

Effects of format and problem structure on problem solving procedures in mental division

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DO VARIATIONS IN PROBLEM STRUCTURE INFLUENCE DIVISION BY MEDIATION WHEN PEOPLE SOLVE DIVISION PROBLEMS?

- People *report* mentally transforming division problems in division formats ($72 \div 9 = []$) into multiplication formats ($9 \times [] = 72$) before solving the problem.
- Participants *respond* faster to division problems in multiplication formats than in division formats, but only for large problems (Mauro et al., 2003).

METHOD

- In 3 experiments, participants solved division problems and problem structure was manipulated.
- Eye tracking was used to measure processing time for each problem element

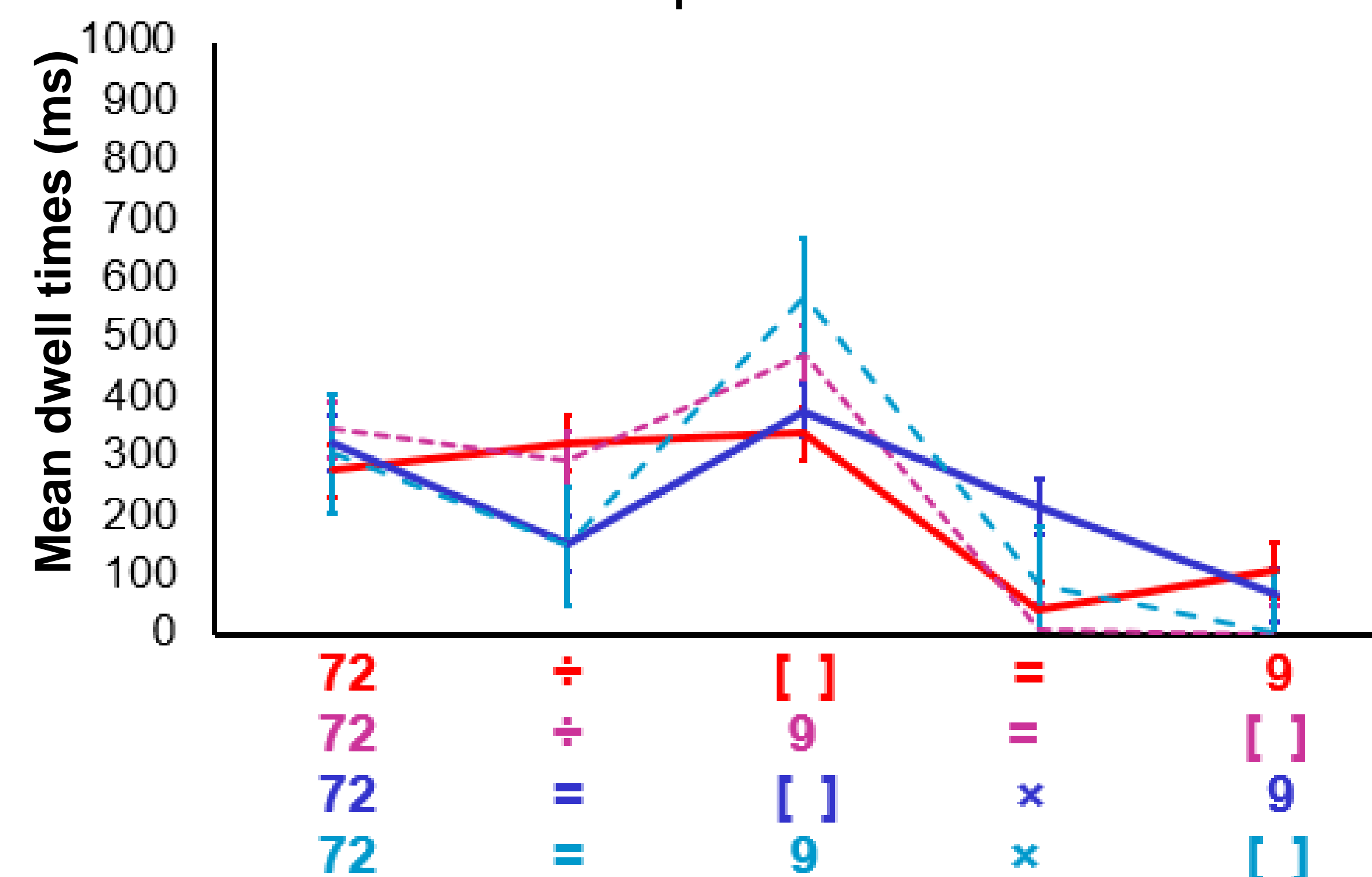
RESULTS: As shown in Table 1, evidence for mediation was only found in Experiment 2 where both multiplication formats were solved more quickly than both division formats

Table 1. Response times (in ms) and standard errors for large problems across 3 experiments

Experiment 1 (n=32)		Experiment 2 (n=30)		Experiment 3 (n=29)	
format	mean	format	mean	format	mean
division format					
$72 \div [] = 9$	1825	$72 \div [] = 9$	2087	$[] = 72 \div 9$	1926
$72 \div 9 = []$	1755	$72 \div 9 = []$	2134	$9 = 72 \div []$	1924
multiplication format					
$72 = [] \times 9$	1823	$[] \times 9 = 72$	1752	$72 = [] \times 9$	1819
$72 = 9 \times []$	1705	$9 \times [] = 72$	1829	$72 = 9 \times []$	1987

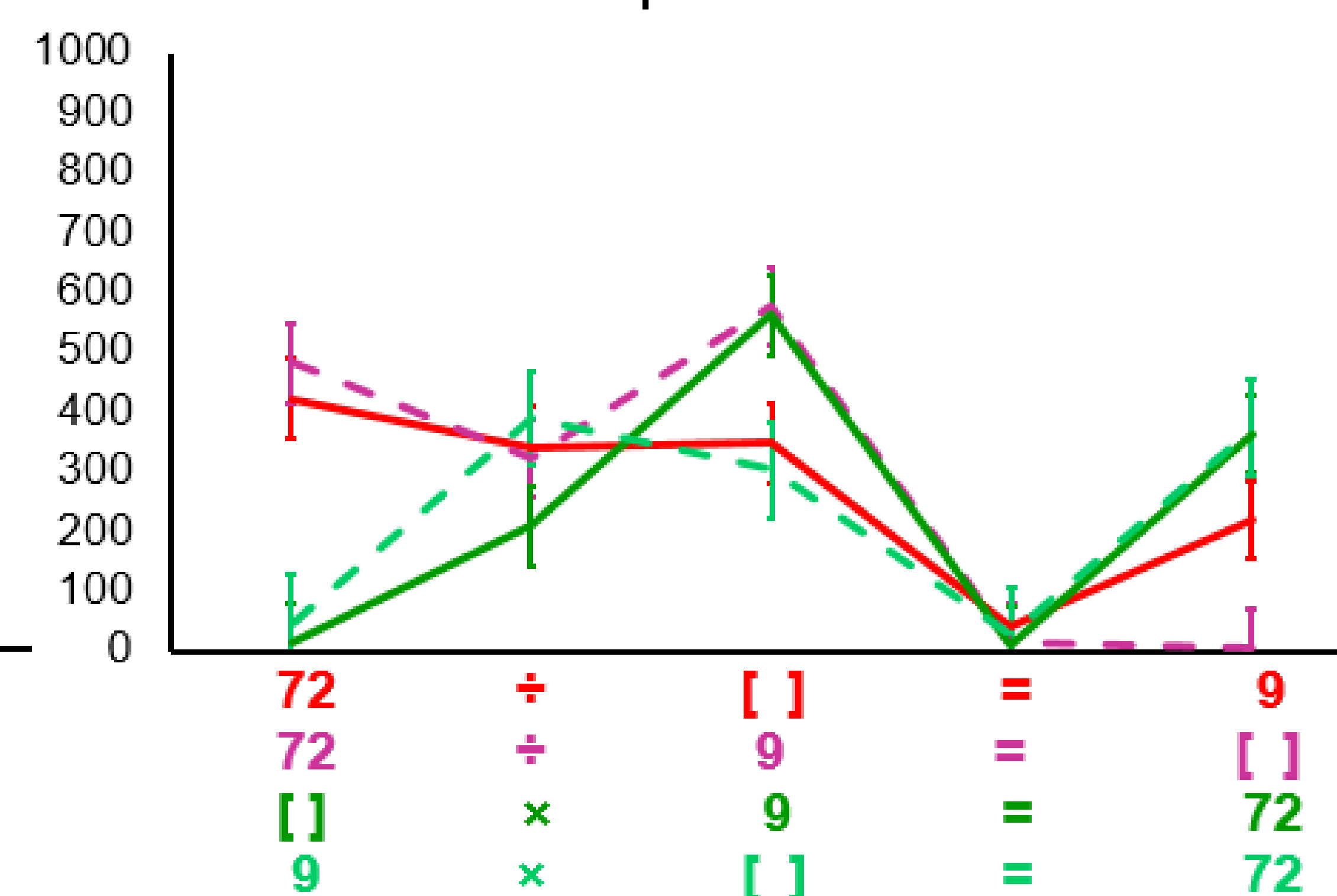
Figure 1. Dwell times (in ms) on problem elements

Experiment 1



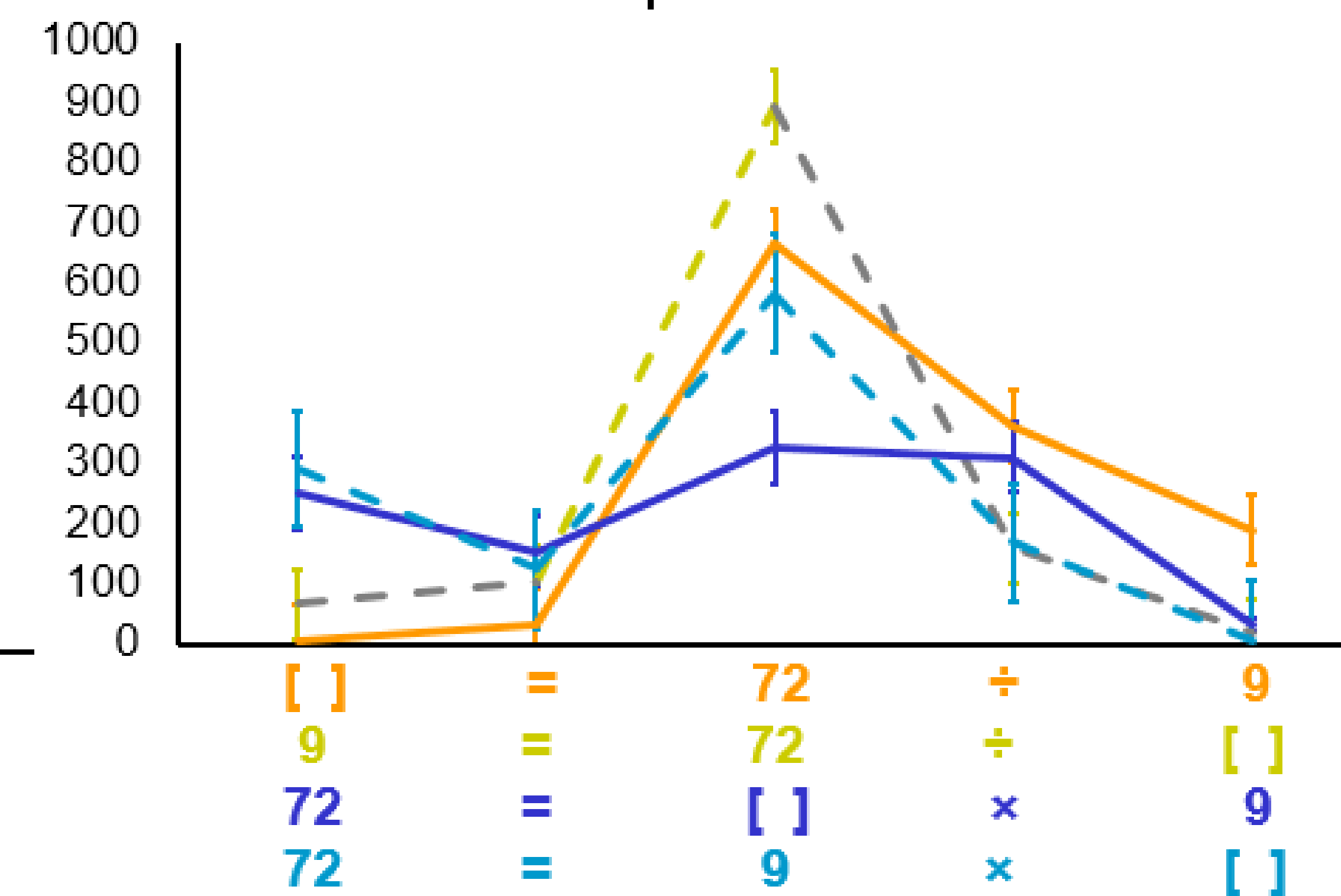
- Dwell times in Experiment 1 were similar across problem elements, suggesting that participants did not differentially process by format
- Presence of the dividend in the first position *on all problems* cued the activation of division representations and strategies

Experiment 2



- Dwell times in Experiment 2 show a clear differentiation by format and by problem element
- Presence of the dividend in the last position *on half the trials* may have cued activation of multiplication strategies and thus mediation

Experiment 3



- Presence of the dividend in the centre (which supports neither multiplication nor division) increased variability across problems
- Neither multiplication nor division strategies were consistently activated in relation to problem format

CONCLUSIONS:

- When problem structure is varied, division by mediation is not always observed.
- Variations in the combinations of problem formats within each experiment may have influenced the extent to which multiplication representations were activated during problem solutions
- **Mediation effects are easily influenced by context**