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BACKGROUND INFORMATION

Behavioral Inhibition (BI) refers to the avoidance of and withdrawal from novel situations, objects, and people (Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984). Research has demonstrated strong associations between BI and anxiety disorders in later childhood and adulthood (Grant et al., 2009; Kagan & Snidman, 1999; Rosenbaum et al., 1993), however, research in early childhood is lacking and is needed to establish BI as a *risk factor* for anxiety disorder development. In addition, while standardized observational measures of BI exist, BI is typically measured via self- and parent-report which has inherent bias, particularly when the informant is also reporting on symptoms. Further, BI has been linked with social anxiety specifically (Essex et al., 2010) as well as with depression (Brady & Kendall, 1992), suggesting that BI subtypes may exist that differentially relate to disorder onset. Within this literature, research has failed to explore potential moderation of BI-symptom associations by child sex which may be particularly important given differences in prevalence rates of internalizing disorders beginning in adolescence.

CURRENT STUDY

The present study seeks to address many of these issues by examining BI and its association with early emerging anxiety symptoms in a community sample of 409 three-year old children as well as child sex as a potential moderator of these relationships. Observational ratings of child BI taken from three episodes in the Laboratory Assessment Battery were used for analyses. Early emerging symptoms were indexed via the Child Behavior Checklist (CBCL; Achenbach, 2001) completed by the child's primary caregiver. Results reveal an association between high levels of social BI and anxiety related symptoms. High BI expressed during novel situations is associated with higher depressive symptoms in boys only, while high BI expressed in threat related tasks is associated with higher anxious-depressed symptoms in girls. Findings suggest that BI may be a multivariate construct that is differentially related to the development of psychopathology in boys and girls.

METHOD

Participants

Participants were a community sample of 409 three-year-old children living in South-Western Ontario (50.9% female; mean age = 3.43 years) and their primary caregivers. Children with significant medical, physical, or other problems were excluded. Children were predominately Caucasian (90%), and of average cognitive ability (M = 111.94, SD = 14.32).

BI Tasks

Risk Room (RR): The child was left to explore a set of novel and ambiguous stimuli, including a Halloween mask, balance beam, and black box. After 5 minutes the experimenter returned and requested that the child interact with each object.

Jumping Spider: The child was asked to touch a realistic looking "pet spider". When the child complied, the experimenter made the spider jump. After four trials, the child was told it was just a toy.

Stranger: The child was left alone briefly in the room before a friendly male accomplice entered, speaking to the child while slowly walking closer. Upon the stranger's exit the child was introduced to the stranger by the experimenter.

Coding of BI Tasks

BI was coded using an approach similar to previous studies (e.g., Durbin et al., 2005; Pfeifer, Goldsmith, Davidson, & Rickman, 2002; Olino et a., 2010). The tasks were videorecorded and coded by trained research assistants (average ICC = .90 for 10-15% of tapes). BI tasks were coded for the following task relevant behaviors: latency to fear (reversed); facial, vocal, and bodily fear; latency to touch objects & total number of objects touched (reversed); tentative play; referencing the parent; proximity to parent; referencing the experimenter; time spent playing (reversed); startle; sad facial affect; latency to vocalize; approach toward the stranger (reversed); avoidance of the stranger; gaze aversion; and verbal/nonverbal interaction with the stranger (reversed). BI was computed as the average standardized ratings of these variables. The following aggregates are used in analysis: risk room BI (α = .93), stranger BI (α = .61), and spider BI (α = .86), overall BI (all three tasks; α = .93), and a non-social BI (Risk Room and Spider only; α = .93).

Child Symptom Measures

Child symptoms were measured using the Childhood Behavior Checklist (CBCL; Achenbach, 2001) completed by the child's primary caregiver (mostly mothers N = 380; 93%). DSM-oriented scales for affective problems, anxiety problems, and ADHD were utilized in the analyses (Achenbach, Dumenci, & Rescorla, 2003). The anxious-depressed syndrome scale was also used to further probe relationships between BI and anxiety specifically. ADHD symptoms were included in analyses to establish specificity of behavioral inhibition in relation to internalizing symptoms.

RESULTS

All analyses were conducted in IBM SPSS Statistics (v.21; IBM Corp., 2012). Bivariate correlations were explored between independent variables and possible covariates. As child age was significantly correlated with BI it was controlled for as a covariate in all analyses (Table 1).

Table 1. Correlations between independent variables and possible covariates

	1	2	3	4	5	6	7	8
1. Child age	-							
2. Child sex	0.06	-						
3. Family income	0.06	-0.02	-					
4. PPVT[1]	0.05	0.07	0.11*	-				
5. Stranger BI	-0.10*	0.09	0.06	-0.02	-			
6. Spider BI	0.02	0.03	0.06	0.04	0.03	-		
7. Risk room BI	-0.14**	0.07	0.05	-0.01	0.25**	0.10*	-	
8. Non-social BI	-0.13**	0.07	0.06	0.01	0.24**	0.40**	0.95**	-
9. Overall BI	-0.15**	0.07	0.07	0.00	0.37**	0.41**	0.93**	0.99**

*p < .05 level (2-tailed); ** p < .01 (2-tailed)
Child sex coded as males = 0, females = 1; correlations with child sex are point-biserial
[1] PPVT = Peabody Picture Vocabulary Test – Fourth Edition

Main Effects

Hierarchical multiple linear regression was used to explore main effects and interactions. A significant main effect of stranger BI on DSM anxiety problems was found, such that high levels of social BI was associated with higher levels of anxiety symptoms (b = 0.63, p = .03). Main effects of child sex on DSM anxiety symptoms (b = 0.61, p = .02) and CBCL anxious-depressed symptoms (b = 0.65, p = .00) were revealed, with girls displaying higher anxiety symptoms than boys.

Interaction Effects: Moderation by Child Sex

Several significant interactions were found between child sex and BI variables in association with DSM affective problems and CBCL anxious-depressed symptoms. Interactions were probed using procedures described by Aiken & West (1991). The Johnson-Neyman technique was used to obtain regions of significance (ROS) for each interaction (Johnson and Fay, 1950).

Child sex moderated the association between risk room BI and DSM affective problems (b = -1.49, t(395) = -2.20, p = .03). Girls had lower levels of affective symptoms with increasing risk room BI whereas boys exhibited the opposite effects (neither simple slope is significant; see Figure 1 legend). Boys and girls differ significantly in their levels of affective symptoms only at low (1 SD below the mean) levels of risk room BI, (b = 0.70, t(395) = 2.52, p < .05).
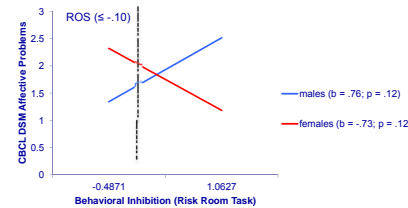

Figure 1. Relation Between Affective Problems and Behavioral Inhibition as a Function of Child Sex. ROS = Region of significance

A trend level interaction was found between sex and non-social BI in association with DSM affective problems (b = -1.35, t(397) = -1.82, p = .07; see Figure 2). Probing this interaction revealed the same pattern of findings as those in Figure 1 and suggest that BI expressed during risk room (rather than jumping spider) is responsible for the effect.
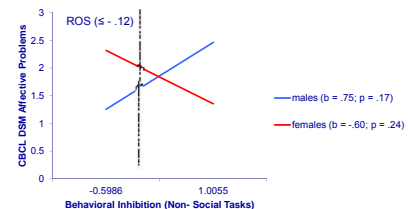

Figure 2. Relation Between Affective Problems and Non-Social Behavioral Inhibition as a Function of Child Sex. ROS = Region of significance

A trend level interaction was found between sex and spider BI in association with the CBCL anxious-depressed scale (b = 0.88, t(395) = 1.74, p = .08). Girls have significantly higher CBCL anxious-depressed symptoms with increasing spider BI (b = .89, t(395) = 2.38, p = .02); however, there is no effect for boys (see Figure 3). Boys and girls differ significantly in their levels of anxious-depressed symptoms at moderate, (mean levels; b = 0.64, t(395) = 2.87, p < .01) to high levels of BI, (1 SD above the mean; b = 1.03, t(395) = 3.25, p < .01).
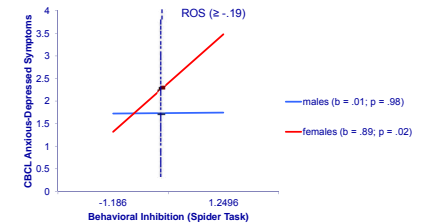

Figure 3. Relation Between Anxious-Depressed Symptoms and Behavioral Inhibition as a Function of Child Sex. ROS = Region of significance

CONCLUSION & IMPLICATIONS

Overall girls displayed more anxiety related symptoms than boys which is typical across development (Mackinaw-Koons & Vasey, 2000). Anxiety symptoms were positively associated with the social construct of BI which is congruent with recent literature that suggests that BI is more strongly associated with social anxiety than general anxiety (Essex, Klein, Slattery, Goldsmith, & Kalin, 2010).

The association between anxiety related symptoms and BI during the spider task was significantly moderated by child sex, such that girls had significantly higher anxious-depressed symptoms with increasing BI while boys did not. This suggests that high levels of fear/BI expressed during a threat related task such as jumping spider task may be more problematic for girls than boys. In contrast, higher BI during risk room was associated with greater affective problems for boys with girls showing the opposite effect. This suggests that high BI expressed in novel situations may be indicative of greater internalizing risk for boys. Girls with low levels of BI during risk room had significantly higher levels of affective symptoms than boys. Literature suggesting that it is typical for females to display greater fear/inhibition than males supports the idea that low BI during this task may be atypical and problematic for girls but normative for boys (McCann, Stewin, & Short, 1991).

Overall, findings suggest that BI is a multivariate construct and this variation should be reflected in how BI is measured and utilized in future developmental psychopathology research.

LIMITATIONS

These data are cross-sectional and therefore directionality/causality cannot be inferred. Future longitudinal research is needed to determine if BI at age 3 predicts symptom or full-blown disorder development over time. Developmental changes in behavioral constructs (such as BI) can occur over time, therefore temporal change in BI and its relation to environmental variables and symptoms development should be explored (Caspi, Roberts, & Shiner, 2005).