Mindless Math: the Finesse of Fluency

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Introduction

How many cubic feet of dirt are there in a hole that is 3' deep x 3' wide x 3' long? [5]

What is your intuitive response to the above problem?
• 84% of an n-Turk sample responded with a variety of intuitive answers involving calculations [5].
• When faced with numeric information, our intuitive response can be to start performing mathematical operations.
• But what about when math cannot help us to reach a correct answer?

Mindless math

We explore problem solving situations where there is task-relevant numeric information, but the cues operations inhibit reaching a correct answer.
• We call performing these irrelevant mathematical operations mindless math.

Our research question is how and why does fluency affect the performing of mindless math?

Methods

Participants.
In Study 1 (2) we recruited 450 (602) participants from Amazon’s Mechanical Turk Platform.

Dependent Variables.
DV1: ‘correct’ – responding correctly
DV2: ‘MM’ – responding with mindless math

Experimental design
Study 1. 1 IV between-subjects: numeric demands of study items. (easier / harder)
Controls: CRT [3], numeracy [2]

Materials and procedure
In Study 1 (2) participants were asked to respond to four (three) study items. The response format was numeric entry. Participants faced all study items in the same condition. In Study 1 (2), the four study item were separated by non-conflict filler questions (participants answered three study items with no filler). The study items used in both studies:

Q. Easier condition

On my way to the Himalayas, imagine I meet a man with his wife going the opposite direction. His wife was carrying a sack and the sack had a cat in it. How many living creatures, in total, were going to the Himalayas?

Study 1. Study 2.

Harder condition

On my way to the Himalayas, imagine I meet a man with four wives going the opposite direction. Each wife was carrying a sack and each sack had a cat in it. How many living creatures, in total, were going to the Himalayas?

Imagine Joey is going to the store to buy a pack of chips. A bottle of water costs $3.00, a pack of chips costs $2.00. How much does he spend in total? (in dollars)

Imagine Joey is going to the store to buy a pack of chips. A bottle of water costs $3.05, a pack of chips costs $2.00. How much does he spend in total? (in dollars)

Imagine 5 candles stand burning in a dining room. A strong breeze blows in through an open window and extinguishes 3 of them. Assuming the wind doesn’t extinguish any more candles, how many candles do you have left in the end?

Imagine 27 candles stand burning in a dining room. A strong breeze blows in through an open window and extinguishes 25 of them. Assuming the wind doesn’t extinguish any more candles, how many candles do you have left in the end?

Hypotheses:

H1: Moving from the ‘easier’ to the ‘harder’ numeric demands will decrease the rate of ‘correct’ responding and increase the rate of ‘MM’ responding.

H2: Moving from ‘none’ to the ‘fast’ time pressure condition will decrease the rate of ‘correct’ responding and increase the rate of ‘MM’ responding.

Results.

Study 1.

• One-way ANOVA tests with numeric demands against ‘correct’ and ‘MM’ statistically significant at p < 0.001 (H1).

• CRT and BNT significantly predict ‘correct’ and ‘MM’ responding.

• In predicting ‘MM’ responding, coefficients for harder X CRT and harder X BNT marginally significant p = 0.059, p = 0.078.

Study 2

• Numeric demands has significant main effect (H1)
• ‘fast’ has negative main effect on likelihood of ‘correct’ responding p < 0.001 and positive main effect on likelihood of ‘MM’ responding p < 0.001 (H2)

Conclusions

• Our results serve as a boundary condition of the relationship between answer fluency and FOR judgments.
• Respondents can reach the ‘mindless math’ answer quicker with easier numeric demands.
• This is supported by timing data and difficulty ratings.
• This higher fluency in reaching the (incorrect) mindless math answer is associated with a higher likelihood of reaching the correct answer.
• Under time pressure, people are more likely to respond with the ‘mindless math’ answer than the ‘correct’ answer.
• Both ‘harder’ numeric demands and ‘fast’ time pressure lead to a substitution to mindless math, rather than just introducing noise.
• This suggests that mindless math is an intuitive process that we have to correct.

Future directions

• We believe that one reason why ‘correct’ responding is higher in the ‘easier’ numeric demands condition could be that the easier calculation does not meet people’s expectations of task difficulty.
• Understanding the role of expectations in this paradigm is an important next step.
• Additionally, we want to understand the contexts in which mindless math could hurt people.
• Is mindless math limited to standardized test situations, or does it affect decision-making?

References


