

Visualizing probability: Young children's reasoning in estimating probabilities on a probability scale

Lena S. Jaeger¹

¹Bielefeld University, Germany

lena.jaeger@uni-bielefeld.de

INTRODUCTION: ESTIMATING PROBABILITIES ON A PROBABILITY SCALE

Predicting the most likely outcome of a random experiment is crucial in decision-making and therefore a core construct of probabilistic thinking (e.g., Jones et al., 1997). Research suggests that children as young as four years can correctly identify the most likely event in probabilistic situations (Nikiforidou & Pange, 2010; Nikiforidou, 2019). While these studies mainly focus on the correctness of children's responses, others (e.g., Acredolo et al., 1989; Kazak & Leavy, 2018) aim to gain more nuanced insights into the children's probabilistic thinking and reasoning. In doing so, tools such as probability scales – first proposed by Varga (1972) – have proven effective. This study explores how pre-school children (aged four to six years) use a modified probability scale – the *colour scale* – to justify and position their probability estimates when identifying the most likely event in a probabilistic task. The *colour scale* is a horizontal line with a blue-marked end and a yellow-marked end, corresponding to the colours of the materials used in the task (glass stones in blue and yellow). A central mark indicates the midpoint of the scale. In contrast to previously used probability scales, such as the Happy-Face Scale (Acredolo et al., 1989; Kazak & Leavy, 2018), the *colour scale* is explicitly designed to be interpretable from both ends, enabling children to consider both an event and its corresponding complementary event. The study, therefore, investigates the question: How do young children aged four to six use the *colour scale* to express their probability estimates?

METHOD: TASK-BASED DIAGNOSTIC INTERVIEW

A task-based diagnostic interview was conducted individually with 54 kindergarten children aged four to six, none of whom had received prior instruction on probabilistic concepts. In the task, children were asked to identify which colour was more likely to be drawn from a non-transparent bag containing blue and yellow glass stones in varying ratios. After naming and justifying the most likely event, children were introduced to the *colour scale* and asked to indicate their probability estimate accordingly. The interviews were recorded and qualitatively analysed. The qualitative data were subsequently quantified for further analysis.

RESULTS: HOW CHILDREN USE THE COLOUR SCALE

Different categories of the use of the *colour scale* can be identified. Exemplary findings are presented here based on the 4:5 ratio (four blue and five yellow glass stones). Most children ($n = 19$) pointed to the yellow end of the scale, which corresponds to the more likely event in this scenario. Nearly as many children ($n = 17$) pointed to the middle of the scale. A common justification for this placement was that either a yellow or a blue stone could be drawn. Additionally, ten children demonstrated an interpretation of the scale as a continuum by pointing to an area between the midpoint and the yellow end – though not fully at the yellow end. Particularly noteworthy are their justifications, such as: “Because there is still one more yellow stone”, which demonstrate the ability to transfer quite nuanced probabilistic thinking onto the *colour scale*. A total of eight children also pointed to the blue end of the scale. In these cases, their responses were consistent with their earlier (incorrect) estimation that blue was the more likely event in this scenario.

DISCUSSION AND CONCLUSION

The study suggests that even young children can use visual tools like the *colour scale* to express probabilistic judgments in differentiated ways. For educational practice, the *colour scale* offers a low-threshold tool to make children's estimations visible and discussable, particularly due to its dual interpretability. It also provides linguistic support, enabling children to express their reasoning without relying solely on verbal explanations. As the analysis of the data (including different ratios and overarching patterns of scale use) is still in progress, the poster will present initial findings.

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