# Examining Developmental Change in Children's Information Use

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**Abstract**

Adults tend to make biased inferences when they are given base-rates that conflict with individuating information (i.e., a personality description). More recent work has shown that children rely on individuating information by the age of 6, though 4-year-olds rely more on numerical information, arguably providing the more normative response (Gualtieri & Denison, 2018). In two experiments ($N$ = 80 per experiment), we explored age differences in 4- and 6-year-old children's ability to integrate base-rate and individuating information by manipulating the strength of the information provided. Four-year-olds' responses reflected more base-rate use, regardless of the strength of the individuating information. Six-year-olds weighed the information at hand, showing a general preference for the individuating information but relying more on the base-rates when the individuating information was less informative. Though younger preschoolers may *overuse* base-rate information, with development there is an increased sensitivity toward individuating information and weighing information.

**Keywords:** probabilistic reasoning; cognitive development; judgment and decision-making

## Introduction

Adults often have trouble handling multiple, competing sources of information when making decisions. That is, in some cases, adults make biased judgments because they weigh information incorrectly or even appear to ignore one source (Kahneman, 2011; Kahneman & Tversky, 1973; Tversky & Kahneman, 1974). In one classic problem, participants are told that a personality description was taken from a sample of lawyers and engineers. Notably, the personality description and sample information conflict: for instance, there may be 70 lawyers and 30 engineers in the sample, yet the individual is described as enjoying math puzzles and carpentry. When asked to identify the individual's occupation, participants should provide an estimate that reasonably considers the base-rate (i.e., number of lawyers and engineers in the sample) and the individuating information (i.e., the personality description). However, most participants classify the individual's occupation based almost exclusively on the similarity of the personality description to their representation of a typical member of each occupation, showing little sensitivity to the base-rate of occupations. This is often referred to as the representativeness heuristic.

This work raises significant questions regarding the emergence and strengthening of adults' tendency to neglect base-rate information, which has led researchers to examine children's ability to weigh base-rate and individuating information in these problems (Davidson, 1995; De Neys & Feremans, 2013; De Neys & Vanderputte, 2011; Gualtieri & Denison, 2018; Jacobs & Potenza, 1991). In these experiments, participants are given child-friendly adaptations of the adult problem using trait and stereotype information familiar to their age group. For example, in one study, children were given a base-rate of characters (e.g., 8 nice: 2 mean) and were asked to classify a character from the group that they received individuating information about (Gualtieri & Denison, 2018). When the individuating information conflicted with the base-rates, 4-year-olds appeared to take base-rate information into account more than older children and adults. By the age of 6, children seemed to overweigh the individuating information in their judgments at a similar rate as adults, indicating that they neglected the base-rate information in their decisions.

Due to the small body of work on the representativeness heuristic in young children, it is unclear what factors contribute to the emergence and strengthening of a preference for individuating information between the ages of 4 and 6. In two experiments, we presented 4- and 6-year-old children with a child-friendly version of the lawyer-engineer problem. This problem was similar to those presented to children in prior examinations; however, it was modified to achieve two main theoretical goals.

First, we manipulated the base-rate and individuating information to determine if their use was influenced by the strength of the information provided. We investigated whether children are sensitive to the strength of the individuating information by varying the length of the descriptions. This manipulation provides further insight into the development of base-rate neglect, particularly when examining the responses of 6-year-old children from Western cultures, who have shown a general tendency to rely on personality information in various paradigms (Gualtieri & Denison, 2018; Seiver, Gopnik, & Goodman, 2013). In all previous work with children, the individuating information presented has been strong, detailed descriptions that are overwhelmingly representative of one group over the other (Davidson, 1995; Gualtieri & Denison, 2018; Jacobs & Potenza, 1991). Because all previous experiments have used these heavy-handed descriptions, it is unclear if 6-year-olds always rely on the individuating information indiscriminately, or if they weigh the strength of the information in their judgement. Regardless of its strength, 6-year-olds may apply a very simple heuristic where they determine whether the individuating information sounds more like one category or the other, and then choose that category reflexively. However, if children do consider the

strength of the information, this may influence their decision about whether to rely on the individuating information.

To this end, we also manipulated the base-rate information across two experiments to examine children's ability to weigh numerical information in their judgements. This manipulation is particularly informative when interpreting the performance of 4-year-olds, who produced responses that were more in line with base-rates in prior examinations (Gualtieri & Denison, 2018). Four-year-olds have also shown a general tendency to rely on observed statistical data in other paradigms (Lucas, Bridgers, Griffiths, & Gopnik, 2014; Seiver et al., 2013). Similar to how our individuating information manipulation provides insight into 6-year-olds' overreliance on personality descriptions, manipulating the strength of the base-rate information will provide insight into whether 4-year-olds use a *base-rate heuristic*. It is possible that 4-year-olds might be using a simple shortcut in which they match their response to the base-rates reflexively, rather than considering the usefulness of the base-rate information (and other useful information, such as individuating information, when base-rates are less informative).

Second, we created two problems that contained group information that signified a preference for an activity, rather than a social category, allowing for a conceptual replication of recent findings. In one problem, participants were told a story about children in a class that could play baseball or make crafts during free time. In a second problem, participants were told a story about children in a class that could learn about space or wild animals during a trip to a museum. Including problems that contain different social preferences allowed for a broader view on children's conceptual development.

## Experiment 1

In Experiment 1, we examined 4- and 6-year-old children's use of individuating information when it conflicted with base-rate information. To explore the effects of individuating information strength on children's performance, children participated in one of two between-subjects conditions that varied the length of individuating information provided.

### Methods

**Participants** Children were tested individually at their schools or at a local museum. Eighty children were included in the final analyses. Twenty 4-year-olds ($M_{age}$ = 55.33 months; females = 9) and twenty 6-year-olds ($M_{age}$ = 77.51 months; females = 12) participated in the more individuating condition. Twenty 4-year-olds ($M_{age}$ = 54.24 months; females = 11) and twenty 6-year-olds ($M_{age}$ = 78.12 months; females = 12) participated in the less individuating condition. An additional five children were tested and excluded for not finishing the task ($n$ = 3), refusing to agree that there were more kids in the majority group on both trials (despite correction, $n$ = 1) and parental report of atypical development ($n$ = 1). This sample size was decided in advance based on the lab stopping rule at the time of data collection.

**Materials and Procedure** Participants heard two stories about children in a class at a school, narrated live by the experimenter using a PowerPoint presentation. In the activity story, participants were told that children in a class could make a craft or play baseball during free time. Participants were shown a base-rate of children who completed each activity. The base-rate for each problem consisted of eight children completing one activity and two completing the other activity (e.g., eight children making a craft and two children playing baseball). After the experimenter counted the base-rate aloud, participants were asked which activity was completed by more children. Depending on the participant's response, the experimenter agreed or disagreed with the child's answer and stated that there were more children who made a craft and less who played baseball. Following this, participants were told that one child in the class went home for lunch, and they were given case-specific individuating information about the child's traits and preferences that were more stereotypical of a child who, for example, is more likely to enjoy sports versus arts and crafts. The individuating information was representative of the minority group and thus conflicted with the base-rate information. More specifically, if a participant was shown a base-rate of eight children making a craft and two playing baseball, they were given information that corresponded to an interest in sports. After they were told the individuating information, the experimenter asked the participant to indicate which activity they thought the child completed earlier in the day[1].

| | **Condition** | |
|---|---|---|
| | **More individuating** | **Less individuating** |
| *Craft* | This kid likes to paint and play with playdough. They like to make cool things and use their imagination. | This kid likes to paint and play with playdough. |
| *Baseball* | This kid likes to play soccer and tag. They like to run around at recess and ride their bike to school. | This kid likes to play soccer and tag. |
| *Wild animal* | This kid wanted a cat on their cake. They want to take care of animals when they grow up, and they read books about sharks. | This kid wanted a cat on their cake. |
| *Space* | This kid wanted a rocket on their cake. They want to be an astronaut when they grow up, and they read books about aliens. | This kid wanted a rocket on their cake. |

Table 1: Individuating information used in each condition.

Children in the *more individuating* condition were given a lengthier, more informative description that was typical of

[1]Once the child made their choice, the experimenter asked them to rate their confidence in their response. We computed scaled scores based on the dichotomous choice and the confidence judgment, giving us a more sensitive estimate of children's weighing of the information. Though these data are not reported in the current paper due to space constraints, the general pattern of the data and significance comparisons reported with the dichotomous variable held with this more sensitive score.

those used in the classic studies with adults and recent child investigations (Gualtieri & Denison, 2018; Kahneman & Tversky, 1973; Tversky & Kahneman, 1974). Children in the *less individuating* condition were given a shorter, less informative description of the child's preferences, which was still representative of one of the groups (see Table 1 for individuating information for each condition).

In the museum story, participants were told that children on a field trip chose to visit either a wild animal exhibit or a space exhibit, with eight children choosing one exhibit and two choosing the other. Similar to the activity story, participants were given individuating information that corresponded with preferences more representative of the minority group. The order of the stories presented (i.e., activity story first, museum story first), the majority group (and, thus, the individuating information used), the placement of the pictures in the base-rate array, and the group introduced first were counterbalanced across participants.

## Results

Children received a score of 1 on each test trial if they selected the group that corresponded to the individuating information. Though selecting the majority group in line with the base-rate would be a closer approximation to a normative response, we coded the data in this way because we manipulated the strength of the individuating information. This also facilitated comparison across experiments, as children were presented with a 50/50 base-rate in Experiment 2.

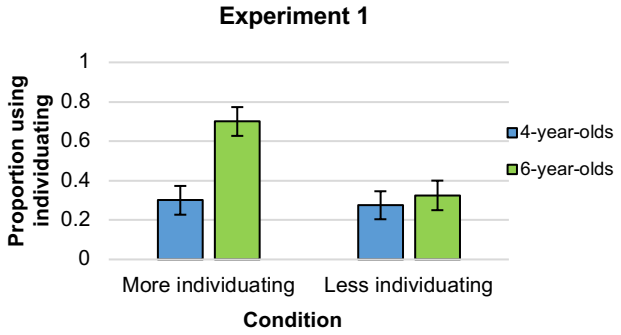


Figure 1: Children's use of individuating information in Experiment 1.

160 trials were included in the final analyses, as each child completed two trials (see Figure 1 for overall means). Preliminary analyses indicated there were no effects of counterbalancing or story type (i.e., problem order: first, second; story: activity, museum) on children's responses. We ran a Generalized Estimating Equation (GEE) binary logistic regression including children's age (4-year-olds, 6-year-olds), condition (more individuating, less individuating) and the interaction between age and condition to examine their impact on children's use of individuating information. This revealed a significant main effect of condition, *Wald* $\chi^2(df = 1) = 5.51$, $p = .019$, and age, *Wald* $\chi^2(df = 1) = 7.12$, $p = .008$. This also revealed a significant age by condition interaction, *Wald* $\chi^2(df = 1) = 4.04$, $p = .044$.

Pairwise comparisons provided additional insight on the age by condition interaction. There was a significant difference between 6-year-olds in the more condition ($M = .70$, $SD = .46$) and 4-year-olds in the more condition ($M = .30$, $SD = .46$; $Mean_{Difference} = -.40$, $p < .001$) and 4-year-olds in the less condition ($M = .28$, $SD = .45$; $Mean_{Difference} = -.43$, $p < .001$). There was also a significant difference between the 6-year-olds in the more condition and those in the less condition ($M = .33$, $SD = .47$; $Mean_{Difference} = -.38$, $p = .001$).

To further understand children's performance at each age, we compared children's overall performance to chance using one sample t-tests. Thus, children received a total score out of 2, which was compared to the chance value of 1. Four-year-olds' use of individuating information was significantly different from chance in both the more ($M = .60$, $SD = .68$), $t(19) = -2.63$, $p = .017$, and less ($M = .55$, $SD = .69$), $t(19) = -2.93$, $p = .009$, conditions. Six-year-olds' use of individuating information was significantly different from chance in the more condition ($M = 1.40$, $SD = .60$), $t(19) = 2.99$, $p = .008$, but not the less condition ($M = .65$, $SD = .81$), $t(19) = -1.93$, $p = .07$.

## Discussion

In Experiment 1, 4- and 6-year-old children were presented with an adapted version of the lawyer-engineer problem. When children were given a more descriptive piece of individuating information, 6-year-olds relied on the individuating information in their inferences while 4-year-olds opted to use the base-rate information. This replicated previous findings in which 4-year-olds' inferences trended toward base-rate use, while 6-year-olds more heavily weighed the individuating information (Gualtieri & Denison, 2018). Notably, 6-year-olds continued to prefer this information more strongly than the base-rates in these problems, which contained personal preference information that are less culturally engrained than the trait and gender stereotypes used in previous problems. However, 6-year-olds did not indiscriminately rely on the individuating information. When presented with the less descriptive individuating information, both 4- and 6-year-olds used the base-rate information in their decisions. Thus, although 6-year-olds show a general tendency to rely on individuating information when it conflicts with base-rates, they seem to monitor the strength of the information provided and opt to rely more on base-rates when the individuating information is less informative.

The results from Experiment 1 suggest that by age 6, children evaluate the strength of the individuating information in their inferences and weigh this information with the base-rate, though they show a general preference toward individuating information. Conversely, 4-year-olds seem to align their responses with the base-rate, regardless of the informativeness of the individuating information. From these findings, it is unclear if 6-year-olds are attending to the base-rate information or if their responses are simply based on the strength of the individuating information. That is, it is possible that 6-year-olds may be selecting the opposite of the

individuating information in the less individuating condition because they find it uninformative, rather than the potentially richer interpretation that they perhaps integrated that information with the base-rates. Importantly, it is also unclear as to whether the 4-year-olds are relying on base-rates in a "rational" way or if they are simply tracking base-rates in their responses with little sensitivity to any other available information in the problem (i.e., the individuating information). In Experiment 2, we presented children with an equal base-rate to examine their use of individuating information. If children are attending to both base-rate and individuating information, they should rely on the individuating information in their inferences as the base-rate is now uninformative.

## Experiment 2

In Experiment 2, we examined children's use of individuating information with an equal base-rate (i.e., 5:5). As in Experiment 1, we varied the strength of the individuating information across two between-subjects conditions.

### Methods

**Participants** Children were tested individually at their schools or at a local museum. Eighty children were included in the final analyses. Twenty 4-year-olds ($M_{age}$ = 56.16 months; females = 8) and twenty 6-year-olds ($M_{age}$ = 76.58 months; females = 9) participated in the more individuating condition. Twenty 4-year-olds ($M_{age}$ = 56.21 months; females = 5) and twenty 6-year-olds ($M_{age}$ = 77.39 months; females = 10) participated in the less individuating condition. An additional five children were tested and excluded for not finishing the task ($n$ = 2) or refusing to agree that there were an equal number of kids in each activity on both trials (despite correction, $n$ = 3).

**Materials and Procedure** The procedure was identical to Experiment 1; however, children were presented with a 5:5 base-rate in both problems. Thus, the base-rate information indicated a 50/50 chance that the child completed either activity. Accordingly, after the experimenter counted the base-rate aloud, she asked participants if more children completed one of the activities or if the same number of children completed both activities. Depending on the child's response, the experimenter agreed or disagreed with their answer and stated that the same number of children completed both activities. As in Experiment 1, the individuating information was varied between conditions, with half of the participants completing the *more individuating* condition and half completing the *less individuating* condition. The order of the stories presented (i.e., activity story first, museum story first), the individuating information used, the placement of the pictures in the base-rate array, and the group introduced first were counterbalanced across participants.

### Results

Children received a score of 1 on each test trial if they selected the group that corresponded to the individuating information. 160 trials were included in the final analyses, as each child completed two trials (see Figure 2 for overall means). Preliminary analyses indicated there were no effects of counterbalancing (i.e., problem order: first, second; story: activity, museum) on children's responses. We conducted a GEE binary logistic regression with age (4-year-olds, 6-year-olds), condition (more individuating, less individuating), and their interaction to examine their impact on children's use of individuating information. This revealed a significant main effect of age, *Wald* $\chi^2(df = 1) = 8.50$, $p = .004$. Condition, *Wald* $\chi^2(df = 1) = .30$, $p = .58$, and the age by condition interaction, *Wald* $\chi^2(df = 1) = .64$, $p = .42$, did not have a significant effect on children's scores. Across conditions, 6-year-olds (more individuating $M = .87$, $SD = .34$; less individuating $M = .80$, $SD = .40$) tended to rely more on the individuating information than 4-year-olds (more individuating $M = .60$, $SD = .49$; less individuating $M = .62$, $SD = .49$).

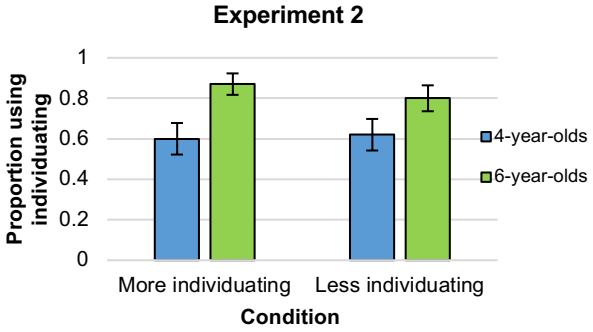


Figure 2: Children's use of individuating information in Experiment 2.

To further understand children's performance at each age, we compared children's overall performance to chance using one sample t-tests. Thus, children received a total score out of 2, which was compared to the chance value of 1. Four-year-olds' use of individuating information was not different from chance in both the more ($M = 1.20$, $SD = .89$), $t(19) = 1$, $p = .33$, and less ($M = 1.25$, $SD = .72$), $t(19) = 1.56$, $p = .14$, conditions. Six-year-olds' use of individuating information was significantly different from chance in both the more ($M = 1.75$, $SD = .44$), $t(19) = 7.55$, $p < .001$, and less ($M = 1.60$, $SD = .68$), $t(19) = 3.94$, $p < .001$, conditions.

### Discussion

In Experiment 2, we presented children with problems that contained an equal base-rate and varied the strength of the individuating information. In this context, 6-year-olds appropriately used the individuating information in their responses. Conversely, 4-year-olds seemed pulled to the

base-rate information, with their mean use of the individuating information close to 50%. From these findings, it seems that 4-year-olds may show a preference for the base-rate information, regardless of whether it is informative or not. However, these findings suggest that 4-year-olds were at least slightly considering the individuating information, in that their means were consistently in the direction aligning with the individuating information in both conditions (approximately 60%).

## General Discussion

In two experiments, 4- and 6-year-old children were given base-rate and individuating information in a child-friendly version of the lawyer-engineer problem. Across manipulations, 4-year-olds seemed to overweigh the base-rate information as they continued to neglect the individuating information even when it would have been reasonable to rely on it in their judgements (i.e., when the base-rate was equal). Conversely, 6-year-olds opted to rely on the individuating information when they were given a strong description that conflicted with the base-rates. However, when the individuating information was not as strong, 6-year-olds used the base-rates in their judgments. From these findings, it seems that 6-year-olds generally prefer the individuating information in their judgments, though they attend to the strength of the information when deciding whether to rely on it over the base-rate.

Between the ages of 4 and 6, children's approach to reconciling base-rate and individuating information undergoes developmental change. Four-year-olds opted to use base-rate information in their judgements, even when this information was not particularly informative to their final decision in Experiment 2. These findings are in line with previous work that has found that 4-year-olds provide responses that are more aligned with observed statistical data, suggesting that they use a more data-driven approach than older children and adults (Gualtieri & Denison, 2018; Lucas et al., 2014; Seiver et al., 2013). However, the current evidence raises the possibility that 4-year-olds are actually *over relying* on base-rate information in this paradigm. Although use of numerical information is often interpreted as the normative response in the judgment and decision-making literature, this interpretation of base-rate use often assumes that the decision-maker is considering all of the available information. Rather, 4-year-olds do not seem to properly account for the individuating information and instead overweigh the base-rate. Four-year-olds' base-rate use may *look* like a normative response, though it seems to be due in part to a non-normative process (i.e., base-rates as an intuitive response, Pennycook, Trippas, Handley, & Thompson, 2014).

Within a period of two years, children develop a preference for individuating information, as evidenced by 6-year-olds' reliance on the strong piece of individuating information that conflicted with a base-rate. It is possible that 6-year-olds have a more general preference for individuating information due to a prior belief regarding the importance of personality descriptions in predicting behaviour, because they have shown preferences for personality information over statistical data in prior work (Gualtieri & Denison, 2018; Seiver et al., 2013). Notably, 6-year-olds' preference for individuating information was affected by the strength of the information. Whereas they relied on the strong individuating information when it conflicted with the base-rate, they used the base-rates in their inferences when it conflicted with a weaker piece of individuating information that contained representative information. This flexible use of base-rate and individuating information suggests that 6-year-olds attempt to weigh information in their decisions.

### Limitations and Future Directions

Although 4-year-olds' current performance suggests that they tend to stick with base-rate data in these problems, we are cautious in our interpretation of their performance, since it is possible that they did not find the individuating information in the current problem useful to their inferences. This issue has been discussed in prior examinations of the representativeness heuristic in children, which have found that young children opt to rely on base-rates more when they are unfamiliar with the group information used in the problem (see De Neys & Vanderputte, 2011, for a discussion of this issue). In the current experiments, we chose to present children with group information that was less practiced in Western cultures, though still age-appropriate for preschoolers. We are currently testing 4-year-old children in a baseline condition that only contains individuating information to ensure that they can use this information when it is presented on its own. Though data collection is ongoing, it seems that they rely on individuating information at above chance levels (current $n = 40$, overall $M = 66\%$, $t(39) = 2.69$, $p = .01$, no significant differences between conditions and story types). This suggests that 4-year-olds rely on individuating information when it is the only information in the problem, though are pulled toward base-rates if available.

Moreover, much future work is needed to elucidate the potential mechanism driving these age-related changes in children's performance. Many aspects of children's cognition develop between the ages of 4 and 6, which could contribute to differences in their approach to solving these problems. Children's executive functions undergo drastic development during the preschool years (see Diamond, 2013, for a review). It is possible that development in children's executive functions aids in their ability to integrate information and/or hold multiple pieces of competing information in mind, accounting for age differences observed in children's sensitivity to the strength of the information. That is, 6-year-olds' ability to weigh the strength of the information in their decisions may be due in part to their better-developed working memory and cognitive flexibility, because these abilities may allow them to hold multiple pieces of information in mind while they consider different decisions.

It is also possible that 6-year-olds' preference for individuating information may be due in part to a stronger sensitivity to the pragmatics of the paradigm. Adults' use of

individuating information is affected by the framing of the problem, suggesting that their sensitivity to the pragmatic features influences their weighing of the information. For instance, if adults are told the individuating information was randomly drawn by a computer, they are more inclined to use the base-rates in their inferences than if it was chosen by a psychologist (Schwarz, Strack, Hilton, & Naderer, 1991). Children's sensitivity to conversational pragmatics develops between the ages of 4 and 6 (Matthews, 2014). In the current paper, 6-year-olds' varied responses across manipulations were interpreted as a development in sensitivity to information strength. However, these data could also be viewed as evidence for a pragmatic account. For instance, a 6-year-old child who is more attuned to conversational pragmatics may wonder why the experimenter provided such a detailed description of the individual if she did not want them to consider the individuating information in their decision. Because the lower quality individuating information was also much shorter, it might be seen as less heavy-handed, which could reduce its use if children are attuned to this pragmatic feature.

A final future direction involves exploring the interaction between children's stereotype familiarity and information quality in their weighing of individuating information. Recent developmental investigations of the representativeness heuristic have gone to great lengths to ensure that children are familiar with the group information given to them in the problem (i.e., presenting them with gender information they are familiar with; see De Neys & Vanderputte, 2011). In the current experiments, we conceptually replicated previous findings with less culturally embedded information, which allowed us to explore if stereotype familiarity was leading 6-year-olds to use individuating information. However, it is possible that children would continue to use less descriptive individuating information in their decisions if it described a social category that they were quite familiar with. Future work manipulating the familiarity and relative entrenchment of group information in tandem with information quality would be pivotal in determining the features that lead young children to rely on individuating information.

**Implications and Conclusions**

Within a period of two years, children employ different strategies when reconciling base-rate and individuating information. Four-year-olds tend to align their responses with the base-rate data, even in situations where it would be reasonable to rely on individuating information. Conversely, 6-year-olds show a preference for strong individuating information, although they weigh the strength of the information and rely on base-rates when the individuating information is less descriptive. These findings provide insight on nuances in the emergence and strengthening of children's developing ability to integrate information that were previously unexplored.

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## References

Davidson, D. (1995). The representativeness heuristic and the conjunction fallacy effect in children's decision making. *Merrill-Palmer Quarterly, 41*(3), 328-346.

De Neys, W., & Feremans, V. (2013). Development of heuristic bias detection in elementary school. *Developmental Psychology, 49*(2), 258-269.

De Neys, W., & Vanderputte, K. (2011). When less is not always more: Stereotype knowledge and reasoning development. *Developmental Psychology, 47*(2), 432-441.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*(1), 135-168.

Gualtieri, S., & Denison, S. (2018). The development of the representativeness heuristic in young children. *Journal of Experimental Child Psychology, 174*, 60-76.

Jacobs, J. E., & Potenza, M. (1991). The use of judgment heuristics to make social and object decisions: A developmental perspective. *Child Development, 62*(1).

Kahneman, D. (2011). *Thinking, fast and slow*. New York: Farrar, Straus and Giroux.

Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80*(4), 237.

Lucas, C. G., Bridgers, S., Griffiths, T. L., & Gopnik, A. (2014). When children are better (or at least more open-minded) learners than adults: Developmental differences in learning the forms of causal relationships. *Cognition, 131*(2), 284-299.

Matthews, D. (2014). *Pragmatic development in first language acquisition.* John Benjamins Publishing Company.

Pennycook, G., Trippas, D., Handley, S. J., & Thompson, V. A. (2014). Base rates: both neglected and intuitive. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 40*(2), 544.

Schwarz, N., Strack, F., Hilton, D., & Naderer, G. (1991). Base rates, representativeness, and the logic of conversation: The contextual relevance of "Irrelevant" information. *Social Cognition, 9*(1), 67-84.

Seiver, E., Gopnik, A., & Goodman, N. D. (2013). Did she jump because she was the big sister or because the trampoline was safe? Causal inference and the development of social attribution. *Child Development, 84*(2), 443-454.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131.