Attention Check Questions in Self-Report Measurement of Math and its Non-Cognitive Factors in College Students.

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Introduction

Online surveys are a common method of data collection. The use of "attention-check" questions are an effective method of identifying careless responding in surveys, which occurs in 10-12% of undergraduate samples. Instructed response type attention checks are straightforward and the most recommended.

This study evaluated the effect of instructed response attention check questions on the measurement of math ability and non-cognitive factors commonly related to math (self-efficacy and math anxiety). We evaluated both level differences as well as whether check questions alter the relationship of non-cognitive factors to math.

We expected that incorrect responding to check questions would lower math performance but were unable to make hypotheses about level of self-report non-cognitive factors. We predicted that incorrect responding to check questions would moderate the relationship between both math anxiety and self-efficacy to math performance.

Participants/Procedures

Participants were 424 undergraduates (age 20.4, SD=2.7) at a large southwestern university. The sample was majority female (74%) but diverse socioeconomically and in race/ethnicity. Missing data was assessed and participants with any missing data in any variable of interest were removed.

The non-cognitive measures were researcher developed/adapted Math Anxiety (MA) and Math Self-Efficacy (MSE; Betz & Hackett, 1993) scales, with items selected directly targeting the use/manipulation of math in everyday life; both showed good reliability (α = .95). The two math scales were also researcher developed/adapted; one was a pure symbolic computational measure (EM-A) and the other consisted of word problems in an everyday context (EM-B). These measures had good reliability (α = .80 and α = .73).

Four check questions (e.g., answer "X" for this item) were embedded in the surveys and two groupings were formed for analyses: Grouping 1 were those who correctly answered all four check questions (N = 318) versus those who did not (N = 106); Grouping 2 were those correctly answering either all four or at least three (N = 351) versus those with more than one incorrect response (N = 72).

Data Analysis used correlational and ANOVA techniques.

Table 1. Demographics

N	Age (Mean (SD))	Gender (% Female)	Race (% Caucasian)	Race (% Black)	Race (% Asian)	Ethnicity (% Hispanic)
424	20.4 (2.7)	74%	40%	17%	34%	32%

Table 2. Correlations of Measures

	1	2	3	4	5
1. Check Questions Total Correct	~				
2. Everyday Math A (EM-A)	.47*	~			
3. Everyday Math B (EM-B)	.41*	.61*	~		
4. Math Self-Efficacy (MSE)	.18*	.22*	.32*	~	
5. Math Anxiety (MA)	-.28*	-.30*	-.37*	-.30*	~

Note for table 2: $*p < .0001$

Table 3. Moderation Analyses

Check questions were originally analyzed continuously, but this variable was significantly skewed, so a dichotomous grouping was required.

Check Question Grouping 1: *All Correct vs. Any Incorrect*
Check Question Grouping 2: *All Correct + 1 Incorrect vs. >1 Incorrect*
(Grouping 2 results displayed below)

The relationship between Everyday Math A (EM-A) and Math Self-Efficacy (MSE), and between Everyday Math A (EM-A) and Math Anxiety (MA), when moderated by the 2nd check question grouping.

EM-A and MSE Moderated by Check Group 2

	F	p-value
MSE Total	26.66	<.0001
Check 2	100.1	<.0001
MSE*Check 2	0.00	.974

EM-A and MA Moderated by Check Group 2

	F	p-value
MA Total	49.16	<.0001
Check 2	90.88	<.0001
MA*Check 2	4.25	.04

The relationship between Everyday Math B (EM-B) and Math Self-Efficacy (MSE), and between Everyday Math B (EM-B) and Math Anxiety (MA), when moderated by the 2nd check question grouping.

EM-B and MSE Moderated by Check Group 2

	F	p-value
MSE Total	56.31	<.0001
Check 2	62.54	<.0001
MSE*Check 2	0.18	.668

EM-B and MA Moderated by Check Group 2

	F	p-value
MA Total	77.13	<.0001
Check 2	54.09	<.0001
MA*Check 2	1.43	.233

Results

Descriptively, check questions were skewed – 75% of participants answered all check questions correctly, and a further 8% missed only one.

Relations of both MA and MSE with math (EM-A and EM-B) were modest though significant ($|r|$ = .22 to .37) and in the expected direction (all $p < .001$). Check questions were related to level of all tasks ($p < .001$), with incorrect responses resulting in lower math performance, lower MSE, and higher MA.

Check questions did not generally moderate the relation of MA or MSE to either type of math performance, with the exception that MA was more strongly related to EM-A in those who missed several check questions. Post hoc, analyses were repeated with the alternate dichotomous grouping (grouping 1). Results were similar, though in this case, the relation of EM-A and MA was no longer moderated by check question failure.

Discussion

Check questions showed a clear relation to both self-report and math performance measures. However, check questions did not generally alter the relation of MA or MSE to math performance in general.

To the extent that check questions represent reduced effort, relations with performance measures make sense. That the relations held (though to a lesser degree) suggest that for self-perceptions, check questions may also represent carelessness or response bias. Results highlight a role for check questions even outside of objective performance indicators, while also demonstrating established effects with novel measures. Future work could examine the effect of different types of check questions in other domains.

Key References

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