form a reciprocal relationship and cause

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the development of social anxiety. The Bellini study had a sample of 41 children with ASD ages 12 to 18, who had average cognitive abilities for their ages. The results showed that children who had more physical symptoms of anxiety-which is related to the temperamental construct of autonomic arousal-scored higher on social anxiety. Furthermore, those who scored low on social skills measures scored higher on measures of social anxiety, providing support for a portion of model. The study also found that empathy, a critical social skill which means one can take the perspective of others, and assertiveness, a social skill associated with prioritizing one's own needs and approaching others, were negatively correlated with social anxiety.

Although Bellini [1] investigated the role that autonomic arousal plays in social anxiety in children with ASD, the study did not consider all aspects of temperament. Temperament can be understood as two sides of a coin, determining both an individual's ability to self-regulate emotional arousal, and the type and strength of affect that is the typical response to stimuli [16].

In other words, an individual's temperament explains: (a) the regulation of the arousal the individual experiences in response to a stimulus, and (b) the tendency for a particular valence of affect. The former relates to the construct of arousal that was measured by Bellini [1], whereas the latter refers to the construct of emotionality. The current study aims to add to the Bellini model by investigating the role of emotionality.

Emotionality can be understood as the tendency to react with negative or positive affectivity. Thus, an individual high in negative affectivity is prone to experiencing negative emotions, such as distressed limitations, sadness, fear, and discomfort, in response to stimuli [16]. Negative affectivity is correlated with the adult personality factor of Neuroticism [12], which has been linked to anxiety and other mood disorders [17]. Furthermore, negative affectivity is correlated with difficulty with social interactions [18-20]. It is, therefore, important to consider the role of this aspect of temperament in social anxiety, particularly in ASD. It is reasonable to assume that a child who is rejected by peers and has a temperament consistent with negative affectivity would experience even greater unpleasant emotions. The child may then be deterred from seeking more social opportunities and learning social skills, making him or her more prone to social anxiety. In this way, the emotionality element of temperament explains the mechanism in the Bellini [1] model by which negative peer interactions predict high social anxiety, at least for those children who are high on negative affectivity.

Another factor in Bellini's [1] model that warrants further exploration is the role of social skills in the development of social anxiety. The Bellini model addressed the importance of social skills in the development of social anxiety, specifically empathy and assertiveness. A next step would be to examine variations of the broad social skills construct, such as pragmatic language use or the adaptive use of social skills. Pragmatic language use has been shown to be a deficit common in ASD [21,22]. Pragmatics ability is defined as having the knowledge of when to say what, and how much, to whom [22]. This is difficult for children with ASD because these children already have difficulties with theory of mind, paying attention to contexts, and understanding prosody, which are necessary in order to have pragmatic abilities [10,23-25]. Furthermore, pragmatics ability is intuitively predictive of negative peer interactions. If a child lacks the knowledge of how to have a normal conversation, every conversation has the potential to be an awkward and negative experience. Therefore, pragmatic ability may be more proximally related to the development of social anxiety than the

skills of empathy or assertiveness.

Another possible variation on the Bellini [1] study would be to study the relationship between social anxiety and the adaptive (or applied) use of social skills. For example, adaptive behavior measures such as the Vineland Adaptive Behavior Scale (VABS) [26] measure skills that are conceptually similar to pragmatics skills, but specifically as they are performed in adaptive settings. Therefore, this measure of social skills might also be more proximally related to the development of social anxiety, because it measures how well the child puts his or her skills into practice.

Purpose of the Study

The current study investigated the elements of negative affectivity and social skills in the context of the Bellini [1] model of the development of social anxiety in children with ASD. First, we conducted an analysis of the relationship between pragmatics ability and social anxiety. We predicted that lower pragmatic skills would be related to higher social anxiety. Second, we conducted an analysis between adaptive social skills and social anxiety. We predicted that lower adaptive social skills would be related to higher social anxiety. However, we also predicted that the temperament construct of negative affectivity would be positively associated with social anxiety. An individual with this type of temperament would be prone to more negative emotions and worry in response to difficult social situations. We, therefore, predicted that negative affectivity would moderate each relationship between social skills (pragmatics, adaptive social skills) and social anxiety (Figures 1 and 2).

Methods

Participants

The participants were 28 children and adolescents with ASD between the ages of 9 and 15. They were recruited from the community through local parent groups, service agencies, and pediatrician's offices (Table 1 for demographic information). The participants were 25 boys and 3 girls. This demographic nearly reflects the ratio of diagnosis of ASD, which is 4 to 8 times higher in boys than girls [27].

The participants had previously received a diagnosis of an ASD, and the diagnosis was confirmed during the visit using the Autism Diagnostic Observation Schedule (ADOS) [28,29] given by

Characteristic	Statistics
Age in years	
Mean	12.34
SD	1.93
Range	9.45-15.83
Cognitive Test Index Score	
Mean	107.89
SD	17.57
Range	78-142
Race/Ethnicity	
African American	*N=0*
White American	*N=25*
Asian American	*N=3*
Hispanic American	*N=0*
Sex	
Male	*N=25*
Female	*N=3*

N=28 children with ASD

Table 1: Participant information and demographics.

a ADOS trained/reliable examiner, the Lifetime Form of the Social Communication Questionnaire (SCQ-L) [30], and the clinical judgment of a clinical psychologist (with extensive diagnostic experience related to ASD) based on criteria from the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition, Text Revision [2] for Autistic Disorder, Asperger's Disorder, or Pervasive Developmental Disorder, not otherwise specified. They also were administered the Wechsler Abbreviated Scale of Intelligence (WASI) [31] to ensure that they were able to understand the self-report questionnaires. All the children included in the study had Full Scale IQs that were within two standard deviations of the mean for their ages, $M=107.89$, $SD=17.57$ (Table 1). Given this exclusion criteria, our sample would sometimes be labeled as high-functioning, although there are no definitive criteria that define this subgroup of ASD [32]. In total, 36 participants attempted to complete the diagnostic, cognitive, and research battery, but eight participants were excluded from the study. Four participants did not meet diagnostic criteria for an ASD despite a previous diagnosis, one participant had an IQ score below the threshold we set, and three participants were not able to finish the questionnaires.

Measures

Social anxiety: The Social Anxiety Scale for Children-Revised (SASC-R) [33,34] and the Adolescent Adaptation (SAS-A) [9] were administered to the participants to measure social anxiety. The SAS is the same as the SASC-R except some wording is changed to be appropriate for adolescents. The SASC-R is a self-report questionnaire with 22 descriptive statements that the participants rate on a 5 point Likert scale from (1) not at all to (5) all the time. Statements include items such as-I worry about being teased or it's hard for me to ask other kids to play with me. This measure has been shown to be between a second or third grade reading level according to Flesch-Kincaid formula [35]. The measure contains three factors: Fear of Negative Evaluation, Social Avoidance and Distress in New Situations, and Social Avoidance and Distress General. For the current study, the overall score was utilized. A score of 50 or above on the SASC-R or SAS-A signifies a clinical level of social anxiety. Cronbach's alpha was calculated to ensure reliability for the sample because it is part of a special population. It was found to be strong for the SASC-R and SAS-A adapted version ($α=0.87$).

Social skills: Two measures of social skills were used. First, to measure pragmatic ability, part of the Clinical Evaluation of Language Fundamentals-Fourth Edition (CELF-4) was administered [36]. The CELF is widely used to diagnose language disabilities. Because this study is concerned only with pragmatic ability, parents were only asked to fill out the Pragmatics Profile section, which is a one page 22 item questionnaire. The Pragmatics Profile (and more generally, the construct of pragmatic ability) was chosen because it encompasses a representative variety of social skills. Items include statements such as my child-maintains eye contact, appropriate body position during conversations, tells/understands jokes/stories that are appropriate to the situation, or uses appropriate strategies for getting attention. The parents responded on a Likert scale of (1) never to (4) always. The clinical cutoffs vary by age; a nine-year-old would be classified as having clinical concerns if they scored 132 or lower, whereas a 15-year-old has a higher cutoff score (142 or lower).

Second, to measure applied social skills, the VABS was administered [26]. The VABS provide a measure of the child's skill levels within adaptive settings. They are dependent on the expectations of others or the standards of the social context, and they can improve or deteriorate over time.

Importantly, adaptive behavior scores reflect the individual's typical performance, rather than his or her ability to do the skill. The scale yields scores in the domains of communication, socialization, and daily living. In the current study, the socialization domain was used to measure adaptive social skills, which is a standard score with a mean of 100 and a Standard Deviation (SD) of 15. For this measure, a score of 1-2 SDs below the mean is considered moderately low, and an SD of 2 or lower is considered low. This domain is made up of three subdomains: interpersonal relationships, play and leisure time, and coping skills, but for the current study, only the overall score was utilized.

Temperament: The Early Adolescent Temperament Questionnaire-Revised (EATQ-R) [37] short form was administered to assess temperament. The EATQ-R is a 65 item self-report questionnaire intended for children ages 9 to 15. Participants responded to statements such as-I find it hard to shift gears when I go from one class to another at school-When someone tells me to stop doing something, it is easy for me to stop, or When I'm really mad at a friend, I tend to explode at them. The participants responded on a Likert scale of (1) almost always untrue to (5) almost always true. For this study, we looked at the factor of negative affectivity. Negative Affectivity breaks into the subscales of Frustration, Depressive Mood, and Aggression. Because the measure was developed for typically developing children, there is no clinical threshold score. We conducted a preliminary analysis to ensure that it was able to reliably measure the constructs of the variables for children with ASD. Cronbach's alpha was calculated for this sample for the nineteen items comprising the Negative Affectivity subscale of the EATQ-R and it was reliable ($α=0.78$).

Procedure

All portions of the study took place at a university center located in the community. All aspects of the study were approved by the University of Notre Dame Institutional Review Board and treatment of participants was in accordance with the ethical standards of the American Psychological Association. Participants completed consent/assent forms, and then completed the diagnostic and IQ evaluation. Children then filled out two self-report questionnaires: the EATQ-R and the SASC-R/SAS-A (depending on which form was age appropriate), with time for breaks and snacks. Meanwhile, parents filled out the Pragmatics Profile and the Vineland Adaptive Behavior Scale in a separate room. Trained research assistants were available as monitors, to give basic instructions or pronounce any confusing words, but did not direct the children or parents in how to answer.

Data Analysis Plan

The study investigated the hypothesis that negative affectivity would moderate the relationship between pragmatics ability and social anxiety. In order to accomplish the investigation, a number of statistical analyses were conducted. First, a linear regression was conducted with social anxiety (SAS-A/SASC-R) as the dependent variable and Pragmatics Profile and negative affectivity (EATQ-R) as the independent variables. Age was entered in the first step as a predictor, because the Pragmatics Profile scores are expected to be higher for older children. Then, in order to test whether applied social skills predicted social anxiety, another linear regression was computed which was identical to the first, except with the socialization domain of the VABS as a predictor instead of pragmatics ability (Figure 2). Since the VABS measures adaptive social behaviors, it was considered a proxy for applied social skills.

Results

The current study examined social anxiety in children with ASD by collecting data via self-reports and parent reports from children diagnosed with ASD. As expected, the respondents with ASD showed scoring trends on these measures that were different from those of typically developing populations. Notably, participants scored low on the Pragmatics Profile with 24 of the 28 participants below the criterion score for his or her age, signifying a communication deficit in the area of pragmatics ability. On average, the sample's scores on the SASC-R and SAS-A were slightly below the clinical threshold of 50 for these measures (M=45.86, SD=13.71). Of the 28 participants, 10 were above this clinical cutoff. Overall, all of the variables exhibited variation across the sample (Table 2 for descriptive statistics).
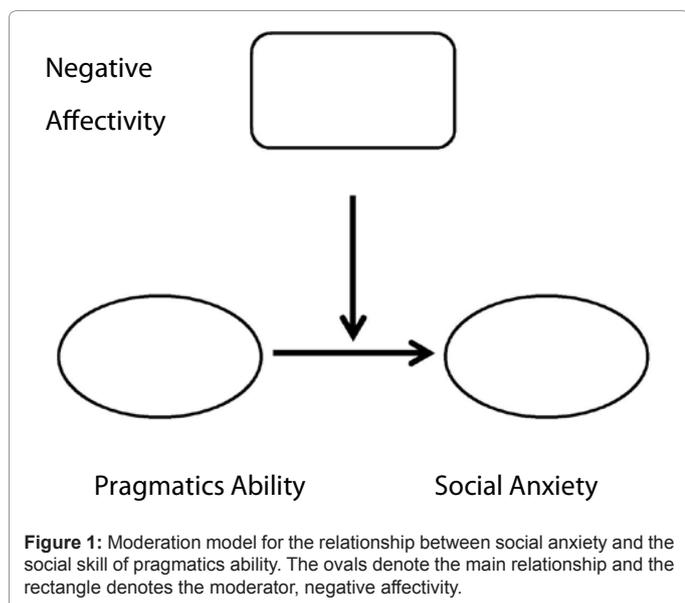
When testing the model that negative affectivity would moderate the relationship between pragmatics ability and social anxiety (Figure 1), it was found that after controlling for age, the overall model was significant, $F(4, 23)$=4.49, p=0.008 (Table 3). The model accounted for a large portion of the variance in scores on the SASC-R/SAS-A (adjusted R^2=0.34). Also, the subscale for Negative Affectivity was a significant predictor of social anxiety (β=0.56, p=0.006). However, the Pragmatics Profile scores were not a significant predictor in the model (β=0.08, p=0.62), nor was the interaction term a significant predictor (β=0.15, p=0.42). This indicated that the moderation hypothesis was not confirmed.

When testing the model that negative affectivity would moderate the relationship between VABS Socialization and social anxiety (Figure 2), this version of the model was significant overall, $F(3, 24)$=10.04,

	Measure	EATQ-R Negative Affectivity		Pragmatics Profile		VABS-Socialization		SAS-A/ SASC-R	
	Statistic Type	M	SD	M	SD	M	SD	M	SD
	Statistic	51.21	11.87	118.22	20.41	85.93	13.52	45.86	13.71

M=Mean; SD=Standard Deviation; EATQ-R=Early Adolescent Temperament Questionnarie-Revised [37]; SAS-A=Social Anxiety Scale for Adolescents [9]; SASC-R=Social Anxiety Scale for Children-Revised [33,34]; VABS=Vineland Adaptive Behavior Scale [26]
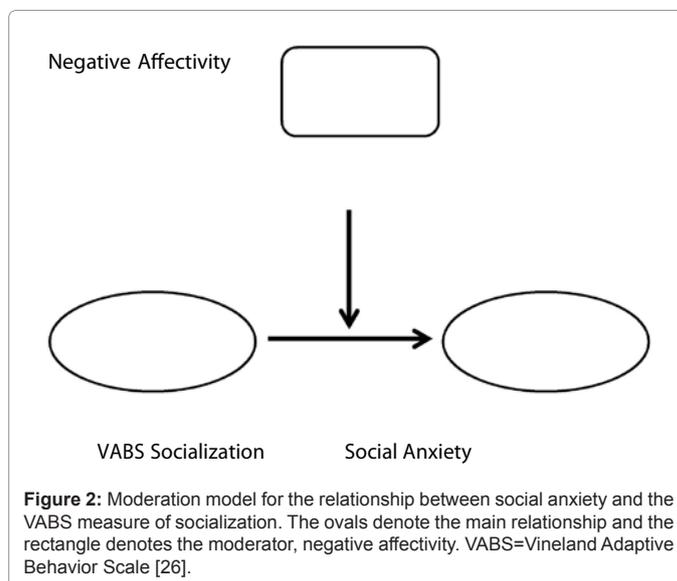
Table 2: Descriptive statistics by measure.

Figure 1: Moderation model for the relationship between social anxiety and the social skill of pragmatics ability. The ovals denote the main relationship and the rectangle denotes the moderator, negative affectivity.

	Model	Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	β	t
1	(Constant)	22.97	16.75		1.37
	Age	1.85	1.34	0.26	1.38
2	(Constant)	36.12	14.29		2.53
	Age	0.81	1.15	0.11	0.708
	Pragmatics Profile	0.05	0.11	0.08	0.50
	EATQ-R (Negative Affectivity)	0.64	0.21	0.56	3.05*
	Interaction PPxEATQ-R	0.01	0.01	0.15	0.82

Linear regression predicted scores on the Social Anxiety Scale for Adolescents (SAS-A) [9] or the Social Anxiety Scale for Children–Revised (SASC-R) [33,34]. Variables were entered into the model in two steps. Only age was entered in the first step. R^2=0.44; Adjusted R^2=0.34 EATQ-R=Early Adolescent Temperament Questionnaire-Revised [37]. *p<0.01

Table 3: Summary of linear regression predicting social anxiety from Pragmatics Ability and Negative Affectivity.

Figure 2: Moderation model for the relationship between social anxiety and the VABS measure of socialization. The ovals denote the main relationship and the rectangle denotes the moderator, negative affectivity. VABS=Vineland Adaptive Behavior Scale [26].

		Unstandardized Coefficients		Standardized Coefficients	
		B	Standard Error	β	t
	(Constant)	45.16	1.85		24.46**
	EATQ-R	0.92	0.17	0.80	5.42**
	Negative Affectivity				
	VABS	0.01	0.14	0.01	0.08
	Socialization				
	Interaction Term	-0.04	0.01	-0.41	-2.79*

Linear regression predicted scores on the Social Anxiety Scale for Adolescents (SAS-A) [9] or the Social Anxiety Scale for Children-Revised (SASC-R) [33,34]. Variables were entered into the model at the same step. R2=0.56; Adjusted R2=0.50. EATQ-R=Early Adolescent Temperament Questionnaire-Revised [37]. VABS=Vineland Adaptive Behavior Scale [24]. *p=0.01, **p<0.001

Table 4: Summary of post-hoc analysis: linear regression predicting social anxiety from VABS Socialization and EATQ-R Negative Affectivity.

p<0.001 (Table 4). It accounted for an even greater portion of the variance than the previous model (R^2=0.50). Again, the subscale of Negative Affectivity was a strong predictor (β=0.80, p<0.001), whereas VABS socialization was not a significant predictor (β=-0.08, p=0.93). The interaction coefficient was significant, meaning that the moderation model was significant (β=-0.41, p=0.01). The moderation
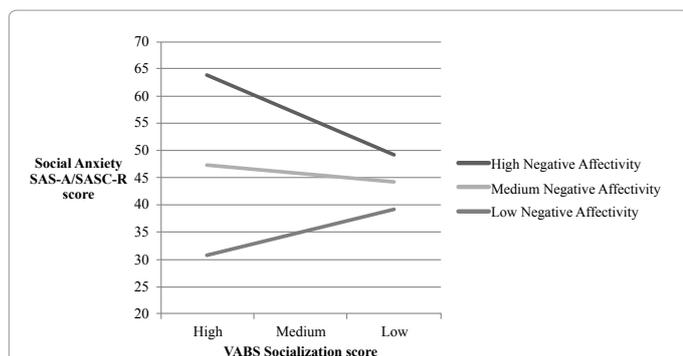
Figure 3: Post-hoc analysis: Negative Affectivity as a moderator of the relationship between VABS socialization scores and SAS-A/SASC-R social anxiety scores. VABS socialization score predicts social anxiety differently for high negative affectivity, medium negative affectivity and low negative affectivity. The cell means were computed using the program ModGraph-I [42]. Negative Affectivity is based on a subscale of the EATQ-R=Early Adolescent Temperament Questionnarie-Revised [37]; VABS=Vineland Adaptive Behavior Scale [24]; SAS-A=Social Anxiety Scale for Adolescents [9]; SASC-R=Social Anxiety Scale for Children-Revised [33,34].

effect was plotted; displaying that for high negative affectivity scorers, high socialization scores were positively associated with low social anxiety scores (Figure 3). However, for low negative affectivity scorers, the relationship was reversed such that high socialization scores were positively associated with high social anxiety scores. This supported the hypothesis that negative affectivity is an important moderator of the relationship between social skills and social anxiety in children with ASD.

Discussion

In this study, we examined the relationship between social skills (pragmatics and adaptive social skills), social anxiety, and temperament. It was hypothesized that negative affectivity would moderate the relationship between social skills and social anxiety. We found that negative affectivity moderated the relationship between adaptive social skills (as measured by the Socialization subscale of the VABS) and social anxiety. We did not find a relationship between pragmatic skills, a subset of the broad category of social skills, and social anxiety.

The current study intended to elaborate on the findings of Bellini [1] by investigating the relationship between pragmatics ability and social anxiety. Bellini proposed a developmental model of social anxiety, and found a negative association between two social skills, assertiveness and empathy, and social anxiety in ASD. In this study, we found that another subset of social skills, pragmatics ability, was not associated with social anxiety. These findings suggest that certain types of skills are more relevant to social anxiety than others.

In order to better understand how different social skills sets fit into the developmental framework, a second model was run, using the socialization domain of the Vineland Adaptive Behavior Scale instead of Pragmatics Profile scores. The Socialization domain was chosen because it measures skills that are conceptually similar to pragmatics skills, but specifically as they are performed in adaptive settings. In other words, the parent reports not on whether the child is capable of a skill, but on how well the child puts his or her skills into practice, particularly in situations outside of the family. For this analysis, there was a significant interaction between socialization scores and negative affectivity scores related to social anxiety. These findings support and extend the Bellini [1] model which suggests that social skills are associated with

the development of social anxiety. These findings extend this theory by indicating that certain skills are more important to social anxiety than others. Furthermore, the findings suggest that having the skills to interact socially is not the most accurate predictor of social anxiety. Rather, how often the child puts skills into practice across various situations is relevant to social anxiety. Bellini suggested that having more skills would mean that the child has more positive interactions, less likely to avoid social situations, and therefore encounters more opportunities to practice and learn social skills and that this is protective against social anxiety development. It is logical that a measure of social skills in adaptive settings is more accurate, because it necessarily means the skill is being applied and the child is therefore encountering more social opportunities and learning opportunities.

As expected, the current study found that negative affectivity moderates the relationship between social skills and social anxiety. Bellini [1] suggested that lower levels of social skills would be associated with higher levels of social anxiety. The current study's findings indicate that this is true for children high on negative affectivity. Those with high negative affectivity and low social skills had the highest scores of social anxiety. This could be explained by the fact that these children, who typically experience more frustration and distress than their peers would be particularly affected when they have negative interactions due to their low skills and this may lead to the development of social anxiety. In contrast, for children with ASD who were low on negative affectivity, higher levels of social skills were associated with higher social anxiety. An explanation for this is that these easygoing children who do not typically worry or get upset may develop social anxiety because their higher skill level makes them more aware of negative interactions and of rejection. Therefore, those with low negative affectivity and low social skills had the lowest scores of social anxiety. These interaction effects reveal that negative affectivity does moderate the relationship between social skills and social anxiety.

This finding is consistent with the literature that indicates a relationship between negative affectivity and general anxiety in typically developing adults [17]. The current study extends relationship to a specific type of anxiety, namely social anxiety, in the special population of children with ASD. Furthermore, Clark and Watson [38] proposed a theory of anxiety in typically developing adults and psychiatric patients in which there is a component of autonomic or physiological arousal and a distress factor. Similarly, Bellini [1] found that the tendency in children with ASD to experience autonomic hyper-arousal was associated with higher levels of social anxiety. The current study's findings indicate that this distress factor or temperamental factor of negative affectivity is similarly related to social anxiety in children with ASD.

Clinical Implications

These findings bear clinical implications. First, when working with a child with ASD, the child's temperament may provide insight into how his or her peer interactions, and reactions to these peer interactions, are affecting the development of social skills. Clinicians providing therapy for social anxiety and/or social skills should consider measuring temperament to better individualize an intervention plan. Second, this study reiterates the importance of focusing on specific skills since some skill sets are more relevant than others to social anxiety. Findings indicate that therapy that targets applying skills in adaptive settings would be beneficial for alleviating social anxiety. Therefore, a focus should be not only on knowing how to act in a given situation, but being encouraged to do so with greater frequency. Interventions should

target practicing skills with individuals outside of the family.

Limitations and Future Directions

Although the study has strong implications, it is also limited in its scope. The limitations of this study include its small sample size and relatively homogeneous demographic. There were only three girls in the sample. Although this is nearly an 8:1 ratio, and the ratio expected based on diagnosis rates is between 4:1 and 8:1 [27,39] for males to females, it is still important to study larger samples of females to rule out gender effects. Also, all of the participants had IQ index scores above 70; as such, our sample of individuals with ASD could be considered on the high-functioning end of the autism spectrum. This subset of individuals with ASD constitutes a majority of individuals with the diagnosis, and a much higher proportion than previously thought [32,40,41]. Still, approximately 38% of children with ASD have IQ scores below 70 [42], which mean that these findings cannot be generalized to the entire population of children with ASD. Finally, we did not use the Social Skills Rating System, which was used in the original Bellini [1] study. That study found that the subscales of Empathy and Assertiveness on the Social Skills Rating System were related to social anxiety. Although we were not able to directly replicate their finding, we were able to identify subtle differences in the relationship between social skills and the development of social anxiety.

Further research is needed to clarify which social skills are most important to social anxiety development. Also, it seems that negative social interactions may be the negative stimuli that are related to hyper-arousal and frustration. Future research should look at the role that negative interactions, particularly with peers, plays in the development of social anxiety. Potential protective factors such as positive interactions with peers or peers who are accepting of friends with ASD should be considered as well to determine if they are negatively associated with social anxiety. Additionally, the current study measured the variables at one time point. Longitudinal studies would be useful to understand the direction of the relationships of these factors in the development of social anxiety, and to understand when interventions would be most helpful. Finally, this study did not examine the influence of therapy (e.g., social skills therapy, cognitive-behavioral therapy) on any of our variables. An important consideration for future research would be to examine how a therapy addressing one area (e.g., anxiety) might have downstream effects on other areas (e.g. social skills) during development.

In conclusion, the current study examined factors that may predict social anxiety, which is associated with downstream deficits in social functioning [9]. The study's findings advanced the understanding of which types of social skills are associated with social anxiety. The study introduced negative affectivity as an important moderator of social anxiety in children with ASD. Further investigation is needed in order to understand when and how the many factors of social anxiety interact in children with ASD.

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