American Psychological Association

Emotion

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ISSN: 1528-3542

2021, Vol. 21, No. 1, 1–16
http://dx.doi.org/10.1037/emo0000694

Advanced Emotion Understanding: Children's and Adults' Knowledge That Minds Generalize From Prior Emotional Events

Kristin Hansen Lagattuta and Hannah J. Kramer
University of California, Davis

We examined an advanced form of emotion understanding in 4- to 10-year-olds and adults ($N = 264$): Awareness that people's minds generalize from past emotional episodes to bias how they feel, think, and make decisions in new situations. Participants viewed scenarios on an eye tracker, each featuring an initial perpetrator who caused a character to feel positively (P) and/or negatively (N) in 2-event sequences (NN, PP, NP, PN). Later, the character encountered a new agent who was highly similar to the initial perpetrator. Participants predicted the character's affective reactions (emotions, thoughts, decisions) to the unknown agent while we recorded their eye movements to past episodes. Participants also judged characters' emotions upon seeing additional agents, who differed in degree of similarity to the initial perpetrator. Four- to 5-year-olds discounted pasts with initial perpetrators—believing instead that characters would feel happy, anticipate good, and approach new agents. In contrast, adults exhibited robust beliefs that people generalize from past emotional experiences: They attributed more positive responses to new agents following PP > NP > PN > NN pasts, and they expected characters to have biased emotional reactions to even somewhat dissimilar new agents. Between 6 and 10 years, children increasingly assumed that the past would have a biasing impact; however, they drew stricter boundaries than did adults. Eye-tracking analyses revealed that all age groups attended to characters' emotional past histories when reasoning about reactions to new agents (especially negative events), adults prioritized recent negative events in PN pasts, and participants' attention biases to past event information correlated with their reasoning about emotion generalization.

Keywords: emotion, development, prospection, generalization, social cognition

Supplemental materials: http://dx.doi.org/10.1037/emo0000694.supp

Within childhood as well as between childhood and adulthood, individuals develop stronger awareness that emotions are caused not only by current events but also by remembering the past and anticipating the future (Lagattuta, 2014). During this age period, individuals also increasingly recognize interconnections among how people feel, think, and make decisions; for example, thinking pessimistically can override positive experiences, and people who feel worried are likely to anticipate negative outcomes and make avoidant decisions (Bamford & Lagattuta, 2012; Lagattuta, 2007; Lagattuta, Elrod, & Kramer, 2016; Lagattuta & Wellman, 2001; Lara, Lagattuta, & Kramer, 2019). These emerging intuitions about the close interplay among life events, mind, and emotion represent key improvements in emotion cognition during middle childhood as well as in mental state reasoning, or *theory of mind,* more broadly (see Kramer & Lagattuta, in press; Lagattuta et al., 2015). The current project aimed to expand theory and research on the development of emotion understanding by examining 4- to 10-year-olds' and adults' beliefs about a complex, yet common, emotional occurrence: People's minds can generalize from prior emotional experiences to bias their emotions, thoughts, and decisions in new situations.

Emotion generalization—drawing from past emotional episodes to inform how to feel, think, and make decisions later in time—can follow narrow pathways. For example, if David has been repeatedly harmed by a red-haired boy in the past, then it is understandable that David will feel worried, anticipate future harm, and stay away next time he sees that same boy. Lagattuta and Sayfan (2013) tested the development of children's and adults' awareness of this direct form of emotion generalization. Four- to 10-year-olds and adults predicted how characters would feel, think, and make decisions upon reencountering the same human or animal that had previously caused them to feel positive emotions (P), negative emotions (N), or both positive and negative emotions (four types of two-event sequences: PP, NP, PN, NN). Even 4- to 5-year-olds

This article was published Online First November 4, 2019.

Kristin Hansen Lagattuta and Hannah J. Kramer, Department of Psychology and Center for Mind and Brain, University of California, Davis.

This research was funded by National Science Foundation Grant 0723375 to Kristin Hansen Lagattuta. We thank the children and adults who participated. We also thank the Mind-Emotion Development Lab staff, especially Liat Sayfan, Amanda Blattman, Christina Harvey, Elizabeth Lowen, and Sandra Diaz, for their assistance with this research. Special thanks to Megan Wong Relagado, Sarah Mian, and Sarah Lagattuta for artwork.

Correspondence concerning this article should be addressed to Kristin Hansen Lagattuta, Department of Psychology and Center for Mind and Brain, University of California, Davis, 1 Shields Avenue, Davis, CA 95616. E-mail: khlaga@ucdavis.edu

expected past episodes to bias mental states in specific ways: All age groups rated characters' emotions, thoughts, and decisions more positively for PP > NP > PN > NN trials, with the identical pattern occurring for human and animal perpetrators. This awareness that past experiences shape future affective reactions to the same agents, including that people more heavily weight the recent past in mixed-valence pasts (e.g., anticipating a more positive emotional reaction to an identical agent after PN vs. NP), improved during middle childhood and between childhood and adulthood. That is, with increasing age, participants more strongly differentiated people's affective responses to identical perpetrators in line with their prior emotional experiences with those individuals (see also Lagattuta, Tashjian, & Kramer, 2018).

It is important to note, however, that understanding such direct, past-to-future mappings is conceptually far simpler than is awareness of the broader, more indirect ways that emotional experiences can "get under the skin" to bias future responses to a wide variety of situations. For example, to appreciate that David could also feel worried upon seeing a new, unknown red-haired boy—despite zero prior history with this individual—requires recognition that emotion generalization can also take indirect, far-reaching, and often unjustified pathways. Scientists have shown that human emotional reactions are not bound to a specific stimulus, time, or place. Instead, children and adults regularly generalize from their prior emotional experiences to new stimuli that share some perceptual, psychological, or taxonomic similarity (Dunsmoor & Murphy, 2015; Strack & Deutsch, 2004; Wyer, Xu, & Shen, 2012), biasing their later emotions, thoughts, and decisions across a more expansive range of future situations (Barrett & Bliss-Moreau, 2009; Gilbert & Wilson, 2007; Lerner, Li, Valdesolo, & Kassam, 2015; Lindquist, 2013; O'Connor, McCormack, Beck, & Feeney, 2015). This broader emotion generalization can contribute to the formation of stereotyping and prejudice (Stroessner & Sherman, 2015), as well as irrational fears and phobias (Hermans, Baeyens, & Vervliet, 2013). Awareness that shared similarity can elicit emotion generalization drastically magnifies the scope of evidence children consider when trying to identify and understand the causes of their own and others' affective reactions. Without this awareness, individuals cannot take action to try to mitigate its potential harmful effects.

Knowledge that minds generalize from emotional pasts with an initial perpetrator to new, similar agents likely follows a more protracted developmental timetable than does recognition of more direct past-to-future mappings. For example, 3- to 5-year-olds show greater understanding that seeing the same versus a similar-looking cue (e.g., a picture of one's own rabbit vs. another rabbit) can trigger memories and reinstate prior emotions (e.g., sadness about the pet rabbit being lost; Lagattuta, Wellman, & Flavell, 1997). It is not until 5−6 years of age that children exhibit consistent awareness that worry and preventative decisions (e.g., hiding a toy) can be elicited by seeing an agent who looks similar to a perpetrator of prior harm (e.g., looks like the boy who previously stole a prized possession), at least in basic scenarios involving single negative past events (Lagattuta, 2007). More generally, between 4 and 8 years of age there is significant growth in children's ability to use information about people's past behaviors to infer their future actions and psychological traits (Heyman, 2009; Liu, Gelman, & Wellman, 2007; Miller & Aloise-Young, 2018). It is also not until 6−9 years of age that children reliably predict that characteristics of an individual (e.g., traits, abilities) will likely be shared by members of the category or group to which they belong, with adults assuming greater individual-to-group generalization than do children (Goldfarb, Lagattuta, Kramer, Kennedy, & Tashjian, 2017; Rhodes & Gelman, 2008; Riggs, Kalish, & Alibali, 2014; Sloutsky, Deng, Fisher, & Kloos, 2015).

To test 4- to 10-year-olds' and adults' beliefs about whether and how people's prior emotional episodes impact their later affective responses to new agents, we made a critical change to Lagattuta and Sayfan (2013). Instead of reencountering the same human or animal perpetrator from the past (e.g., the same red-haired boy), characters saw a new, unfamiliar agent who only shared similarity to the initial perpetrator (e.g., a new red-haired boy). Participants predicted character's emotions, thoughts, and decisions in response to this highly similar agent, who was marked as "new" and someone the character had "never seen before." We included this trio of affective responses to assess beliefs about whether past emotional experiences with a different perpetrator would bias not only later emotions but also how the character anticipated the future and made decisions. For example, perhaps participants may judge that individuals will experience a reinstatement of past emotions but not expect this new agent to cause any harm. To assess children's and adults' intuitions about whether degree of similarity between present and past impacts emotion generalization—that is, whether they expected boundaries to emotion generalization—participants also judged characters' emotional responses to several additional new agents that varied in similarity to the initial perpetrator (e.g., by size, gender). We included consistent-past (NN, PP) as well as mixed-valence pasts (NP, PN) to capture the complexity of emotional experiences in everyday life. That is, we tested children's and adults' beliefs about generalized downstream affective reactions following multiple types of emotional pasts.

Whereas on the surface this appears to be a minor methodological tweak from Lagattuta and Sayfan (2013)—switching from same to similar agents—it tests much more complex concepts about emotional and mental processes. Thus, we expected this change to expose significant gaps in young children's emotion knowledge that are not filled until middle childhood or beyond. More specifically, we predicted that 4- to 5-year-olds would exhibit no or weak understanding that minds generalize from prior emotional experiences to new agents, with improvements between 4 and 10 years. That is, we reasoned that 4- to 5-year-olds would not treat information about the initial perpetrator as relevant evidence when inferring characters' reactions to someone new. Failed generalization (i.e., discounting the past) would be evidenced by equivalent judgments for characters' affective responses regardless of their prior experiences with the initial perpetrator (NN = PP = NP = PN). Because children and adults anticipate the greatest difference in reactions to same perpetrators for PP versus NN trials (Lagattuta & Sayfan, 2013), we predicted that this would be the first contrast that young children would grasp about this broader, more indirect form of emotion generalization. That is, we hypothesized that children would reach this milestone (i.e., know that characters will feel happier, think more positively, and make more approach decisions toward a new, never seen before agent if that agent looked highly similar to the perpetrator of a PP vs. NN past) by 6−7 years of age.

We considered two possibilities for 8- to 10-year-olds and adults. On the one hand, these older participants may assume complete emotion generalization, matching the pattern documented by Lagattuta and Sayfan (2013) for same agents (i.e., more intensely positive emotions, thoughts, and decisions for PP > NP > PN > NN). On the other hand, these older age groups may intuit near-complete generalization, assuming that past event sequence does not matter for mixed-valence pasts (i.e., more intensely positive judgments for PP > NP, PN > NN). That is, perhaps the heuristic, or cognitive shortcut, to allocate more weight to recent versus initial past events only applies to predicting individual-to-individual mappings (i.e., consistency of an individual's behavior over time), not individual-to-group emotion generalizations (i.e., consistency between an individual's behavior and that of similar-looking associates). Because adults make inductive generalizations more widely than do children across a range of emotional and nonemotional contexts (Riggs et al., 2014; Sloutsky et al., 2015), we expected complete generalization—whether it happens at all—to be apparent in adults. We further hypothesized that 8- to 10-year-olds and adults would still anticipate boundaries to emotion generalization: Differentiation of characters' emotional reactions by past experience as well as intensity of emotion judgments should dampen as new agents become increasingly dissimilar to the initial perpetrator, with children presuming narrower emotion generalization than do adults.

To gain deeper insight into children's and adults' beliefs about emotion generalization to new agents, we incorporated eye tracking into our verbal procedures. Recent studies have indicated that people's knowledge, beliefs, and goals guide their visual search; individuals look most at things that they find meaningful or important (Hayhoe & Ballard, 2005; Henderson & Hayes, 2017; Lagattuta & Kramer, 2017; Lagattuta & Sayfan, 2013; Wolfe & Horowitz, 2017). As we outline later, analyses of eye movements provide a promising technique for learning how children and adults process and prioritize evidence about characters' emotional past histories when reasoning about their reactions to new situations; information that cannot be gleaned from their verbal judgments alone. We acknowledge that combining live experimenter questioning with eye tracking was not without risk. Interviewing decreases participants' attention to the eye-tracking monitor by pulling attention to the experimenter. Indeed, standard eye-tracking paradigms intentionally minimize experimenter interference (i.e., participants look at visual stimuli, press buttons on a keyboard, and/or read instructions on the screen). Such "interference" is necessary, however, for obtaining responses from prereading children who have comparatively weak or absent keyboarding skills.

The impetus for pairing eye tracking with traditional story-based methods came from Lagattuta and Sayfan (2013). Because the current research is the second ever (to our knowledge) attempting this innovation, it was critical to further test the feasibility and value of using this new approach for assessing emotion cognition across a wide age range. More specifically, eye tracking enabled us to determine whether young children even consider characters' emotional histories as relevant evidence when reasoning about their reactions to new agents. If we were to find that 4- to 5-year-olds looked at past emotional events with initial perpetrators, but their verbal judgments evidenced no knowledge about generalization to new, highly similar agents, then we could be more confident that young children intentionally discount those past events as carrying relevance for new contexts. Second, we examined whether the same visual attention biases documented for direct emotion generalization (i.e., children and adults look more at the most recent past in mixed-valence trials; Lagattuta & Sayfan, 2013) operate when individuals reason about the broader, more indirect ways that emotional experiences bias later reactions. Finally, we tested whether the connection between eye gaze and meaning making documented by Lagattuta and Sayfan for same perpetrators (i.e., visual attention biases correlate with verbal judgments; e.g., individuals with greater biased attention to negative past events in PN trials predict greater worry, more negative thoughts, and more avoidant decisions) would replicate in this new generalizing context and participant sample. Thus, we analyzed associations between biases in children's and adults' attention to past emotional events and their predictions for how characters will feel, think, and decide when seeing someone new.

In summary, we designed a multilayered research paradigm to test developmental changes in children's and adults' knowledge about a common yet complex form of emotion understanding: Prior emotional experiences can generalize in indirect, far-reaching ways to bias how individuals react to new agents. We focused on children's and adults' reasoning about two overarching questions: (a) When seeing someone new, does the emotional past matter? and (b) When seeing someone new, how does the emotional past matter? Figures 1 and 2 illustrate these central aims, including the verbal and eye-tracking metrics designed to address each component.

Method

Participants

Four- to 10-year-olds and adults ($N = 264$) were divided into four age groups: 64 four- to 5-year-olds ($M = 5.04$, $SD = .59$; range = 4.02−5.95; 33 female), 64 six- to 7-year-olds ($M = 7.01$, $SD = .50$; range = 6.12−7.96; 34 female), 67 eight- to 10-year-olds ($M = 9.32$, $SD = 1.03$; range = 8.01−11.76; 32 female), and 69 adults ($M = 20.32$ years, $SD = 1.57$; range = 18.10−24.89; 36 female). Targeted sample sizes and age groups were selected to conform to Lagattuta and Sayfan (2013).

The child sample was 76% Caucasian, 5% Asian, and 19% some other race or ethnicity or multiracial. Adult participants were 51% Caucasian, 23% Asian, and 23% some other race or ethnicity or multiracial. Two adults (3%) did not report their race or ethnicity. Most participants (93% of children; 64% of adults) had at least one parent with a college degree. We recruited children from within a 20-mile radius of a university town using advertisements, research flyers, and a database of previous participants (none had participated in prior studies on past-to-future reasoning). We recruited adult participants from a university subject pool. All participants were fluent in English (parent-reported for children; self-reported for adults), were typically developing (no diagnosed cognitive or affective disorders), and did not have any uncorrected visual deficits that would prevent them from seeing the stimuli on the eye-tracking monitor. Two additional children participated in a small portion of the procedures (one 5-year-old girl; one 7-year-old boy) but were excluded from the final sample due to disruptive behavior and failure to respond to questioning. For participating,

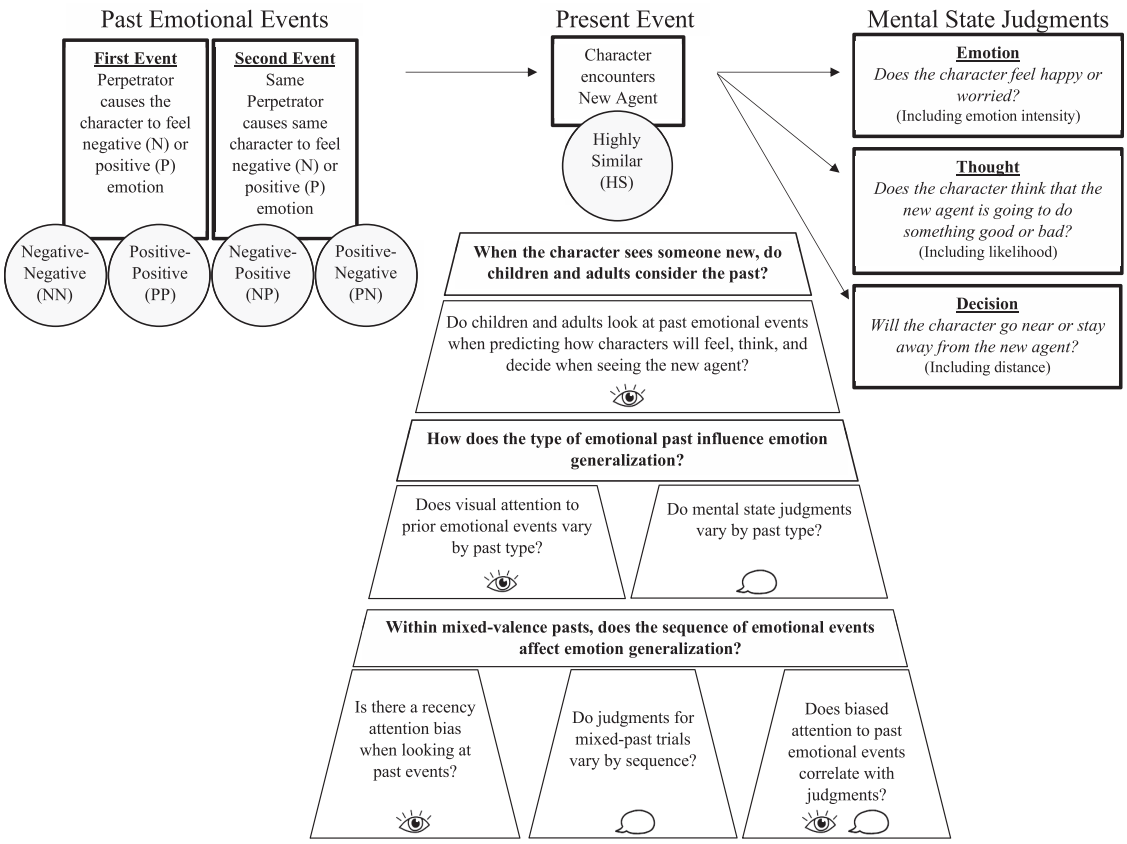

Figure 1. Schematic of research questions and methods for the generalization from the past task. indicates that verbal judgments were analyzed to address that question; indicates that visual attention was analyzed to address that question.

children received a $15.00 gift card and small prizes, and adult participants received course credit. This study was approved by the Institutional Review Board at the University of California, Davis (215273; project title: Children's Reasoning About Future-Oriented Thoughts, Emotions, and Decisions).

Materials and Procedure

Scale training. Before responding to the generalizing from the past (GFP) scenarios, participants received extensive training on the emotion, thought, and decision scales that they would later

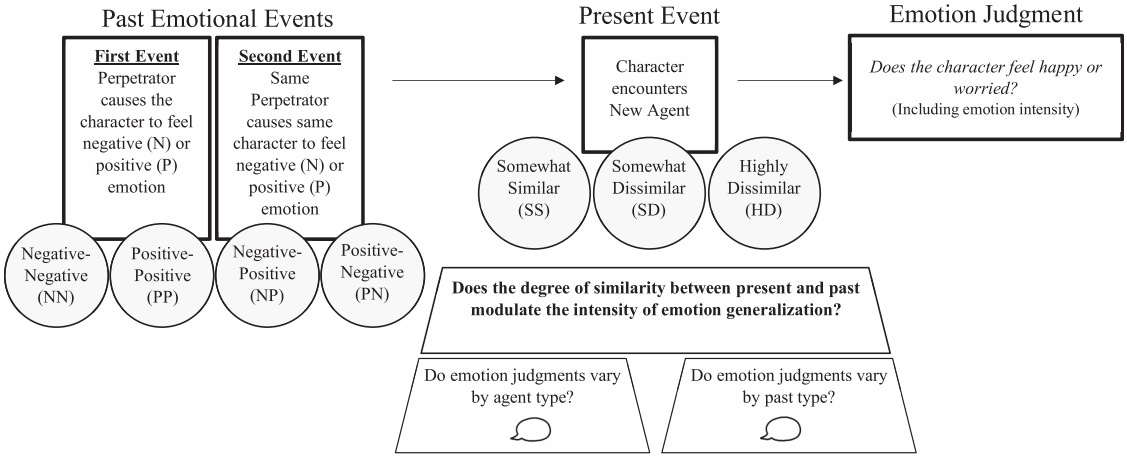

Figure 2. Schematic of research questions and methods for the degree of similarity task. indicates that verbal judgments were analyzed to address this question.

use to make mental state judgments. For details about scale training, see the online supplemental materials (S1 Method section).

Generalizing from the past (GFP). After training on the scales, participants were shown eight narrated movies on a Tobii T-60 Eyetracker (see Figure 1 for GFP aims). Four- to 7-year-olds sat in a high-back booster that limited their head movement, and older children and adults sat in a chair. We calibrated participants' eye movements using the Tobii Studio standard 9-point protocol. Eye movements were recorded at a rate of 60 Hz, with .5-degree accuracy.

During each trial, a distinctively labeled human or animal perpetrator (red-haired boy, short-haired girl, big teenager boy, big teenager girl; orange cat, brown horse, spotted dog, blue parrot) caused a focal character to feel positive emotions (P: happy) or negative emotions (N: sad or scared) on two separate occasions in varying orders (NN, PP, NP, PN; one human and one animal perpetrator for each past type). After each past event, participants were told and shown how the focal character felt. The experimenter verified the participant's comprehension of each event by asking a control question (e.g., "Why does David feel happy?"). All focal characters, initial perpetrators, and past events were the same as those used in Lagattuta and Sayfan (2013). As detailed in that study, pilot testing with a separate sample of children and adults ensured that past events ranged in intensity from medium to very (good or bad) and that all paired negative and positive past events (NP, PN) matched in both intensity and visual interest.

In the final scene, the focal character saw a new agent who looked highly similar to the initial perpetrator. For example, if the initial perpetrator was a red-haired boy, then the new agent was another red-haired boy labeled *a red-haired boy who David has never seen before.* Characters were shown a profile so that no emotion expressions could be discerned. Participants judged each focal character's affective responses using two-step Likert scale questioning, with the initial question probing the direction or valence of the reaction and the second question assessing the intensity of that direction (Albaum, 1997; Marsh, Debus, & Bornholt, 2005). As with Lagattuta and Sayfan (2013), we omitted the neutral option, because the aim was to assess whether children and adults would attribute a negative or a positive affective response (see also Bamford & Lagattuta, 2019; Krosnick & Presser, 2010). More specifically, participants predicted the focal characters' future-oriented emotions (*happy* vs. *worried,* then selected intensity: *little, medium, very*), thoughts (*think something good will happen* vs. *think something bad will happen,* then selected verbal likelihood—*might, probably, definitely*—and a more precise numerical likelihood using a graduated peg scale: 0−10), and *decisions* (*go near* vs. *stay away,* then selected degree of distance: *little, very*) upon seeing this new agent.

Note that although Lagattuta and Sayfan (2013) found that participants provided equivalent response patterns for human and animal perpetrators and when answering verbal or numerical thought likelihood questions, we kept these perpetrator and questioning variants in the current study. We maintained close fidelity with Lagattuta and Sayfan to isolate the key manipulation (i.e., the change to a similar agent in the final scene) and because these features could matter in an indirect emotion generalization context. That is, we reasoned that beliefs about affective reactions to humans versus animals could potentially diverge (e.g., perhaps children and adults expect people's minds to generalize more for animals vs. humans). As well, because indirect emotion generalization may produce a weaker effect than does direct emotion generalization (as tested in Lagattuta & Sayfan, 2013), the numerical likelihood scale may better capture fine-grained differences in thought judgments compared to the verbal likelihood scale.

During questioning, the images of the binary choices (worried/happy, thumbs up/thumbs down, dot together/dots apart) appeared at the bottom of the screen and participants were asked to tell the experimenter as well as look at their answer (results for visual attention to the binary choices on the eye tracker will be presented in a separate article on uncertainty monitoring). These icons also helped focus children's and adults' attention to the specific question they were answering (e.g., whether it was about the character's emotion, thought, or decision). Past-event stimuli stayed at the top of the screen to permit recording of eye movements as well as to remove memory constraints. Participants also explained the characters' emotions and thoughts to provide more time to capture their attention during mental state reasoning.

Figure 3 provides an example of a PN trial, including the timing and questioning. Note that the verbal and pictorial details of each event scenario, including the control question and test questions, were directly taken from Lagattuta and Sayfan (2013), with the only change being the switch to the new, highly similar agent as opposed to the return of the initial perpetrator in the final scene. This is important, because Lagattuta and Sayfan documented that these methods were comprehensible and appropriate for 4- to 10-year-olds and adults, with even 4- to 5-year-olds demonstrating awareness that individuals' past emotional experiences will bias how they feel, think, and make decisions when reencountering the same, initial perpetrator from the past. Thus, any difficulties young children have reasoning about emotion generalization to new, similar agents cannot be exclusively attributed to the testing procedures.

Degree of similarity for generalization (DSG). After the GFP set of questioning for each trial, participants then predicted how focal characters would feel (same scale as GFP: from *very worried* to *very happy*) upon seeing five new agents (see Figure 2 for DSG aims). There were three types of additional agents: *somewhat similar* (SS), for agents who shared a core attribute with the initial perpetrator (gender for humans; species for animals) and were labeled with that shared category name (two human, two animal trials); *somewhat dissimilar* (SD), for agents who shared a physical characteristic with the initial perpetrator (e.g., hair and skin color for humans; fur color for animals) but were not labeled with that common attribute (two human, two animal trials); and *highly dissimilar* (HD), for agents with no similarity to the initial perpetrator (one human, one animal trial; all nonthreatening). Each of the five characters was shown individually in random order. Focal characters and new agents faced each other in profile, and the past event stimuli stayed on the screen. Figure 4 provides examples of these different agent types.

General procedure. Participants were tested individually in a quiet room by a female experimenter. For GFP, the order of the different trial types (NN, PP, NP, PN), test questions (emotion vs. thought question first), and response options (e.g., happy vs. worried labeled first) were counterbalanced. The decision question always came last so that participants reasoned about how focal characters would feel prior to making an approach or avoidance

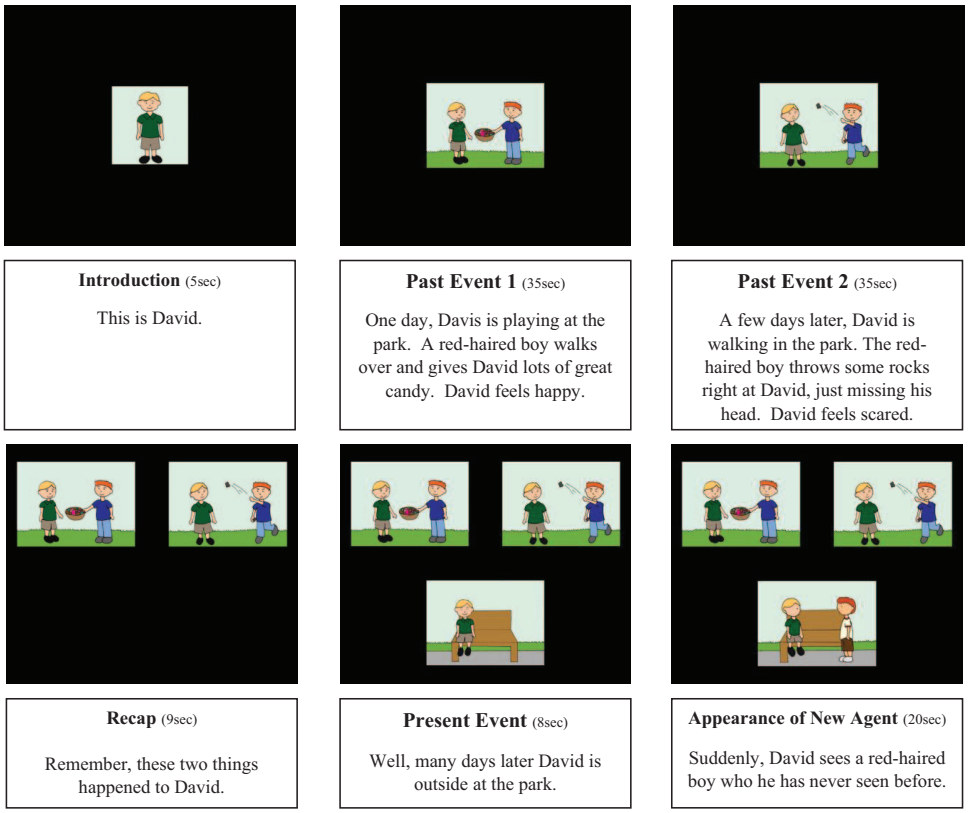

Figure 3. Example of a positive−negative (PN) trial. Participants answered control questions after Past Event 1 and Past Event 2 (Why is David feeling X right now?). Script: "Now I am going to ask you some questions about David and this **NEW** red-haired boy. All of the pictures showing what happened to David before will stay on the screen. You'll see these kinds of answer choices in the white rectangle at the bottom of the screen [show poster of response options and remind participant again: happy/worried, good/bad, near/far]. I want you to look at the answer you think is best and tell me. Ready to start?" *Thought:* "Does David think that the **NEW** red-haired boy is going to do something bad or good? Does David think the **NEW** red-haired boy *might do* something [bad/good], *probably will* do something [bad/good], or *definitely will* do something [bad/good]? So, David thinks the **NEW** red-haired boy [might/probably/definitely will] do something [bad/good]. Now, point to the peg that shows how likely David thinks this will happen (graduated peg scale was on table in front of participant). Why does David think the **NEW** red-haired boy [might/probably/definitely will] do something [bad/good]?" *Emotion:* "How do you think David feels right now? Does he feel worried or happy? Can you show me how David feels right now (pictorial emotion scale was on table in front of participant)? Why does he feel X?" *Decision:* "What do you think David will do next? Do you think he will go near the **NEW** red-haired boy or stay away from the **NEW** red-haired boy? How [near/far] do you think he'll go toward the **NEW** red-haired boy? A little [near/far], or very [near/far]?". See the online article for the color version of this figure.

decision. For the DSG questioning, the presentation of agents was randomized. Although this experiment was part of a larger study on social cognition and future thinking, no other measures during the session tested emotion cognition or inductive generalization. Scale training, GFP, and DSG took about 45−60 min to complete, and children were given short breaks if necessary.

Areas of interest. We created three areas of interest (AOIs) over each of the past events (initial and recent, each 2.88 in. × 4.11 in.) as well as over the current scene (appearance of the new agent, 2.88 in. × 4.11 in.) during the time period when participants predicted and explained focal characters' emotions, thoughts, and decisions. Fixation criteria were as follows: Minimum fixation duration was 60 ms, velocity threshold was 30 deg/s, maximum angle between fixations was .5 degrees, and maximum time between fixations was 75 ms.

Coding and scoring.

Mental state judgments. Following scoring procedures by Lagattuta and Sayfan (2013), we combined the two-step binary and intensity ratings into scaled scores for emotions (−3 = *very worried,* −2 = *medium worried,* −1 = *little worried,* 1= *little happy,* 2 = *medium happy,* 3 = *very happy*), thoughts (verbal likelihood: −3 = *something bad definitely will happen,* −2 = *something bad probably will happen,* −1 = *something bad will might happen,* 1 = *something good might happen,* 2 = *something good probably will happen,* 3 = *something good definitely will happen;* numerical likelihood: −10 to 10), and decisions (−2 =

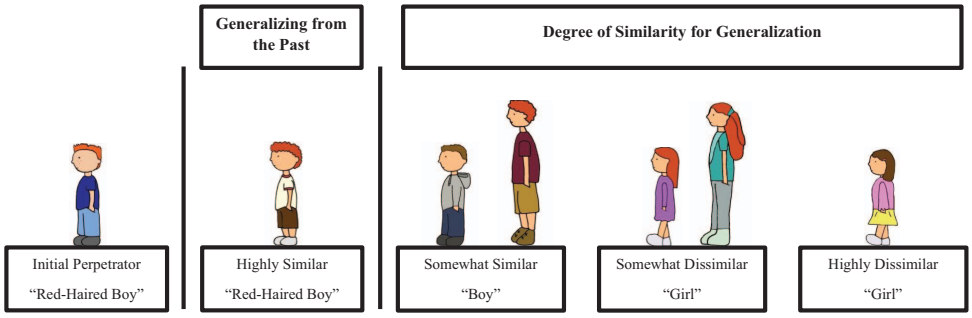

Figure 4. Stimuli example of the degree of similarity for generalization (DSG) task. Here we show pictures of agents included in the red-haired boy trial: The initial perpetrator and highly similar, somewhat similar, somewhat dissimilar, and highly dissimilar associates. Script: "OK, now let's imagine that David sees some different people instead. I am going to show you pictures of five other people. I want you to point to the face that shows how you think David will feel when he sees each one (point to laminated emotion scale). The **NEW** person will appear in the white rectangle at the bottom of the screen (point to general direction). The pictures showing what happened to David before will stay on the top of the screen (point to general direction). Ready to start? (In a random order; questioned about somewhat similar, somewhat dissimilar, and highly dissimilar agents only for DSG): How do you think David will feel when he sees this X (where X = label in quotation marks below each picture; participants pointed to pictorial emotion scale that was on table)." Each character was shown one at a time. If viewing this figure in the print version of the article, note that all people share the identical hair and skin color except for the somewhat similar boy in the sweatshirt and the highly dissimilar girl. See the online article for the color version of this figure.

stay very far away, −1 = *stay a little far away,* 1 = *go a little near,* 2 = *go very near*). All scaled scores included the zero placeholder for *the positive and negative affective response is equally likely.* This ensures a balanced Likert scale where the between-categories scale distance (e.g., from *little happy* to *little worried*) is correctly larger than the within-category scale distance (e.g., from *little happy* to *medium happy*). This zero placeholder also enhances interpretability: Means do not differ from zero if an age group is noncommittal as to whether the character would experience a negative or positive reaction (see also Bamford & Lagattuta, 2019, for use of the zero placeholder in a future expectations task).

Visual attention scores.

Past attention. To assess participants' attention to past events while reasoning about future-oriented mental states, we calculated a past attention score ([Duration Looking to Both Past Events]/[Duration Looking to Both Past Events + Duration Looking to the Current Scene]) for each trial type (NN, PP, NP, PN). First, we calculated six separate proportions (i.e., one each for thought, emotion, and decision judgment for human and animal perpetrators). Trials in which participants failed to look at any AOI were considered missing. We averaged across the six scores to create a single past attention score for each trial type (NN, PP, NP, PN). Scores greater than .50 indicate more attention to past events, scores less than .50 reflect more attention to the current event, and scores no different from .50 show balanced looking to the past and present.

Recency attention bias. To assess whether participants prioritized the recent past when reasoning about future-oriented emotions, thoughts, and decisions, we calculated a recency attention bias score ([Duration Looking to Recent Past Event – Duration Looking to Initial Past Event]/[Duration Looking to Both Past Events]) for each trial type (NN, PP, NP, PN). We initially calculated six separate attention biases (i.e., one each for thought, emotion, and decision judgment for human and animal perpetrators). Trials in which a participant did not look at either past event (initial or recent) were considered missing. We then averaged across the six scores to create a single recency attention bias score for each trial type (NN, PP, NP, PN). Positive scores indicate biased attention to the recent past event, negative scores reflect biased attention to the initial past event, and scores no different from zero show balanced looking at both past events.

Results

Results are divided into four sections. First, we examined the effects of age and past (NN, PP, NP, PN) on children's and adults' judgments about how a focal character would feel, think, and make decisions upon seeing a new agent who was highly similar to the initial perpetrator (GFP). Second, we analyzed how participants predicted focal characters would feel seeing agents who looked somewhat similar (SS), somewhat dissimilar (SD), and highly dissimilar (HD) from the initial perpetrator (DSG). Third, we assessed participants' visual attention to past events as well as their differential attention to recent versus initial past events. Last, we tested relations between participants' visual attention and their intuitions about characters' emotions, thoughts, and decisions. Initial, preliminary analyses tested for effects of perpetrator type (human vs. animal) and participant gender. Consistent with Lagattuta and Sayfan (2013), neither factor moderated GFP judgments (see the S2 Results section, Table S1, in the online supplemental materials), so we averaged across the levels of these two factors for primary analyses. Further consistent with Lagattuta and Sayfan, analyses of verbal likelihood and numerical likelihood thought judgments yielded equivalent patterns (see Table S2 in the online supplemental materials). Thus, we focused on verbal likelihood

thought judgments for primary analyses. Analyses were conducted in RStudio Version 1.0.143 (R Core Team, 2017; RStudio Team, 2015).

Generalizing From the Past to Highly Similar Agents (GFP)

For each judgment type (emotion, thought, decision) we conducted a 4 (age: 4- to 5-year-olds, 6- to 7-year-olds, 8- to 10-year-olds, adults) × 4 (past: NN, PP, NP, PN) repeated-measures analysis of variance (ANOVA) on participants' average scores. Each of these analyses resulted in main effects for age and past, qualified by an Age × Past interaction (Fs > 6.35, ps < .001, η_p^2s > .07; see Figure 5).[1]

As expected, adults exhibited a consistent expectation that minds generalize from past emotional experiences to new agents: They predicted that focal characters would experience more intensely positive emotions, anticipate a higher likelihood of positive future outcomes, and make closer approach decisions after PP > NP > PN > NN pasts (ps < .001, ds > .51). Eight- to 10-year-olds followed the same pattern (ps < .031, ds > .26), but they equated NP and PN trials when reasoning about thoughts and emotions (ps > .402, ds < .10), and they provided comparable decision judgments for NN and PN trials (p = .091, d = .21). Six- to 7-year-olds anticipated more positive emotions, thoughts, and decisions when the recent past was positive (PP, NP) versus when the initial perpetrator caused negative emotions twice (NN; ps < .044, d > .25). This age group also judged that characters would anticipate a positive future as more likely after PP than PN trials (p = .031, d = .27). Further consistent with our hypotheses, 4- to 5-year-olds exhibited no awareness of generalizing minds in their verbal judgments: All predictions were equally positive regardless of the past (ps > .056, ds < .24).

Degree of Similarity for Generalization (DSG)

We analyzed whether participants expected emotion generalization to depend on the degree of similarity between the new agent and the initial perpetrator. As with GFP analyses, we collapsed across human and animal perpetrators (see Table S4 in the online supplemental materials, which includes emotion ratings by age, perpetrator, and past). A 4 (age) × 3 (similarity: somewhat similar, somewhat dissimilar, highly dissimilar) × 4 (past) repeated-measures ANOVA on emotion ratings revealed main effects for similarity and past, qualified by Age × Similarity, Age × Past, Similarity × Past, and Age × Similarity × Past interactions (Fs > 5.40, ps < .001, η_p^2s > .06). To examine the three-way interaction, we ran separate 3 (similarity) × 4 (past) ANOVAs for each age group (see Figure 6).[2] Here, we were testing for the key Similarity × Past interaction because it reveals whether an age group expected past experiences with initial perpetrators to bias emotional responses to some agents more than to others. This Similarity × Past interaction was significant for only the 8- to 10-year-olds and adults (Fs > 7.42, ps < .001, η_p^2s > .10)[3]; it was null for the 4- to 7-year-olds (Fs < 2.00, ps > .065, η_p^2s < .03).[4]

Consistent with our hypothesis that children would expect narrower emotion generalization than would adults, 4- to 7-year-olds discounted the past when new agents were somewhat similar, somewhat dissimilar, or highly dissimilar from the initial perpetrators. Although 8- to 10-year-olds anticipated that past experiences with the initial perpetrator would influence emotional reactions to somewhat similar agents (PP > NP, PN > NN, ps < .017, ds > .29), they did not differentiate emotion ratings by past type for somewhat dissimilar or highly dissimilar agents (PP = NP = PN = NN, ps > .111, ds < .20). In contrast, adults expected past emotional experiences to have a broad, far-reaching future impact on responses to new agents: They anticipated the past to bias how characters would feel seeing somewhat similar (PP > NP > PN > NN; ps < .001, ds > .60) as well as somewhat dissimilar (PP, NP > PN, NN; ps < .001, ds > .45) agents, only drawing the boundary to emotion generalization at highly dissimilar agents (NN = NP = PN; NN = PP; ps > .085, ds < .21).

Within past types, adults also expected the intensity of reactions to dampen as the similarity between the new agent and the initial perpetrator weakened. That is, for trials in which the initial perpetrator had caused negative emotions (NN, NP, PN), adults attributed increasingly positive emotions the more the new agents differed from that initial harmdoer (somewhat similar < somewhat dissimilar < highly dissimilar; ps < .027, ds > .27). Likewise, for PP trials, adults attributed more intensely positive emotions the more the new agents shared similarity to the initial perpetrator (somewhat similar > somewhat dissimilar, highly dissimilar; ps < .001, ds > .58). Eight- to 10-year-olds showed some initial insight by expecting characters to feel most intensely positive seeing agents who were highly dissimilar from initial perpetrators of harm (NN, NP, PN: highly dissimilar > somewhat dissimilar, somewhat similar; ps < .003, ds > .37).

Visual Attention

We next examined how participants attended to past emotional events when reasoning about how characters would feel, think, and decide when seeing a highly similar agent (GFP).

Attention to emotional past. First, we analyzed the duration that participants looked at characters' past emotional experiences while predicting how those individuals would react to new, highly similar agents (see the Method section for calculating the past attention score). A 4 (age) × 4 (past) repeated-measures ANOVA on past attention scores revealed main effects for age and past (Fs > 5.22, ps < .001, η_p^2s > .02; see Table 1). Although all age groups attended more to the present than to the past when reasoning about how characters would feel, think, and decide ($|t|$s > 5.98, ps < .001, ds > .75), they were especially vigilant to the past when initial perpetrators had repeatedly caused negative emotions

[1] For precise means and standard deviations see online supplemental materials: In particular, see Table S2 (emotion intensity, thought verbal likelihood, thought numerical likelihood, decision distance) and Table S3 (binary responses: feel worried versus happy, think good versus bad, go near versus stay away) for ratings by judgment, age, and past.

[2] For precise means and standard deviations by age group, similarity, and past see online supplemental materials: In particular, see Table S4 for emotion intensity ratings by age, similarity, perpetrator, and past and Table S5 for emotion intensity ratings by age, similarity, and past.

[3] These analyses also resulted in main effects for similarity and past (Fs > 6.40, ps < .001, η_p^2s > .09).

[4] Both main effects were also null for the 4- to 5-year-old analysis (Fs < 2.70, ps > .071, η_p^2s < .04). The 6- to 7-year-old analysis resulted in a main effect for similarity, $F(2, 126) = 22.67$, $p < .001$, $\eta_p^2 = .26$; the effect for past was not significant, $F(3, 189) = 2.33$, $p = .076$, $\eta_p^2 = .04$.

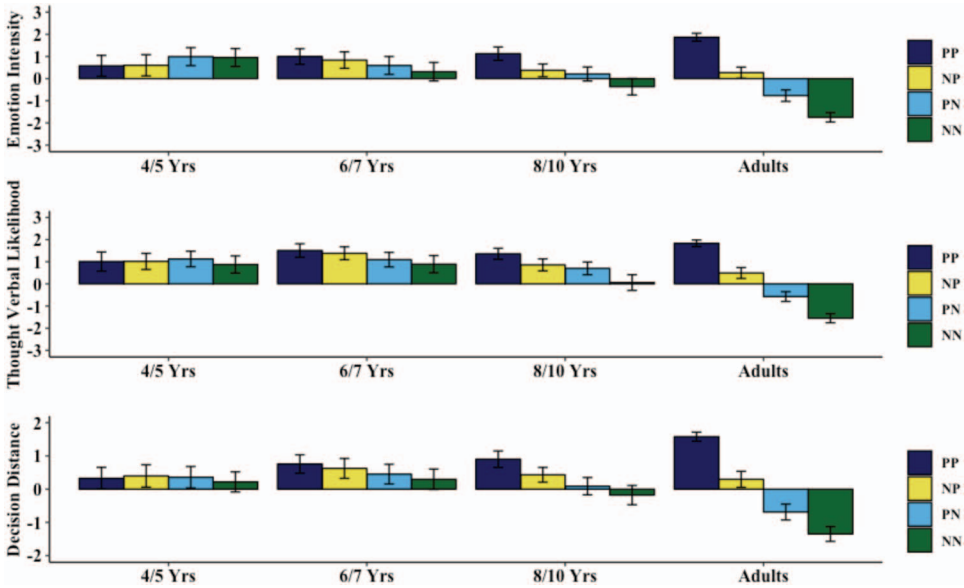

Figure 5. Generalizing from the past: Age × Past interaction for each of the judgments (emotion, thought, decision). PP = two positive events; NP = a negative followed by a positive event; PN = a positive followed by a negative event; NN = two negative events. Error bars are 95% confidence intervals. Yrs = years. See the online article for the color version of this figure.

(NN > PN, NP, PP; *p*s < .032, Tukey's honestly significant difference [HSD], *d*s > .17). Four- to 5-year-olds and 8- to 10-year-olds looked longer at past emotional events than did adults during questioning (*p*s < .006, Tukey's HSD, *d*s > .57).

Attention to recent emotional past. We inspected children's and adults' visual attention within the different past event sequences. Of interest was whether children and adults prioritized the initial (Past Event 1) or most recent (Past Event 2) emotional past when reasoning about characters' emotions, thoughts, and decisions (see the Method section for calculating the recency attention bias scores). As described previously, this was the pattern documented by Lagattuta and Sayfan (2013) when children and

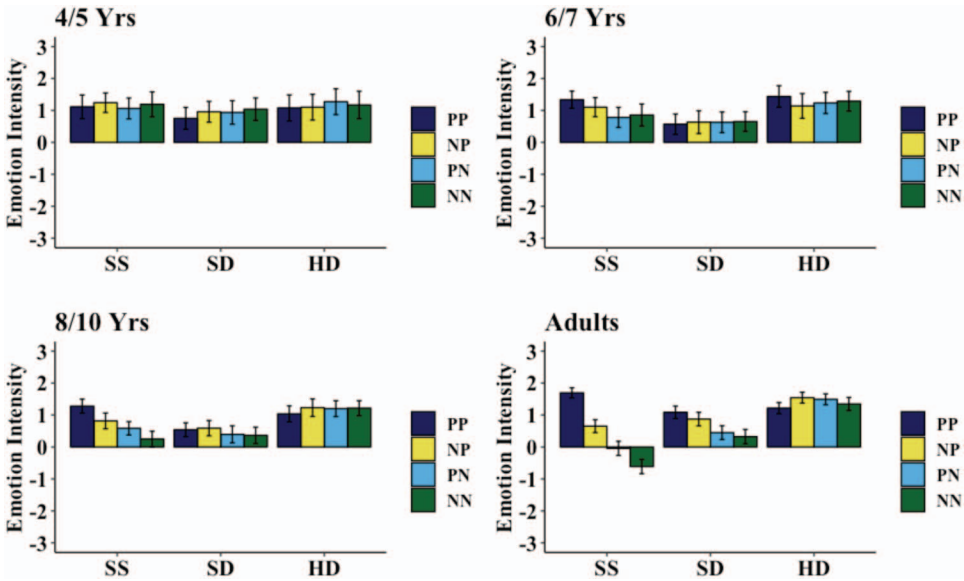

Figure 6. Degree of similarity for generalization: Age × Similarity × Past interaction. Error bars are 95% confidence intervals. PP = two positive events; NP = a negative followed by a positive event; PN = a positive followed by a negative event; NN = two negative events; SS = somewhat similar to the initial perpetrator; SD = somewhat dissimilar from the initial perpetrator; HD = highly dissimilar from the initial perpetrator; Yrs = years. See the online article for the color version of this figure.

Table 1
Past Visual Attention Score by Age and Past

Variable	4–5 years (n = 64)	6–7 years (n = 64)	8–10 years (n = 67)	Adults (n = 69)	All age groups (N = 264)
PP	.29 (.11)***	.28 (.14)***	.31 (.15)***	.27 (.19)***	.29 (.15)***
NP	.30 (.13)***	.30 (.14)***	.34 (.17)***	.24 (.16)***	.30 (.16)***
PN	.32 (.15)***	.29 (.14)***	.32 (.16)***	.26 (.14)***	.30 (.15)***
NN	.36 (.18)***	.32 (.16)***	.35 (.13)***	.28 (.13)***	.33 (.15)***
All past types	.32 (.10)***	.30 (.10)***	.33 (.10)***	.26 (.10)***	.30 (.10)***

Note. Past visual attention score = (Duration Looking to Both Past Events)/(Duration Looking to Both Past Events + Duration Looking to the Current Scene). Past attention score is calculated from participants' attention during the generalizing from the past task. Scores over .50 indicate more attention to past events than to the present event; scores below .50 reflect more attention to the present event than to past events; scores no different from .50 demonstrate balanced looking. Standard deviations appear in parentheses. NN = two negative events; PP = two positive events; NP = a negative followed by a positive event; PN = a positive followed by a negative event.
*** $p < .001$ compared to chance (.50).

adults reasoned about characters' affective responses to the return of initial perpetrators. A 4 (age) × 4 (past) repeated-measures ANOVA on recency attention bias scores resulted in main effects for age and past, qualified by an Age × Past interaction (Fs > 2.46, ps < .009, η_p^2s > .02; see Figure 7).[5] (Two participants were excluded because on one or more trials they never looked at either past event.) Adults had a stronger recency bias for PN trials than did children (ps < .001, ds > .72), adults exhibited more biased looking to the recent past during PN trials versus all other trial types (ps < .001, ds > .51), and adults prioritized recency during PN trials more than expected by chance (0 = *balanced looking*), $t(68) = 5.92$, $p < .001$, $d = .71$. In contrast, adults did not allocate more weight to recent versus initial past events in NP, PP, or NN trials (ts < 1.31, ps > .194, ds < .16). Children exhibited balanced looking at both past events within a sequence regardless of past (ts < 1.84, ps > .071, ds < .22), except for 4- to 5-year-olds, who looked longer at initial negative events in NP trials, $t(63) = -2.05$, $p = .045$, $d = .26$.

Visual Attention and Emotion Generalization From a Mixed-Valence Past

Finally, we examined connections between biases in how children and adults looked at past emotional events and their reasoning about whether and how characters would generalize their emotional history to new, highly similar agents. All reported correlations control for age (continuous). As predicted, participants' visual attention reflected the meaning they drew from the past when reasoning about emotion generalization. Children and adults with a stronger bias to attend to the recent negative event in PN trials predicted that characters would feel more intensely worried (intensity: $r = -.21$, $p < .001$; binary: $r = -.25$, $p < .001$), anticipate a more negative future (verbal likelihood: $r = -.20$, $p = .001$; binary: $r = -.24$, $p < .001$), and make more avoidant decisions (distance: $r = -.14$, $p = .026$; binary: $r = -.12$, $p = .048$) when encountering highly similar agents. As well, participants (one adult was excluded for failure to look; $n = 263$) with stronger bias to focus on the recent positive event during NP trials judged that characters would feel happier (intensity: $r = .27$, $p < .001$; binary: $r = .31$, $p < .001$), anticipate a more positive future (verbal likelihood: $r = .27$, $p < .001$; binary: $r = .33$, $p < .001$), and approach closer (distance: $r = .23$, $p < .001$; binary: $r = .24$, $p < .001$) to highly similar agents.

The tendency to expect recent emotional events to matter most for later affective responses positively correlated with age ($r = .30$, $p < .001$) and individuals who prioritized recent (vs. initial) emotional past events did so for both NP and PN trials ($r = .16$, $p = .009$). The degree of this recency bias also predicted more complete emotion generalization to new agents. Participants with a stronger recency attention bias predicted a larger difference between NP and PN trials for how characters would feel (intensity: $r = .23$, $p < .001$; binary: $r = .27$, $p < .001$), think (verbal likelihood: $r = .19$, $p = .002$; binary: $r = .25$, $p < .001$), and decide (distance: $r = .15$, $p = .012$; binary: $r = .18$, $p = .003$) when encountering someone new.[6]

Discussion

To help foster innovations for investigating advanced emotion cognition across a wide age range, we created a hybrid verbal reasoning and eye-tracking paradigm to examine 4- to 10-year-olds' and adults' awareness that prior emotional experiences can transcend specific agents, time, and location: People's minds generalize from prior emotional histories to bias how they later feel, think, and make decisions in new situations. Although all age groups visually attended to characters' past emotional experiences with initial perpetrators when evaluating their affective responses to new, highly similar agents, 4- to 5-year-olds treated that prior history as irrelevant evidence and expected characters to respond positively to new agents. In contrast, adults predicted that emotion

[5] For precise means and standard deviations by age group and past see online supplemental material (Table S6).

[6] We ran correlations separately for adults and children. For adults, the recency attention bias correlated with all three mental state judgments for NP and PN trials ($|r|$s > .25, ps < .037; scaled and binary), as well as differentiation between NP and PN trials for emotions, thoughts, and decisions (rs > .27, ps < .028; scaled and binary). For children, the recency attention bias was related to NP and PN emotions and thoughts ($|r|$s > .15, ps < .041; scaled and binary) but not decisions ($|r|$s < .11, ps > .141), and it correlated with differentiation between NP and PN for scaled and binary emotions and for binary thoughts (rs = .18, ps < .013). P = positive events; N = negative events.

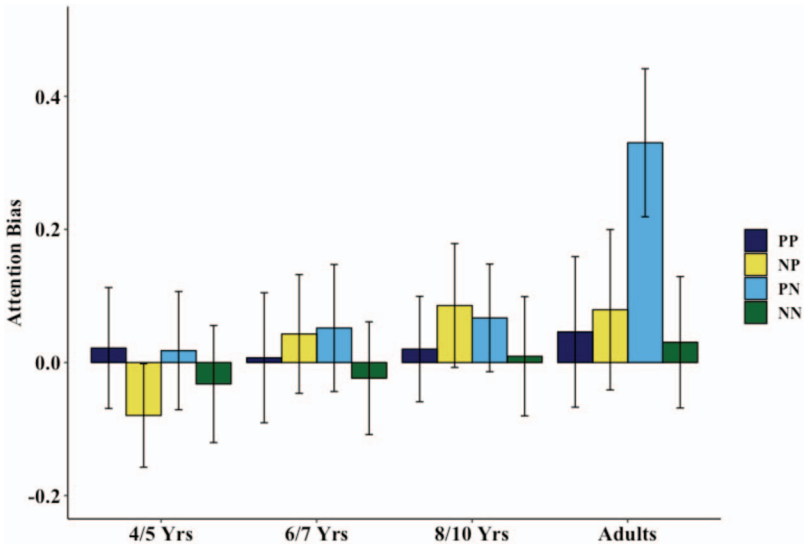

Figure 7. Generalization from the past: Age × Past interaction for recency attention bias. Recency Attention Bias = ([Duration Looking to Recent Past Event – Duration Looking to Initial Past Event]/[Duration Looking to Both Past Events]). Positive scores indicate more attention to recent than to the initial past events, negative scores illustrate more attention to initial than to recent past events, and scores no different from zero demonstrate balanced looking. Error bars are 95% confidence intervals. PP = two positive events; NP = a negative followed by a positive event; PN = a positive followed by a negative event; NN = two negative events; Yrs = years. See the online article for the color version of this figure.

generalization would be far-reaching, biasing characters' affective reactions to somewhat similar and even to somewhat dissimilar agents, with emotion intensity calibrated by degree of similarity. Six- to 10-year-olds revealed a transitional awareness, expecting more restricted emotion generalization than did adults, with responses of 8- to 10-year-olds more closely approximating adult intuitions. Eye-tracking analyses supported these developmental patterns and showed significant relations between how individuals prioritized past emotional episodes and their judgments about emotion generalization to new agents. In the next sections, we elaborate on these results and bridge them to broader research in emotion and cognition.

Age-Related Changes in Beliefs That Minds Generalize From Past Emotional Episodes

Saarni (1999) outlined multiple skills of emotional competence, including decoding and labeling emotions, communicating emotions to others, and regulating emotions, as well as understanding the causes and consequences of emotions. Over the next two decades, researchers made substantial progress in delineating age-related changes and sources of individual differences in these core abilities (Camras & Shuster, 2013; Harris, de Rosnay, & Pons, 2016). This has included growing evidence of close developmental synergies between children's understanding of mind and emotion: Mental states (e.g., desires, beliefs) can give rise to emotions and emotions influence mental states (Flavell, Green, Flavell, Harris, & Astington, 1995; Harris, de Rosnay, & Ronfard, 2014; Lagattuta, 2014; Lagattuta et al., 2015; Lara et al., 2019; Rieffe, Terwogt, & Cowan, 2005; Sayfan & Lagattuta, 2009; Wu & Schulz, 2018).

Most relevant to the current research, Lagattuta and Sayfan (2013) reported that 4- to 5-year-olds can integrate past events when judging characters' future affective responses to same perpetrators (i.e., predicting more positive affective responses for PP > NP > PN > NN pasts). The present findings show that this early knowledge about past-to-future connections is extremely tenuous, however, when tested in a broader generalizing context. One change—focal characters see a highly similar agent who they "have never seen before" versus reencounter the initial perpetrator—revealed striking differences between young children's and adults' intuitions. Indeed, 4- to 5-year-olds evidenced no awareness that people generalize from past emotional events to similar individuals. By 6−7 years, children predicted that people would respond more negatively to highly similar agents after NN than PP pasts, but they did not expect prior events to impact responses to agents less similar to the initial perpetrator. Eight- to 10-year-olds widened the generalizing scope to anticipate more positive reactions for PP > NP, PN > NN for highly similar and somewhat similar agents but expected no biased responses to dissimilar agents. Only adults recognized the potential for expansive emotion generalization: They differentiated by past event valence and sequence for highly similar and somewhat similar agents (PP > NP > PN > NN) and by recency for somewhat dissimilar agents (PP, NP > PN, NN). Still, adults showed restraint by calibrating emotion intensity by degree of similarity to the initial perpetrator and assuming no impact on reactions to highly dissimilar others.

What makes these developmental patterns particularly fascinating is that it cannot be that 4- to 7-year-olds are simply unable to draw from people's past experiences to predict their future affective responses. To reiterate, we know from Lagattuta and Sayfan

(2013), using identical past event sequences, that even 4- to 5-year-olds recognize that past events bias how a person feels, thinks, and decides when reencountering the same individual, with growth in this understanding between 4 and 10 (see also Rholes & Ruble, 1986). In the current study, young children's rejection of the past event evidence as insufficient may have been bolstered by a belief that memories and resulting biases can be triggered only by rewitnessing an exact part of the past (a "copy concept" of memory; Lagattuta et al., 1997, p. 1098). With such an intuitive theory, it is straightforward for young children to predict that people would feel happy seeing someone new.

The present findings further show that 8- to 10-year-olds and adults did not view emotion generalization as simply an associative process in which the new, similar agent reactivates the previous emotion. If so, then they would have judged that people's current emotions are influenced by the past, but they still have unbiased thoughts and decisions (e.g., David will feel worried seeing a new red-haired boy after an NN past due to an associative trigger but still think this new one will do no harm and choose to approach). No age group did this. Even more telling, adults calibrated emotions to new agents by past and similarity, with some insights by 8- to 10-year-olds. Take for example, NN trials. Adults judged characters to feel medium worried when the new agent was highly similar to the initial perpetrator ($M = -1.75$), a little worried when somewhat similar ($M = -.61$), neutral when somewhat dissimilar ($M = .33$), and a little happy when highly dissimilar ($M = 1.35$). Comparing these responses to the very intense worry a different sample of adults attributed to characters when the same perpetrator returned ($M = -2.62$; Lagattuta & Sayfan, 2013) further verifies that adults expect current emotions to be biased, but not associatively replicated from the past, in these broader generalizing contexts.

Potential Developmental Mechanisms

Although children exhibit much earlier knowledge of direct (i.e., individual-to-individual; Lagattuta & Sayfan, 2013) than indirect, broader forms of emotion generalization (i.e., individual-to-similar others; current study), the potential for the latter type is considerably greater in everyday life. For example, one is more likely to see *a* red-haired boy than *the* red-haired boy who caused past harm, or *a* spotted dog versus *the* spotted dog that behaved positively. Nevertheless, appreciation that past-learned biases can spread to new, similar contexts likely requires a higher level of metacognition because the root cause of the bias is more distant, indirect, and hidden. Related research has indicated that between the ages of 3 and 10, children develop stronger awareness that thoughts and emotions can be uncontrollable (Davis, Levine, Lench, & Quas, 2010; Flavell & Green, 1999), and they exhibit greater ability to introspect on the source and content of their thoughts (Flavell et al., 1995). Such improvements could help children track experiences of their own minds generalizing from emotional pasts to new situations in these often unwanted, unfair, and overextended ways, as well as better appreciate the prospect of this happening to others.

This task not only measures advanced emotion understanding. Children and adults likely recruit several related cognitive skills to engage in reasoning about emotion generalization to new situations. It is important to note that there is significant improvement between 3 and 10 years of age and between age 10 and adulthood in children's ability to infer people's traits and future behaviors from their past actions, with younger children typically needing more pieces of evidence than do older age groups to make inferences about individuals (Boseovski & Lee, 2006; Heyman, 2009; Liu et al., 2007; Rholes & Ruble, 1986; Sloutsky et al., 2015), including their membership in a specific category or group (Goldfarb et al., 2017). During this age period, children also develop stronger skills in simulating future events (Atance & Mahy, 2016; Coughlin, Robins, & Ghetti, 2019). More frequent experiences of richer episodic prospection may expedite children's recognition of both direct and indirect connections between past and present, including how the mind regularly draws from the past to imagine what will happen next (Szpunar, Spreng, & Schacter, 2014). Age-related expansions of semantic association networks (Brainerd, 2013; Huang & Snedeker, 2011) may also contribute to increases in the frequency and recognition of instances of generalization. Improvements in executive control from 3 to 10 years and from childhood to adulthood also correlate with advances in psychological understanding (Devine & Hughes, 2014; Lagattuta, Sayfan, & Harvey, 2014; Lagattuta et al., 2018).

Aside from cognitive growth, social and motivational changes may contribute to these developmental patterns. Three- to 7-year-olds exhibit a stronger positivity bias than do older children and adults when evaluating people's characteristics and anticipating the future (Bamford & Lagattuta, 2019; Boseovski, 2010). Such positivity has to be overridden to appreciate fully that a negative emotional past could generalize to similar contexts. Indeed, part of the failure of younger children to generalize may stem from their reluctance to attribute negative internal states to characters who meet someone new. Even by the ages of 6–7, when children started to expect generalization from NN pasts, average mental state ratings dropped in positivity but did not cross into the negative range. As an extension of socioemotional selectivity theory (Carstensen, Isaacowitz, & Charles, 1999), Lagattuta et al. (2018) suggested that young children's more positive outlook may be adaptive during early childhood—a time of broadening and building social networks and trying new things. Having positive affective reactions (despite their similarity to a certain type or group that caused previous harm) may aid in this process. On the negative side, this positivity bias could also lead to risky behaviors, because generalizing from the past can serve protective functions (Dunsmoor & Murphy, 2015).

Visual Attention as a Window Into Meaning, Biases, and Individual Variability

The inclusion of eye tracking enabled investigation of developmental changes in beliefs about emotion generalization that could not be garnered from verbal judgments alone. All age groups looked to characters' emotional past histories when reasoning about how they would feel, think, and make decisions when seeing highly similar agents, being especially attuned to NN sequences (NN > PP, NP, PN in looking time). These data suggest across-age awareness that prior emotional episodes could be relevant for the future and perhaps even nascent attentiveness to indirect forms of emotional generalization in 4- to 5-year-olds. The prioritization of NN pasts further confirm the salience of negative emotional stimuli (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Lagattuta

& Kramer, 2017; Vaish, Grossmann, & Woodward, 2008), in this case, when viewing complex sequences depicting multiple emotional events.

We also examined whether children and adults looked more at certain episodes within past-event sequences when predicting characters' reactions to new agents, an indication that they allocated greater meaning. We found that the across-age recency bias for PN pasts when reasoning about same agents (Lagattuta & Sayfan, 2013) remained strong, but just for adults, when current agents shared a only highly similar appearance to initial perpetrators. For same agents, children and adults may prioritize recency because it signals whether a specific individual has turned good or turned bad, useful information for forecasting what that agent will do next (Cone & Ferguson, 2015; Ferguson, Mann, Cone, & Shen, 2019). In contrast, adults' recency emphasis for similar agents may reflect recognition that minds are most biased by events occurring closest in time (Gilbert & Wilson, 2007). That adults' recency attention bias for PN trials holds when reasoning about broader, indirect generalization further underscores the greater cognitive stickiness of negative information for decision-making, especially when following positive information (Cone & Ferguson, 2015; Ledgerwood & Boydstun, 2014).

Eye-tracking analyses not only highlighted what kinds of information children and adults considered and weighted but also showed that attention biases correlated with judgments about emotion generalization. Controlling for age, participants who looked most at negative events in PN pasts predicted that characters would feel more negative, anticipate a higher likelihood of a negative future, and stay farther away from highly similar agents. A recency bias for NP trials correlated with more positive emotion, thought, and decision judgments. Moreover, the stronger the recency bias, the larger distinctions participants made between PN and NP pasts in their future-oriented mental state judgments. These connections between attention and verbal reasoning—the first replication of Lagattuta and Sayfan (2013), who initiated this approach—is potentially transformative for emotion researchers and for psychological science more broadly. Evidence that one can determine the actual, semantic meaning individuals have extracted from a scene based on their attention biases opens up numerous possibilities for further empirical study and potential intervention (e.g., manipulate attention to alter how a person thinks or believes).

Limitations and Future Directions

An alternative account could be that adults expected characters to generalize from their emotional pasts because they knew what we were testing. The very inclusion of past-event information may have set up a demand effect (if the past is irrelevant, why was it provided?). To offset this possibility, we purposely added distinctiveness language stating that the character had never seen this agent before, and stressed eight times per trial that the agent was new. Adults could have just as easily interpreted the study as testing their skill at inhibiting unfair biases to treat individuals fairly and without prejudice. We find it more likely that our procedures hampered the youngest children's performance. Four- to 5-year-olds may have interpreted the repeated *new* as an abundantly clear signal that past experiences with the initial perpetrator should not matter. This repetitive newness language, combined with multiple test questions, could have overly taxed young children's more fragile understanding. Indeed, in a previous paradigm with single past events where the experimenter never explicitly marked the similar agent as new, 4- to 5-year-olds evidenced some basic awareness, but they may have confused the past perpetrator and the new agent as being one and the same (Lagattuta, 2007). That older children and adults overcame the salient newness language as well as the complexity of the task speaks to the strength of their beliefs about the broad biasing impact of past emotional histories.

A related concern is whether adults really believe that emotion generalization takes these indirect, far-reaching pathways. Do such unwarranted, unfair generalizations from emotional histories actually occur? Furthermore, would adults reason differently if they were responding to scenarios about adults rather than to episodes involving child protagonists? It is important to note that adults' responses to our paradigm reflect real-world phenomenon. Research on both emotion (Barrett & Bliss-Moreau, 2009; Gilbert & Wilson, 2007; Lerner et al., 2015; Lindquist, 2013; O'Connor et al., 2015) and stereotyping (Banaji, Baron, Dunham, & Olson, 2008; Stroessner & Sherman, 2015) has indicated that children and adults make robust extensions between past and present and from individuals to categories. Especially when forecasting under uncertainty, adults rely on limited information without considering its nonrepresentativeness (Kahneman & Tversky, 1972). Indeed, the extent to which participants themselves generalized could have impacted their inferences about characters' mental states. For example, if participants first generalized from the initial perpetrator to the new agent in their own minds, they may then have assumed that the character would have this bias too. Given that most research on emotion generalization has focused on adults, it is possible that the causes and scope of emotion generalization vary by age (e.g., more diminished in children compared to adults). This could contribute to age-related differences in the ability to experience as well as detect emotion generalization in self and others.

Future research could move beyond testing whether children and adults know that emotion generalization occurs to having them evaluate its accuracy and appropriateness (e.g., whether it is logical, fair, or moral). Do people recognize the fallacy of these biased expectations; that is, do they understand that generalizations typically run counter to objective reality? It would also be interesting to assess children's and adults' beliefs about how to counteract overgeneralizations once they have identified their presence and source. That is, do they think people can intentionally stop generalizing from the past, and, if so, using what strategies? Such inquiries would improve the knowledge about how children and adults understand and regulate their own and others' past-generated biases. Additional studies are also needed to unpack sources of variability in children's and adults' reasoning about how minds generalize from prior emotional episodes, including connections to cognitive, social, and life-historical factors. Extending this paradigm to a wider age range (adolescents and aging adults) and more diverse populations would provide a more complete understanding of development, variability, and mechanisms of change. Finally, these kinds of paradigms with large sample sizes, several age groups, multiple verbal judgments, and eye tracking may be especially rich for developing computational models of emotion cognition (Ong, Zaki, & Goodman, 2015). That is, researchers may be able to derive mathematical representations

for how children and adults weight valence, sequence, and similarity when predicting the biasing impact of the past.

Conclusions

Not surprisingly, research on emotion understanding has historically focused on emotions—individuals' comprehension of emotion labels as well as their reasoning about causes and consequences of emotions. In line with this tradition, when first framing this article, we considered centering on children's and adults' emotion predictions and minimizing attention to thought and decision judgments. Upon reflection, we realized that doing so would detract from a critical innovation of our approach: We tested not only children's and adults' reasoning about how prior emotional events influence emotional reactions to new agents but also how people's emotional histories bias their future-oriented thoughts and decisions in new situations. Because the field of affective science has expanded to consider interconnections among people's emotions, life experiences, thoughts, and decisions, research on the development of emotion understanding needs to progress in turn to identify children's and adults' awareness of and beliefs about these more complex emotional processes. Further contributions to emotion research stemmed from our investigative tools. By showing the feasibility of combining eye tracking with live interviewing across a wide age range, we reveal that this technology can raise the bar on the types of questions that can be addressed by emotion scientists, especially connections between visual attention and how children and adults think about the meaning and future impact of emotion-infused events.

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Received March 19, 2019
Revision received September 6, 2019
Accepted September 9, 2019 ■