

# The malleability of subjective numeracy

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## Abstract

Greater subjective numeracy (SNS) corresponds with greater motivation and confidence with numbers. However, little is known about the malleability of individuals' SNS and its causal effects are unknown. In the present research, we attempted to manipulate individuals' SNS through the ease or difficulty experienced from working on numeric problems. Participants were randomly assigned to complete hard, easy, or no math problems. Results confirmed our hypotheses that simply working on more difficult math problems lowered individuals' numeric-ability beliefs and preferences for numbers, leading to decreased persistence on a subsequent numeric task. However, inconsistent with our hypotheses, working on easy math problems did not improve individuals' subjective numeracy.

## Intro

Recent research has found that greater **subjective numeracy (SNS)** correlates with experiencing better financial outcomes (e.g., avoiding an overdraft or bounced check from one's account; Tompkins & Peters, 2015) and greater financial wellbeing (e.g., "I am securing my financial future;" Tompkins, Peters, Knoll, *in progress*), controlling for objective numeracy (ONS). However, subjective numeracy's causal effects on decision outcomes are unclear.

**Subjective numeracy** is defined as self-assessed numeracy and measured as self-reports of one's objective ability with and preference for numbers. It has been linked, independent of objective numeracy, with having more motivation (a state of energizing and impelling behavior), confidence (belief in one's ability), and positive emotions to numbers, all of which may lead to greater engagement with numeric information.

Greater engagement or greater persistence with numeric information is one plausible mechanism for why greater subjective numeracy corresponds to experiencing better financial outcomes and financial wellbeing.

## Objectives

### 1) Attempt to manipulate individuals' numeric-ability beliefs and preference for numbers

- **H1:** Working on difficult math problems will lower individuals' SNS relative to control
- **H2:** Working on easy math problems will increase individuals' SNS relative to control

### 2) Examine the impact of subjective numeracy on persistence on unsolvable numeric problems

- **H3:** Individuals higher in SNS will persist longer on unsolvable numeric problems

## Method

Undergraduate students (N=292, 58% female) were randomly assigned to complete hard, easy, or no math problems (control). Following the manipulation, participants completed measures of subjective and objective numeracy, followed by unsolvable numeric problems.

### Experimental conditions

Hard	Easy	Control
<ul style="list-style-type: none"> <li>• 8 difficult items</li> <li>• Is the following true or false? <math>1/2 \times 4/5 &gt; 3/5</math></li> </ul>	<ul style="list-style-type: none"> <li>• 8 easy items</li> <li>• Is the following true or false? <math>4 \times 5 &gt; 21</math></li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>

### Subsequent measures

- SNS scale "How good are you at working with fractions?" (1) Not at all to (6) Extremely good (8-item; Fagerlin et al., 2007)
- ONS scale (8-item; Weller et al., 2013)

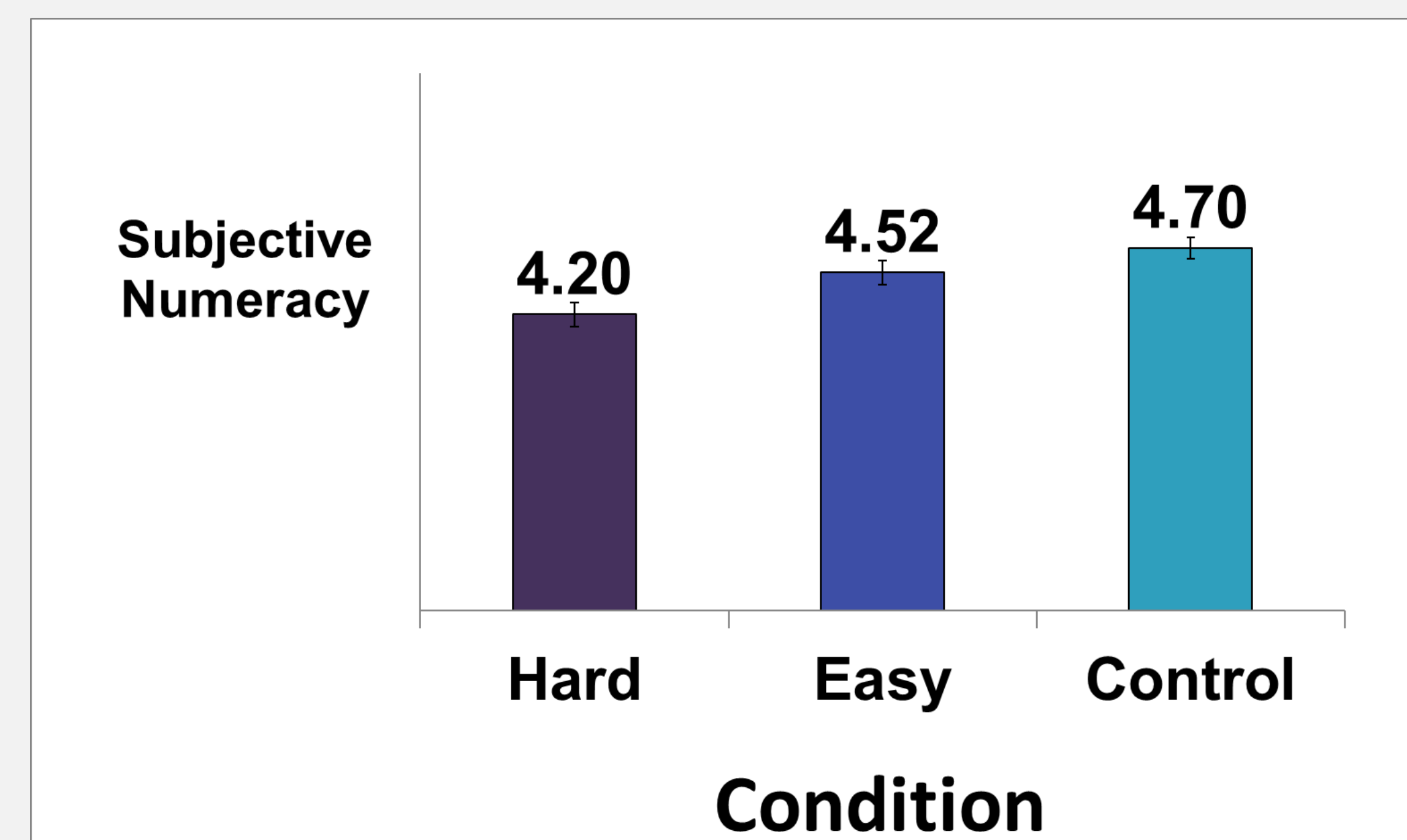
### Unsolvable numeric problems

- Two items. E.g., "Imagine that you have 10 coins in your pocket (pennies, nickels, dimes, or quarters). The value of the coins adds up to \$1.53. What are the coins?"

## Results

**Manipulation check.** Participants in the Hard condition reported greater difficulty solving the math items (mean difficulty (SE)= 5.6(0.3) than participants in the Easy condition (mean difficulty (SE)= 1.4(0.1);  $p < 0.001$ ).

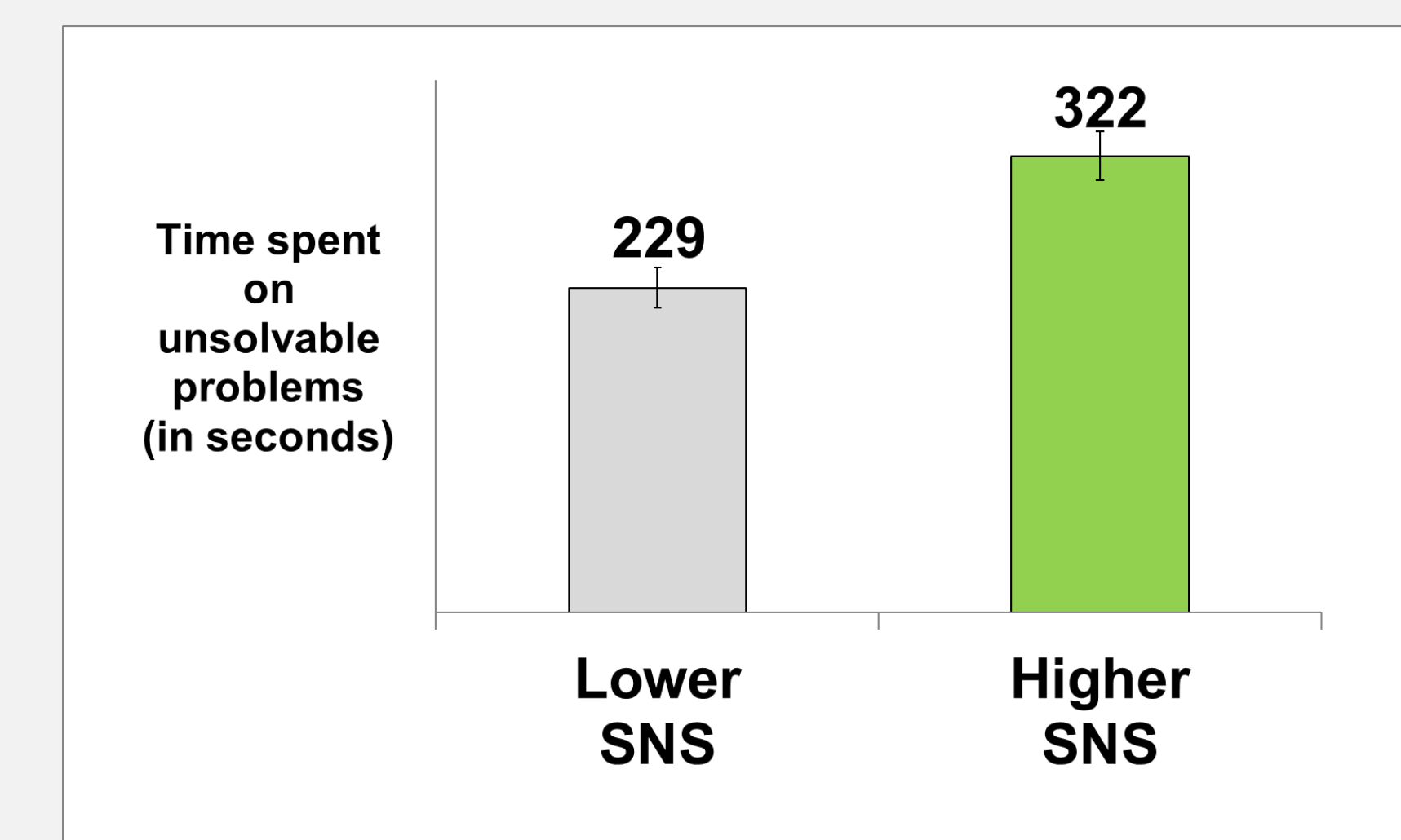
**Figure 1.** Consistent with **H1**, participants in the Hard condition had lower SNS relative to those in the Control condition ( $p < 0.0001$ ). Inconsistent with **H2**, participants in the Easy condition did not differ from Control ( $p = 0.14$ ).



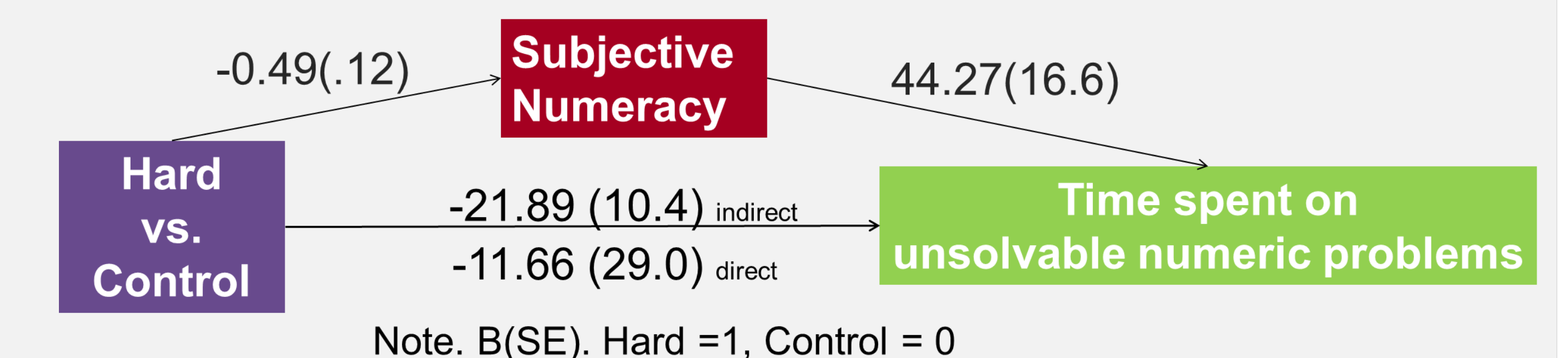
## Results

**Unsolvable numeric problems.** To examine persistence on the unsolvable numeric problems, we regressed SNS, ONS, and a dummy variable (whether or not the participant indicated the problem was unsolvable) onto total time spent working on the problems.

**Figure 2.** Consistent with **H3**, participants higher vs. lower in SNS persisted longer on unsolvable numeric problems ( $p = 0.01$ ).



**Figure 3.** Mediation analyses indicated that participants in the Hard vs. Control condition persisted less on the unsolvable numeric problems (total effect  $p = 0.07$ ) and this effect was mediated by individuals' subjective numeracy scores (indirect effect 95% CI: -46.7, -4.4).



## Discussion

- Simply working on a few difficult math items lowered individuals' belief in their numeric ability and preference for numbers. However, working on easier math items did not improve individuals' subjective numeracy relative to controls.
- Subsequently, individuals lower in SNS gave up on unsolvable numeric problems more quickly than individuals higher in SNS.
- Greater persistence with numeric information may explain why higher-SNS individuals were found to have better financial outcomes in prior research.
- Additional SNS manipulation studies are in progress to try to improve SNS.

### ACKNOWLEDGEMENTS

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