



Perceptual Account of Symbolic Reasoning

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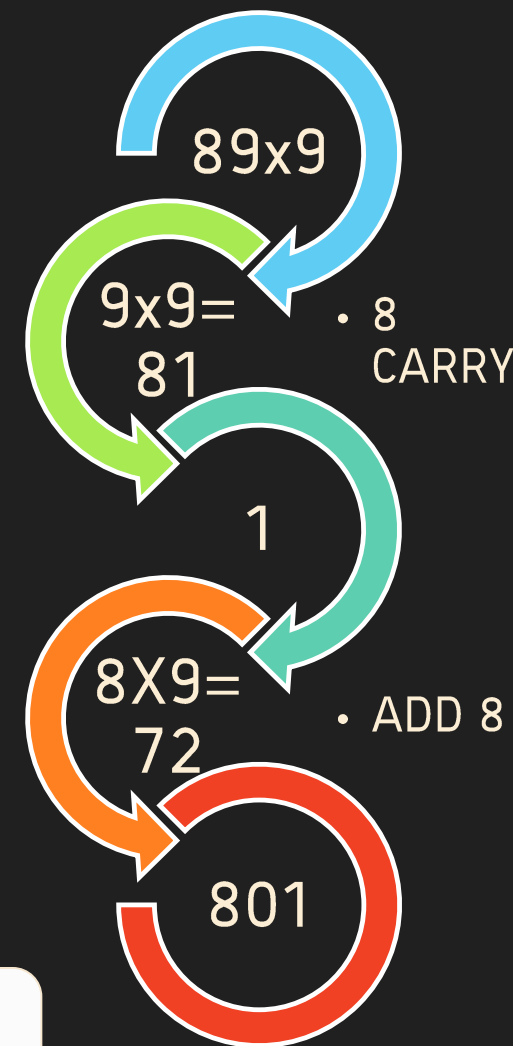


Introduction

Symbolic reasoning has been thought of as the ability to internally represent numbers, logical and mathematical rules in an abstract and amodal way.

The focus has been on the "inner" i.e. notations are "translated" into corresponding mental structures and processes.

Cyborg View



There were 2 x 2 trees

We believe that symbols may act as targets for powerful perceptual and sensorimotor systems as *Landy et al* propose in their: "Perceptual Manipulation Theory"^[1].

P.M.T.

Symbolic reasoning involves the application of peripheral processes to notational structures themselves. Such reasoning requires notations on which to operate, and depends crucially on their physical instantiation and the processes that act on those instantiations (spatial perception, imagined motion, detection of action affordances, subitization, and so on). In that sense, such reasoning is modal.

Parentheses create visual groups

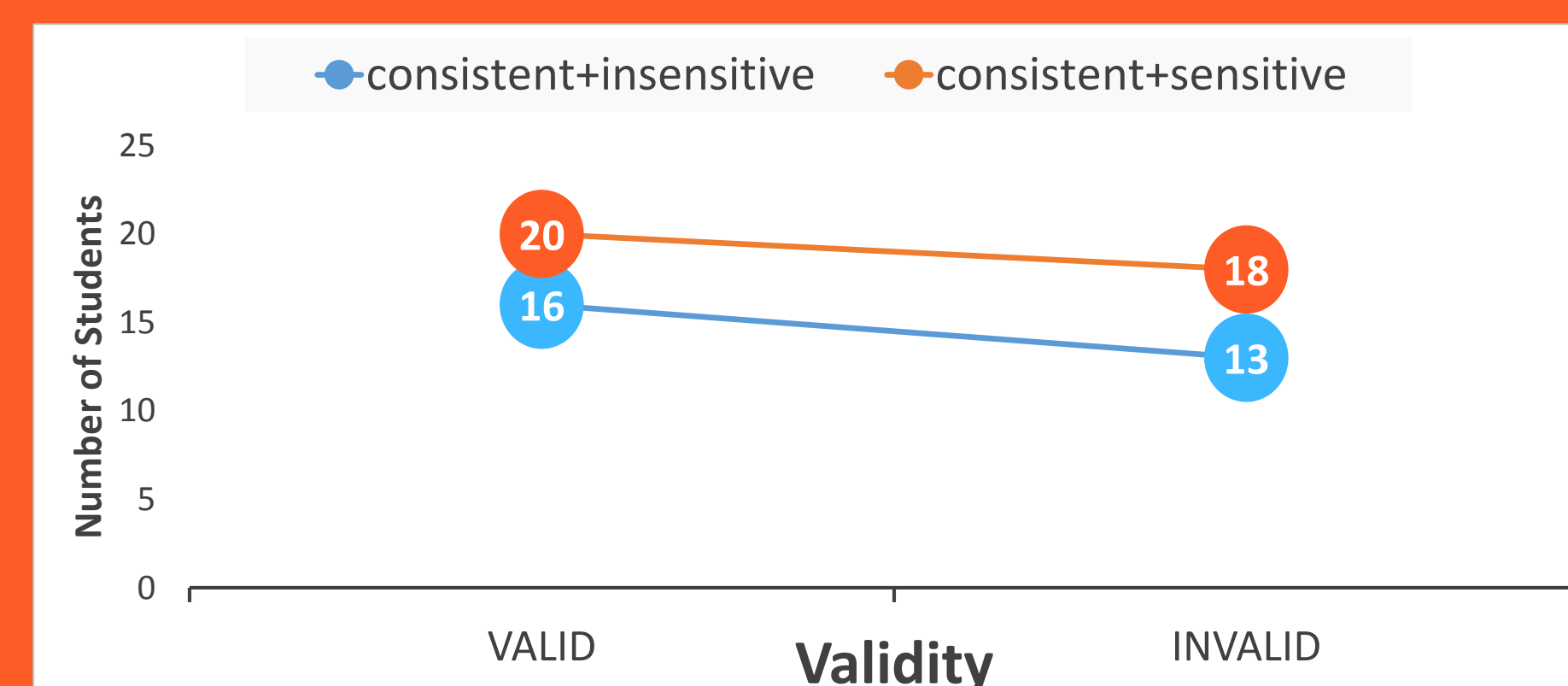
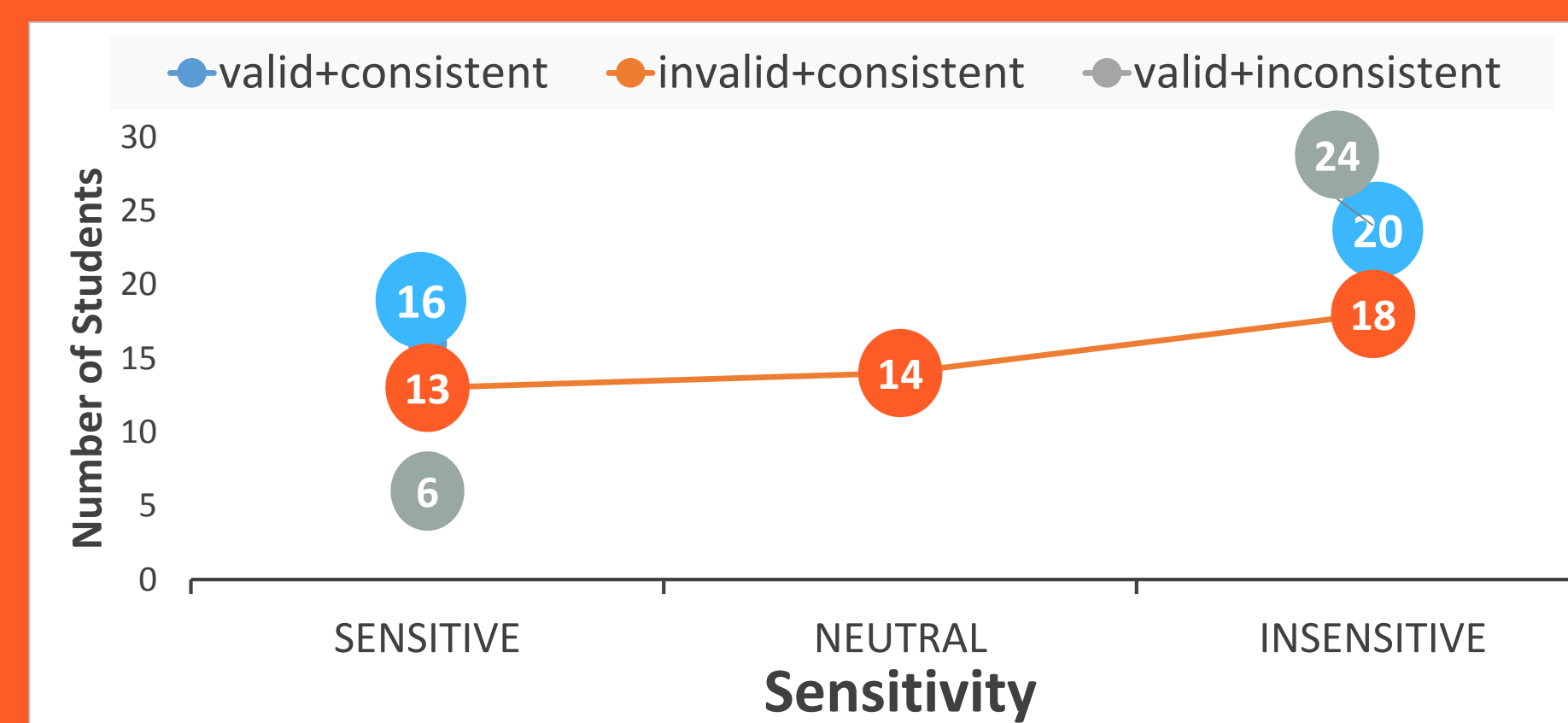
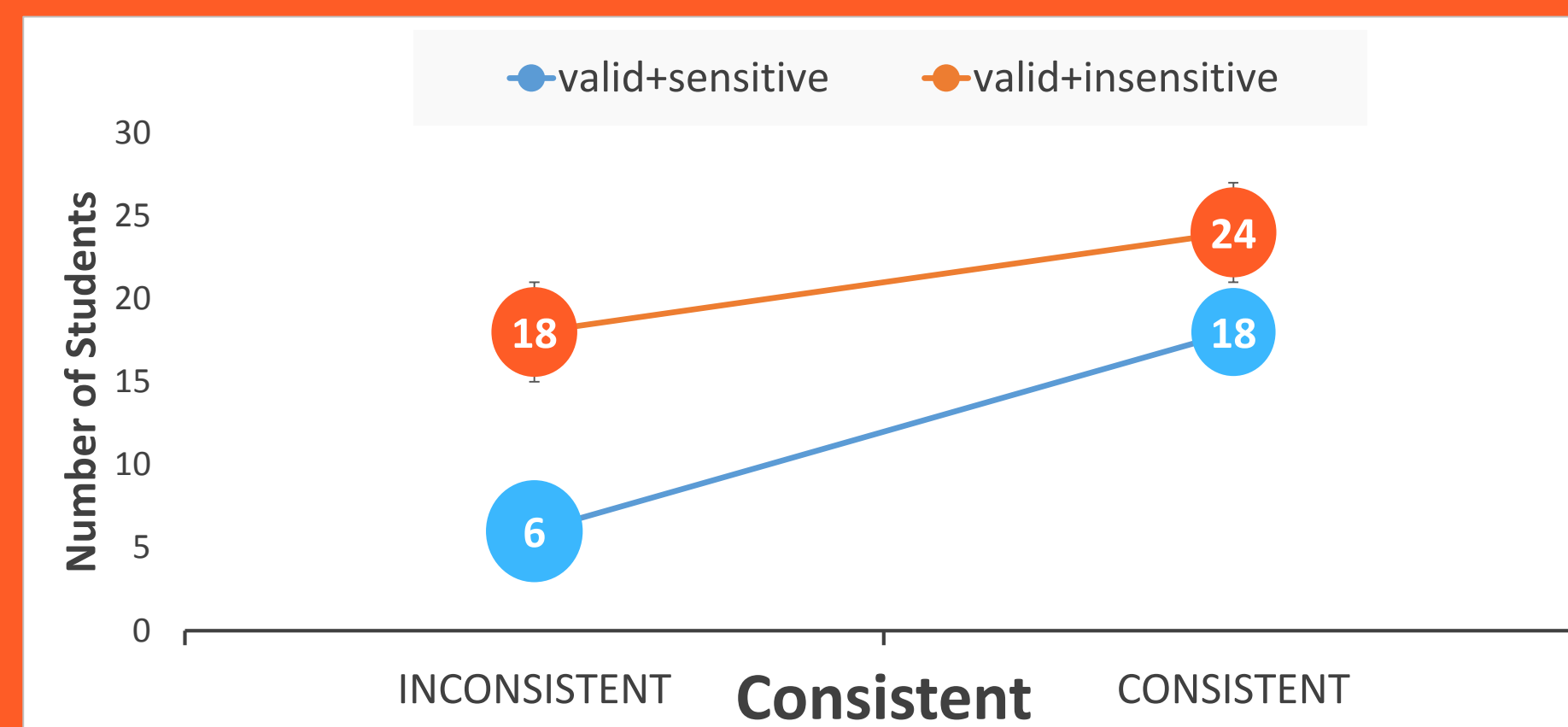
$$a * b + c * d = c * d + a * b$$

Transposition and motion

$$a + b * c = d - a$$

Impact of non-mathematical grouping pressures

- A set of 20 questions designed to test against
 - Consistency
 - Sensitivity
 - Validity of equations.
- A non mathematical "Grouping Pressure" is applied to bias subject. This type of visual grouping influences judged formal grouping.
- A time pressure is also applied.



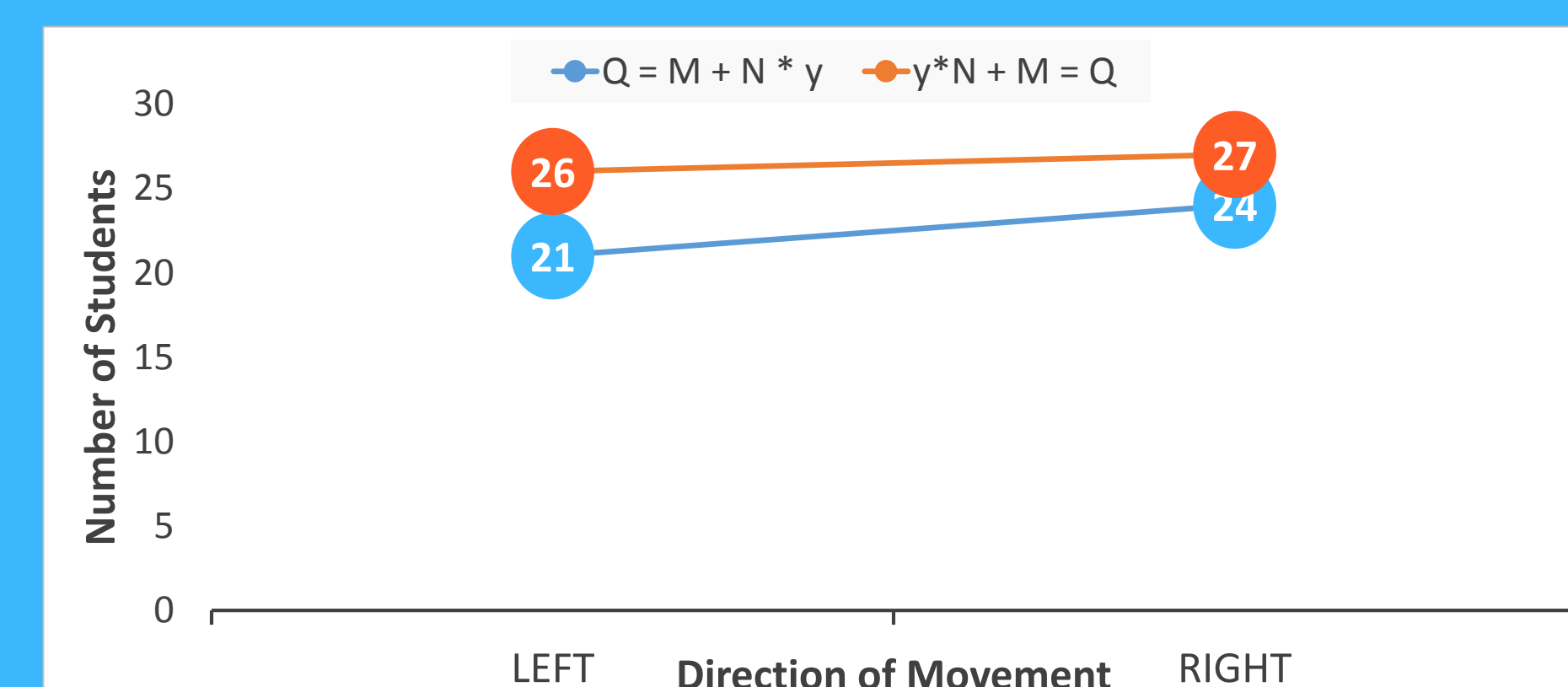
Impact of background motion.

- A set of 20 questions designed to test unwind strategy.
- The equation solves for y
- The time taken by the candidate is also noted to check the difference between novice and expert subjects.

In the unwind strategy, one starts by finding the isolated constant, identifies the next available operation on the variable side (+2 in this case), inverts the operation, and solves the resulting problem (8-2)

$$8 = 2 + 3 * y$$

Background moves left or right



Results

Experiment 1

- After analysis of the first experiment the consistency was found to have impact on performance of UG students as the students were able to score more on consistent than inconsistent equations.
- Sensitivity was found to have negligible impact on expert undergraduate level students.
- The consistent + insensitive equations were found to have lower score than consistent + sensitive equation. This is in contrast with the mechanisms thought for expert UG students.

Experiment 2

- The results are concurrent with the hypothesis that the expected score is in accordance with the movement. Thus, unwind strategies are used to complete algebraic tasks.

Perceptual and motor processing is central to symbolic reasoning. The problem as represented perceptually already differs substantially from the problem as it is presented notationally. Perceptual processes re organize and simplify the symbolic problems we are faced with. On this view, the relevant perceptual processes are taken to be central components of the properly mathematical reasoning.

Future studies

- Experiment 2 will be conducted on novice and expert subjects to find out whether perceptual stimuli affects symbolic reasoning equally for both levels of mathematical expertise.
- The experiment 2 can also be conducted with different velocity and size level of the background dots.

References

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