The Influence of Attachment Figure Responsiveness on the Modification of Support Provision Expectations in Infants with Different Attachment Types

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Abstract

Sensitive responsiveness of attachment figures constitutes a crucial antecedent for the development of secure attachment in children. The present study employed an adapted attachment expectation paradigm to investigate how deterministic and probabilistic responsiveness of attachment figures influences young children' s expectations of support provision and expectation updating in real-time interactive contexts. The findings revealed that, compared to insecurely attached children, securely attached children initially held greater expectations that attachment figures would provide support to the dependent. Children demonstrated the ability to consistently update their expectations regarding whether an attachment figure would provide support based on both deterministic and probabilistic responsiveness. Furthermore, low-level responsiveness exerted a stronger influence on children' s expectation updating than high-level responsiveness. The study demonstrates that children around five years of age can update their expectations of attachment figures based on responsiveness information derived from real-time interactions, which has important implications for understanding the development of children' s attachment representations.

Full Text

The Influence of Attachment Figures' Response Patterns on Support-Giving Expectation Revision in Young Children with Different Attachment Styles

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Abstract

Sensitive responsiveness from attachment figures represents a crucial antecedent for the development of secure attachment in children. This study employed an adapted attachment expectation paradigm to examine how deterministic and probabilistic responses from attachment figures influence young children' s support-giving expectations and expectation revision in real-time interactive contexts. The findings revealed that, compared to insecurely attached children, securely attached children more frequently expected attachment figures to provide support in their initial expectations. Children could consistently revise their expectations about whether an attachment figure would provide support based on both deterministic and probabilistic responses from that figure. Moreover, low-level responses exerted a greater influence on children' s expectation revision than high-level responses. These results demonstrate that five-year-old children can revise their expectations of attachment figures based on response information from real-time interactions, offering important insights into understanding the development of children' s attachment representations.

Keywords: support-giving expectation, attachment expectation revision, response pattern, attachment style, young children

Parent-child interactions and their influence on children' s lifelong development have remained a central concern for attachment researchers (Bosmans et al., 2015). Attachment refers to the emotional bond formed between an attachment seeker and an attachment figure through interactive processes (Bowlby, 1969/1982). Previous research has primarily focused on how maternal characteristics relate to the development of secure attachment in children, including maternal mental states, relationship quality with partners, and maternal responsiveness (Bakermans-Kranenburg et al., 2003; Belsky & Jaffee, 2006; Bernier et al., 2014; Fearon & Belsky, 2016; Posada & Waters, 2018). However, such research largely treats children as passive recipients of environmental information rather than as active cognitive agents who process information (Lin et al., 2013; Johnson & Chen, 2011). In contrast, predictive processing theory posits that the brain does not passively perceive information but actively predicts incoming information (Clark, 2013). How, then, do children—as active processors—represent their interaction experiences with attachment figures and engage in attachment-based interactions based on these experiences?

According to attachment theory, attachment interaction experiences are stored as attachment representations within memory networks (Dykas & Cassidy, 2011; Posada & Waters, 2018). Specifically, children develop representations of attachment interactions that include a series of "if-then"components (Bretherton, 1990; Posada & Waters, 2016; Waters & Waters, 2006). For example: "If I encounter difficulties, then I will seek help from my mother; if I seek help from my mother, then she will help me." Consequently, a core component of attachment representations involves expectations about the future behaviors and intentions of attachment figures (Dykas & Cassidy, 2011; Verhees et al., 2019). Attachment

expectations refer to anticipations regarding the behaviors and mental states of either the attachment seeker or the attachment figure within attachment interaction contexts, including but not limited to expectations about whether the attachment figure will provide support, whether the seeker will accept help, and whether help will be effective (Johnson et al., 2010; Posada & Waters, 2016). Among these, the attachment seeker' s expectation about whether the attachment figure will provide support (hereinafter referred to as "support-giving expectation") constitutes the foundation for other attachment expectations and has garnered research attention.

Attachment theory posits that individuals with different attachment styles develop distinct expectations about whether attachment figures will provide support when they encounter difficulties (Dykas & Cassidy, 2011). Specifically, securely attached children tend to expect that parents will provide support when they face future difficulties; anxiously attached children expect parental rejection; and avoidantly attached children expect to resolve difficulties independently without parental reliance (Bosmans et al., 2013). Infant research provides supportive evidence for this perspective, finding that securely attached infants more frequently expect attachment figures to provide support to distressed seekers, whereas insecurely attached infants more frequently expect that support will not be provided (Lin et al., 2014; Johnson et al., 2007; Johnson et al., 2010). Despite this evidence, no studies have examined the influence of attachment style on support-giving expectations in preschool-aged children. Therefore, the first research question addresses how attachment style affects young children' s support-giving expectations in separation contexts.

Many characteristics of attachment figures may influence children' s support-giving expectations, among which response patterns warrant particular attention. Attachment figure responsiveness refers to the manner in which caregivers detect, interpret, and react to signals when the attachment seeker expresses needs (Ainsworth et al., 1978). Research demonstrates that attachment figure responsiveness constitutes a key factor influencing the development of secure attachment in children (Bakermans-Kranenburg et al., 2003; Bernier et al., 2014; Posada & Waters, 2018). Caregivers of securely attached children typically respond to their needs promptly; caregivers of anxiously attached children exhibit intrusive and overstimulating responses; and caregivers of avoidantly attached children tend not to respond to children' s needs (Belsky et al., 1984; Fearon & Belsky, 2016). Intervention studies further indicate that enhancing maternal responsiveness to infant signals can improve attachment security in infants and young children (Bakermans-Kranenburg et al., 2003; van den Boom, 1990).

Although numerous studies have examined the role of attachment figure responsiveness in children' s attachment development, few have investigated how attachment figure responses influence children' s attachment in real-time interactive contexts. Several reasons may account for this gap. First, conceptually, attachment-related cognitive and behavioral patterns have traditionally been considered relatively stable and difficult to change within short timeframes (Jia

et al., 2020). Second, methodologically, assessments of children' s attachment rely on tools such as the Strange Situation Procedure and Attachment Q-Sort, which cannot detect real-time changes in children' s attachment. However, the introduction of the "attachment expectation"concept makes it possible to explore how attachment figure responses influence children' s attachment in interactive contexts. Conceptually, "expectations" are components of belief systems that possess both relative stability and flexibility/dynamism (Dweck, 2008). This aligns with Bowlby' s (1969/1982) concept of the "working model," which refers to a dynamic, adjustable, context-sensitive, and variable complex social representation. Methodologically, expectations can be measured in real-time during experiments, allowing researchers to track the dynamic changes in individuals' expectations to investigate the dynamic changes in attachment representations (Bosmans et al., 2019).

Bosmans et al. (2019) explored how caregiver support effectiveness influences 9-12-year-old children' s trust in and support-seeking behavior toward caregivers in interactive contexts, finding that children trusted caregivers who provided more effective help and sought more help from them. In contrast, 12-month-old infants' expectations of attachment figures appeared to depend on their attachment style rather than interactive experiences within the task (Johnson et al., 2010). This may suggest developmental differences in children' s ability to form expectations based on attachment figure responses. Can preschool children form expectations about future supportive behavior based on attachment figure responses? According to attachment development theory, children aged 3-6 are in the "goal-corrected partnership" stage, where they can incorporate situational information about the attachment figure' s current activities and goals when planning intimacy-seeking strategies (Bowlby, 1969/1982; Marvin et al., 2016; Posada & Waters, 2016). Furthermore, developmental research indicates that children over four years old can compare the effectiveness of solving problems through their own perceptual experiences versus information provided by adults, subsequently choosing more effective approaches (DiYanni & Kelemen, 2008), and they can engage in causal reasoning based on evidence that conflicts with prior knowledge (Kushnir & Gopnik, 2007). Thus, five-year-old children can already extract situational information and make predictions based on this information. The second research question, therefore, asks whether five-year-old children can form expectations about future support provision based on attachment figure response information in interactions.

In real life, attachment figure responses to children are not deterministic but probabilistic. When discussing how maternal behavioral characteristics influence individual differences in attachment, Bowlby (1969/1982) adopted Winnicott' s (1953) concept of the "good enough mother," suggesting that maternal responsiveness reaching a certain level is sufficient to ensure healthy child development. Bosmans et al. (2019) provided supportive evidence for this view by manipulating the probability of caregivers providing effective support, finding that an 80% probability of effective support increased children' s trust in the caregiver, while a 20% response probability decreased trust. Can children

form support-giving expectations based on probabilistic responses from attachment figures? No studies have examined this question. Developmental research indicates that children over four years old can already evaluate probabilistic information and make inferences based on it (Corriveau et al., 2009; Kushnir & Gopnik, 2005). This suggests that five-year-old children should be able to extract probabilistic information from contexts to form expectations. Therefore, the third research question investigates whether five-year-old children can revise their support-giving expectations based on probabilistic responses from attachment figures.

Based on the social expectation paradigm (Johnson et al., 2007; Johnson et al., 2010), this study adapted the methodology using child-friendly cartoon animal characters to create parent-child interaction scenarios, exploring in a more ecological manner how attachment figure response patterns influence support-giving expectation revision in children with different attachment styles. The experiment included two types of response patterns: deterministic and probabilistic. These patterns not only reflect the degree of covariation between children' s support-seeking and attachment figure responses but also represent two distinct relationship qualities. The deterministic condition indicates a unique, unchangeable relationship between events, whereas the probabilistic condition suggests a diverse and potentially changeable relationship (Rapp & Wilkening, 2005; Starling et al., 2018). Research indicates that understanding relationship qualities influences children' s expectations of future events (Romberg & Saffran, 2013). Therefore, two experiments were conducted to examine the effects of attachment figure responses on support-giving expectations under deterministic conditions (Experiment 1) and probabilistic conditions (Experiment 2).

During the goal-corrected partnership stage, children must negotiate with attachment figures to achieve shared intimacy plans (Marvin et al., 2016). This requires children to acknowledge that attachment figures possess internal thoughts, goals, plans, and feelings, and to decentrally understand the objective causal relationships between attachment figures' mental states and behaviors (Marvin, 1977; Marvin et al., 2016). Therefore, in addition to examining expectations of attachment figures' explicit supportive behaviors as in previous research, this study extended its investigation to expectations regarding attachment figures' willingness to provide support—a psychological state—to more comprehensively understand children' s support-giving expectations.

Based on previous research (Lin et al., 2014; Johnson et al., 2007; Johnson et al., 2010), this study hypothesized that: (1) when facing new attachment figures, attachment style would influence children' s initial expectations of support provision, with securely attached children expecting attachment figures to be more willing and likely to provide support compared to insecurely attached children; (2) five-year-old children could revise their support-giving expectations based on deterministic responses from attachment figures, with response conditions increasing and non-response conditions decreasing children' s expectations; and (3) five-year-old children could revise their support-giving expectations based

on probabilistic responses from attachment figures, with higher-level responses increasing and lower-level responses decreasing children' s expectations of future support provision.

2 Experiment 1: The Influence of Deterministic Attachment Figure Responses on Support-Giving Expectation Revision in Children with Different Attachment Styles

2.1 Purpose

This experiment investigated how attachment style influences children' s initial support-giving expectations of attachment figures and how deterministic responses and non-responses from attachment figures affect the revision of these expectations.

2.2.1 Participants

A total of 161 children aged 5-6 years participated in this study. Three children failed to complete the attachment measurement task, and seven failed to complete the attachment expectation task. The final sample consisted of 151 children (M = 5.66, SD = 0.29; 82 boys). Regarding maternal education, 55.83% held bachelor' s degrees or higher, 30% held associate degrees, 7.5% held high school diplomas, and 6.67% held junior high school education or below. Regarding paternal education, 52.94% held bachelor' s degrees or higher, 26.89% held associate degrees, 13.45% held high school diplomas, and 6.72% held junior high school education or below. The average parental education duration was 14.95 years (SD = 2.52) for mothers and 14.96 years (SD = 2.30) for fathers. According to the Occupational Classification Code of the People' s Republic of China compiled by the Working Committee for Revision of National Occupational Classification Code (2015), parental occupations were categorized as follows: for fathers, 2.7% were heads of state organs, party organizations, enterprises, and institutions; 31.8% were professional technicians; 6.4% were administrative staff; 46.4% were business and service personnel; 6.4% were production and transport equipment operators; 0.9% were military personnel; and 5.5% were other unclassified personnel. For mothers, the corresponding percentages were 2.8%, 23.2%, 7.5%, 45.3%, 2.8%, 0%, and 18.9%, respectively. Informed consent was obtained from children' s guardians before the study began.

2.1.2 Experimental Design

A 2 (attachment style: secure, insecure) × 2 (response pattern: response, non-response) mixed design was employed, with attachment style as a between-subjects variable and response pattern as a within-subjects variable. The dependent variables were children' s behavioral and willingness expectation ratings of the attachment figure.

2.1.3 Tasks and Procedure

Attachment Story Completion Task (ASCT). The ASCT developed by Bretherton et al. (1990) was used to assess children' s attachment styles. This task measures attachment in children aged 3-6 years and includes one warm-up story (birthday party) and five attachment-themed stories presented in the following order: spilled juice, injured knee, monster in the bedroom, separation from parents, and reunion with parents. The task was administered following the procedure outlined by Bretherton et al. (1990). A well-trained experimenter narrated the stories in an emotionally engaging manner to activate children's attachment systems. The entire procedure was video-recorded. Standard coding and attachment classification systems were used to obtain children' s attachment status, yielding two indices: attachment security score and attachment type (Gloger-Tippelt & Kappler, 2016). The attachment security score is a unidimensional measure, with higher scores indicating greater attachment security and lower scores indicating less security. Children' s attachment types were classified as secure, avoidant, anxious, or disorganized.

Two independent raters coded 20% of the sample to calculate inter-rater reliability. The quadratic weighted kappa coefficient for attachment security scores was 0.885, and the kappa coefficient for overall attachment classification was 0.765. The remaining 80% of the sample was coded by one researcher (the first author). The mean attachment security score was 2.30 (SD = 0.85). Regarding attachment types, 69 children were classified as secure, 46 as avoidant, 26 as anxious, and 10 as disorganized.

Attachment Expectation Task. This task was adapted from the social expectation task (Johnson et al., 2010) and programmed using Pygame 1.9.6. The task consisted of two conditions based on whether the attachment figure responded to the seeker: response and non-response conditions. Each condition comprised three phases: baseline, learning, and test phases. Parent-child interaction scenarios were presented using cartoon rabbit mother (35 × 70 pixels) and baby rabbit (25 × 45 pixels) animations. To increase children's engagement, they were invited to play a "Little Rabbit Guessing Game" and were asked to spin around three times and jump twice to "transform into a little rabbit" before beginning the task.

In the baseline phase, a separation event was initially presented [Figure 1: see original paper]A. The rabbit mother and baby rabbit appeared at the bottom of a three-tiered hill, then moved rightward together. As they approached the first slope, the baby rabbit stopped while the mother continued upward to the second tier and stopped. The baby rabbit then attempted to climb the first slope but slipped down to the first tier three times after reaching two-thirds of the way up. Subsequently, a 3.3-second audio clip of a real child crying was played. During this process, the experimenter narrated the scenario: "Mother Rabbit and Baby Rabbit went mountain climbing together. Mother easily climbed to the second tier, but Baby Rabbit couldn' t climb up and cried sadly." Children were then

asked to guess whether Mother Rabbit would return to help Baby Rabbit or ignore it and climb to the third tier. Two pictures depicting these options were presented for children to choose from, with left-right positions randomized. Choosing the mother returning was scored as "1," while the alternative was scored as "0."

Next, four pictures of different facial expressions were presented (from left to right: very happy, happy, unhappy, and very unhappy, as shown in Figure 1A), and children rated Mother Rabbit' s willingness to help. The instructions were: "Mother Rabbit has four possible feelings. This one (pointing to very happy) means she is very willing to help Baby Rabbit, this one (pointing to happy) means she is willing to help, this one (pointing to unhappy) means she is unwilling to help, and this one (pointing to very unhappy) means she is very unwilling to help. Which feeling do you think Mother Rabbit has now?" To ensure children remembered what each expression represented, the meaning of each picture was reminded in every trial. Selecting "very willing" was scored as 4 points, "willing" as 3 points, "unwilling" as 2 points, and "very unwilling" as 1 point. Facial expression pictures were used as aids because, in real life, a mother' s willingness to provide support is often accompanied by emotions, and the consistency between emotion and willingness can help children make better judgments. Pilot testing indicated that children understood the task after one trial. Considering task duration and the need to maintain children' s interest and avoid fatigue, the separation event was presented only in the first trial; subsequent trials began with the post-separation scene (see Figure 1A). The baseline phase included four trials. Children' s behavioral expectation score for the attachment figure equaled the number of trials in which they expected Mother Rabbit to return and help divided by the total number of trials (4). The willingness expectation score equaled the mean of children' s willingness ratings across trials.

The learning phase [Figure 1: see original paper]B included response and non-response conditions, each presented with different rabbit mother-baby pairs (gray rabbits and pink rabbits). This phase began with the post-separation scene, after which children guessed whether the mother would return to help. After children' s responses, feedback was provided: in the response condition, an animation of the mother returning to the baby was shown; in the non-response condition, an animation of the mother moving to the third tier was shown. Each condition included six trials, with trial numbers determined through pilot testing.

The test phase included four trials identical to the last three baseline trials. After completing the first condition, children were introduced to the second rabbit mother-baby pair, emphasizing their difference from the first pair. The two conditions were presented in blocks, with colors of rabbit pairs and block order randomized.

Children participated in a two-session game, completing the ASCT and attachment expectation task on separate days, with task order counterbalanced. Both

tasks were administered individually in a quiet classroom at the kindergarten. Children received stickers as gifts after each task.

2.1.4 Data Analysis

First, to examine the influence of attachment style on children' s initial support-giving expectations, independent samples t-tests were conducted on behavioral and willingness expectations during the baseline phase for different attachment types. Baseline phase support-giving expectations used baseline data from the first response condition presented to children. Second, to investigate the effects of attachment figure response conditions on behavioral and willingness expectations across attachment types, a 2 (attachment style: secure, insecure) $\times$ 3 (response condition: baseline, response, non-response) repeated measures ANOVA was conducted. Insecure attachment included avoidant, anxious, and disorganized types. To further compare differences among insecure subtypes, a 2 (attachment style: avoidant, anxious) $\times$ 3 (response condition: baseline, response, non-response) repeated measures ANOVA was performed. Disorganized attachment was excluded from this analysis due to the small sample size.

Third, regarding the influence of attachment style and response condition on changes in behavioral and willingness expectations, non-parametric tests were used because the change scores were not normally distributed. Change in behavioral expectation (C-BE) or willingness expectation (C-WE) was calculated as the test phase score minus the baseline phase score for each condition. Because the overall change direction differed between the two conditions, negative values of C-BE and C-WE in the non-response condition were used for comparative analyses. Greenhouse-Geisser corrections were applied for sphericity violations when necessary, and Bonferroni corrections were used for p-value adjustments. Statistical analyses were conducted using the bruceR package in R (Bao, 2020).

2.3.1 Influence of Attachment Style on Children' s Initial Support-Giving Expectations

For baseline behavioral expectations, both secure and insecure children scored significantly above chance level, $t(68) = 11.12$, $p < 0.001$, Cohen' s $d = 2.70$, 95% CI [0.76, 0.88]; $t(81) = 7.77$, $p < 0.001$, Cohen' s $d = 1.73$, 95% CI [0.66, 0.78]. However, insecure children scored significantly lower than secure children, $t(147.43) = -2.47$, $p = 0.015$, Cohen' s $d = -0.41$, 95% CI [-0.18, -0.02], with no significant difference between avoidant and anxious subtypes, $t(59.50) = 0.48$, $p = 0.63$. For baseline willingness expectations, insecure children scored significantly lower than secure children, $t(140.83) = -2.66$, $p = 0.009$, Cohen' s $d = -0.45$, 95% CI [-0.49, -0.07], again with no significant difference between avoidant and anxious subtypes, $t(52.97) = 0.76$, $p = 0.45$.

2.3.2 Influence of Response Conditions and Attachment Style on Support-Giving Expectations

Descriptive statistics for behavioral and willingness expectations across conditions are presented in Table 1 . ANOVA results for behavioral expectations revealed a significant main effect of response condition, $F(1.77, 263.03) = 435.30$, $p < 0.001$, $p^2 = 0.745$, with response condition significantly higher than baseline, which was significantly higher than non-response, ps < 0.001. The main effect of attachment style was not significant, $F(1, 149) = 0.5$, $p = 0.48$. The interaction between attachment style and response condition was significant, $F(1.77, 263.03) = 3.92$, $p = 0.026$, $p^2 = 0.026$. Simple effects analysis indicated that secure children had significantly higher behavioral expectations than insecure children during baseline, $t(149) = 2.45$, $p = 0.015$, Cohen' s d = 0.495, 95% CI [0.10, 0.90], but no significant differences emerged in response or non-response conditions, ps > 0.05. ANOVA for avoidant and anxious children' s behavioral expectations showed no significant main effects or interactions related to attachment style, ps > 0.05.

For willingness expectations [Figure 2: see original paper]B, ANOVA revealed a significant main effect of response condition, $F(1.66, 247.17) = 224.73$, $p < 0.001$, $p^2 = 0.601$, with response condition significantly higher than baseline, which was significantly higher than non-response, ps < 0.001. The main effect of attachment style was not significant, $F(1, 149) = 0.71$, $p = 0.402$. The interaction between attachment style and response condition was significant, $F(1.66, 247.17) = 3.77$, $p = 0.032$, $p^2 = 0.025$. Simple effects analysis showed that secure children had significantly higher willingness expectations than insecure children during baseline, $p = 0.008$. For insecure children, response condition was significantly higher than baseline, ps < 0.001, whereas for secure children, no significant difference emerged between these conditions, $p > 0.05$. ANOVA for avoidant and anxious children' s willingness expectations revealed no significant main effects or interactions related to attachment style, ps > 0.05.

2.3.3 Influence of Response Conditions and Attachment Style on Support-Giving Expectation Revision

Attachment security scores showed a significant positive correlation with behavioral expectation change in the non-response condition, $r(151) = 0.27$, $p < 0.001$, but no significant correlation with change in the response condition, $r(151) = -0.04$, $p = 0.649$. For C-BE [Figure 3: see original paper]A, Mann-Whitney U test indicated that the non-response condition was significantly higher than the response condition, $V = 5121.5$, $p < 0.001$ (M_{non}-response = 0.68, SD = 0.37; M_{response} = 0.39, SD = 0.42). Further Wilcoxon signed-rank test showed that for the non-response condition, insecure children were significantly lower than secure children, $W = 2267.5$, $p = 0.030$ (M_{insecure} = 0.55, SD = 0.42; M_{secure} = 0.71, SD = 0.31), whereas no significant difference emerged for the response condition, $W = 3082.0$, $p = 0.330$ (M_{insecure} = 0.40, SD = 0.40; M_{secure} = 0.36, SD = 0.43). No significant difference existed between

secure and insecure children overall, W = 687.5, p = 0.283. Additionally, no significant differences emerged between avoidant and anxious children in either response condition, ps > 0.05.

Attachment security scores showed a significant positive correlation with willingness expectation change in the non-response condition, r(151) = 0.18, p = 0.024, but no significant correlation with change in the response condition, r(151) = -0.08, p = 0.345. Similar analyses for C-WE [Figure 3: see original paper]B revealed that the non-response condition was significantly higher than the response condition, V = 6206.0, p < 0.001 (M_{non}-response = 1.27, SD = 1.06; M_{response} = 0.77, SD = 0.99). Further analysis indicated that for the non-response condition, insecure children were significantly lower than secure children, W = 2226.0, p = 0.023 (M_{insecure} = 1.00, SD = 1.03; M_{secure} = 1.41, SD = 0.97), whereas no significant difference emerged for the response condition, W = 3277.5, p = 0.090 (M_{insecure} = 0.88, SD = 0.97; M_{secure} = 0.63, SD = 1.01). No significant difference existed between secure and insecure children overall, W = 43576.0, p = 0.427. Additionally, no significant differences emerged between avoidant and anxious children in either response condition, ps > 0.05.

Experiment 1 demonstrated that attachment style influenced children' s behavioral and willingness expectations of attachment figures' support provision. Specifically, securely attached children exhibited significantly higher behavioral and willingness expectations than insecurely attached children, supporting Hypothesis (1) and consistent with previous infant research (Lin et al., 2014; Johnson et al., 2007; Johnson et al., 2010). This indicates that when facing new attachment figures, children can form expectations about future support provision based on their own attachment experiences. Consistent with Hypothesis (2), the study found that five-year-old children could revise their support-giving expectations based on deterministic responses from attachment figures, with response conditions increasing and non-response conditions decreasing these expectations. This suggests that five-year-old children can extract characteristic information about attachment figures from immediate interactions and revise their original expectations based on newly acquired information, consistent with research on children' s reasoning (Gopnik et al., 2004; Kushnir & Gopnik, 2007). Furthermore, the study found that children more readily revised their expectations when facing negative attachment interaction experiences, possibly reflecting an adaptive negativity bias when confronting threats. This negativity bias in attachment expectation revision may prevent negative experiences resulting from overestimating attachment figure support when encountering difficulties (Coan & Sbarra, 2015; LoBue, 2009).

Experiment 1 examined the influence of attachment figure response patterns on children' s attachment expectation revision under deterministic conditions. However, in real life, attachment figure responses are typically probabilistic. Bosmans et al. (2019) suggested that 80% may be the "good enough" standard for attachment figure response probability that promotes children' s trust

development. Experiment 2 adopted the probability settings from their study, establishing response probabilities of 20%, 50%, and 80% to explore how probabilistic response patterns influence children' s attachment expectation revision.

3 Experiment 2: The Influence of Probabilistic Attachment Figure Response Patterns on Support-Giving Expectation Revision

3.1 Purpose

This experiment investigated how different response probabilities (20%, 50%, 80%) from attachment figures influence the revision of children' s support-giving expectations.

3.2.1 Participants

A total of 95 children aged 5-6 years participated in this study. Three children failed to complete the attachment measurement task, and two failed to complete the attachment expectation task. The final sample consisted of 90 children (M = 5.46, SD = 0.29; 45 boys). Regarding maternal education, 46.07% held bachelor' s degrees or higher, 37.08% held associate degrees, 12.36% held high school diplomas, and 4.49% held junior high school education or below. Regarding paternal education, 50.56% held bachelor' s degrees or higher, 29.21% held associate degrees, 16.85% held high school diplomas, and 3.8% held junior high school education or below. The average parental education duration was 15 years (SD = 2.07) for mothers and 14.96 years (SD = 1.98) for fathers. According to the Occupational Classification Code of the People' s Republic of China (Working Committee for Revision of National Occupational Classification Code, 2015), parental occupations were categorized as follows: for fathers, 4.4% were heads of state organs, party organizations, enterprises, and institutions; 25.6% were professional technicians; 2.2% were administrative staff; 32.2% were business and service personnel; 5.6% were production and transport equipment operators; and 30% were other unclassified personnel. For mothers, the corresponding percentages were 1.1%, 23.3%, 1.1%, 33.3%, 2.2%, and 38.9%, respectively. Informed consent was obtained from children' s guardians before the study began.

3.2.2 Experimental Design

A 2 (attachment style: secure, insecure) × 3 (response probability: 20%, 50%, 80%) mixed design was employed, with attachment style as a between-subjects variable and response probability as a within-subjects variable. The dependent variables were children' s behavioral and willingness expectations of the attachment figure.

3.2.3 Tasks and Procedure

Attachment Story Completion Task. The task administration and coding procedures were identical to Experiment 1. Two independent raters coded 20% of the sample, yielding inter-rater reliability with a quadratic weighted kappa coefficient of 0.83 for attachment security scores and a kappa coefficient of 0.77 for attachment classification. The remaining 80% of the sample was coded by one researcher (the first author). The mean attachment security score was 2.22 (SD = 0.93). Regarding attachment types, 41 children were classified as secure, 33 as avoidant, 10 as anxious, and 6 as disorganized.

Attachment Expectation Task. This task was similar to Experiment 1. Based on Bosmans et al. (2019), three probabilistic response conditions were established: 20% response, 80% response, and 50% response conditions. Each condition was represented by rabbit mother-baby pairs of different colors (white, gray, and pink). Response probability was defined as the proportion of response trials during the learning phase. Response trials were those in which the mother rabbit returned to the baby rabbit during feedback, while non-response trials showed the mother moving to the third tier. To facilitate probability manipulation, each condition in Experiment 2 included 10 learning trials, with 2, 5, and 8 response trials in the 20%, 50%, and 80% conditions, respectively. The order of conditions and trials within conditions was randomized. Other aspects of the task remained consistent with Experiment 1.

3.2.4 Data Analysis

The data analysis approach was identical to Experiment 1.

2.3.1 Influence of Attachment Style on Children' s Initial Support-Giving Expectations

For baseline behavioral expectations, both secure and insecure children scored significantly above chance level, $t(40) = 7.83$, $p < 0.001$, Cohen' s d = 2.48, 95% CI [0.70, 0.84]; $t(48) = 4.00$, $p < 0.001$, Cohen' s d = 1.15, 95% CI [0.57, 0.71]. Secure children (M = 0.77, SD = 0.22) scored significantly higher than insecure children (M = 0.64, SD = 0.25, $t(87.79) = 2.5$, $p = 0.013$, Cohen' s d = 0.54), with no significant difference between avoidant and anxious subtypes, $t(23.63) = -0.23$, $p = 0.82$. For baseline willingness expectations, no significant differences emerged between secure and insecure children or between insecure subtypes, ps > 0.05.

3.3.2 Influence of Probabilistic Conditions and Attachment Style on Support-Giving Expectations

Descriptive statistics for behavioral and willingness expectations across conditions are presented in Table 2 . For behavioral expectations [Figure 4: see original paper]A, ANOVA revealed a significant main effect of response condition, $F(2.84, 249.83) = 32.45$, $p < 0.001$, $p^2 = 0.269$, with baseline significantly

higher than all three response conditions, ps < 0.05, and both 80% and 50% conditions significantly higher than the 20% condition, ps < 0.001, though no significant difference emerged between 80% and 50% conditions, $p > 0.05$. The main effect of attachment style was marginally significant, $F(1, 88) = 3.50$, $p = 0.065$, $p^2 = 0.038$, with secure children marginally higher than insecure children. The interaction between attachment style and response condition was not significant, $F(2.84, 249.83) = 1.92$, $p = 0.130$. Additionally, ANOVA for avoidant and anxious children' s behavioral expectations revealed no significant main effects or interactions related to attachment style, ps > 0.05.

For willingness expectations [Figure 4: see original paper]B, ANOVA indicated a significant main effect of response condition, $F(2.81, 247.05) = 27.47$, $p < 0.001$, $p^2 = 0.238$, with baseline and 80% conditions significantly higher than 50% and 20% conditions, ps < 0.05, and 50% condition significantly higher than 20% condition, $p < 0.001$, though no significant difference emerged between baseline and 80% conditions, $p > 0.05$. The main effect of attachment style was not significant, $F(1, 88) = 0.69$, $p = 0.409$, nor was the interaction between attachment style and response condition, $F(2.81, 247.05) = 0.76$, $p = 0.510$. ANOVA for avoidant and anxious children' s willingness expectations revealed no significant main effects or interactions related to attachment style, ps > 0.05.

3.3.3 Influence of Response Patterns and Attachment Style on Support-Giving Expectation Revision

Raw means for C-BE and C-WE across conditions are presented in Table 3 . C-BE and C-WE were calculated as in Experiment 1. For C-BE [Figure 5: see original paper]A, Friedman test indicated significant differences among the three response probability conditions, Friedman $^2 = 22.30$, $p < 0.001$. Subsequent Mann-Whitney U tests revealed that the 20% condition was significantly higher than both 80% and 50% conditions, $V = 2047.5$, $p < 0.001$, $V = 2215.0$, $p < 0.001$, with no significant difference between 80% and 50% conditions, $V = 1240.5$, $p = 0.843$. Wilcoxon signed-rank test showed no significant difference in C-BE between secure and insecure attachment styles, $W = 9386.5$, $p = 0.579$. Additionally, no significant differences emerged between secure and insecure children within each response condition, ps > 0.05, nor between avoidant and anxious children, $p > 0.05$.

For willingness expectation change [Figure 5: see original paper]B, Friedman test indicated significant differences among the three response probability conditions, Friedman $^2 = 16.22$, $p < 0.001$. Subsequent tests showed that the 20% condition was significantly higher than both 80% and 50% conditions, $V = 2445$, $p = 0.003$, $V = 2218$, $p < 0.001$, with no significant difference between 80% and 50% conditions, $V = 1668$, $p = 0.383$. No significant difference in C-BE emerged between secure and insecure attachment styles, $W = 9776$, $p = 0.248$. Additionally, no significant differences emerged between secure and insecure children within each response condition, ps > 0.05, nor between avoidant and anxious children, $p > 0.05$.

3.4 Discussion

By manipulating attachment figure response probability, this study found that compared to baseline, the 80% response condition significantly decreased children' s behavioral expectations for support provision, while 20% and 50% conditions significantly decreased both behavioral and willingness expectations, consistent with Hypothesis (3). This indicates that five-year-old children can revise their behavioral and willingness expectations for attachment figures'support provision based on probabilistic response information from immediate interactions. Regarding the magnitude of expectation revision, the 20% response condition produced significantly greater change than 80% and 50% conditions, suggesting that children revise their expectations more substantially after negative interactions, consistent with Experiment 1 results.

4 General Discussion

By manipulating attachment figure responses to seekers' support requests, this study found that when lacking experience with an attachment figure' s response patterns, children form expectations about support provision based on their own attachment styles. However, when they acquire information about an attachment figure' s response patterns through interaction, they can consistently revise their expectations about future support provision based on this information, whether the patterns are deterministic or probabilistic. These findings support all three hypotheses of the current study.

4.1 Influence of Attachment Style on Children' s Support-Giving Expectations

Attachment theory posits that individuals' prior attachment experiences guide their behavior in unfamiliar interpersonal relationships (Dykas & Cassidy, 2011; Mohammadzade Naghashan et al., 2021). Securely attached children typically view others as trustworthy, whereas insecurely attached children view others as untrustworthy (Wang et al., 2005; Bretherton & Munholland, 2008). Consistent with this view, the current study found that compared to insecurely attached children, securely attached children more frequently expected attachment figures to provide support to distressed seekers during the baseline phase, aligning with previous research (Lin et al., 2014; Johnson et al., 2007; Johnson et al., 2010). The study also found no differences between avoidant and anxious children in support-seeking expectations, consistent with previous infant research (Lin et al., 2014; Johnson et al., 2010). According to the insecure attachment conflict model (Ainsworth et al., 1978), insecure children' s support-seeking behavior results from the interaction between two conflicting motivations: the desire for closeness and fear of intimacy. When environmental threat levels are low, the desire for closeness outweighs fear of intimacy. In this study, where children predicted whether an attachment figure in a video would support a distressed seeker, threat levels were low, making fear of intimacy too weak to trigger explicit attachment defense strategies.

Interpretive bias may represent a mechanism through which attachment style influences children's initial support-giving expectations (De Winter et al., 2016). Interpretive bias guides individuals to process new experiences in ways consistent with current expectations (Beck, 1964; De Winter et al., 2015). Automated attachment interpretive bias enables children to rapidly and effectively evaluate their interactions with attachment figures and select appropriate behaviors (De Winter et al., 2016). Securely attached children possess a secure interpretive bias, interpreting mothers' ambiguous behaviors more positively, making them more likely to perceive mothers as available and supportive, whereas insecurely attached children show the opposite pattern (Bowlby, 1969/1982; De Winter et al., 2016; Dykas & Cassidy, 2011). Thus, when encountering new attachment figures, children with different attachment styles interpret and expect the figures' ambiguous behaviors in ways that align with their own attachment experiences.

Interestingly, attachment style influenced five-year-old children's support-giving expectations only during the baseline phase; when children obtained direct evidence about support provision, they based their expectations on this evidence. This differs from infant research findings, where Johnson et al. (2010) found that 12-month-old infants' expectations of attachment figures depended on attachment style rather than interactive experiences within the task. This suggests that five-year-old children can flexibly integrate prior knowledge with current interaction information, selectively basing expectations on specific types of information. Consistent with this view, Kushnir and Gopnik (2007) found that children over four years old can make inferences based on new evidence that conflicts with their prior knowledge. From an interpretive bias perspective, when information about whether an attachment figure will provide support is unambiguous, the likelihood of children making alternative interpretations of the behavior decreases; unambiguous behavior reduces children' s interpretive bias, making them more likely to base expectations on clear information.

4.2 Influence of Attachment Figure Response Patterns on Children' s Attachment Expectation Revision

This study demonstrates that five-year-old children can extract information about attachment figure behavioral characteristics in complex real-time social interaction tasks and revise their support-giving expectations based on new information. This aligns with developmental research showing that four-year-old children can evaluate covariation evidence, learn new causal relationships after just two observations, and make predictions based on these relationships (Gopnik et al., 2004; Kushnir & Gopnik, 2007). Five-year-old children' s high learning capacity for new experiences enables them to use these experiences to revise original expectations. Moreover, this study found that five-year-old children can revise expectations based on both deterministic and probabilistic responses from attachment figures. Specifically, the direction of children' s expectation revision was consistent with the nature of the attachment figure' s responses: higher-level responses increased expectations, while lower-level re-

sponses decreased them. Consistent with this result, Bosmans et al. (2019) also found that the probability of effective caregiver support influenced children' s trust and future help-seeking expectations.

Additionally, this study found that children's expectation revision was more sensitive to lower-level responses from attachment figures, meaning that children' s support-giving expectations were more sensitive to negative than positive interactions. This may reflect an adaptive negativity bias when facing potential threats. From an evolutionary perspective, rapid detection and identification of threat information in contexts enables individuals to escape danger quickly and increase survival rates (LoBue, 2009). Research shows that individuals are more sensitive to negative than positive information (Coan & Sbarra, 2015; Hughes et al., 2017). The study also found that securely attached children were more sensitive to negative responses than insecurely attached children, showing greater expectation revision after negative interactions. According to social baseline theory, attachment relationships represent important social resources, and securely attached children hold more reliable prior beliefs about them, enabling better task performance (Coan & Sbarra, 2015). This also aligns with the view that securely attached children process attachment-related information more openly and flexibly, whereas insecurely attached children are more likely to adopt defensive information processing strategies (Dykas & Cassidy, 2011).

4.3 Possible Mechanisms Underlying the Influence of Attachment Figure Response Patterns on Attachment Expectation Revision

The process of children forming support-giving expectations based on attachment figure responses can be divided into information acquisition and expectation formation. The information acquisition process can be viewed as a reinforcement learning process (Bosmans et al., 2020). According to prediction error minimization theory (Olsson et al., 2020), the discrepancy between children' s expected value of attachment figure support and actual experienced outcomes (i.e., prediction error) updates their value representations of the attachment figure. Under both deterministic and probabilistic response conditions, children adjust their subsequent expectations through a series of prediction-feedback cycles, gradually reducing prediction error. During this process, a goal-directed learning system constructs internal representations of attachment figure responses, allowing children to quickly incorporate new information into existing models and revise them (Olsson et al., 2020). Alternatively, children may form trait-based judgments about attachment figures, such as "this mother is good," consistent with propositional models of learning that view learning as acquiring propositional beliefs about relationships between events (De Houwer, 2009). Preschool children already understand trait stability; research shows that 3-5-year-old children often make holistic judgments about information sources based on dichotomous trait inferences (Reyna & Brainerd, 2011).

After obtaining information about attachment figure support provision, children must form expectations about the figure' s future supportive behavior and will-

ingness. This study found that five-year-old children can not only form expectations about future behavior based on learned response patterns but also make inferences and evaluations about future willingness consistent with behavioral expectations. This aligns with previous research showing that the development of mental state reasoning abilities in preschool children enables them to recognize close associations between explicit behaviors and mental states (Haver & Justice, 1993; Lagattuta & Kramer, 2021). Different information acquisition methods lead to different expectation formation processes. If children learn associations between attachment figures and their supportive behaviors (US), they form expectations about future behavior based on response frequency information and subsequently infer internal psychological willingness based on behavioral pattern characteristics. If children learn traits of attachment figures, they form expectations about future behavior and willingness based on these traits. Although both situations involve theory of mind in expecting attachment figure willingness, the former reflects inference from explicit behavior to mental states (particularly desires), whereas the latter reflects inference from psychological traits to desires (Huang & Lin, 2003; Wellman, 1990).

According to predictive processing theory (Clark, 2013), children' s support-giving expectation revision is influenced not only by attachment figure support provision information during interactions but also by existing knowledge about attachment figures' supportive behaviors and willingness, such as children' s initial behavioral and willingness expectations. Existing knowledge about willingness and behavior may also influence expectation revision. This study found that under deterministic response conditions, children' s behavioral expectation revision was greater than willingness expectation revision. This may be because, for children, attachment figure willingness is more likely associated with stable personality traits and less susceptible to change. Therefore, compared to behavioral expectation revision, children' s willingness expectation revision was lower.

4.4 Limitations and Future Directions

This study has several limitations. First, as an emotional bond, the affective component is crucial for distinguishing attachment relationships from other relationships. The attachment expectation task used cartoon animal parent-child pairs to present experimental scenarios, with children forming expectations through observation. This may reduce activation of attachment-related emotions. Future research could use more ecological materials, such as stimuli created from children' s own photos with their mothers. Second, the number of trials differed between conditions in Experiments 1 and 2, limiting direct comparisons between the two experiments. Third, the sample age was concentrated around five years, preventing examination of developmental differences in how attachment figure response patterns influence children' s attachment expectation revision. Future research should adopt a developmental perspective to investigate how children across different age stages update their attachment

expectations based on attachment figure response patterns.

5 Conclusions

1. Five-year-old children' s initial expectations of support provision from new attachment figures are influenced by their own attachment styles, with securely attached children more likely than insecurely attached children to expect that attachment figures will and will be willing to provide support.
2. Five-year-old children can revise their expectations about whether an attachment figure will provide support based on both deterministic and probabilistic responses from that figure in real-time interactions.
3. Compared to high-level responses, low-level responses from attachment figures have a greater influence on five-year-old children' s support-giving expectation revision.

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