Insights into Young Children's Probability Reasoning

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A pilot study with eight children (ages 6–8) explored their use of visual probabilistic information in a task where Lucy lemur plays the roulette. Children estimated happiness of Lucy and chose games based on probabilities, showing consistent choices matching the two modalities and no clear preference for specific probability values. Results indicate that young children can process complex visual probabilistic information and make consistent estimates, laying the groundwork for further research on probabilistic reasoning. [c]

Understanding how children reason about probability is a fundamental question in cognitive development. As our world becomes more driven by data and uncertainty, children's ability to interpret and integrate probabilistic information is increasingly relevant both in education and daily life.

Classic research has shown that children can use both frequencies and probabilities for decision-making, but their reasoning can be affected by context and how information is presented. Schlottmann's Lucy Lemur test [2] introduced a playful and intuitive method for studying probabilistic reasoning, minimizing linguistic demands and focusing on visual and intuitive judgments. Later studies [3, 4] confirmed that even young children can integrate probabilities and outcomes, although individual differences and task features modulate their performance.

The present pilot study aims to assess the consistency and sophistication of young children's probabilistic reasoning using a simplified, digital version of the Lucy task. We focus on how children integrate visual cues to form probabilistic judgments and how their choices align with their initial estimations.

Method

Participants and context. Eight children (4 first graders, 4 third graders; ages 6–8) from Suecia School, Montevideo, participated after informed consent. The pilot is part of a larger project in collaboration with the Interdisciplinary Center for Cognition, Education, and Learning (CICEA), aiming to include 100 children in future phases.

Procedure and tasks. Testing was conducted individually on tablets in a quiet room. The Lucy task consisted of two blocks (see Figs. 1 and 2). In Block 1, the children viewed a game composed of two independent roulettes, each divided into green (winning) and red (losing) sections. To win the game -and thus make Lucy happiest- both roulettes had to land on green. Children used a slider to indicate how happy Lucy would be with each configuration, effectively expressing how likely it was for both roulettes to land on green. This task allowed them to map their probabilistic intuitions onto a non-verbal scale of expected happiness. After familiarization, each child judged nine different dual-roulette configurations.

In Block 2, children completed a two-alternative forced-choice (2AFC) task, selecting which of two games -each composed of a dual-roulette configuration- would make Lucy happier, covering 33 pairs of distinct probability distributions (Figs. 2). This block tested whether their earlier ratings predicted their actual choices.

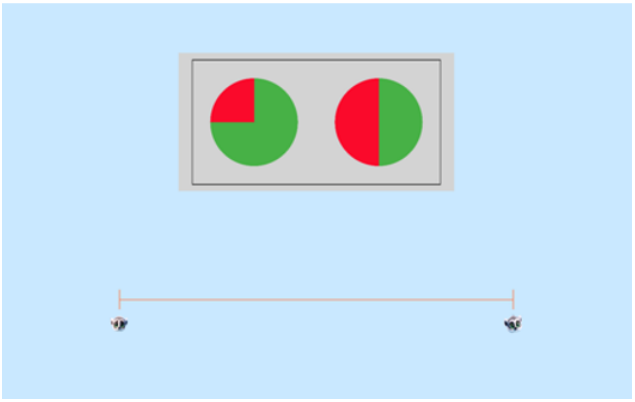

Figure 1: Block 1: Happiness estimation interface (example with two roulettes: 3 green, 2 red; and 2 green, 2 red).

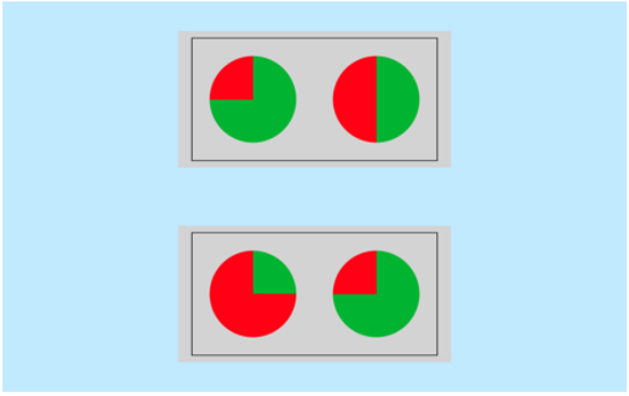

Figure 2: Block 2: Choice between two probability games.

Results

Children's happiness ratings increased proportionally with the number of green sections, indicating effective use of the visual cues to guide their judgments. Importantly, no significant preference was found between

options presented on the left or right ($p > 0.05$), supporting the interpretation that children responded to probability and not spatial position. The heatmap in Fig. 3 shows the pattern of ratings, with a gradient from red (low) to green (high), further confirming balanced integration.

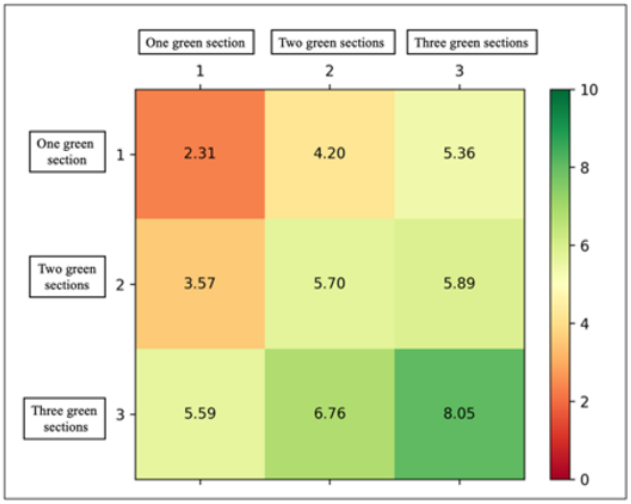

Figure 3: Heatmap of average happiness ratings for different roulette configurations.

Analysis of Block 2 showed high consistency: first graders' choices matched their Block 1 ratings in 78% of cases, third graders in 80% (Fig. 4). These high match rates, along with a z-test showing no significant difference between grades, suggest that even at age six, children can recall and use probabilistic information flexibly across tasks.

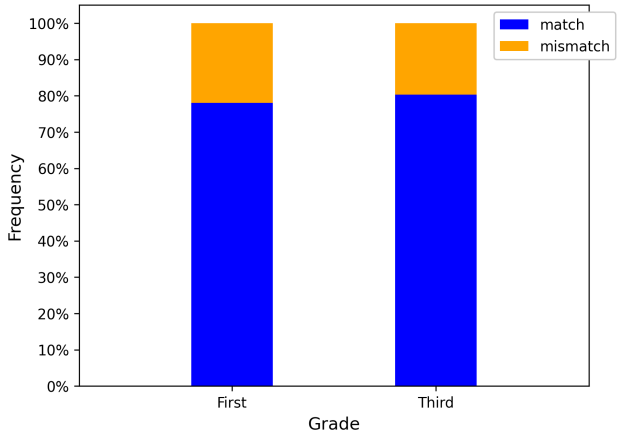

Figure 4: Proportion of match (blue) and mismatch (orange) choices by grade.

Performance was strong across both grades, with third graders performing slightly better (mean correct = 0.92, SD = 0.05) than first graders (mean = 0.86, SD = 0.13), though this difference was not statistically significant ($p > 0.05$; see Fig. 5).

Conclusions

This pilot study demonstrates that young children are capable of integrating and applying probabilistic visual

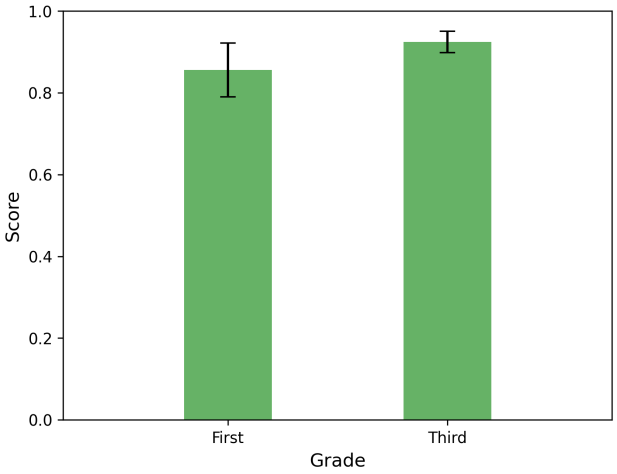

Figure 5: Average accuracy for correct game choices in Block 2 (error bars: SEM).

information with remarkable coherence across estimation and choice tasks. Our findings replicate and extend prior work by showing that a visually intuitive, game-based task can reliably capture children's probabilistic reasoning even in small samples.

Limitations include the small sample size and possible reliance on a "more-green-more-happy" heuristic. Future research with larger samples and incongruent (heuristic-violating) trials is planned to clarify how children balance probabilistic cues versus simple strategies.

Overall, these results support using the Lucy task for early assessment of probabilistic thinking, and provide a strong foundation for scaling up research on how children learn about uncertainty and decision-making.

Notes

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