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ORIGINAL PAPER

Approach and Avoidance Tendencies in Spider Fearful Children: The Approach-Avoidance Task

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Abstract Fear in children is associated with the tendency to avoid situations related to the fear. In this study, the Approach-Avoidance Task (AAT) was evaluated as a test of automatic behavioral avoidance tendencies in children. A sample of 195 children aged between 9 and 12 years completed an AAT, a Behavioral Assessment Task (BAT), and two spider fear questionnaires. The results indicate that all children showed an automatic avoidance tendency in response to spider pictures, but not pictures of butterflies or neutral pictures. Girls who reported more fear of spiders on the self-reports and behaved more anxiously during the BAT also showed a greater avoidance tendency in the AAT. These relationships were absent in boys.

Keywords Children · Spider fear · Approach and avoidance · Behavior · Cognitive biases

Introduction

All children experience some fear and anxiety; this is expected at specific times during development. While isolated occurrences of fear are normal and short-lived, a prolonged high level of fear can hinder children's development. Therefore, disruptive levels of fear should be detected and followed early on, especially as anxiety is a risk factor for later psychopathology (e.g., Essau et al. 2000). Since many fears develop in childhood, it is essential to have valid measurements to quantify fear in children and to further investigate the development and maintenance of related disorders.

In the past decades, cognitive theories have emphasized the importance of cognitive processes in the onset and maintenance of anxiety disorders (for a review, see Mathews and MacLeod 2005). The central assumption of these theories is that cognitive processes are driven by schemata. Schemata are cognitive structures of associations between knowledge elements that influence perception, interpretation, attention, and memory. In individuals with an anxiety disorder, schemata that are organized around the themes of threat and danger are chronically overactive (e.g., Williams et al. 1997 for a schema-based theory of childhood anxiety, see Kendall and Ronan 1990). Due to processing resources being focused chronically and disproportionately upon threat-relevant information, biases in perception, interpretation, attention, and memory occur (for a review, see Daleiden and Vasey 1997).

To assess cognitive processes biased by fear and anxiety, both direct and indirect measures have been used. Direct measures are for example questionnaires or interviews in which participants are asked about their feelings and opinions. An advantage of these measures is that they are fast and easy to administer, and that they are reliable in the sense that measurement errors are small. A limitation of direct measures is that participants will only report what they are willing and able to report because responses are given in a controlled, deliberate manner (e.g., Nisbett and Wilson 1977). As a result, answers may be biased by social desirability, limitations of introspection, and experimenter demands (e.g., Bijttebier et al. 2003). Therefore, direct measures cannot reliably capture cognitive processes that are fast and automatic in nature. In order to capture specific automatic cognitive processes more purely, indirect measures can be used. Indirect measures are often reaction time

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tasks that require fast responses which are thought to reflect more automatic processes. Although indirect measures have not been used in studies of child anxiety as intensively as in adults, more and more studies have been reported over the last few years (for reviews, see Huijding et al. 2009b; Puliafico and Kendall 2006).

A limitation of these indirect tasks is that they mainly measure behavior (e.g., pressing keys on a computer keyboard) that is not directly related to fear and anxiety. Information processing models, however, propose that the information contained in cognitive representations is not only semantic and evaluative in nature, but also includes specific behavioral-response information. This is particularly relevant in fear and anxiety (Lang et al.1997), because they consist of a triad of responses: cognitive processes, physiological reactions, and a behavioral tendency to avoid the threatening stimuli. In the more general Reflective-Impulsive Model (Strack and Deutsch 2004), the association-based impulsive system also contains both semantic and behavioral schemata. The indirect measures described above, however, tell us little about behavioral schemata, namely how fearful children differ from non-fearful children in their automatic approach and avoidance reactions.

To assess approach-avoidance tendencies, the Approach-Avoidance Task (AAT; Rinck and Becker 2007) may be a good alternative. The AAT is a task in which single stimuli are presented to participants on a computer screen. The participants' task is to respond as quickly as possible to each stimulus by pushing or pulling a joystick. The AAT is based on the finding that approach and avoidance are basic responses associated with the primary motive systems of the brain that underlie complex emotional responding (Lang et al. 1997). In particular, pleasant stimuli produce automatic approach tendencies, whereas negative stimuli produce automatic avoidance tendencies (e.g., Chen and Bargh 1999). Several studies have shown that avoidance is associated with pushing objects away from oneself, and approach is associated with pulling the objects closer (e.g., Chen and Bargh 1999; Solarz 1960). However, the AAT is not merely a measure of stimulus valence: Even positively evaluated stimuli can evoke an avoidance reaction, e.g., smiling faces in the socially anxious (Heuer et al. 2007; Lange et al. 2008), and even negatively evaluated stimuli can evoke an approach reaction (e.g., alcohol pictures in alcoholics).

Rinck and Becker (2007) used the AAT to study approach–avoidance responses in spider fearful adults. In one of their experiments, the participants' task was to respond to each stimulus presented on the computer screen by pushing or pulling a joystick. The pictures showed spiders and 'empty' pictures (backgrounds without spiders), but the participants were told to ignore the contents of the pictures. Instead they pushed or pulled the joystick depending on picture format (landscape vs. portrait). A critical feature of this AAT is the use of a ''zooming'' function: When participants push the joystick away from themselves, the picture on the screen shrinks. When the joystick is pulled, the picture grows until it fills the screen. This zooming effect creates the visual impression that the pictures are coming closer upon pulling of the joystick and that they move away upon pushing it. Although picture contents was task-irrelevant in the study by Rinck and Becker (2007), a stimulus–response compatibility effect was found: Spider-fearful participants were faster to push spider pictures away than to pull them closer, which was not true for empty pictures or for non-fearfuls. Rinck and Becker (2007) concluded that the AAT might be a valid procedure to assess how strongly individuals react with automatic avoidance.

The AAT has been used many times to study approach and avoidance tendencies in different fears (e.g., Heuer et al. 2007; Lange et al. 2008, 2010; Roelofs et al. 2010) and in addiction (Wierset al. 2009). Moreover, it was also used for training purposes in adult samples (Wiers et al. 2010; Woud et al. 2008). However, we only know of a single study that used the AAT in a child sample (Huijding et al. 2009a). In this study, the AAT was used as a training task. The children had to repeatedly push away some unknown animals and repeatedly pull closer other animals. As a result, the children reported increased fear of previously pushed-away animals. This effect was only found for girls, and there were no training effects found on implicit attitudes. This study tells us that repeatedly pushing away an object may cause a fear response, but it does not tell us whether fearful children also show a spontaneous behavioral avoidance tendency to a feared object. This study also leaves open whether the measurement of reaction times (RTs) in the AAT is reliable enough for child studies. In a training task, it is only important that children push or pull the joystick repeatedly, but differences in RTs between pulling and pushing are not necessarily calculated.

Although it seems that the AAT was never used for measuring already existing avoidance tendencies in children, it can be expected that the AAT should be suitable for children, due to the simple task instructions and the use of non-verbal stimuli. Therefore, the goal of the present study was to evaluate the usefulness of the AAT in children. More specifically, the AAT was used to measure automatic behavioral avoidance tendencies in children varying in their level of spider fear. We chose to assess spider fear for several reasons. First, specific phobias are common and highly persistent in children (Strauss and Last 1993). It is therefore important to know more about the underlying mechanisms that play a role in the development and maintenance of specific phobias. Using the AAT could shed more light onto the automatic behavioral processes that play a role in these phobias. Knowing more about these processes in specific phobias could be useful for prevention and treatment. Second, we wanted this study to be comparable to the study by Rinck and Becker (2007), because it would be more meaningful to compare and discuss the results of the AAT in adults and children if the same AAT with the same stimuli is used. Third, spider fear is often used as a model for studying other types of fear, since the underlying processes are believed to be very similar (Williams et al. 1997). Finally, there are good behavioral measures for fear of spiders, unlike for other fears and anxieties.

An analogue sample of children varying in their level of spider fear participated in this study. Besides participating in the AAT, the children also filled out two questionnaires to assess self-reported fear of spiders. As in one of the experiments by Rinck and Becker (2007), the children also performed a Behavioral Assessment Task (BAT). This particular BAT measures relatively controllable approach behavior related to spiders by asking children to approach a spider step-by-step. Following the findings by Rinck and Becker (2007), we expected that children with high self-reported fear of spiders should be slow to pull spider pictures towards themselves, compared to other children and compared to other pictures. The other children were also expected to show avoidance, but not as much as fearful children. We further expected that the children who showed avoidance in the AAT would also have problems to approach a real spider in the BAT. However, because this BAT measures relatively controllable approach behavior, we expected BAT performance to correlate more strongly with the questionnaires than with the AAT, and we did not expect the AAT to explain variance in BAT performance over and above what was explained by the questionnaires. We had no particular predictions regarding moderating effects of gender. However, several studies suggest that girls generally report higher levels of (spider) fear than boys (e.g. Kindt et al. 1996; Ollendick et al. 2002). Therefore, we analyzed boys and girls separately. Moreover, Rinck et al. (2010) recently found that AAT effects were largest at the beginning of an AAT. Therefore, we analyzed AAT effects separately for the different blocks of the current AAT.

Methods

Participants

An analogue sample of children was recruited from three regular elementary schools in the Netherlands. After parental consent had been granted, a total of 195 children between 9 and 12 years of age participated in the study. Some of these children also participated in two other studies to validate the Spider Anxiety and Disgust Screening for Children (SADS-C; Klein et al. 2009b) and an Emotional Stroop Task (Klein et al. 2009a).

Materials

Approach-Avoidance Task (AAT)

The AAT required children to react to a single picture displayed centrally on a computer screen by pulling or pushing a joystick. The stimulus set consisted of six pictures of spiders, six pictures of butterflies, and one grey image (control picture; see Fig. 1). The AAT was administered via a laptop computer with an external 17'' LCD color monitor. The joystick was connected to the computer, and each picture was presented until a reaction was registered. When the child pushed the joystick away, the size of the picture decreased, disappearing when the joystick had reached an angle of approx. 30° For pulling reactions, the size of the picture increased and then disappeared when the child had pulled the joystick 30° towards himself. The joystick had to be returned to the middle position, and the trigger button was pushed to bring up the following picture.

A round and a square version were created of each picture (spider, butterfly, and control). Half of the children were asked to push the joystick away from themselves for

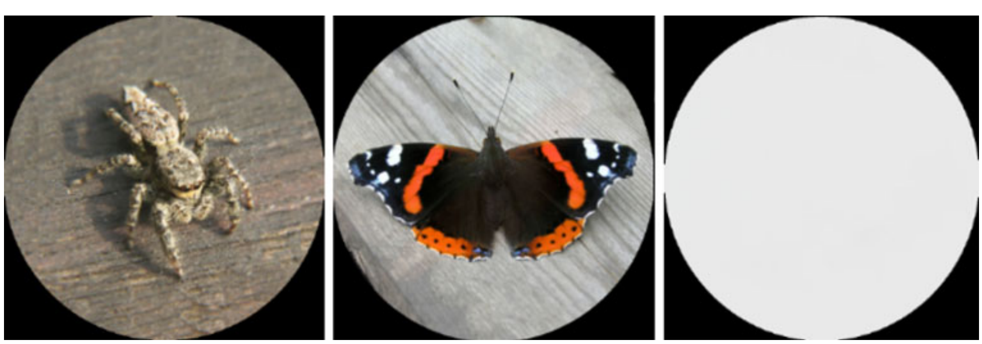

Fig. 1 Example of pictures used in the AAT (Spider, Butterfly, and Control)

round pictures and to pull the joystick towards themselves for square pictures. The other half received reversed instructions. Following 22 practice trials, 6 blocks of 12 spider trials, 12 butterfly trials, and 12 control trials each were presented in pseudo-randomized order. After three blocks (108 trials), the children took a short break. The order of stimuli was designed so that no more than 3 trials of the same type were presented successively. In sum, each child performed 36 trials for each of the 6 possible combinations of picture type (spider, butterfly, control) and response direction (pull/push).

Spider Anxiety and Disgust Screening for Children (SADS-C; Klein et al. 2009a, b)

The SADS-C is a self-report questionnaire that measures responses to four spider-related statements on a 5-point scale ranging from 'completely untrue' to 'completely true'. The four statements address fear of spiders, physical reactions, avoidance, and disgust. A total score is computed from the 4 items. Internal consistency and test–retest reliability were satisfactory ($\alpha = .88$, $r = .91$; Klein et al. 2009a, b). In this study, internal consistency was satisfactory as well ($\alpha = .84$).

Spider Phobia Questionnaire for Children (SPQ-C; Kindt et al. 1996)

The SPQ-C is a self-report measure which allows for 'true' or 'not true' responses to 29 spider-related statements. A total score is computed from the 29 statements. Internal consistency as well as test–retest reliability were satisfactory ($\alpha = .89$, $r = .61$; Kindt et al. 1996). In this study, internal consistency was satisfactory as well ($\alpha = .86$).

Behavioral Assessment Task (BAT)

This task was used to assess the children's fear-related behavior when confronted with a spider (see also Kindt et al. 1996). BAT performance was scored on an eight-point scale and proceeded as follows: The child was asked to enter a room in which a covered box containing a tarantula was located (unbeknown to the children, it was only the spider's skin, which looked like a living tarantula). The child was asked to stand on a mark visible on the ground three meters away from the box. The experimenter explained to the child that a real tarantula was in the box. The child's task was to approach the box as closely as it liked. The experimenter stressed that the procedure was not a competition, and if the child did not want to approach any further, it could say so immediately. The experimenter then uncovered the box and the child was told to look at the tarantula. The child received points initially for each meter traversed towards the box (1 m closer to the box: 1 point, 2 ms: 2 points, and next to the box: 3 points). The child was then asked to put a hand on the box for more than ten seconds (4 points), and then to lift the box (5 points). After putting down the box, the child was then asked to open it (6 points), and to put one hand in the box (7 points). The last step was to touch the tarantula with one hand (8 points). If a child failed to take any particular step, or wanted to stop, the last completed step was recorded as the BAT score. During the child's performance of the BAT, the experimenter knew neither the child's SADS-C or SPQ-C scores nor its AAT score.

Procedure

First, the children individually performed the AAT in a separate room located at the school. Next, the children individually performed the BAT in the same room. Later, they filled out the SADS-C and the SPQ-C as a group in their regular classroom environment. The teacher in each class read aloud the instructions for each self-report. Before the self-reports were filled in individually, the children practiced with two example statements from the SPQ-C. The children were then allowed to ask either the teacher or the experimenter questions, but were not allowed to discuss the statements amongst each other.

Results

Descriptives

To clear the AAT dataset of errors, all incorrect reactions (4.6%), i.e., pushing instead of pulling and vice versa, were removed from the dataset. Next, all reaction times under 200 ms or above 5,000 ms were removed. Reaction times differing more than two SD from the mean were also removed, resulting in removal of 1.7% of correct responses. The data of 20 children with more than 20% incorrect or outlier reactions were excluded from the analyses. As a result, the data of 175 children (75 boys and 100 girls) between 9 and 12 years of age ($M = 10.37$) were used in subsequent analyses.

Approach-Avoidance Task

First, AAT scores for every single block were calculated. To compute the AAT scores, the difference between push reaction times and pull reaction times was calculated separately for each of the three picture types. A negative AAT score indicates an avoidance tendency because pushing away is faster than pulling closer. Correspondingly, a positive AAT score indicates an approach tendency

Table 1 AAT mean scores and standard deviations for each picture type shown separately for each block

Block	AAT mean scores Spider (SD)	Control (SD)	Butterfly (SD)
1	−36.74 (150.81)	6.43 (136.14)	28.14 (165.17)
2	−5.82 (129.47)	−5.38 (120.18)	−12.45 (145.65)
3	−9.95 (134.23)	−10.22 (122.05)	−9.40 (140.40)
4	−22.17 (142.69)	−2.27 (140.19)	−1.28 (120.24)
5	−7.82 (124.05)	7.39 (143.96)	−21.89 (137.86)
6	−6.46 (136.00)	−17.67 (120.46)	2.02 (145.88)
Total	−14.83 (70.27)	−3.62 (60.36)	−2.60 (70.18)

because pulling closer is faster than pushing away. The resultant AAT scores and standard deviations are presented in Table 1.

The internal consistency of AAT scores across all 6 blocks was $\alpha = .45$ for spider images, $\alpha = .26$ for control images, and $\alpha = .34$ for butterfly images. A mixed-factor ANCOVA with Picture Type (spider/butterfly/neutral) as within-subjects factor, Gender as between-subjects factor, and Age as covariate was conducted. The AAT scores for different picture types were compared using the Bonferroni correction. There was neither a main effect of Gender ($F(1,172) = .79$) nor of Age ($F(1,172) = .01$), but a significant main effect of Picture Type ($F(2,171) = 8.24$, $p < .001$). The AAT score for spider images was significantly more negative than the ones for control images ($p = .006$) and butterfly images ($p < .001$). The latter two scores did not differ from each other significantly ($p > .05$). Additionally, three-one-sample t-tests were conducted to test whether the three AAT scores were significantly different from 0. This value was chosen because a score of 0 would indicate a neutral score, meaning that there were no differences between push and pull movements. As expected, the spider AAT score was significantly negative ($t(174) = -3.2$, $p = .002$), and the AAT score was significantly positive ($t(174) = 2.3$, $p = .025$). The AAT score for the neutral picture did not differ significantly from 0 ($t(174) = .63$, $p > .05$). These differences were only found in Block 1, however, in accordance with the findings of Rinck et al. (2010). In the following analyses, therefore, the spider AAT score for Block 1 and the combined spider AAT score for Blocks 2–6 were treated as separate variables. The control AAT score and the butterfly AAT score did not differ significantly across blocks ($t(175) = .16$, *n.s.*).

Self-Reports

The mean score on the SADS-C was 2.25 (SD = .92), the mean score on the SPQ-C was 1.22 (SD = .16). A multivariate ANCOVA with SADS-C scores and SPQ-C scores as dependent variables, Gender as between-subject variable, and Age as covariate was conducted. A multivariate effect was found for Gender ($F(2,171) = 12.45$, $p < .001$), but not for Age ($F(2,171) = .02$). Univariate tests showed that there was a main effect of Gender on the SADS-C ($F(1,172) = 20.07$, $p < .001$), because boys ($M = 1.90$, SD = .71) scored lower than girls ($M = 2.50$, SD = .97). There was also a main effect of Gender on the SPQ-C ($F(1,172) = 23.69$, $p < .001$). Again, boys ($M = 1.27$, SD = .11) scored lower than girls ($M = 1.50$, SD = .18). In addition to the lower means, the boys also showed less variation in spider fear than girls did, as evidenced by significantly smaller standard deviations on both the SPQ-C ($F(74,99) = 2.60$, $p < .001$) and the SADS-C ($F(74,99) = 1.91$, $p < .001$). On both questionnaires, relatively few boys indicated high fear of spiders.

Behavioral Assessment Task (BAT)

The mean BAT score was 6.53 (SD = 1.68; the higher the score, the less fearful the child). An ANCOVA with BAT score as the dependent variable, Gender as between-subjects factor, and Age as covariate was conducted. There was a main effect of Gender ($F(1,172) = 4.90$, $p = .029$), because boys ($M = 6.85$, SD = 1.52) scored higher than girls ($M = 6.29$; SD = 1.77), but no effect of age ($F(1,172) = .47$). We also tested for differences between the standard deviations for boys and girls, finding that the boys' standard deviation was smaller than the girls' standard deviation ($F(74,99) = 73.37$, $p < .001$). This indicates that relatively few boys had a low score on the BAT.

Correlations Separately for Boys and Girls

Because of the gender differences on the self-reports and the BAT, correlations were calculated separately for boys and girls. All correlations were controlled for age.

Girls

The correlation between the SADS-C and the SPQ-C was $r = .81$ ($p < .001$). As expected, the self-reports correlated with the BAT: girls who reported less fear of spiders approached the spider more closely (BAT and SPQ-C: $r = -.40$, $p < .001$; BAT and SADS-C $r = -.35$, $p < .001$). The spider AAT score of Block 1 correlated significantly with the SPQ-C ($r = -.25$, $p = .006$), and with the SADS-C ($r = -.20$, $p = .026$): Girls who reported more spider fear also showed a stronger automatic avoidance tendency on the AAT. The spider AAT score of Block 1 also correlated significantly with the BAT ($r = .20$, $p = .024$): Girls who showed a stronger automatic avoidance tendency on the AAT also had more problems to approach the spider during the BAT. These correlations were absent for the spider AAT score of Blocks 2–6 (with SPQ-C: $r = -.06$, *n.s.*; SADS-C: $r = .09$, *n.s.*; BAT: $r = -.01$, *n.s.*). As expected, the control AAT scores did not correlate significantly with either the SADS-C ($r = .16$, *n.s.*), the SPQ-C ($r = -.14$, *n.s.*), or the BAT ($r = -.08$, *n.s.*), and neither did the butterfly AAT scores (SADS-C: $r = -.01$, *n.s.*; SPQ-C: $r = -.01$, *n.s.*; BAT: $r = -.18$, *n.s.*). This indicates that girls who report fear of spiders or show an avoidance reaction on the BAT do not necessarily show an automatic avoidance or approach reaction towards neutral stimuli or butterflies. This result suggests that the AAT does indeed measure spider-specific response tendencies.

Boys

The correlation between the SADS-C and the SPQ-C was $r = .62$ ($p < .001$), slightly lower than in girls. As expected, the self-reports correlated with the BAT: Boys who reported less fear of spiders approached the spider more closely (BAT and SPQ-C: $r = -.35$, $p = .001$; BAT and SADS-C: $r = -.39$, $p < .001$). Unlike for girls, the spider AAT scores of Block 1 did not correlate significantly with the SPQ-C ($r = -.03$, *n.s.*), the SADS-C ($r = .01$, *n.s.*), or the BAT ($r = -.03$, *n.s.*). The spider AAT scores for Blocks 2 –6 did not correlate significantly with the SPQ-C ($r = .08$, *n.s.*) or the SADS-C ($r = .10$, *n.s.*), but did show an unexpected correlation with the BAT ($r = -.30$, $p = .009$). This means that boys who showed an automatic avoidance reaction on the later parts of the AAT approached the spider more closely during the BAT. This finding was limited to Block 6, in which boys reacted in the opposite direction of what we expected. As expected, the AAT scores for the control image did not correlate with the SADS-C ($r = -.17$, *n.s.*), the SPQ-C ($r = -.08$, *n.s.*), or the BAT ($r = .08$, *n.s.*). The butterfly AAT scores did not correlate with the SADS-C ($r = .01$, *n.s.*), the SPQ-C ($r = .04$, *n.s.*), or the BAT ($r = -.06$, *n.s*) either.

Keeping in mind that there were far fewer boys who scored high on the questionnaires than girls, we ran an additional analysis with only those 16 boys who scored medium to high on the SPASC (SPASC score > 2.5). For them, we calculated correlations between the SPQ-C, BAT, SPASC, and spider AAT score of Block 1. Although not statistically significant because of the small sample, the correlations between these variables were in the same direction as the ones for girls (SPQ-C and AAT: $r = -.34$, $p = .099$; BAT and AAT: $r = .21$, $p > .05$; SADS-C and AAT: $r = -.29$, $p > .05$). This suggests that highly fearful boys do appear to show an automatic avoidance reaction on the BAT which is larger than the one exhibited by medium-fearful boys.

Regression Analysis

In order to predict the relatively controllable behavior measured by the BAT, we used two hierarchical regression analyses, separately for boys and girls. The BAT score was used as the dependent variable, the predictors were the SADS-C, the SPQ-C, and the spider AAT score of block 1. We included the SADS-C and the SPQ-C in step 1 and the spider AAT score in step 2, because our main interest was the amount of predictive power the AAT could add to the direct measures. For girls, the SADS-C and the spider AAT score did not explain a significant amount of additional variance. The regression model with only the SPQ-C was significant ($F(1,98) = 16.82$, $p < .001$), and it explained 14.7% of the total variance. For boys, the SPQ-C and the spider AAT score did not explain a significant amount of additional variance. The regression model with only the SADS-C was significant ($F(1,73) = 11.41$, $p < .001$), and it explained 13.5% of the total variance. Thus, only one of the two questionnaires was necessary to predict behavior on the BAT; for girls it was the SADS-C, for boys it only the SPQ-C.

Discussion

The goal of the present study was to examine the usefulness of the Approach-Avoidance Task (AAT) for measuring automatic behavioral avoidance tendencies in spider-fearful children. Following the findings by Rinck and Becker (2007), we expected that children who are highly fearful of spiders should show automatic avoidance, that is a negative AAT score, for spider pictures, but not for butterflies or neutral pictures. The non-fearful children were also expected to show avoidance of spider pictures, but not to the same degree as fearful children. Moreover, we expected that children who show an automatic avoidance reaction towards spiders in the AAT would also have problems to approach a real spider during the BAT. While we expected correlations between the AAT, the self-report measures, and the BAT, this would not necessarily mean that the questionnaires and the AAT predict unique variance in BAT performance. Moreover, we expected the largest AAT effects at the beginning of the AAT, and based on the literature, we expected girls to report higher levels of spider fear than boys.

As expected, the observed results indicate that all children showed an automatic avoidance reaction in response to pictures of spiders, but not to control images or butterfly pictures. This effect was only found for the first block of the AAT. When looking at the relation between reported fear of spiders and the AAT scores for Block 1 in girls, we found significant correlations between the spider AAT scores, the SPQ-C, the SADS-C, and the BAT. These relationships were absent in the subsequent blocks, indicating that the avoidance response to threatening stimuli is initially present in girls, but becomes more difficult to measure with extended duration of the AAT. The latter results fits in nicely with recent results by Rinck et al. (2010), and may be due to practice effects: With extended practice, participants may learn to concentrate on the task-relevant format of the pictures and to ignore the task-irrelevant picture contents. Therefore, the early AAT effects reflect automatic avoidance tendencies more reliably, and they also correlate more reliably with self-reports and approach behavior towards a real spider.

Second, habituation may have occurred. Children (and adults alike) may react with automatic avoidance only for the first few times they are confronted with the spider stimuli. After longer exposure, they might become used to the stimuli, as pictures of spiders are more easily habituated to than real spiders. It is therefore not surprising that we did not find any correlations between the spider AAT scores for Blocks 2–6 and the self-reports or the BAT. The positive conclusion that one might derive from this result is that a brief and time-saving version of the AAT is not only sufficient, but actually optimal for measuring automatic behavior tendencies in children. As expected, neither the control image AAT score or the butterfly AAT score correlated with the self-reports or the BAT, indicating discriminative ability of the AAT.

As expected, boys reported less spider fear on the questionnaires and behaved more "bravely" in the BAT than girls. In the current study, the variance in our girl sample was also larger than in the boy sample. As a result of a lower mean and smaller variance, there were only very few boys who showed a high level of fear on the questionnaires and a high avoidance reaction on the BAT. This low variation in self-reported fear and behavioral avoidance might explain our lack of correlations with AAT scores for boys. Indeed, when looking at the correlation within medium-to-highly fearful boys, we did see the same pattern as in girls. A follow-up study with more medium-fearful to high-fearful boys could show whether boys do indeed exhibit the same correlational pattern as girls when they are spider fearful. In the current study, the only remarkable finding for boys was that in Block 6, they reacted in the opposite direction of what was expected: Boys with an avoidance spider AAT score in Block 6 approached the spider more closely in the BAT. We have no plausible theoretical explanation of this finding, and we suspect that it reflects a chance fluctuation in the data.

The regression analyses revealed that the AAT spider scores did not add unique additional variance over and above the questionnaires when explaining the relatively controllable avoidance behavior measured with the current BAT. This was to be expected because the AAT measures automatic avoidance behavior, whereas the questionnaires and the BAT measure relatively controllable processes. This result is also perfectly in line with the findings of Huijding and de Jong (2006) who used an EAST to measure automatic associations towards spiders. They used a comparable BAT to measure relatively controllable behavior, and startle probe response to measure relatively uncontrollable fear responses. They found that questionnaires best predicted BAT scores, whereas the EAST best predicted startle probe response. The only seemingly contradictory finding was reported by Rinck and Becker (2007). In their study, the AAT did predict variance in a BAT over and above what the questionnaires predicted. However, in that study, the dependent BAT variable was approach speed, which contains more automatic aspects than the dependent variable of the BAT used in this study.

It should also be noted that the AAT has some limitations, when compared to other indirect measures. While the AAT takes automatic behavioral tendencies into account, these tendencies are limited to approach and avoidance behavior in a standard setting. Second, the AAT does not distinguish between different types of associations, all of which might relate to approach and avoidance behavior. The AAT cannot, for example, distinguish between fear of spiders and disgust of spiders.

Further research is required to evaluate the Approach–Avoidance Task (AAT) for studying the underlying mechanisms of fear in boys. So far, it seems that differences in AAT responses between highly fearful and non-fearful girls indicate that pictures of spiders are evaluated as threatening, and that the body immediately responds to this threat stimulus by preparing an avoidance reaction. This shows that the AAT is suitable for studies of children, at least in girls.

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