

Should health messages make 'not' more noticeable? Young and older adults' comprehension and processing of health statements with negation.

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INTRODUCTION

Poor health literacy: Major socioeconomic issue, particularly for older adults.^{1,2}



Negations are common in health advice.

E.g., 'no' and 'not' phrases featured heavily in the World Health Organization's COVID-19 mythbusters (see left).³

Negations may affect health literacy.

Negations linked to processing cost, comprehension inaccuracy, memory errors.⁴⁻⁷

Older adults may experience difficulty with negations:

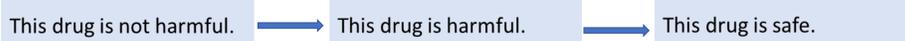
- Age-related declines in working memory, inhibition, episodic memory.^{11,12}
- More word-skipping during reading.¹³
- Age-related preference for positive information.¹⁴

Making 'no' and 'not' visually salient may make reading easier and more accurate, by:

- Reducing processing cost.
- Prompting fixation of 'no' and 'not'.
- Mitigating the positivity effect.

Why are negations difficult?

Readers theorised to first simulate a positive representation, then a negative representation.⁸



Small and common words are skipped more frequently, so readers may skip over 'no' and 'not'.^{9,10}

RESEARCH QUESTIONS

1. Are health statements with negation processed with more difficulty by young and older adults?
2. Are health statements with negation comprehended less accurately by young and older adults?
3. Does salient negation reduce processing difficulty and/or increase comprehension accuracy, and does this differ between young and older adults?

METHODS

Participants

- 60 young adults (18-25 years).
- 60 older adults (65-90 years).
- Native English speakers.

Design

- All young and older adults read statements in three negation conditions (see right).
- Completed comprehension tasks immediately and after a delay.
- We measured reading time, accuracy and evaluation time (time to correctly complete tasks).

Materials

- 120 experimental health statements (each in three conditions); 40 positive fillers; two comprehension tasks per statement.
- Statements featured fictional illnesses: spaceitis (affects astronauts) and frigavirus (affects Antarctic researchers).

Condition	Example health statement
No Negation	A red, blotchy rash is normal with frigavirus.
Standard negation	A red, blotchy rash is not normal with frigavirus.
Salient negation	A red, blotchy rash is not normal with frigavirus.

Time	Task	Correct ending: no negation	Correct ending: standard/salient negation
Immediate	Frigavirus is...	normally associated with a red, blotchy rash.	rarely associated with a red, blotchy rash.
	Frigavirus sufferers are...	likely to get a red, blotchy rash.	unlikely to get a red, blotchy rash.

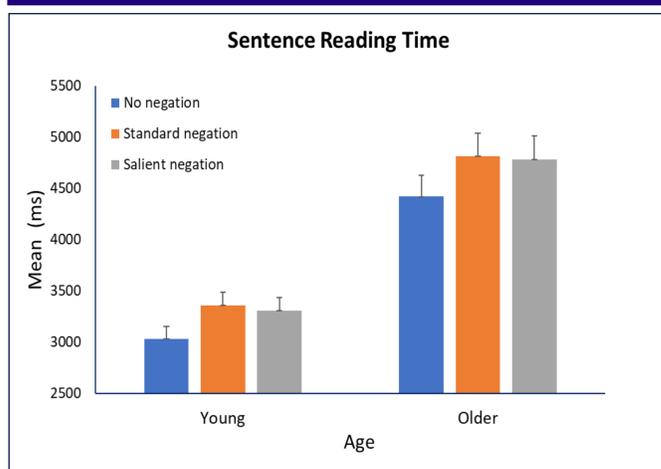
Procedure

- Online experiment.
- Part 1: Reading counterbalanced statements; completing a task immediately after each one.
- Part 2: Completing delayed tasks.

Data Analysis

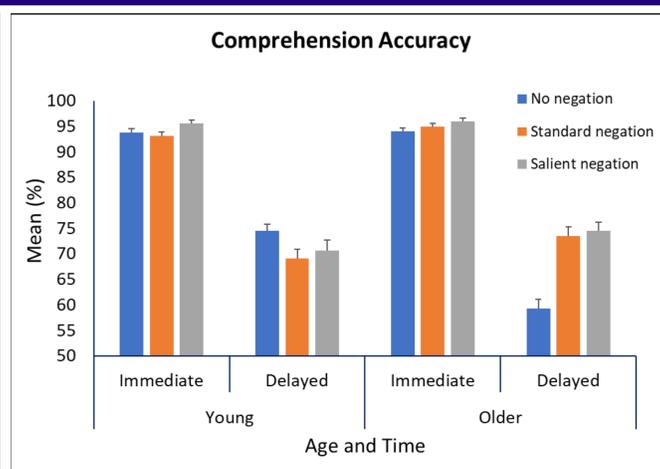
- Variance across participants (F_1) and items (F_2) computed via analyses of variance.
- Effects significant if $p < .05$ in both F_1 and F_2 analyses.
- Post hoc Bonferroni tests.

KEY RESULTS



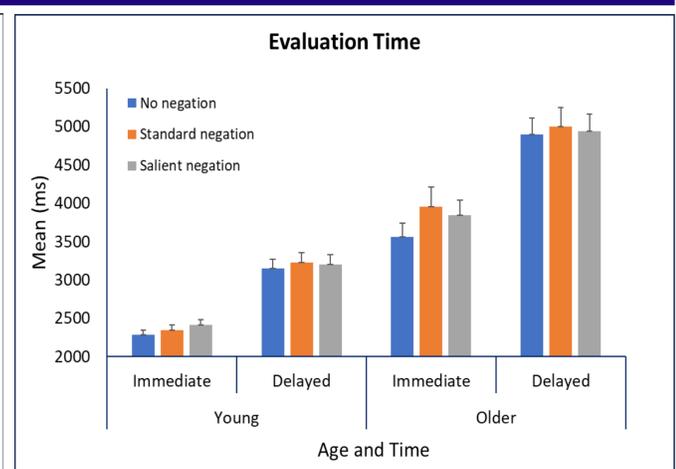
Sentence reading time

- Standard negation took longer than no negation, both $p < .001$.
- No significant difference for standard versus salient negation, both $p = 1.00$.
- Older adults took longer than young adults, both $p < .001$.
- No interactions.



Comprehension accuracy

- No significant difference for no negation versus standard negation, $p = .09$ (F_1), $p = .196$ (F_2).
- Salient (versus standard) negation saw a small but significant increase in overall accuracy, $p = .044$ (F_1), $p = .036$ (F_2).
- Overall, no significant difference between young and older adults, $p = .525$ (F_1), $p = .085$ (F_2).
- Interactions: for delayed tasks, older (but not young) adults had lower accuracy with no negation, versus standard negation.



Evaluation time

- No reliably significant difference for no negation versus standard negation, $p = .004$ (F_1), $p = .139$ (F_2).
- No significant difference for standard versus salient negation, both $p = 1.00$.
- Older adults took longer than young adults, both $p < .001$.
- No interactions.

Note: Error bars on all charts denote standard error of the mean.

KEY FINDINGS

Negation

- Health statements with standard negation, versus no negation, took longer to read but not evaluate.
- Overall, statements with standard negation and no negation comprehended with similar accuracy.
- Salient (versus standard) negation saw a small but significant increase in overall accuracy.

Age

- Older adults took longer than young adults to read and evaluate health statements in all conditions.
- Older adults' overall accuracy did not significantly differ from that of younger adults.

IMPLICATIONS FOR PRACTICE

1. Making 'no' and 'not' highly salient could enable health statements with negation to be understood more accurately.
2. Health statements with 'no' and 'not' will take longer to read.
3. Older adults will need longer than young adults to read and evaluate all health statements.

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