Do Conditionals Matter In Conditional Reasoning?

Haylie Smith and Dr. David W. Braithwaite
Department of Psychology, Florida State University
hcs22g@fsu.edu

Introduction

The power of mathematics depends on its ability to express generalities, which are often expressed in conditionals like "If *m* and *n* are both positive, then *m*+*n* is positive."

Such statements are often used in mathematical arguments, such as "If *m* and *n* are both positive, then *m*+*n* is positive; *m* and *n* are both positive; therefore *m*+*n* is positive."

However, including a true conditional as a premise has no effect on an argument's logical validity. To illustrate, this argument is just as valid as the one above: "*m* and *n* are both positive; therefore *m*+*n* is positive."

We aim to test how participants' evaluations of mathematical arguments are affected by the presence of conditionals.

Participants will also complete a brief mathematics test to determine if the effects of the presence of the conditional differ by mathematical ability.

Materials

- Stimuli will be based on 16 mathematical conditionals, four for each of four features:

Feature	Conditional
Sign	If *m* and *n* are both positive, then *m*+*n* is positive.
Magnitude	If *m* and *n* are both greater than 2, then *m*+*n* is greater than 4.
Parity	If *m* and *n* are both even, then *m*+*n* is even.
Multiples	If *m* and *n* are both multiples of 3, then *m*+*n* is a multiple of 3.

- Participants will evaluate four inferences with each conditional - two valid and two invalid:

Valid Example

Assume this statement is true: If *m* and *n* are both positive, then *m*+*n* is positive.

Suppose that: *m* and *n* are both positive

If the above statements are true, which of the following **must** be true?

- ○ *m*+*n* is positive
- ○ *m*+*n* is not positive
- ○ Neither of the above

Invalid Example

Assume this statement is true: If *m* and *n* are both positive, then *m*+*n* is positive.

Suppose that: *m*+*n* is positive

If the above statements are true, which of the following **must** be true?

- ○ *m* and *n* are *both* positive
- ○ *m* and *n* are not both positive
- ○ Neither of the above

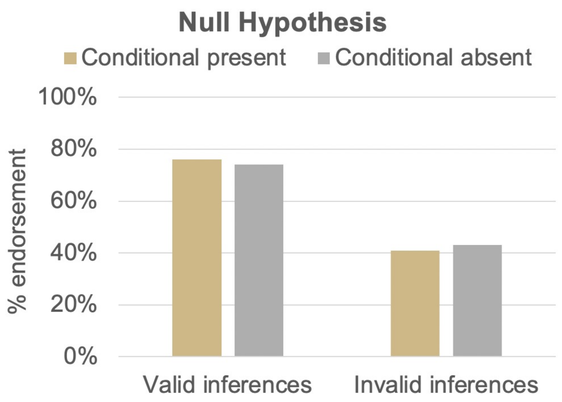
Procedure

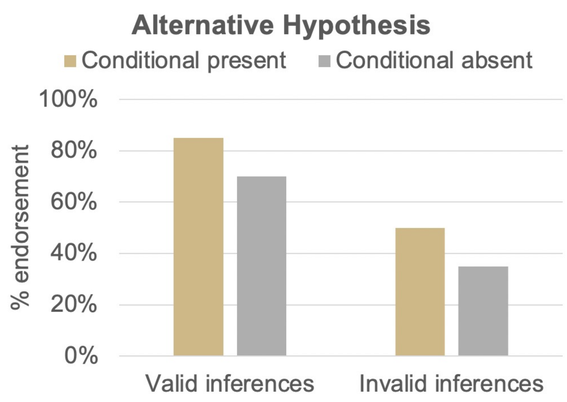
- Participants will be randomly assigned to one of two conditions:

Condition	Explanation
Sign & Magnitude	Inferences involving **sign** and **magnitude** are presented **<u>with</u>** the conditional
	Inferences involving **parity** and **multiples** are presented **<u>without</u>** the conditional
Parity & Multiples	Inferences involving **parity** and **multiples** are presented **<u>with</u>** the conditional
	Inferences involving **sign** and **magnitude** are presented **<u>without</u>** the conditional

- The inferences will be presented in blocks, one block for each conditional
- The inferences **<u>with</u>** conditional will be presented either all before or all after the inferences **<u>without</u>** conditional; this factor will be counterbalanced within each experimental condition

Expected Results





Discussion

It is not fully understood yet whether, when, and how people use conditional statements during reasoning.

Prior research has found that people accept valid and invalid arguments more overall when presented with the conditional, depending on the perceived sufficiency and necessity between the premise and conditional. (Klauer, 2010). This suggests we would expect to find similar results in our experiment, which deals with mathematical arguments. If we find the presence of the conditional increases acceptance of inferences, this result would align with our alternative hypothesis.

However, there is also theoretical support for the null hypothesis. Specifically, Dawkins & Norton (2022) have argued that most individuals do not reason at the level of generalities in math, but instead reason at the level of specific examples. If so, the conditionals should not affect reasoning at all, because they are only meaningful at the level of generalities.

Dawkins, P. C., & Norton, A. (2022). Identifying mental actions for abstracting the logic of conditional statements. *The Journal of Mathematical Behavior*, *66*, 100954.
Klauer, K. C., Beller, S., & Hütter, M. (2010). Conditional reasoning in context: A dual-source model of probabilistic inference. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *36*(2), 298–323.