When Simple Counting Fails: Young Children Understand Event Prevalence Using Proportional Reasoning

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Abstract

Proportional reasoning is essential for many real-world tasks, yet its developmental trajectory remains debated. Children's performance in nonsymbolic proportional reasoning varies across tasks and plummets when numerical information is misleading. The present study investigates whether 5- to 7-year-old children can accurately compare proportions in a naturalistic context where counting strategies are ineffective. Children listened to short stories in which a subset of people from each of two groups experienced an event (e.g., catching the flu). Given the equal numbers of affected individuals in both groups and different group sizes, children needed to rely on proportional reasoning to compare the prevalence of the event. Results showed that children performed significantly above chance overall. Moreover, they were more accurate in adverse scenarios (e.g., avoiding illness) than in favorable ones (e.g., acquiring rewards). These preliminary findings suggest that the ability to compare nonsymbolic proportions emerges by age 5 but varies depending on context.

Keywords: nonsymbolic proportional reasoning; mathematical cognition; cognitive development

Introduction

The ability to reason about proportions despite misleading absolute number information is essential for everyday and scientific reasoning. For instance, when comparing flu infection rates across different social groups, the group with a larger population may have a lower infection rate even if more individuals contract the flu. Similarly, proportional reasoning is crucial for understanding fundamental concepts in the sciences such as physics (e.g., density, velocity) and chemistry (e.g., concentration). Given its significance, much research has investigated the developmental trajectory of proportional reasoning.

Previous research suggests that preverbal infants can discriminate between different ratios and proportions presented in nonsymbolic formats (Denison & Xu, 2014; McCrink & Wynn, 2007). For example, McCrink and Wynn (2007) demonstrated that 5- to 7-month-old infants could distinguish between different ratios by habituating them to a specific proportion of blue pellets and yellow Pac-Men (e.g., 4:1). When tested with a novel ratio (e.g., 2:1), infants looked longer, suggesting sensitivity to different proportions. Similarly, Denison and Xu (2014) found that 10- to 12-month-old infants could use proportional information to make probabilistic inferences. In their study, an experimenter randomly drew an object from each of two jars and placed the objects into two cups. Results showed that 10- to 12-month-olds chose the cup that was more likely to yield a preferred object based on proportion of the preferred object, rather than its absolute number in each jar.

However, research with older children presents mixed findings. Some studies indicate that children as young as 4 years old can reason about nonsymbolic proportional information, while others indicate that children continue to struggle with proportional reasoning tasks until as late as age 10 (Abreu-Mendoza et al., 2020; Acredolo et al., 1989; Duffy, Huttenlocher, & Levine, 2005; Goswami, 1989; Hurst & Cordes, 2017; Jeong, Levine, & Huttenlocher, 2007; Noelting, 1980; Piaget & Inhelder, 1975; Spinillo & Briant, 1991). Several studies have reported early successes. For example, Goswami (1989) showed that 6-year-old children could recognize and match proportional relationships across different shapes. In the task, children were presented with a sequence of shapes with the same proportional pattern (e.g., a half-black square, a half-black circle, and a half-black trapezoid). When asked to select the next shape in the sequence, they correctly chose a half-black rectangle rather than an incorrect alternative, such as a quarter-black rectangle. Spinillo and Briant (1991) found that children as young as 4 years of age could successfully match proportions despite differing absolute quantities. In their study, children were shown two identical boxes, each containing sections of blue and white bricks arranged in different ratios (e.g., 1/8 vs. 3/8). When presented with a picture of another target box displaying a specific blue-to-white ratio, 4- to 7-year-olds correctly selected the box that matched the target ratio. In addition, Duffy, Huttenlocher, and Levine (2005) found that by the age of 4, children could recognize and match proportional relationships. In their study, children were presented with a target dowel placed inside a container. Four-year-olds successfully selected another dowel that maintained the same proportional relationship to its own container. These findings suggest that young children can identify and match proportional relationships in various non-numerical contexts, such as geometric shape, proportional area, and length.

On the other hand, Jeong, Levine, and Huttenlocher (2007) found that even 10-year-old children performed at chance in a nonsymbolic proportion comparison task, suggesting difficulties in reasoning about proportions when absolute number information was misleading. In their study, children were presented with two donut-shaped spinners, each divided into red and blue regions, varying in both size and red-to-blue ratio. Children were tested in 3 conditions, *continuous*, *discrete adjacent*, and *discrete mixed*. In the *continuous* condition, the spinners were undivided. In the *discrete adjacent* condition, the spinners were divided into blocks, with same-color blocks adjacent to each other. In the *discrete mixed* condition, the spinners were divided into blocks, and the different-color blocks were intermixed. At test, children had to select the spinner with a higher proportion of red. In the discrete conditions, two possible strategies were available: (1) comparing the proportional area of redness (2) counting and comparing the number of red blocks. To differentiate between these strategies, the study included *counting-consistent* trials, where absolute number and proportion aligned, and *counting-misleading* trials, where a higher number of red blocks did not correspond to a larger proportional area (e.g., 4 red out of 9 = 44% vs. 3 red out of 5 = 60%). Results showed that 6-, 8-, and 10-year-olds performed at chance on *counting-misleading* trials in both discrete conditions, suggesting challenge in reasoning about proportions correctly.

One way to look at the discrepancy between children's performance across different tasks is the format they used to represent proportions. In tasks where younger children succeeded, *proportions were represented as continuous quantities*. For example, proportion was represented as the relative length of a dowel to its container, or a continuous section of a brick/shape painted blue/black. (Duffy, Huttenlocher, & Levine, 2005; Goswami, 1989; Spinillo & Briant, 1991). Although some infant studies used discrete quantities (large numbers of colored dots, lollipops), it was unlikely that 6- to 12-month-olds succeeded by counting individual items (Denison & Xu, 2014; McCrink & Wynn, 2007). In contrast, older children who succeeded in continuous proportional reasoning often struggled when proportions were represented in discrete formats. For example, children up to age 10 accurately compared the proportional area of redness in two continuous spinners but failed to compare two spinners divided into blocks (Abreu-Mendoza et al., 2020; Acredolo et al., 1989; Jeong, Levine, & Huttenlocher, 2007; Noelting, 1980; Piaget & Inhelder, 1975). One possible explanation is that as children become more fluent in counting, they increasingly rely on an erroneous counting strategy. They count and compare absolute numerators rather than attending to the proportions when faced with discrete proportional reasoning tasks. In other words, children may only focus on absolute quantities and overlook the proportional relationship (Boyer & Levine, 2015; Hurst & Cordes, 2017; Jeong, Levine, & Huttenlocher, 2007). Indeed, research has shown that prompting children to use a proportional comparison strategy rather than simple counting significantly improved their performance. For example, Boyer and Levine (2015) conducted a study in which 6- to 10-year-old children were shown a target proportion of juice and water in a vertical column and were asked to select a matching proportion from two options, both differing in absolute length from the original example. In *continuous* trials, the juice and water appeared as continuous sections, whereas in *discrete* trials, the columns were divided into equal-sized blocks. In the experimental condition, children completed a block of *continuous* trials first, while in the control condition, they began with *discrete* trials. Results showed that 6-, 8-, and 10-year-olds in the experimental condition outperformed those in the control group, suggesting that prior exposure to continuous proportions and the proportion comparison strategy facilitated proportional reasoning in discrete contexts. Similarly, Hurst and Cordes (2017) found that 5- to 6-year-old children who first completed a block of *continuous* spinner trials performed significantly better in subsequent *discrete*, *counting-misleading* trials compared to children who started with discrete trials. These findings suggest children's proportional reasoning abilities might have been masked by their overemphasis on counting and comparing discrete units.

A more recent study using the spinner task found that context framing can help mitigate children's tendency to rely on an erroneous counting strategy in *discrete*, *counting-misleading* trials. In the study, participants were randomly assigned to one of two conditions: *gain* or *loss*. In the *gain* condition, children were told they could win a sticker if the spinner landed on red. In the *loss* condition, they would lose a sticker if the spinner landed on blue. There was suggestive evidence that children performed better in the *loss* condition than in the *gain* condition (Hamamouche & Cordes, 2023). It appears that children's performance in proportional reasoning may be influenced by positive or negative context framing.

While previous research reveals children's success in some proportional reasoning tasks, several questions remain open. First, prior studies have primarily focused on game-like scenarios such as the spinner game, juice mixing (e.g., Boyer & Levine, 2015; Jeong et al., 2007). Children's ability to apply proportional reasoning in everyday contexts is underexplored. Perhaps young children would be better at proportional reasoning when presented with more familiar scenarios. Second, previous research demonstrates success in tasks where proportions are represented in a continuous format. However, children still struggled with tasks involving discrete units, particularly when the numerator was misleading. Third, in previous discrete proportional reasoning tasks, the numerators were always different, leaving open the possibility that children relied on simple counting rather than proportional reasoning in both *counting-consistent* and *counting-misleading* conditions.

The current study investigates 5- to 7-year-old children's proportional reasoning, using more familiar contexts. We used a more naturalistic task in which proportions were represented as event prevalence in fictional social scenarios. Second, in our proportion comparison task, the numerators in two proportions were the same (e.g., 4 out of 16 vs. 4 out of 8). For example, if three children on a soccer team (3 out of 20) and three children in a singing group (3 out of 10) caught the flu, simply counting and comparing the numerators would be ineffective, which may help children switch to proportional reasoning. We hypothesized that these changes would enhance children's performance in a discrete proportional reasoning task. To further investigate contextual influences, we presented both positive and negative story framing to examine whether children's performance differs based on the context, as prior research suggests that context framing (e.g., loss vs. gain) may influence children's proportional reasoning (Hamamouche & Cordes, 2023).

In the current study, children listened to short stories in which two groups of characters experienced an event (e.g., catching the flu, winning a prize) at different rates. The group sizes followed a 2:1 ratio (e.g., 16 green children vs. 8 yellow children), and an equal number of individuals from each group experienced the event (e.g., 4 green and 4 yellow children caught the flu). Because the absolute number of affected individuals was the same in both groups, counting and comparing absolute numerators alone could not lead to the correct response. Instead, children needed to rely on proportional reasoning. To ensure comparability with previous studies, we selected proportional differences (50% vs. 25%, or 33% vs. 17%) based on prior work investigating children's ability to compare proportions (Jeong et al., 2007).

At test, children answered two questions for each story: (1) Which group do you want to be in (implicit comparison)? (2) Which group experiences the event more often (explicit comparison)? Each child completed four stories — two adverse scenarios (e.g., flu, stomachache) and two favorable scenarios (e.g., candy, prize). If children successfully compared proportions, we expected them to prefer the group with the lower event prevalence in adverse scenarios and the group with the higher event prevalence in favorable scenarios. Additionally, we predicted that children would correctly identify the group with the greater event prevalence.

Methods

Participants

Thirty-two 5- to 7-year-old children were tested. No participants were excluded from the data analysis. The final sample consists of 32 participants (Age range = 5.02 – 7.87, Mean = 6.4, SD = 0.88, 16 male and 16 female). Age was measured continuously based on date of birth and date of testing (in decimal years; e.g., 5.25 years). Participants were either recruited from a database and tested via Zoom, a video conferencing software, or recruited and tested in person at a local science museum. Participants were compensated with a $5 Amazon gift card or received a small prize (e.g., a small toy).

Materials

Materials consist of cartoon sketches of children and four different events. Stimuli were created using Microsoft PowerPoint. All stimuli were presented on a 13” laptop.

Design

The study consisted of 4 stories, including two adverse scenarios (i.e., *flu*; *stomachache*) and two favorable scenarios (i.e., *candy*; *prize*). Each participant answered two test questions per story (one preference, one event prevalence), for a total of 8 test trials. In each story, participants were introduced to two groups of children. One group always had twice as many children as the other group (a ratio of 2:1; e.g., 16 green children and 8 yellow children). An equal number of children from each group experienced the same event (e.g., 4 green children and 4 yellow children caught the flu). Because the group sizes were different, the proportion of children experiencing the event differed between the two groups. In the *flu* and the *candy* stories, the event prevalences in the two groups were 25% vs. 50%. In the *stomachache* and the *prize* stories, the event prevalences in two groups were 16% vs. 33%.

The study employed a within-subject design, with story order and majority side counterbalanced across participants. Each participant was randomly assigned to one of two story orders: [*flu*, *stomachache*, *candy*, *prize*], or [*candy*, *prize*, *flu*, *stomachache*]. Each participant was also assigned to one of two orders of the majority group’s side in each trial (left vs. right: LRRL or RLLR).

Procedure

At the beginning of the study, all participants completed a color check. They saw eight colored stars and were asked to name the colors. The colors tested included red, yellow, green, gray, blue, pink, orange, and purple.

Participants were told that they will listen to some stories and answer questions about the children in those stories. For each story, participants were asked to answer three questions, one group size comparison question and two test questions. In each story, the questions were always asked in the following order: 1. *group size comparison* 2. *test question one - group preference* 3. *test question two - event prevalence*.

Adverse Story 1 - *Flu*

Proportions of individuals experiencing the event in the two groups were 4/16 (25%) and 4/8 (50%).

Group Size Comparison. At the beginning of the story, participants were shown two groups of children, each positioned on one side of the screen with a blank space in the middle. One group had 16 green children in it, and the other group had 8 yellow children in it. Children within the same group looked identical. The children were arranged in rows such that both groups had the same number of rows (Figure 1a). The experimenter said to the participant, “Look, these are all the kids! Are there more [Color 1] kids or more [Color 2] kids [reading the colors from left to right]?” Participants responded either verbally or by pointing. The group size comparison ensured that participants could correctly identify colors and compare group sizes. Participants who failed one or more group size comparison questions were excluded from the analysis.

Story Introduction. After completing the group size comparison, a cartoon virus appeared in the blank space between the two groups (Figure 1b). The experimenter said to the participant, “One summer kids in the town got sick.” Next, cartoon symbols of sneezing and coughing appeared next to four randomly selected children from each group (Figure 1c). The experimenter explained, “Look, four [Color 1] kids got sick and started sneezing and coughing [pointing to each of them]. Four [Color 2] kids also got sick and started sneezing and coughing [pointing to each of them].”

Test Question 1 – Group Preference. After the story introduction, the experimenter asked: "[Child's name], if you don't want to get sick, which group will you hang out with? The [Color 1] group or the [Color 2] group [pointing to each respective group]?"
Test Question 2 – Event Prevalence. The experimenter then asked: "Do you think the [Color 1] kids get sick more often, or the [Color 2] kids get sick more often?"

Adverse Story 2 – *Stomachache*

The procedure was similar to the one in Adverse Story 1. In this story, one group had 6 red children in it, and the other had 12 blue children in it. Proportion of individuals experiencing the event in each group was 2/12 (16%) or 2/6 (33%).
Story Introduction. A cartoon symbol of rotten fruit appeared, and the experimenter said to the participant, "One day the weather was hot, and fruit went bad. Everybody had some bad fruit. Two [Color 3] kids got a stomachache, and two [Color 4] kids also got a stomachache." Stomachache cartoon symbols appeared next to the respective children.
Test Question 1 – Group Preference. The experimenter asked: "[Child's name], if you don't want to get a stomachache, which group will you be in?"
Test Question 2 – Event Prevalence. Same as in Adverse Story 1.

Favorable Story 1 - *Candy*

The procedure was similar to the one in Adverse Story 1. In this story, one group had 10 gray children in it, and the other had 20 purple children in it. Proportion of individuals experiencing the event in each group was 5/20 (25%) or 5/10 (50%).
Story Introduction. A cartoon symbol of a county fair appeared, and the experimenter said to the participant, "There was a county fair and there were two candy machines. The candy machines only gave out candies some of the time. Five [Color 5] kids got a candy, and five [Color 6] kids also got a candy." Candy symbols appeared next to the respective children. (Figure 2a-2c)
Test Question 1 – Group Preference. The experimenter asked: "[Child's name], if you really want to get a candy, which group will you be in?"
Test Question 2 – Event Prevalence. The experimenter asked: "Do you think the [Color 5] kids get candies more often, or the [Color 6] kids get candies more often?"

Favorable Story 2 - *Prize*

The procedure was similar to the one in Adverse Story 1. In this story, one group had 18 orange children in it, and the other had 9 pink children in it. Proportion of individuals experiencing the event in each group was 3/18 (16%) or 3/9 (33%).
Story Introduction. A cartoon symbol of a game booth appeared, and the experimenter said to the participant, "There were two game booths, and you could get a prize if you win the game. Three [Color 7] kids won a prize, and three [Color 8] kids also won a prize." Prize symbols appeared next to the respective children.
Test Question 1 – Group Preference. The experimenter asked: "[Child's name], if you really want to win a prize, which group will you be in?"
Test Question 2 – Event Prevalence. Same as in Favorable Story 1.

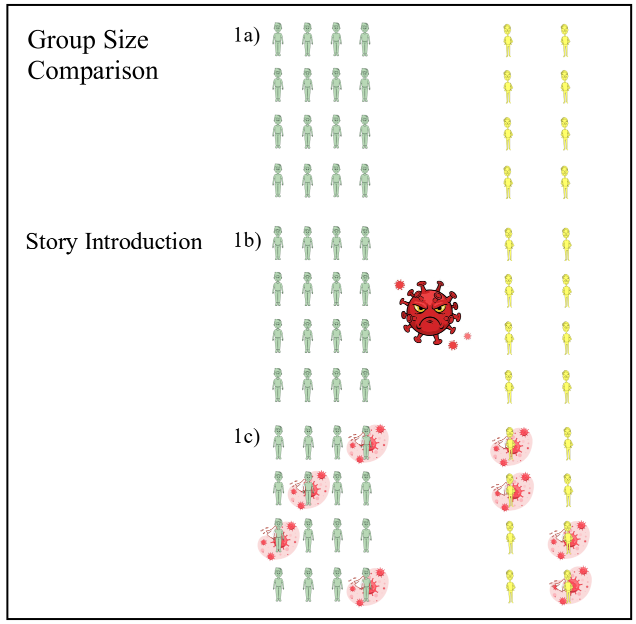

Figure 1: Adverse Story 1 - *flu*. 1a) *group size comparison*. 1b) - 1c) *story introduction*.

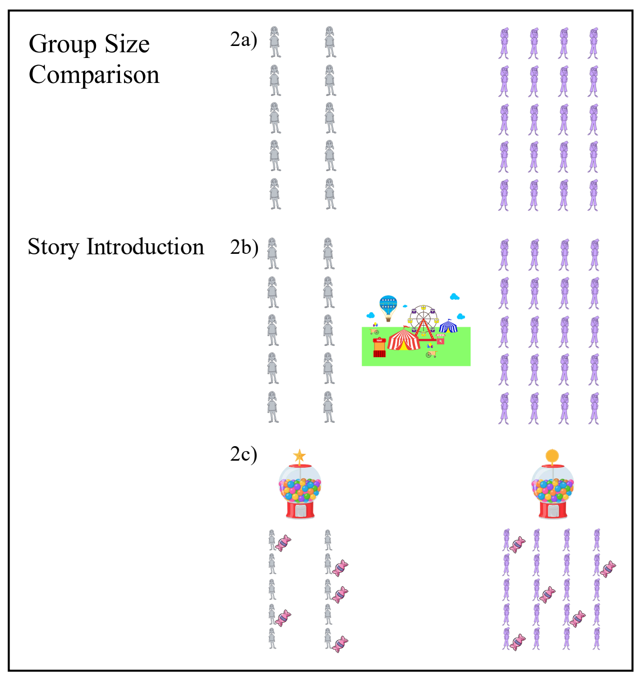

Figure 2: Favorable Story 1 – *candy*. 2a) *group size comparison*. 2b) - 2c) *story introduction*.

Results

All participants passed the *group size comparison* questions. For the test questions, chance was established at 50% as there were two options for each question.

We first examined the effects of gender (male vs. female), test location (Zoom vs. in person), story order (whether participants saw the two negative stories first), and majority side (the side where the majority group was on in each story). Wilcoxon rank-sum tests found that there was no effect of gender (W = 7936, $p = 0.59$), or test location (W = 8192, $p = 0.27$). There was also no effect of story order (W = 7552, $p = 0.18$) or majority side (W = 7936, $p = 0.59$). Gender, test location, story order, or majority side did not significantly influence the participants' responses.

The mean correct response for participants across all test questions was 69%. A Wilcoxon test found that the participants' performance was significantly greater than chance (50%), (V = 22616, $p < 0.001$, r = 0.37).

Next a generalized Linear Mixed Effects Model (GLMM) was fit to predict participants' binary responses (1 = correct, 0 = incorrect), from the fixed effect of age (continuous), story type (adverse vs. favorable story), and test question type (Test Question 1 vs. 2) with a random intercept for participant id. There was a main effect of age ($\hat{\beta} = 0.60$, SE = 0.26, z = 2.285, $p = 0.02$). There was also a main effect of story type ($\hat{\beta} = -1.57$, SE = 0.33, z = -4.70, $p < 0.001$). There was no effect of question type ($\hat{\beta} = -0.38$, SE = 0.31, z = -1.23, $p = 0.22$) nor any other interactions. Overall, the participants' performance improved as their age increased. Moreover, the participants performed significantly better in adverse story scenarios compared to favorable story scenarios.

Given the significant effect of story type, we conducted separate Wilcoxon signed rank tests to compare participants' performance in different stories to chance. For the Test Question 1 in each story, participants' mean accuracy was 91% for adverse story – *flu* (V = 479, $p < 0.001$, r = 0.81), 91% for adverse story – *stomachache* (V = 479, $p < 0.001$, r = 0.81), 41% for favorable story – *candy* (V = 215, $p = 0.29$, r = 0.19), and 66% for favorable story – *prize* (V = 347, $p = 0.08$, r = 0.31). For Test Question 2 in each story, participants' mean accuracy was 75% for adverse story – *flu* (V = 396, $p = 0.005$, r = 0.50), 72% for adverse story – *stomachache* (V = 380, $p = 0.01$, r = 0.44), 63% for favorable story – *candy* (V = 330, $p = 0.16$, r = 0.25), and 53% for favorable story – *prize* (V = 281, $p = 0.73$, r = 0.06). Participants performed above chance in the two adverse stories, regardless of test question type, but not in the two favorable stories. (Figure 3)

Although the GLMM model did not reveal a significant effect of question type, descriptive data suggest that in the adverse stories, participants performed better on Question 1 (M = 91%, 91%) compared to Question 2 (Mean = 75%, 72%). An exploratory analysis with a Wilcoxon rank-sum test confirmed this difference as statistically significant (W = 2400, $p = 0.01$). However, this pattern was not observed in the positive stories (Question 1 Mean = 0.53, SD = 0.06; Question 2 Mean = 0.58, SD = 0.06; W = 1952, $p = 0.60$).

Given the main effect of age, we split the children into two groups, younger (M = 5.61, SD = 0.11) and older (M = 7.17, SD = 0.08). Separate Wilcoxon signed rank tests showed that when collapsing all eight test questions, performance was significantly above chance in both the younger group (V = 4967, $p = 0.02$, r = 0.20) and the older group (V = 6386, $p < 0.001$, r = 0.55). (Figure 4)

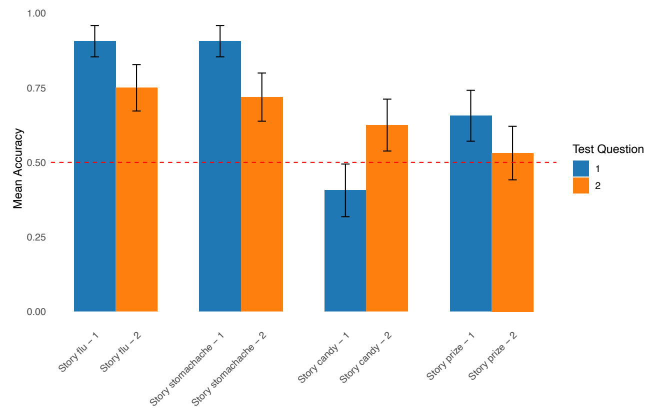

Figure 3: Mean accuracy for Group Preference (Test Question 1) and Event Prevalence (Test Question 2) judgments across different stories.

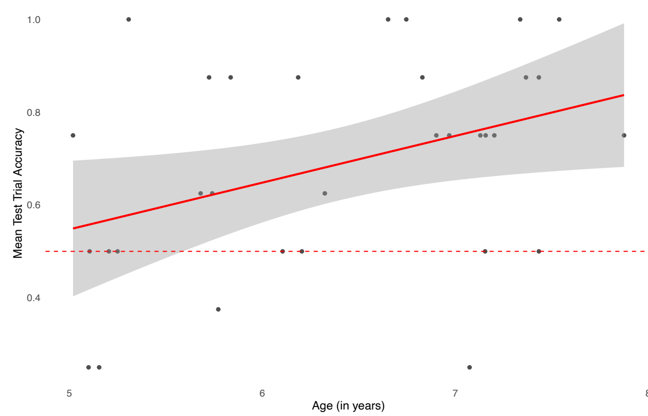

Figure 4: Participants' performance by age (in decimal years). Each dot represents a participant's mean performance across all 8 test questions.

Discussion

We found that 5- to 7-year-old succeeded in comparing two nonsymbolic proportions represented as event prevalence in two populations, when simply counting the number of occurrence was ineffective. Participants' performance increased with age and varied across story types. They performed well above chance in the two adverse story scenarios but performed at chance level in the two favorable story scenarios.

Our study provides evidence that children as young as 5 can correctly compare two nonsymbolic proportions. Because the numerators were the same in each pair of proportions, children could not succeed by simply comparing the absolute numbers of affected individuals. Instead, their success suggests that they engaged in reasoning about the proportions — the relationship between the number affected and the total group size. Previous research demonstrating success in proportional reasoning in preschoolers showed that young children can compare continuous proportions (Duffy, Huttenlocher, & Levine, 2005; Goswami, 1989; Spinillo & Briant, 1991). Our findings suggest that children, even before formal schooling, possess an intuitive understanding of nonsymbolic, discrete proportions. When simply counting numerators is uninformative, even preschoolers show competency in discrete proportional reasoning.

One possible alternative interpretation of our findings is that in the adverse scenarios, children may have used an alternative strategy rather than proportional reasoning. Specifically, in Test Question 1 (group preference), participants may have reached the correct answer by comparing the number of non-affected children rather than directly comparing the proportion of affected individuals. For example, in the flu scenario, the correct answer aligns with the group that has more non-sick children, which might have been a simpler heuristic for children to use rather than explicitly reasoning about proportions. However, if children were relying on this heuristic, we would expect them to be at chance in Test Question 2 (event prevalence), where they were directly asked to compare the two proportions. Since children performed significantly above chance in Test Question 2 in the adverse stories, it was unlikely that they relied on a simple heuristic but instead engaged in proportional reasoning.

Our results also highlight the variability in children's proportional reasoning depending on the context of the task. Children performed significantly better in the adverse scenarios (*flu* and *stomachache*) than in the favorable ones (*candy* and *prize*). This suggests that children may be more adept at processing proportional information when the motivation is to avoid a negative consequence rather than to acquire a reward. In other words, children might be more attentive to proportional reasoning when the stakes involve a potential negative outcome, leading to improved performance. Alternatively, this effect may be driven by differences in how easily children understand the mechanisms underlying the events. It might be easier for them to understand the mechanism of the adverse stories (e.g., catching the flu) because they have everyday experience with them. But in the favorable scenarios (e.g., getting a candy from a machine), children might form incorrect assumptions about the mechanism. For example, they might assume that the chance of getting a candy is not related to group membership but determined by other characteristics like the children's color. It is possible that in the favorable stories, participants did not rely on proportional information and thus resulted in the chance-level performance.

Our findings raise important questions for future research. While previous studies show that children up to 10 years of age have difficulty in proportional reasoning tasks, our study demonstrates success in an adapted task from 5 years of age. This suggests that the ability may emerge earlier than previously thought. Future studies may explore whether younger children (e.g., 3- to 4-year-olds) can reason about nonsymbolic discrete proportions in order to understand the developmental origin of proportional reasoning.

Furthermore, as children's performance diverged between adverse and favorable scenarios, it would be valuable to examine the reason for such disparity. One issue in the current study is that the scenarios might mislead children to make incorrect assumptions about the event mechanism. For example, in the *prize* story, children might think that winners receive prizes because they are inherently better at the game, unrelated to group membership. Future studies should adapt the favorable stories to minimize potential misinterpretations. Additionally, future research can measure and analyze children's verbal explanations of event mechanisms and their reasoning about their choices. These extensions would provide a more comprehensive understanding of children's discrete proportional reasoning in varying contexts.

Finally, our findings suggest that when simply comparing the numerators is ineffective, children can use proportions to guide their reasoning. This supports the idea that proportional reasoning is an emerging cognitive ability in early childhood. However, many real-world scenarios require reasoning about proportional relationships with misleading numbers. For example, when comparing flu prevalence in cases like 100 out of 1000 women versus 200 out of 10,000 men, we need to focus on the proportional relationship and inhibit focusing on the absolute number of cases. Future research can explore how young children navigate misleading numerical information and shift their focus to proportional reasoning.

In conclusion, our study provides evidence that children as young as 5 to 7 years old can correctly compare nonsymbolic discrete proportions, when comparing absolute numerators is uninformative. While previous research focused on proportions in abstract games, we designed a task with everyday contexts where proportions were represented as event prevalence in populations. These familiar scenarios, especially the adverse ones, enhanced children's performance in discrete proportional reasoning. Our findings also reveal variability in performance depending on the task context. Children performed better in adverse scenarios than in favorable ones, suggesting that contextual factors may influence children's ability to accurately compare discrete proportions. This work contributes to a growing understanding of how cognitive and contextual factors interact to reveal the true scope of young children's emerging proportional reasoning skills.

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