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# Calibration information reduces bias during estimation of factorials: A (partial) replication and extension of Tversky and Kahneman (1973)

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## Abstract

Tversky and Kahneman (1973) found that, under time pressure, people massively underestimated the expansion of  $8!$  (correct value 40,320), and this bias was mitigated for participants presented the descending ( $8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$ ; Median=2,250) vs. ascending order ( $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$ ; Median=512). In a first-ever replication ( $N=140$ ), we also found predominant underestimation, but no significant between-subjects descending vs. ascending order effect. However, when participants then estimated the opposite order, we reproduced this order effect within-subjects. Finally, participants received calibration information (the correct value of  $6!$  or  $10!$ ) and again estimated both orders of  $8!$ . Participants who received  $10!$  made more accurate estimates for  $8!$  (Median=38,000), which did not differ statistically from the correct value. Participants who received  $6!$  still grossly underestimated (Median=2,678.5), despite  $8!$  being closer to  $6!$  than  $10!$  in linear and log units. Thus, we surprisingly found the classic factorial estimation bias only within-subjects, and provide evidence for how calibration can reduce it.