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Verbal Framing and Statistical Patterns Influence Children's Attributions to

Situational, but not Personal, Causes for Behavior

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Abstract

Adults from Western cultures attribute others' behavior to personal causes more readily than situational causes; however, little research has explored the developmental origins of this attributional bias. Research has shown that children can use both the statistical patterns present in observed behavior, as well as the verbal framing of the behaviors, to infer personal causes. However, research has not explored whether children also use these factors to infer situational causes. The present study examined the impacts of statistical patterns and verbal framing on four- and six-year-old children's ($n = 218$) attributions to personal and situational causes for behavior, as assessed by their explanations for characters' interactions with toys. In a factorial design the statistical pattern of characters' behaviors suggested either a personal or situational cause (or neither), and the experimenter's verbal framing of the behaviors suggested either a personal or situational cause (or neither). Across age groups, children showed a bias toward providing personal explanations. Both statistical pattern and verbal framing influenced causal attributions, but both impacts were asymmetric such that situational cues increased situational explanations relative to neutral cues, but there was no difference in children's explanations following personal and neutral cues. These results suggest that verbal framing and statistical patterns impact children's developing social causal attributions, specifically with respect to situational causes, and also that a personal attribution bias emerges early in development.

Keywords: Causal reasoning, Attribution, Situations, Explanation, Verbal framing, Statistical patterns

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Attributions of behavior to either a personal cause (e.g., personality, dispositional traits, internal states) or a situational cause (e.g., circumstances, environmental conditions, constraints) have been a long-standing focus of research on social causal attribution (Kelley, 1967; Jones & Harris, 1967; Ross, 1977). These judgments have wide-ranging consequences for social cognition and behavior; they have been linked to stereotyping and prejudice (Bastian & Haslam, 2006; Keller, 2005), support for the status quo (Hussak & Cimpian, 2015), and moral judgments of blame and guilt (McGraw, 1987; Weiner, Graham, & Chandler, 1982). In Western cultures, adults offer personal explanations for others' behavior more readily than situational explanations (Gilbert & Malone, 1995; Jones & Harris, 1967; Na & Kitayama, 2011; Ross, 1977). This bias has many harmful social consequences; for example, people attribute criminal behavior to bad character rather than to bad circumstances (Clabaugh & Clabaugh, 2005), attribute child obesity to individual choice rather than to healthy food availability (Power, Bindler, Goetz, & Daratha, 2010), and attribute sexual assault to survivors' actions rather than to the surrounding culture (Cowan & Campbell, 1995). Despite the wealth of research on the social impacts of this attributional bias, little is known about its developmental origins. How do children learn to reason about personal and situational causes, and how might this attributional bias emerge over development?

Like adults, children are able to attribute behavior to personal causes. Children represent human actions in terms of internal mental states, such as goals (Woodward, 1998), preferences (Kushnir, Xu, & Wellman, 2010), knowledge (Brosseau-Liard & Birch, 2010), and emotions

(Gnepp, 1983), in some cases doing so within the first year of life. By the preschool years, children also reason about more stable factors, such as personality (Gnepp & Chilamkurti, 1988; Rholes & Ruble, 1984) and personal traits (Liu, Gelman, & Wellman, 2007; Heyman & Gelman, 1998), and they represent these factors as playing a causal role in influencing others' behaviors. In contrast to this vast research on children's reasoning about personal causes, however, very few studies have explored how children reason about situational causes or whether children's personal attributions come at the expense of their reasoning about situational causes (though see Seiver, Gopnik, & Goodman, 2013, discussed below).

The lack of research on children's reasoning about situational causes, relative to research on children's reasoning about personal causes, stands in contrast to a wealth of social psychological evidence that situations exert a profound influence on behavior. Classic studies in social psychology have shown that behavior is influenced not only by personalities, but also by norms (Sherif, 1936), others' behaviors (Asch, 1956), context (Milgram, 1963), setting (Zimbardo & Leippe, 1991) and other situational factors. Indeed, highlighting the ways that situations exert an influence on behavior is critical for reducing adults' personal attribution bias and its many pernicious social effects. For example, adults' social reasoning and behavior change when they read about environmental, rather than biological, explanations for phenomena such as gender differences (Coleman & Hong, 2008; Dar-Nimrod & Heine, 2006), racial differences (Williams & Eberhardt, 2008), homosexuality (Weiner et al., 1988), and obesity (Monterroso, Royzman, & Schwartz, 2005).

In the current study, we explore children's attributions to both personal and situational causes in early childhood, as well as factors that influence these attributions. We view social

causal attributions as part of the broader causal reasoning abilities children employ as they develop intuitive theories about the physical and social worlds. Children engage in causal reasoning about the physical world from a very early age (for review, see Carey, 2009; Muentener & Bonawitz, 2017), detecting causal relations between interacting objects within the first year of life (Cohen & Oakes, 1990; Leslie & Keeble, 1987), spontaneously searching for causes to explain events (Bullock, Gelman, & Baillargeon, 1982; Muentener & Schulz, 2014), and using these causal frameworks to explain, predict, and act on the world around them (Gopnik, Sobel, Schulz, & Glymour, 2001; Gopnik & Wellman, 2012; Wellman & Gelman, 1992). Research on children's physical causal reasoning has shown that children utilize both (1) the statistical patterns present in observed events, as well as (2) the language used to verbally frame these events, in order to make causal inferences about the physical world. In this study, we leverage research on children's causal reasoning in the physical domain in order to better understand children's causal reasoning in the social domain. We explore whether children utilize these two cues, statistical patterns and verbal framing, to make personal and situational causal inferences about others' behaviors, just as they use these cues to make causal inferences about the physical world.

The role of statistical patterns in early causal reasoning

One cue that children use to reason causally about observed physical events is the statistical patterns of evidence present in the learning input (Gopnik & Wellman, 2012; Schulz, 2012; Wellman & Gelman, 1992). For instance, given two potential causes (A and B), a novel outcome (C: Present = '+', Absent = '-'), and a relevant statistical pattern relating to them to each other (e.g., A and B predicts C+, B alone predicts C-), young children reliably make

judgments about which is the cause of the event (i.e., A causes C to occur), can intervene on the causal system (e.g., take away A to stop C), and can design novel experiments (e.g., isolate A and B if they co-predict C+) (Gopnik, Sobel, Schulz, & Glymour, 2001; Cook, Goodman, and Schulz, 2011). Moreover, children engage in a cognitive process much richer than simply tracking associations between events, as children form causal hypotheses not warranted by simple associative mechanisms (Sobel, Tenenbaum, & Gopnik, 2004) and form abstract causal hypotheses that go beyond those warranted by the observed statistical patterns (Schulz, Goodman, Tenenbaum, & Jenkins, 2008). Recent research suggests that the ability to reason causally about events by tracking statistical patterns may also be cross-culturally and socioeconomically universal (Wente et al., 2017).

In addition to using statistical patterns of physical events to infer physical causes, children also use statistical patterns of social behavior to infer others' preferences (Diesendruck, Salzer, Kushnir, & Xu, 2015; Kushnir, Xu, & Wellman, 2010; Lucas et al., 2014; Ma & Xu, 2011). For example, young children can infer that an individual holds a preference when the individual chooses a sample of toys that is not representative of the population (e.g., ducks chosen from a box filled with mostly balls), but not when the individual chooses a sample of toys that is representative (e.g., ducks chosen from a box filled with mostly ducks). Children can also track the toy selections of multiple actors, and use these patterns to infer not only those actors' preferences, but also the preferences of other actors from the same social group (Diesendruck, Salzer, Kushnir, & Xu, 2015). Notably, this research has focused on children's use of statistical patterns to make inferences about personal causes for behavior (e.g., others' preferences), but has

not examined how children use statistical patterns to make inferences about situational causes for behavior.

Finally, more limited research has examined children's ability to use statistical patterns to reason about both personal *and* situational causes for behavior. For instance, Seiver, Gopnik and Goodman (2013) investigated 4- and 6-year-old children's attributions to 'trait-like' causal factors following statistical patterns of evidence suggesting either a personal or a situational cause for two characters' actions. In the person condition, children saw one character play with two different toys and another character play with neither toy, a pattern suggesting a difference between the characters. In contrast, in the situation condition, children saw both characters play with one toy and neither character play with the other toy, a pattern suggesting a difference between the toys. Three main results emerged from this study: First, children reasoned rationally based on the statistical pattern relating the characters to the toys -- children provided more personal, 'trait-like' explanations in the person condition than in the situation condition. Second, children made predictions about the characters' future actions in a manner consistent with the statistical pattern. Third, older children showed a personal bias in their 'trait-like' explanations for behaviors with neutral statistical patterns that suggested neither a personal nor a situational cause (e.g., Sally plays with one toy and Josie plays with another toy), while younger children did not, suggesting that tracking and encoding behaviors in terms of statistical patterns may play a causal role in the onset of the attribution bias towards personal explanations. Similarly, at least with respect to their own actions, younger 16-month-old toddlers can use the statistical relation between other people's actions and outcomes to reason about their own failed actions as caused

by their own inabilities (i.e., personal cause) or by an ineffective toy (i.e., a situational cause; Gweon & Schulz, 2011).

Thus, children's ability to track the statistical patterns of behaviors is a central component of their learning about the physical and social worlds. Children are sensitive to statistical patterns in their environment from a very young age, and use these patterns to causally explore and explain both physical systems as well as social behaviors. While much research suggests that children use these patterns to infer personal causes (i.e., preferences) underlying others' behaviors, less research has focused on children's use of statistical patterns to infer and reason about situational causes for behaviors. One aim of the current study was to extend these findings to investigate preschool-aged children's use of statistical patterns of behaviors to infer both personal and situational causes of behavior.

The role of verbal framing in early causal reasoning

Although research has shown that children use statistical patterns to decide among competing causal explanations in the physical and social domains, many of these studies provide children with the interventions that help to decide between competing hypotheses (e.g., Bonawitz, Ullman, Gopnik, & Tenenbaum, 2012) or with experimentally-constrained hypothesis spaces (e.g., Schulz, Gopnik, & Glymour, 2007). Yet, children's causal reasoning process includes not only deciding between potential causal hypotheses, but also initially generating the causal hypotheses to consider when encountering statistical evidence. Identifying the contextual factors that influence children's generation of causal hypotheses, as well how these factors interact with statistical patterns of evidence, is important for understanding the onset of social attribution biases across development (see also Garvin & Woodward, 2015).

One contextual cue that influences children's physical causal reasoning is the verbal framing of observed events, which may highlight candidate causes for children as they encounter statistical patterns of evidence (for review, see Muentener & Schulz, 2012).¹ For instance, verbally framing events with causal language (e.g., "The block can make it go") helps toddlers represent predictive relations (i.e., a toy's activation reliably follows a block's motion) as causal relations (i.e., the block's motion *causes* the toy's activation) (Bonawitz et al., 2010; Muentener, Bonawitz, Horowitz, & Schulz, 2012). In contrast, when identical statistical patterns are framed without causal language (e.g., "here's my block", "watch my show"), toddlers do not spontaneously generate a causal hypothesis. Similarly, preschool-aged children are more likely to learn conditional probability information about a physical causal relation when it is accompanied by verbal framing that highlights causal hypothesis testing (Sobel & Somerville, 2009). Thus, verbal framing impacts children's causal attributions of physical events.

In addition to impacting children's causal reasoning about physical events, verbal framing also impacts children's causal reasoning about social behavior. For instance, children infer others' preferences from the statistical patterns of their actions only when verbal framing suggests that the actions are caused by a preference (e.g., "some toys make her really happy") rather than simply describing the action (e.g., "some toys she always chooses"; Garvin & Woodward, 2015). Similarly, verbally framing complex actions as a causal search task (e.g., "Will you help me figure out which animals make Lion laugh?") facilitates children's reasoning about a puppet's emotional state (Butler & Markman, 2012). Thus, the existing research has

¹ We view 'verbal framing' as any linguistic description that precedes or accompanies an event, though we recognize that the impact of linguistic descriptions can be diverse (e.g., effects on children's linguistic explanations and/or non-linguistic conceptual representations) and occur through a variety of mechanisms (e.g., via semantic, syntactic, and/or pragmatic pathways).

shown that verbal framing influences children's ability to infer personal causes for others' behaviors, such as preferences and emotions. However, there has been no research focused on how verbal framing influences children's inferences about situational causes for behavior. The current study extends the existing research by investigating whether the verbal framing of observed behavior influences children's attributions to both personal and situational causes for the behavior.

Critical to the aims of the current study, the single prior study investigating how preschool-aged children reason about behavior using statistical patterns invariably highlighted personal causes (Seiver et al., 2013). Specifically, children always heard framing such as, "Look! Sally is playing on the trampoline. *She's not scared*" (italics added for emphasis). Although children's reasoning was influenced by the statistical patterns of the behaviors, the verbal framing of the character's mental state (i.e., "She's scared") may also have increased their tendency to attribute behavior to personal causes. Thus, in the current study we manipulated verbal framing to suggest either a personal cause, a situational cause, or neither. In doing so, we sought to investigate the impact of verbal framing on children's social causal attributions, and also to better understand how children reason about personal and situational causes when verbal framing did not highlight any particular cause.

Current study

In sum, prior research has shown that statistical patterns guide children's causal inferences about both the physical and social worlds from a young age. Additional studies have shown that the verbal framing of observed events can also guide children's inferences about physical causes and certain social causes (i.e., preferences, personality traits). However, few

studies have explored how children reason about situational causes of behavior, whether social causal reasoning is biased toward personal causes and away from situational causes, and what factors influence the emergence of this attributional bias over development. Given the social importance of recognizing situational causes for behavior, the aim of the current study was to extend prior research by investigating the respective impacts of verbal framing and statistical patterns on children's attributions to personal *and situational* causes.

Our methods were modeled after those used by Seiver et al. (2013), in which children viewed characters playing or not-playing with toys. We manipulated both the statistical patterns present in the behaviors (to suggest either a personal cause, situational cause, or neither), as well as the verbal framing that accompanied the patterns (to suggest either a personal cause, situational cause, or neither), in a full factorial design. We then asked children to provide explanations for the observed behaviors and planned to code whether their explanations attributed the behaviors to the characters (i.e., a personal cause) or to the toys (i.e., a situational cause).²

We made two changes to the methods of Seiver et al. (2013). First, we used a different sequence of events to display a neutral pattern of observed evidence (neither a personal nor a situational cause). In the neutral condition of Seiver et al. (2013), children viewed each character respond to only one toy: one character played with one toy and a second character did not play with a different toy. Although this overall sequence of events was not biased toward a personal or situational cause – both characters' behaviors could be explained equally well by either a personal cause (e.g., one character was brave and the other character was not) or a situational

² In the coding section of the methods discussed below, we note an additional “combined” causal attribution category that was added following initial study design and data collection but prior to data analysis.

cause (e.g., one toy was dangerous and the other was not) – this condition was not matched to the personal- and situational-pattern conditions. Whereas children in the personal- and situational-pattern conditions saw two characters respond to two toys and were required to track this pattern to make causal inferences, children in the neutral-pattern condition saw a simpler pattern in which each character interacted with only a single toy.

For the neutral-pattern condition of the current study, we chose a pattern of events that more closely matched the other conditions, but which also was not intrinsically biased toward an overall personal or situational cause. More specifically, children saw each character display both playing and not-playing behaviors and also saw each toy both played-with and not-played-with. One character played with the first toy and did not play with the second toy, and a second character did not play with the first toy and played with the second toy. Critically, this overall pattern of events was also not intrinsically biased toward a personal or situational cause, as the behaviors could equally well be attributed to differences between the characters (each character both played and did not play) or to differences between the toys (each toy was both played-with and not-played-with).³

Second, we used different coding criteria than Seiver et al. (2013) to categorize children's explanations as referring to personal or situational causes. As Seiver and colleagues focused on children's ability to reason about 'trait-like' causes, they considered only those explanations referring explicitly to a stable and intrinsic property of the character as a personal explanation. For example, when a participant provided an explanation such as "she wants to," which could be

³ Children may have made attributions for any single character-toy interaction. However, even these individual interactions were ambiguous as they could be due to either personal causes (e.g., a person's preference) or situational causes (e.g., a specific feature of a toy) and children were not constrained in the kinds of explanations they could provide. We return to an extended discussion of this issue in the General Discussion.

ambiguous with respect to stability, the experimenter prompted the participant to provide an additional explanation (e.g., “why did she want to?”) or provided a follow-up forced-choice response option (e.g., “because she’s the kind of person who gets scared, or because the trampoline is dangerous to play on?”). In contrast, in the current study, we coded as personal any explanation that referred to the characters, regardless of whether the explanation referred to a stable or more temporary property of the characters, for several reasons. First, the primary aim of the current study was to investigate children’s initial localization of the cause to either personal or situational causes, broadly, without a specific interest in stable, trait-like attributions. Second, we reasoned that any explanations referring to characters’ wants and likes could be referring to either temporary whims or stable preferences. Finally, we were concerned that the need for follow-up questions or forced-choice responses could differ across conditions; if so, then the possibility that children revised their causal attributions following additional prompts could also differ across conditions. Therefore, we concluded that a broad and conservative coding scheme, which considered any reference to the characters to be personal and any reference to the toys to be situational, would best capture children’s initial causal attributions for social behavior.⁴

By manipulating both statistical pattern and verbal framing in two age groups, we sought to explore three research questions, concerning (1) whether children hold an overall bias toward personal attributions, (2) the impacts of verbal framing and statistical pattern on social causal attributions, and (3) any age-related developmental effects.

First, we explored whether children would exhibit an overall bias toward personal attributions, as research has demonstrated in adults from Western cultures. By fully crossing

⁴ We return to a discussion of the implication of the coding differences between the current study and Seiver et al. (2013) in the General Discussion.

three levels (personal, neutral, and situational) of both verbal framing and statistical patterns, we were able to investigate children's reasoning in the neutral conditions as a baseline measure of any attributional bias. Additionally, this approach allowed us to compare children's reasoning in the neutral conditions with their reasoning in the personal and situational conditions, as another measure of children's attributional bias: If children hold a personal bias, their explanations in the neutral conditions should be similar to their explanations in the personal conditions, but different from their explanations in the situational conditions. In this way, we were able to assess the impact of situational cues (from either pattern or framing), which have been under-studied in past research, and these cues' impact on any early attributional bias.

Second, we assessed the impacts of verbal framing and statistical patterns on children's social causal reasoning. If children use statistical patterns to inform their causal attributions for others' behavior, then children should provide more personal explanations when the evidence suggests a personal cause than when it suggests a situational cause. Similarly, if children use verbal framing to inform their attributions, then they should provide more personal explanations when the framing suggests a personal cause than when it suggests a situational cause. We also assessed the interaction between these factors: Given that we fully crossed verbal framing and statistical patterns in our design, some children were provided with congruent information across the cues (e.g., a verbal frame suggesting a personal cause with a statistical pattern suggesting a personal cause) while others were provided with incongruent information across the cues (e.g., a verbal frame suggesting a personal cause with a statistical pattern suggesting a situational cause). If verbal framing and statistical pattern cues interact in children's social causal attributions, then we should see facilitative effects when these cues provided congruent information.

Finally, we tested both 4- and 6-year-old children to assess how the impacts of verbal framing and statistical patterns change over development. As Seiver et al. (2013) found that younger children were more receptive to statistical pattern information than older children, we expected to find this as well. However, we did not make a specific a priori hypothesis concerning the interaction between age, verbal framing, and statistical pattern.

In addition to assessing children's explanations of observed social behaviors, we also assessed whether children were able to generalize the patterns of evidence they observed. For this measure we only asked prediction questions specific to the statistical patterns presented during familiarization: we assessed only personal generalizations in children who viewed personal patterns and only situational generalizations in children who viewed situational patterns. Consistent with Seiver et al. (2013), we reasoned that children would have no basis to make predictions that were inconsistent with their observed statistical patterns. For instance, having viewed that one character played with two toys while the other played with neither (i.e., a personal pattern), children should have no basis upon which to predict how a new character would play with a familiar toy (i.e., the prediction question from the situational-pattern conditions, discussed further below in the Methods section). Similarly, we did not include prediction questions in the neutral-pattern conditions, as this overall pattern of events did not support an attribution to personal or situational causes.

Note that the prediction measure addressed a distinct and much narrower research question than the explanation measure. Although we used the explanation measure to assess the kinds of causal attributions (i.e., personal or situational) that children made following distinct patterns of events (personal, situational, or neutral), we only used the prediction measure to

assess whether children generalized appropriately from the personal or situational statistical pattern they observed. Thus, the prediction measure was not designed to assess any baseline bias that children may have when making predictions about social behavior. Rather, the prediction measure was a secondary dependent measure that allowed us to assess children's sensitivity to the specific statistical patterns of events in the personal- and situational-pattern conditions. Based on the findings from Seiver et al. (2013), we expected that older, but not younger, children would be more likely to generalize appropriately from a personal pattern than a situational pattern.

Although the current study assessed the impact of verbal framing, including its independent and interactive effects, on children's explanations, we did not make any a priori predictions regarding the impact of verbal framing on children's predictions, given that this was not the primary focus of the current study. Similarly, although we asked prediction questions that assessed children's ability to generalize a given statistical pattern (i.e., asking about a novel characters behavior with familiar toys in the situational-pattern condition), we did not ask questions that assessed children's sensitivity to incongruent verbal frames (e.g., asking whether children make situational-consistent predictions following a personal pattern with a situational verbal frame). Therefore, children's prediction data also cannot be used to speak directly to the impact of verbal framing on children's predictions.

Method

Participants

Two hundred eighteen 4- and 6-year-old children participated in this study ($n = 110$ four-year-olds, 52 girls, mean age = 53.3 months, range = 48-59 months; $n = 108$ six-year-olds, 53

girls, mean age = 75.6 months, range = 72-83 months) between October 2015 and August 2017. Within each age group, participants were randomly assigned to 9 conditions (3 verbal framing conditions crossed with 3 pattern conditions), with at least 12 participants in each condition. We inadvertently recruited two additional participants than initially planned; one 4-year-old child in the situational-pattern/neutral-framing condition, and one 4-year-old child in the personal-pattern/situational-framing condition. We chose to include these additional participants in the full sample prior to conducting analyses. A power analysis shows that this sample size is sufficient to detect a medium effect size for the analysis of a two-way-interaction between pattern and verbal framing, which were planned a priori for the primary hypotheses discussed above, at a power level of at least 80 %.

Participants were recruited from local museum and school settings. Although we did not collect demographic information on socioeconomic status or ethnicity, per standard museum policy for researchers, demographic information for the museum visitor population suggests that our sample was predominantly White and from middle- to upper-middle class families. All participants whose parents provided consent to participate completed this study.

Materials

Six small toy characters (three boys and three girls, all with light skin tone but diverse in clothing, hairstyle, and hair color) and six small toy playground structures (a waterslide, a climbing structure with a swing attached, a spinning playground-style merry-go-round, a climbing wall, a zipline, and a hanging festival-style carousel) comprised the stimuli in this study.

Procedure

All participants completed two trials, each consisting of a *familiarization phase* and a *test phase* described below. All procedures discussed below were identical across age groups.

Familiarization phase. Participants were randomly assigned to view behaviors that varied with respect to both the pattern and the verbal framing of the behaviors, across conditions. Three different patterns of behavior (personal, situational, neutral) and three different verbal framings (personal, situational, neutral) were crossed to produce 9 between-subjects conditions.

We modeled the statistical pattern of behavior (personal, situational, neutral) after Seiver, and colleagues (2013). Each pattern involved two characters each interacting with two toys (T1, T2; the specific toys were counterbalanced across the stimulus set), yielding four total interactions. The first trial always involved two female characters (named Sally and Josie), whereas the second trial always involved two male characters (named Diego and Marcus). An interaction could either consist of a character going up to a toy and then playing on it, or a character going up to a toy and then turning and walking away from it. Each interaction was repeated four times consecutively within a trial's familiarization phase. Thus, the familiarization phase always consisted of two playing actions and two walking-away actions, each repeated four times for a total of 16 interactions. The pattern of these actions varied either by the character (in the personal-pattern condition) or by the situation (in the situational-pattern condition), or was neutral (neutral-pattern condition).

In the personal-pattern condition, participants would see one character play with both toys (i.e., Sally plays on T1 and T2), and another character play with neither toy (i.e., Josie backs away from T1 and T2), a pattern that warrants a broad inference that the set of behaviors could

be attributed to personal factors. Which character did which behavior was counterbalanced within the condition. In the situational-pattern condition, participants would see both characters play with one toy (i.e., Sally and Josie both play with T1), and neither character play with the other toy (i.e., Sally and Josie both back away from T2), a pattern that warrants a broad inference that the set of behaviors could be attributed to situational factors. Whether the first character played with T1 or T2 was counterbalanced within the condition. In the neutral-pattern condition, participants would see one character play only on one toy (i.e., Sally plays with T1 and backs away from T2), and the other character play in the reverse pattern (i.e., Josie backs away from T1 and plays with T2), a pattern that does not warrant a broad inference towards either personal or situational factors. Participants always saw Sally on T1 first, then Josie on T1, then Sally on T2, then Josie on T2; this order was fixed across pattern conditions. Only the nature of the interactions (playing or backing-away) varied by pattern condition. See Figure 1 for an overview of the conditions.

Within each pattern condition, we also varied the verbal framing used to describe the interactions in three different ways, also in a between-subjects design. In the personal-framing condition, participants heard, “She’s [not] gonna play on it; she’s [not] scared,” a verbal frame that highlighted the character as a potential causal factor. In the situational-framing condition, participants heard, “She’s [not] gonna play on it; it’s [not] scary,” a verbal frame that highlighted the toy as a potential causal factor. In the neutral-framing condition, participants heard, “She’s [not] gonna play on it.” Thus, although the personal and situational verbal frames provided, by design, an additional explanation for the characters’ behaviors, the neutral verbal frame did not. Given that personal and situational verbal frames were differentiated primarily by the subject of

the additional description (i.e., “she” vs. “it”), any relevant additional explanation would also explicitly point towards a personal or situational cause. Thus, we chose to not include any additional explanation in the neutral verbal frame. This language accompanied each interaction: participants heard the verbal frame 16 times per trial.

Test phase. Immediately following the familiarization phase, participants completed a test phase. For participants in the personal- and situational-pattern conditions, the test phase consisted of two explanation questions and two prediction questions. For participants in the neutral-pattern condition, the test phase consisted only of two explanation questions and no prediction questions.

First, children were asked to explain the most recent action they had seen (i.e., Josie with T2), and then the next most recent action (i.e., Sally with T2). Children were asked, for example, “So, why did Josie play on the [T2]?” If the participant refused to answer, the experimenter prompted the participant again several times (e.g., “Do you have any ideas? You can just take a guess.”). If the participant still refused to answer, the experimenter reminded children of the behavior, and then asked for an explanation again (e.g., “Do you remember when Josie played on the [T2]? So, why did Josie play on the [T2]?”).

After the explanation questions participants in the personal-pattern and situational-pattern conditions (but not the neutral-pattern conditions) were asked to make two predictions about future behavior. More specifically, we asked prediction questions that tested whether children made generalizations appropriate to the particular statistical pattern they viewed during the familiarization phase. Thus, participants were asked to make different predictions across the statistical pattern conditions. For instance, in the personal-pattern condition, the observed

evidence allowed one to predict what each character would do in a new situation, given the pattern of evidence pointed towards personal causal factors. Therefore, participants in these conditions were shown a new toy and asked if Sally would play on it, and then if Josie would play on it. ("Now we're going to pretend they have a new toy, a [T3]! Do you think Sally's going to play on it? Do you think Josie's going to play on it?"). In contrast, in the situational-pattern condition, the observed evidence allowed one to predict how a new character might interact with two familiar toys, given the pattern of evidence pointed towards situational causal factors. Therefore, participants in these conditions were introduced to a new character, Mary, and asked if they would play on T1, and if they would play on T2. ("Now we're going to pretend they have a new friend, this is Mary! Do you think Mary is going to play on the [T1]? Do you think she's going to play on the [T2]?"). Participants in the neutral-pattern conditions were not asked any prediction questions, given that the pattern of evidence did not consistently point towards a general personal or situational causal factor that would facilitate any future predictions.

For each prediction question, children answered either "yes" or "no," thus revealing whether or not they were able to make predictions about new interactions based on previously observed statistical evidence. Children who were reluctant to answer were prompted again. In both conditions, a correct series of responses included one "yes" and one "no" answer. That a correct response involved a series of different yes/no answers, the order of which was counterbalanced both within and across conditions, makes it unlikely that children's pattern-consistent predictions would reflect an overall response bias (e.g., a bias to always answer 'yes' or 'no,' always respond that a character would play or would not play, etc).

As discussed in the Introduction, we did not include test trials from the opposing pattern condition during the prediction phase (e.g., we did not ask the prediction questions from the personal-pattern condition to children in the situational-pattern condition). Consistent with Seiver et al. (2013), we reasoned that children should have no basis to make predictions that were inconsistent with the observed statistical patterns. For example, a child who viewed that Sally always played while Josie always did not (i.e., a personal pattern) should have no basis upon which to predict how Mary would play with a familiar toy (i.e., the prediction question from the situational-pattern condition). Moreover, and somewhat in contrast to the explanation measure, children's performance on both kinds of prediction questions would not have provided evidence of a biased attribution of the familiarization events. For example, if a child saw both Sally and Josie play with T1 but not T2 (i.e., a situational pattern), and we asked "will Sally play on T3?" (i.e., the prediction question in the personal-pattern condition), neither a "yes" nor a "no" response to that question would indicate that the child had represented the original pattern as personal. Thus, the pattern condition and prediction questions were critically linked: the prediction measure could inform us only as to whether children generalized a specific pattern of evidence they viewed in the familiarization phase. The prediction questions were not designed to address questions concerning the kinds and range of generalizations children make following each statistical pattern.

After the first trial (consisting of a familiarization phase and test phase), participants then participated in a second trial following the same procedure. The pattern and framing conditions were constant across trials, but the second trial always involved two male characters (Diego and Marcus) and a new set of toys; the verbal framing included 'he' rather than 'she.' Thus, across

both trials, participants in the personal- and situational-pattern conditions produced a total of four explanations and four predictions; participants in the neutral-pattern conditions produced a total of four explanations and no predictions, given that we did not include prediction questions in these conditions.

Coding

Explanations were coded as referring to personal causes, situational causes, or combined causes for the character's behavior, by a coder who was blind to the pattern and framing conditions of the participant. As noted in the Introduction, we used a broad construal of personal and situational explanations as we were interested in children's initial identification of the causal locus of the character's behavior. This construal is consistent with how personal and situational causes are identified in the adult literature on social attribution, in which attributions to moods, desires, preferences, goals, and other qualities are often considered personal despite potentially referring to temporary states (Miller, Smith, & Uleman, 1979). Moreover, our coding scheme was not based on the content of explanations; rather, it was based off of their form. Because there are many different possible interpretations of "personal" and "situational," with the boundary between them often being blurry and overlapping (Miller, Smith, & Uleman, 1979), we circumvented this issue by relying on the syntax of participants' explanations, using the subject of the sentence to indicate the initial localization of the cause. Thus, *personal* explanations were defined as any explanation that included a person as the subject of the sentence (e.g., "Because *she* was...", "Cause *he* wanted..." "Maybe *Sally* likes..."), and *situational* explanations were defined as explanations that included the situation (playground toy or ride) as the subject of the sentence (e.g., "Cause *it* has..." "Because *it's* not..." "Cause *the swing* goes..."). This coding

did not require that children's explanations accurately account for the full set of familiarization events (e.g., "because she didn't have a bathing suit on" to explain why a character played on the water slide when the other character, who did not play on the water slide, was also not wearing a bathing suit). Instead, as noted in the Introduction, we used children's explanations to determine their initial localization of the cause to either personal or situational factors.

Early in participant recruitment and coding of the initial participants' explanations, but prior to data analysis, we also noticed that several participants included both kinds of causes in their explanations. Therefore, we added an additional *combined* category to capture this explanation subtype. *Combined* explanations were defined as explanations that either (a) referred to both the person and the situation as subjects in separate clauses of the explanation (e.g., "Because he thought it was..."), (b) qualified a statement about a situation with "for her" or "to him" (e.g., "Because for her, it wasn't scary") or (c) switched back and forth between the person and situation within the explanation (e.g., "Because she... because it's... scary"). Table 1 provides examples of each kind of explanation provided by participants.

A subset of explanations (30% of sample) was coded by a second coder who was also blind to framing and pattern conditions of the participant. Interrater reliability on those codes was high (Cohen's kappa = .80). All interrater disagreements pertained to personal vs. combined and situational vs. combined disagreements, and never personal vs. situational disagreements. All data from the first coder were used for the following analyses.

Results

Explanations

Each participant received separate scores for the percentage of their total explanations that referred to personal, situational, or combined causes as explanations for the characters' behaviors. Although the majority of participants provided four explanations, one participant provided only three explanations; for this participant the percentage score was calculated based on three total explanations.

Table 2 displays the mean percentage for each kind of explanation separately by verbal framing and covariation condition. Inspection of the descriptive statistics across conditions shows that children were most likely to produce personal explanations across conditions. Participants generally provided more personal explanations (~ 60% on average) than situational explanations (~ 23% on average) across conditions. Even in the neutral-pattern and neutral-framing condition, the mean percentage of personal explanations was 74%. Out of nine conditions, the only one in which situational explanations exceeded 50% was the situational-pattern and situational-framing condition.

To determine the extent to which statistical patterns and verbal framing information influenced participants' bias to provide personal or situational explanations for behavior, we needed a single score that would capture each participant's tendency to refer to either personal or situational causes in their explanations. To this end, we calculated an explanation score for each participant by taking the difference between each participant's percentage of personal explanations and percentage of situational explanations.⁵ Thus, each participant's explanation

⁵ Note that analyses conducted separately on the percentage of each kind of explanation yields the same pattern of results discussed in the main text results section. Children were more likely to produce personal explanations

score could range from 100% (i.e., all personal explanations) to -100% (i.e., all situational explanations). Given that combined explanations referenced both personal and situational factors for the characters' behaviors, the percentage of combined explanations was not entered directly into the explanation score. However, the percentage of combined explanations did impact participants' explanation scores indirectly, by effectively diluting the overall percentage of personal or situational explanations offered out of the total four (e.g., a participant who gave three combined explanations and one personal explanation would receive an explanation score of 25%).⁶

Next, we conducted a 3 (statistical pattern: personal, situational, neutral) x 3 (verbal framing: personal, situational, neutral) x 2 (age: 4 years, 6 years) between-subjects analysis of variance (ANOVA) on participants' explanation scores (Figure 2). We found a main effect of statistical pattern ($F(2, 200) = 15.53, p < .001; \eta_p^2 = .134$). This effect was largely driven by the influence of situational statistical patterns, rather than by both personal and situational statistical patterns. Follow-up pairwise comparisons between statistical pattern conditions, using Bonferroni-correction to control for multiple comparisons, revealed that participants' explanation scores were significantly higher (i.e., more personal) in both the personal-pattern condition ($M = 61.64\%$, $SD = 50.88\%$) and the neutral-pattern condition ($M = 43.63\%$, $SD = 67.88\%$) than in the situational-pattern condition ($M = 7.19\%$, $SD = 79.0\%$), but that the explanation scores did not differ between the personal-pattern and neutral-pattern conditions.

following personal or neutral verbal framing or patterns than following situational verbal framing or patterns. Similarly, children were more likely to produce situational explanations following situational verbal framing or patterns than following personal or neutral verbal framing or patterns.

⁶ Removing the indirect influence of combined explanations on the overall explanation scores, by calculating the percentage of children's personal explanations (or inversely, situational explanations) only from the total number of personal and situational explanations, also yields the same pattern of results discussed in the results section.

We also found a main effect of verbal framing ($F(2, 200) = 25.41, p < .001; \eta_p^2 = .203$). Similar to the effect of statistical pattern, this main effect was driven by situational verbal framing. Follow-up pairwise comparisons between verbal framing conditions, using Bonferroni-correction to control for multiple comparisons, revealed that participants' explanation scores were significantly higher in both the personal-framing condition ($M = 55.90\%$, $SD = 62.59\%$) and the neutral-framing condition ($M = 60.50\%$, $SD = 59.09\%$), compared to the situational-framing condition ($M = -3.77\%$, $SD = 70.55\%$), but that explanation scores did not differ between the personal and neutral verbal framing conditions.

Next, we analyzed whether participants' explanations were personal overall, separately in each pattern condition and framing condition. Separate two-tailed, one-sample t-tests, using Bonferroni-correction for multiple comparisons, comparing explanation scores to a score of zero (i.e., explanations that were neutral with respect to personal and situational causes) revealed that participants' explanation scores were significantly more personal overall in both the personal-pattern and neutral-pattern conditions (personal-pattern condition: $t(72) = 10.35, p < .05$; neutral-pattern condition: $t(71) = 5.45, p < .05$), but in not the situational-pattern condition, which did not differ from zero. Participants' explanation scores were also significantly more personal than neutral only in the personal- and neutral-framing conditions (one-sample t-tests compared to zero, using Bonferroni-correction for multiple comparisons; personal-framing condition: $t(71) = 7.58, p < .05$; neutral-framing condition: $t(72) = 8.75, p < .05$).

With respect to developmental differences, we found no significant main effect of age ($F(1, 200) = .074, p > .75; \eta_p^2 = .00$), and no significant two- or three-way interactions between statistical pattern, verbal framing, or age.

In sum, both verbal framing and statistical patterns influenced children's explanations, supporting our first hypothesis. Specifically, children produced more personal explanations after observing a personal or neutral pattern compared to a situational pattern. The same asymmetry was found in the impact of verbal framing; children produced more personal explanations after hearing personal or neutral framing compared to situational framing. This asymmetrical impact of both pattern and framing information, such that personal conditions were no different from neutral conditions, supported our hypothesis concerning children's overall bias toward personal explanations. Finally, the overall prevalence of personal explanations, even in the neutral conditions, also supported our hypothesis of an overall personal bias in children's social causal attributions.

Predictions

Participants received a prediction score based on the percentage of predictions (out of four) that aligned with the generalization supported by the personal- and situational-pattern condition; given that the neutral-pattern condition did not include a consistent personal or situational pattern from which to generalize, participants in this condition did not make predictions about future events. Recall that an accurate generalization based on the respective pattern conditions required one 'yes' and one 'no' response; thus, the prediction scores reported below reflect children's overall pattern-consistent generalizations, rather than the percentage of either 'yes' or 'no' responses.

We conducted a 2 (age: 4 years, 6 years) x 2 (statistical pattern: personal, situational) x 3 (verbal framing: personal, situational, neutral) between-subjects analysis of variance (ANOVA) on these participants' prediction scores (Figure 3). This analysis revealed a main effect of

statistical pattern ($F(1, 134) = 34.45, p < .001; \eta_p^2 = .204$) which was qualified by a significant interaction between age and statistical pattern ($F(1, 134) = 5.88, p < .05; \eta_p^2 = .042$). Follow-up independent t-tests, using Bonferonni-correction for multiple comparisons, revealed that this interaction was due to the fact that although both age groups were more accurate in providing predictions in the personal-pattern condition than the situational-pattern condition (4-year-olds: $t(72) = 2.7, p < .05$; 6-year-olds: $t(70) = 5.5, p < .05$), four-year-old children were more accurate than six-year-old children in providing predictions in the situational-pattern condition ($t(71) = 2.1, p < .05$), and no such age-related differences emerged in the personal-pattern condition ($t(71) = 1.4, p > .1$). Although predictions following a personal pattern were above chance for both age groups (one-sample t-tests compared to 50%; 4-year-olds: $t(36) = 4.48, p < .05$; 6-year-olds: $t(35) = 6.80, p < .05$), predictions following a situational pattern were no different from chance in either age group (both p 's $> .05$). There were no other significant main effects or interactions.

Thus, statistical patterns had differential effects on children's predictions across age. Whereas both younger and older children made accurate predictions following statistical patterns that suggested a personal cause, younger children were more accurate than older children in making predictions following a statistical pattern that suggested a situational cause. These findings are consistent with our hypotheses and suggest that children used the personal statistical pattern, but not the situational statistical pattern, to make predictions about novel events. Although we did not find any effects of verbal framing on children's predictions, we do not draw any conclusions about this null effect as we did not make any predictions with respect to this

potential relation and did not include prediction questions which would directly assess this relation (i.e., also including personal prediction questions following personal verbal frames).

Exploratory analyses: Imitations of verbal framing

Although our primary analyses focused on whether participants' explanations referred to a personal, situational, or combined cause, we also noticed after data collection began that participants varied in the extent to which they imitated the experimenter's verbal framing of the behavior. Whereas some children provided novel explanations for the characters' behaviors, other children imitated the experimenter's verbal framing. Note that children's verbal imitations cannot alone explain the pattern of children's explanations, as (1) children's explanations frequently included personal factors across most conditions, even in the neutral conditions, and (2) an effect of statistical pattern condition would not have been found if imitation alone accounted for the explanations children offered.

Still, to explore whether children differentially imitated verbal frames across conditions, we conducted exploratory analyses. We coded as imitations any explanation that began with the same content as the experimenter's verbal framing (i.e., Personal-framing condition: "She was scared;" Situational-framing condition: "It was scary"). Although many of the statements coded as imitations were exact matches of the experimenter's verbal framing, we also coded as an imitation any statements that slightly modified the original framing (e.g., it was *too* scary) or statements that continued to expand upon the initial verbal framing (e.g., because she's scared... *and if it goes high*). Interrater reliability between two coders, blind to age and statistical pattern condition but not to verbal pattern condition to allow for assessing imitations, was high ($r > .95$).

We then conducted a 2 (age: 4 years, 6 years) x 3 (statistical pattern: personal, neutral, situational) x 2 (verbal framing: personal, situational) between-subjects analysis of variance (ANOVA) on participants' percentage of imitations. Note that because the verbal framing in the neutral-framing condition did not include an explanation, we could not include that condition in this analysis. The analyses revealed a significant main effect of verbal framing ($F(1, 125) = 17.5$, $p < .001$; $\eta_p^2 = .123$), with children more likely to imitate personal rather than situational frames, as well as a significant interaction between statistical pattern and verbal framing ($F(2, 125) = 6.49$, $p < .01$; $\eta_p^2 = .094$). Children were more likely to imitate personal framing in the personal-pattern condition than in the situational-pattern condition, as well as more likely to imitate the situational framing in the situational-pattern condition than in the personal-pattern condition.

However, these effects were qualified by a significant three-way interaction between age, statistical pattern, and verbal framing ($F(2, 125) = 3.07$, $p = .05$; $\eta_p^2 = .047$). Follow-up analyses, conducted separately within each age group, showed that these findings were likely driven by older children's explanations. Six-year-old children were overall more likely to imitate personal framing than situational framing (main effect of verbal framing; $F(1, 62) = 16.52$, $p < .001$; $\eta_p^2 = .210$); they were also more likely to imitate verbal frames when they were consistent with the statistical pattern, as indicated by a significant interaction between verbal framing and statistical pattern; $F(2, 62) = 6.35$, $p < .01$; $\eta_p^2 = .170$). However, similar analyses on four-year-old children's imitations revealed marginal effects (main effect: $F(2, 63) = 3.57$, $p = .06$; $\eta_p^2 = .054$); interaction ($F(1, 63) = 3.10$, $p = .052$; $\eta_p^2 = .09$).

Thus, although verbal imitation cannot explain the primary analyses reported above, children's verbal imitations differed as a function of the verbal frame and potentially differed

across age. Children, particularly older children, were most likely to imitate verbal frames when they aligned with the statistical patterns present in the behaviors. Although these results should be interpreted with caution given the exploratory nature of the analyses, we discuss the potential implications of these findings below.

Discussion

In the present study, we investigated the impacts of verbal framing and statistical patterns on children's attributions of behavior to personal and situational causes. We presented children with the behavior of two characters interacting with two toys. Between conditions, we manipulated the extent to which the verbal framing of the behavior as well as the statistical patterns present in the behavior suggested either personal or situational causes for the characters' behaviors, or were neutral. Our design fully crossed verbal framing and statistical pattern in order to assess the respective impacts on children's social causal explanations. Importantly, although prior work has explored the impacts of these factors on children's reasoning about personal causes for behavior, relatively less work has explored the impacts of these factors on children's reasoning about both personal and situational causes for behavior.

Three main findings emerged from this study. First, children displayed a bias to explain behavior in terms of personal causes rather than situational causes. This was evident in the overall high frequency of personal explanations relative to situational explanations and the similarity of children's explanations following personal and neutral cues (relative to their explanations following situational cues). Second, both verbal framing and statistical patterns had significant effects on children's social causal attributions. Moreover, both effects were asymmetrical, such that children's reasoning following situational cues (after either a situational

pattern or situational framing) was different from their reasoning following neutral cues, but children's reasoning following personal cues was not different from their reasoning following neutral cues. Third, although we did not detect any age differences in the primary analyses of children's explanations, exploratory analyses suggested that older, but not younger, children were more likely to imitate the verbal framing when it aligned with the cause suggested by the statistical patterns.

Personal bias in children's early social causal attributions

Across conditions children most frequently offered personal explanations. This was the case even when the pattern and framing of behaviors were neutral with respect to personal or situational causes. Notably, children's explanations in both the personal-framing and personal-pattern conditions did not differ from the respective neutral conditions. When provided with neutral evidence suggesting neither a personal nor a situational cause, children generated personal causal explanations that were indistinguishable from the explanations they generated when personal causes were implied for them by statistical patterns or verbal framing. These results suggest that children's explanations are biased towards personal causal attributions for behavior by at least four years of age.

These findings differ from those reported by Seiver et al. (2013), who assessed the impact of statistical patterns, but not of verbal framing, on children's social causal attributions. In contrast to our finding that a personal attribution bias is in place by age four, Seiver and colleagues found that only older children were biased towards personal attributions. Given the methodological changes in the current study with respect to the neutral-pattern condition as well

as the coding of children's explanations, we discuss below how these changes may have contributed to the contrasting results.

The conclusions from the current study depend partly upon an assumption that the neutral-pattern condition did not provide children with a pattern of evidence that was biased toward a personal cause. Therefore, differences in the neutral-pattern condition between the two studies could explain the differences between the findings. Recall that in the neutral condition of Seiver et al. (2013), one character played with the first toy and a second character did not play with the second toy. In contrast, in the neutral-pattern condition of the current study, one character played with first toy and did not play with the second toy, and the other character did not play with the first toy and did play with the second toy. Despite a different sequence of interactions, we believe this condition also presented a neutral pattern of evidence as a single personal or situational causal factor could not explain the full set of events in this pattern (i.e., as each character both played and did not play, and each toy was both played-with and not-played-with). For example, noting that Sally played on the slide because she was brave would not account for why she did not subsequently play on the swing, and noting that the slide was played-on because it was fun would not account for why Josie did not subsequently play on it. In fact, because the neutral pattern of events actually indicates an interaction between personal and situational factors (e.g., one character's fear of heights, in combination with one toy being high), only combined explanations, which specifically marked both the character and the toy, would account for the full set of events.

Yet, as discussed previously, we did not require that children's explanations account for the full set of observed events. Children may have provided personal or situational explanations

that explained a subset of the observed events, or only the specific character-toy interaction they were asked to explain (e.g., “cause she was brave” when she was subsequently scared of the other toy). Even within this more limited scope, however, we believe that each specific interaction was also intrinsically neutral with respect to personal and situational causes. Although children could have attributed the specific interaction to a personal cause (e.g., “Sally was scared of heights”), they also could have attributed it to a situational cause (e.g., “The slide was too high”). Thus, the sequence of behaviors in the neutral-pattern condition could have produced a range of personal, situational, and combined explanations for the characters’ behaviors.⁷

It is also interesting to consider that, at least from an adult perspective, causal attributions for the interactions in the neutral-pattern condition might differ depending on the domain and kinds of entities present in the events. For instance, although an interaction between a person and a toy may most often elicit attributions to personal causes, an interaction between two people may elicit equally attributions to a personal preference (e.g., the first person liked the second person) or a ‘situational’ factor (e.g., the second person mistreated the first person). That the same pattern of events might elicit different attributions depending on the domain and kinds of entities also suggests that the neutral-pattern condition was not *intrinsically* or abstractly biased

⁷ Given that the focus of the current study was on children’s initial causal localizations, children’s explanations were not required to accurately account for all the familiarization events. Thus, although an explanation such as “The slide was too high” may not have accounted for all the interactions (as the second character also played with the slide), such explanations still provided a window into children’s initial causal attributions. However, it is worth noting that we also saw evidence of a personal bias in the content of children’s explanations. Despite the full range of possible explanations, the content of children’s explanations in the neutral-pattern condition referenced a broad range of personal factors. Although attributions to a personal preference may seem to be the most likely explanation from an adult perspective, these explanations comprised the minority of children’s explanations in the neutral condition (10 % of all explanations). Rather, children cited a variety of personal factors in their explanations of the neutral condition, ranging from internal emotions (e.g., “he was nervous”) to surface-level features (e.g., “she was wearing a bathing suit”).

towards personal factors. Rather, we believe children in the current study viewed these abstractly neutral statistical patterns through the lens of their emerging domain-specific theories for social behavior.

Still, we acknowledge that the methodological differences between the current study and Seiver et al. (2013) limit direct comparison of the findings between the studies and motivate further research focused specifically on the emergence of a personal attribution bias in children's social causal reasoning. In particular, future studies could investigate the extent to which children's causal attributions for different neutral patterns of events differ across domains and the kinds of entities present in events, how they compare to personally- or situationally-biased patterns of events, and the extent to which they are consistent with adult attributions.

Rather than resulting from differences in the neutral-pattern condition, we believe that the differing results between our study and Seiver et al. (2013) are more likely due to the differential focus of each study, as discussed in the Introduction. Given that we were interested in children's broad distinction between personal and situational causes, we coded as personal any explanation that referred to the characters, specifically focusing on whether the subject of the sentence referred to the character. In contrast, Seiver and colleagues were focused specifically on permanent, intrinsic trait-like explanations and thus coded as personal only those explanations that referred to a stable property of the character. For example, this approach did not code explanations like "she wants to" or "she likes it" as personal causes, in contrast to our approach. Because previous research on children's reasoning about behavior has focused on inferences of wants, likes, and preferences -- personal qualities which might reflect either temporary whims or stable preferences -- we opted to code these kinds of explanations as personal explanations.

Similarly, research on situational causes of behavior includes both temporary factors (e.g., conformity to those currently nearby, obedience to a present authority figure) as well as more stable factors (e.g., culture). Thus, we included both temporary and stable explanations in our coding scheme. Although this coding difference limits direct comparison to the findings from Seiver et al (2013), we believe the coding procedure in the current approach provides a representative view of children's initial causal attributions, which was the focus of the current study. The difference between children's reasoning about temporary and more trait-like personal causes and the conditions under which children may represent causes as stable or trait-like are both important topics that warrant further investigation.

Although our primary aims were specific to the impact of statistical patterns and verbal frames on children's explanations for social behavior, we also assessed how statistical patterns impacted children's predictions of future events. This measure was specifically designed to confirm that children were sensitive to the statistical patterns present in the familiarization event and cannot speak to broader questions concerning the kinds and ranges of generalizations children make following different patterns of evidence. We found that four- and six-year-old participants made more accurate predictions after observing a personal compared to a situational pattern. Here, in contrast to children's explanations, we found age-related differences between four- and six-year-old children: Four-year-old children made more accurate predictions than six-year-old children following a situational pattern of behavior; however, no such age-related difference existed for predictions following a personal pattern. Yet, neither four- or six-year-old children's predictions were above chance in the situational-pattern conditions.

In the current study, we only asked prediction questions specific to the statistical patterns presented during familiarization. We reasoned that children should have no basis to make predictions that were inconsistent with the statistical pattern presented in the familiarization events or any predictions following the neutral pattern. For instance, having viewed that one character always played while the other did not (i.e., promoting a personal attribution), children should have no basis upon which to predict how a new character would play with a familiar toy (i.e., the prediction question in the situational-pattern conditions). Yet, this methodological choice limits the conclusions that can be drawn from this data. Although we do not believe children's accurate responses reflect a general response bias (because accurate responses required a series of yes and no answers, counterbalanced across conditions), the current study was not designed to assess any baseline responses that children may have when making predictions about social behavior. Children may hold baseline expectations about how a novel character will behave or how a novel toy will be played with. Thus, the prediction measure cannot directly address how statistical patterns might influence any baseline predictions about future interactions. Future research may wish to better understand how children's default predictions interact with the statistical patterns and verbal frames they experience in the social world.

Influence of verbal framing and statistical patterns on social causal attributions

Both verbal framing and statistical patterns influenced children's social attributions to personal and situational causes. Children offered more personal explanations after observing a personal pattern or hearing personal framing, and more situational explanations after observing a situational pattern or hearing situational framing. Yet, rather than both factors exerting a broad

symmetrical influence on children's explanations, increasing personal explanations when suggesting a personal cause relative and increasing situational explanations when suggesting a situational cause, the influence of both cues was asymmetrical: Both cues increased situational explanations when suggesting a situational cause (relative to neutral cues), but did not increase personal explanations when suggesting a personal cause (relative to neutral cues). Although children's rates of personal explanations were high in the personal-pattern and personal-framing conditions, this was not the case in the respective neutral and situational conditions, allowing for possible increases when provided with personal cues in these conditions. Thus, we believe this suggests that this asymmetry was not merely the result of an overall ceiling effect on children's personal explanations.

We also found an asymmetry with respect to the potential facilitative effects of congruent personal cues and congruent situational cues across verbal framing and statistical patterns. Providing congruent situational cues facilitated children's situational reasoning, whereas providing congruent personal cues did not. Here, it is possible that ceiling-level rates of personal explanations may have obscured the potential facilitative effect of having both statistical patterns and verbal frames point towards a personal cause. Further research using a more sensitive measure, providing more congruent evidence, or both, may show that congruent linguistic and non-linguistic cues could provide facilitative effects when reasoning about both situational and personal causes.

Overall, these findings are noteworthy for several reasons. First, they build on previous research showing that children use statistical pattern information to infer personal or situational causes for behaviors (Gweon & Schulz, 2011; Seiver et al., 2013); here, we suggest that verbal

framing may also play a role in this process. The findings also mirror children's causal inferences in the physical domain, in which research has shown that both statistical pattern information and verbal framing information influence children's causal reasoning. Second, although previous research has shown that verbal framing influences children's inferences of preferences and emotions as causes for behavior (Butler & Markman, 2012; Garvin & Woodward, 2015), preferences and emotions represent only personal causes for behavior. We show in the current study that verbal framing also influences children's attributions to situational causes for behavior. In fact, the asymmetrical influence of both statistical pattern and verbal framing suggests that highlighting situational causes can play a uniquely important role in shaping social cognition. Given adult social cognition research showing that highlighting situational causes impacts adults' social reasoning and behavior (Coleman & Hong, 2008; Dar-Nimrod & Heine, 2006; Weiner et al., 1988; Williams & Eberhardt, 2008), the influence of verbal framing on children's attributions to situational causes could have important social implications and enrich our understanding of how social attribution biases develop.

The current study leaves open the precise role of verbal framing in this causal reasoning process. Verbal framing may highlight potential causal hypotheses for evaluation using statistical evidence (Muentener & Schulz, 2012) or even generate novel hypotheses that would otherwise not be generated based only on early-developing, core cognitive representations (Carey, 2011). Verbal framing and statistical information may also interact such that they encourage further causal exploration, as prior research suggests that conflicts between children's own beliefs and observed evidence motivate their exploration, explanation, and belief revision (Bonawitz, van Schijndel, Friel, & Schulz, 2012; Legare, Gelman, & Wellman, 2010). Finally,

verbal framing effects may result from independent or compound effects of children's semantic, syntactic, and pragmatic inferences (Lewis, Braginsky, Tsuji, Bergmann, Piccinini, Cristia, & Frank, 2017). Independent of the underlying mechanism, the current study shows that verbally framing the possible causes of behavior may serve as an independent piece of evidence children use to form and update their theories about the social world.

Although we primarily focused on children's verbal explanations in the current study, the early emergence of the personal attribution bias also raises questions about children's nonlinguistic social causal reasoning earlier in development. One possibility is that children's personal bias is a result of how children represent behaviors prelinguistically, perhaps as part of core conceptual systems for representing dispositional agents and their actions (Carey, 2009; Spelke & Kinzler, 2007). Indeed, prior research with infants, toddlers, and preschoolers shows a close link between causal reasoning and early representations of dispositional agents (Cohen & Oakes, 1993; Leslie & Keeble, 1987; Muentener & Carey, 2010; Muentener et al., 2012). Alternatively, this bias may be the result of consistent observation of personal statistical patterns or consistent exposure to personal verbal framing. Data from naturalistic observation studies show that parents and children's everyday conversations focus on people and personal causes (Callanan & Oakes, 1992; Hickling & Wellman, 2001) and that children spend a significant portion of time looking at people and their actions (Frank, Vul, & Saxe, 2012). Therefore, it is possible this skewed input might lead to a personal bias. Under both proposals, verbal framing, statistical patterns, or both may then play a role in expanding the types of potential causes that children consider when engaging in causal reasoning, drawing their attention specifically to situational causes. Although the current study cannot distinguish between these alternatives, it

motivates future research exploring the role of verbal framing and statistical patterns on linguistic and non-linguistic social causal attributions in younger children.

Exploratory analyses: Imitations of verbal framing

One potential concern with the current methodology is that children may have simply imitated the experimenter's verbal framing throughout the study. Children were free to, and did at times, imitate the experimenter's verbal framing. However, we do not believe verbal imitation alone can explain the current findings. First, the majority (70%) of children's explanations across the study included novel content. In addition, within each verbal framing condition, children's explanations differed across statistical pattern conditions, which would not have been the case if children were simply imitating the frame they heard. Finally, we found a similar personal attribution bias in children's predictions, suggesting that children's linguistic production mirrors children's non-linguistic causal inferences, rather than mere imitation of particular syntactic features. Therefore, although further research probing children's causal explanations aside from or beyond verbal frame imitations would be informative, we believe these exploratory analyses still shed further light on the role of verbal framing in social causal attribution.

Specifically, we found that children differentially imitated the experimenter's verbal framing as a function of the congruence between the verbal framing and statistical pattern. This interaction also changed with age; even though all children imitated personal frames more than situational frames, older children were more likely than younger children to imitate the verbal framing when it aligned with the statistical pattern. That is, they imitated more personal verbal frames for personal statistical patterns and more situational verbal frames for situational statistical patterns.

Although these exploratory analyses should be interpreted with caution, we believe they may shed light on how children use verbal framing as they engage in causal learning and belief revision in the social domain. For younger children, verbal frames may serve to direct their attention towards and allow them to consider different kinds of causal explanations (i.e., situations) for behavior. In contrast, older children may use verbal frames as a means of confirming beliefs, as they were most likely to imitate verbal framing when it aligned with the statistical patterns. Similar to findings showing that older children are sometimes less likely than younger children to use evidence to form unlikely causal hypotheses (i.e., hypotheses that conflict with their prior beliefs; for review, see Gopnik, Griffiths, & Lucas, 2015), older children may be more likely to use verbal framing to confirm existing beliefs rather than identify new causal hypotheses. In contrast, if younger children's representations of social behaviors are more malleable or they have a weaker prior expectation for a given hypothesis, they may be more receptive to using verbal framing to identify new potential causal hypotheses.

Potential future directions

Although the current study shows that verbal framing influences social causal attribution, the study cannot speak to the extent to which verbal framing interacts with the many other properties of behavior and the many prior beliefs children hold. There were several aspects of the specific behaviors in the current study which may have influenced children's explanations: All toys used were playground equipment, all characters used were White, and all properties mentioned in the verbal frames were related to scariness/scaredness. For each of these aspects of the behaviors, children may have had specific prior beliefs that they called upon during the task.

The impact of these prior beliefs on children's representations of individuals, situations, and behavior properties represents an important area for future research.

We also note that the diversity of explanations provided by children in the current study was not fully captured by our coding scheme. For example, personal explanations encompassed both potentially temporary mental states (e.g., "she's scared," "she wants to") as well as more permanent trait-like qualities (e.g., "he's the scaredy-cat," "she's brave"), and qualities within one's control (e.g., "she's not wearing water shoes") as well as those out of one's control (e.g., "she's younger," "he'd been on it before"). Situational explanations were diverse as well, encompassing both objective qualities of objects (e.g., "it was wet down there," "it's wobbly") as well as subjective qualities (e.g., "it's fun," "it could go too fast," "it's not that high") that inherently also reflect the person deeming it "too" fast or "that" high. Further research specifically exploring these differences would provide a deeper understanding of children's social causal attributions.

We also note that in this study, as in society generally, we referred to characters as named individuals while referring to situations by their generic labels and always included the characters as the subject of the sentence) (e.g., "Marcus is playing on the zipline?"); we also asked participants to explain the events in terms of character's actions (e.g., "why did Marcus play on the zipline?"), rather than to explain situations ("why was the zipline played upon?"). The nature of both the verbal frames and the questions children were asked may have increased children's likelihood of giving personal explanations. Although we referenced both the individual character and the individual zipline in the demonstration and questions, the uniqueness and individuality of people relative to objects, and asking for explanations with

respect to particular characters rather than particular toys, may have also nevertheless implicitly directed children's attention towards personal causes rather than situational causes. Similarly, in everyday life we also typically label people as individuals but objects as generic kinds and discuss people's behaviors. Thus, this mechanism could drive the emergence of a personal attribution biases across development.

Finally, we note that real-world situational factors (e.g., norms, treatment, upbringing, culture, authority) are often more abstract than the toy objects used as situational causes in this study. By making personal and situational causes equally tangible and salient, we were able to control for some of the differences in saliency that might otherwise account for the personal attribution bias. However, future research should explore how reasoning about situational factors might be even more difficult when the situational factors involved are qualitatively different from personal factors by being more abstract or less salient.

Conclusion

In sum, the current study provides evidence for a personal attribution bias in children's social causal reasoning and evidence that verbal framing and statistical patterns impact children's reasoning about both personal and situational causes, specifically with respect to their explanations for social behavior. We also show that the impacts of both patterns and framing are driven by situational cues, which exert a particular influence on children's attributional reasoning. Children have conceptual biases to represent behavior in terms of personal causes, but can identify situational causes if they are suggested through the language they hear or the patterns of evidence they observe. Studying social causal attribution in early childhood may

have important implications for understanding the origins of the attribution biases found throughout adulthood.

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*Table 1**Examples of personal, situational, and combined explanations.*

Personal explanations	Situational explanations	Combined explanations
"Because she wanted to." "Cause she likes it." "Because she's older." "Because she wasn't scared." "Because he didn't like sitting for a super long time." "Because he was braver." "Because he's not the scaredy cat." "Cause he loves it." "Because she was ready." "Maybe he likes to do whatever he wants."	"Cause it's fast." "Cause it's not scary." "Cause it had chairs." "Because it was too, um, watery." "Because it turns." "Cause it was fun." "Because it's wobbly." "Cause it's dizzy." "Cause it was wet down there." "Cause it goes spinning and it could goes too fast and him could FOOM in the sky."	"Because he thought it was lots of fun." "Because it's too fast for her." "She thinked it was scary." "Not scary for him." "Because she had been on the swing before and she saw that she wouldn't fall." "Because she thinks she... it's fun." "She thought it was scary and she didn't like to swim in water."

Table 2

Descriptive statistics (mean and standard deviation) for personal, situational, and combined explanations across conditions.

		Explanation type		
Statistical Pattern condition	Verbal Framing condition	Personal	Combined	Situational
Personal	Personal	84.38% (24.24%)	10.42% (22.01%)	5.21% (14.71%)
	Neutral	89.58% (20.74%)	4.17% (12.04%)	6.25% (15.20%)
	Situational	45.00% (31.88%)	34.00% (33.76%)	21.00% (27.65%)
Neutral	Personal	78.13% (31.55%)	11.46% (25.52%)	10.42% (23.22)%
	Neutral	74.31% (33.69%)	9.38% (23.09%)	16.32% (30.34%)
	Situational	38.54% (42.97%)	28.13% (34.03%)	33.33% (40.83%)
Situational	Personal	54.17% (44.03%)	12.50% (20.85%)	33.33% (39.47%)
	Neutral	66.00% (38.11%)	9.00% (22.68%)	25.00% (36.08%)
	Situational	17.71% (27.07%)	22.92% (34.51%)	59.38% (42.23%)

Figure 1. Overview of study design. The statistical patterns present in the event (personal, situational, or neutral) were fully crossed with the verbal framing used to describe the behaviors (personal, situational, or neutral), yielding a total of 9 conditions in a between-subjects design. All participants were asked the same explanation questions, but prediction questions varied by condition. The specific version of the personal pattern shown might have involved either Sally or Josie engaging (only the former is depicted here), and the specific version of the situational pattern shown may have involved Toy A or Toy B being engaged-with (only the former is depicted here), counterbalanced across participants. Only Trial 1 is depicted here; Trial 2 involved the characters Diego and Marcus.

Statistical Pattern	Verbal Framing	Explanation DV	Prediction DV									
Personal Pattern <table><tr><td></td><td>Toy A</td><td>Toy B</td></tr><tr><td>Sally</td><td>✓</td><td>✓</td></tr><tr><td>Josie</td><td>✗</td><td>✗</td></tr></table>		Toy A	Toy B	Sally	✓	✓	Josie	✗	✗	Personal Framing: "She's [not] gonna play on it; she's [not] scared." Neutral Framing: "She's [not] gonna play on it." Situational Framing: "She's [not] gonna play on it; it's [not] scary."	<p>"So, why did[n't] Josie play on the [toy]?" "Why did[n't] Sally play on the [toy]?"</p>	"Imagine they have a new toy, a [Toy C]. Do you think Sally will play with [Toy C]?" "Do you think Josie will play with [Toy C]?"
	Toy A	Toy B										
Sally	✓	✓										
Josie	✗	✗										
Neutral Pattern <table><tr><td></td><td>Toy A</td><td>Toy B</td></tr><tr><td>Sally</td><td>✓</td><td>✗</td></tr><tr><td>Josie</td><td>✗</td><td>✓</td></tr></table>		Toy A	Toy B	Sally	✓	✗	Josie	✗	✓	Personal Framing: "She's [not] gonna play on it; she's [not] scared." Neutral Framing: "She's [not] gonna play on it." Situational Framing: "She's [not] gonna play on it; it's [not] scary."	(No prediction DV)	
	Toy A	Toy B										
Sally	✓	✗										
Josie	✗	✓										
Situational Pattern <table><tr><td></td><td>Toy A</td><td>Toy B</td></tr><tr><td>Sally</td><td>✓</td><td>✗</td></tr><tr><td>Josie</td><td>✓</td><td>✗</td></tr></table>		Toy A	Toy B	Sally	✓	✗	Josie	✓	✗	Personal Framing: "She's [not] gonna play on it; she's [not] scared." Neutral Framing: "She's [not] gonna play on it." Situational Framing: "She's [not] gonna play on it; it's [not] scary."	"Imagine they have a new friend, Maria. Do you think Maria will play with [Toy A]?" "Do you think Maria will play with [Toy B]?"	
	Toy A	Toy B										
Sally	✓	✗										
Josie	✓	✗										

Figure 2. Participants' average explanation score as a function of the statistical patterns of the behavior and the verbal framing used to describe the behavior. The explanation score is the difference between the % of personal explanations and the % of situational explanations provided by each participant to explain each character's behavior. Scores could range from -100 (all situational explanations) to 100 (all personal explanations); the extent to which scores deviate from 0 indicate more frequent personal or situational explanations.

Figure 3. The percentage of participants' predictions that were consistent with the generalization supported by the statistical pattern as a function of the statistical patterns of the behavior and participants' age.