HOW BENCHMARKS AFFECT THE NATURAL NUMBER BIAS AND STRATEGY USE IN FRACTION COMPARISON

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Fractions are difficult for many people. One source of difficulty is people's tendency to overextend natural number reasoning to fractions. For example, when people are asked to choose the larger of two fractions, natural number components can interfere with reasoning about magnitudes, yielding a "natural number bias" (Ni & Zhou, 2005). However, not all studies reveal the bias, and some studies have revealed a reverse bias (e.g., DeWolf & Vosniadou, 2015). In this study, we investigated whether encouraging people to use benchmarks (reference numbers, e.g., ½) in fraction comparisons would help them to activate fraction magnitudes and overcome a potential bias. We also examined patterns of strategy use.

Adults solved complex fraction comparison problems and reported their strategies on a trial-by-trial basis. All fractions were smaller than 1, and none of the pairs had common numerators or denominators. Half of the pairs were congruent (i.e., the larger fraction had the larger components) and half were incongruent (i.e., the larger fraction had the smaller components). The congruent and incongruent sets were balanced in terms of the fractions' magnitudes relative to common "benchmarks" (i.e., reference points, specifically, ¼, ½, or ¾). In "straddling" problems, one fraction was smaller and the other larger than one of these benchmarks. In "in-between" problems, both fractions were in between two adjacent benchmarks. In a special subcategory of "in-between" problems, both fractions were either smaller than ¼ or larger than ¾; in these problems, one fraction was close to 0 or 1, which may be especially salient benchmarks. Some participants also received a tip that benchmarks could be useful.

Overall, we found a reverse "smaller components—larger fraction" bias. Participants varied in their strategy use across problem types, indicating that they used strategies adaptively. On problems in which one fraction was close to 0 or 1, they used generally incorrect, component-based strategies much more often than on other problems. For the other two problem types, participants used component-based strategies less often, and used benchmark strategies somewhat more often. The tip about using benchmarks had little effect.

Participants used strategies adaptively in ways that made good use of the affordances of different problems (Alibali & Sidney, 2015), including the fractions' relative positions to benchmarks. Thus, patterns of strategy use may at least partially explain the occurrence and the direction of the natural number bias in fraction comparison. To better understand the natural number bias and why it varies across studies and across samples, it will be critical to understand the strategies people use in making specific fraction comparisons.

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