

## Effects of linguistic manipulations on the comprehension of COVID-19 health messages

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The coronavirus pandemic challenges health communication: How do you persuade someone to wear a mask, get vaccinated or practice social distancing (especially in a divided sociopolitical context like the U.S.)? We (i) investigate what modulates the effectiveness of COVID-19 health messages and (ii) test psycholinguistic theories in a real-world context.

**Background:** Information mentioned earlier in the sentence is known to be privileged: Speakers mention the most prominent information early in the sentence; comprehenders construe early information as most topical (e.g. Prat-Sala & Branigan 2000, Kaiser 2011). But psycholinguistic research often uses materials with little relevance to daily life. It is unclear to what extent order-of-mention effects exist ‘in the wild’ during different tasks (e.g. assessing risk, receiving advice). We report two exploratory studies on the comprehension of COVID-related health messages, which test (i) effects of order-of-mention (Exp1: virus vs. victim, Exp2: agent vs. behavior), (ii) how they interact with other information (Exp1: numbers, Exp2: perspectival cues), and (iii) top-down effects (differences in COVID anxiety, political views).

**Exp1 (Facts).** 71 U.S. English speakers read facts about COVID and rated how scary each is (6-pt scale: 1=not at all scary, 6=very scary). We manipulated (i) order-of-mention using active/passive (virus = subject or in by-phrase) and (ii) presence/absence of numbers (Table 1). We used verbs like *afflict*, *damage*, *infect*. In passives, the victim (human, body part) is the subject. *The virus is always the agent*; it is simply mentioned early or late. People were also asked about COVID anxiety, political views and other demographic information in Exp1-2.

**Predictions:** Health research has not clearly separated **order-of-mention** from agentivity, but some suggest ‘virus as agent’ boosts threat perception (McGlone et al. 2013, but see Ma & Miller 2021 for null results). This might mean higher fear ratings for actives. Numeracy challenges in health communication are well-known (Brust-Renck et al 2013); **number** messages may be a ‘turn-off’ (lower ratings). Also, no-number versions are more open to interpretation: anxious people may interpret e.g. ‘millions’ as more millions (scarier) than less-anxious people.

**Results:** Facts *without numbers* are rated scarier than facts with numbers (Fig.1a, Imer, z-scores,  $|t|=2.019$ ,  $p<.05$ ). There is no order-of-mention effect, no interaction ( $p$ 's $>0.5$ ). A median-split on COVID anxiety scores suggests number effects may be related to anxiety (Fig.1b). More anxious people rate no-number messages as scarier than ones with numbers ( $|t|=2.1$ ,  $p<.04$ ); the less-anxious show no such effect ( $p>.4$ ). We find no clear effects of political views.

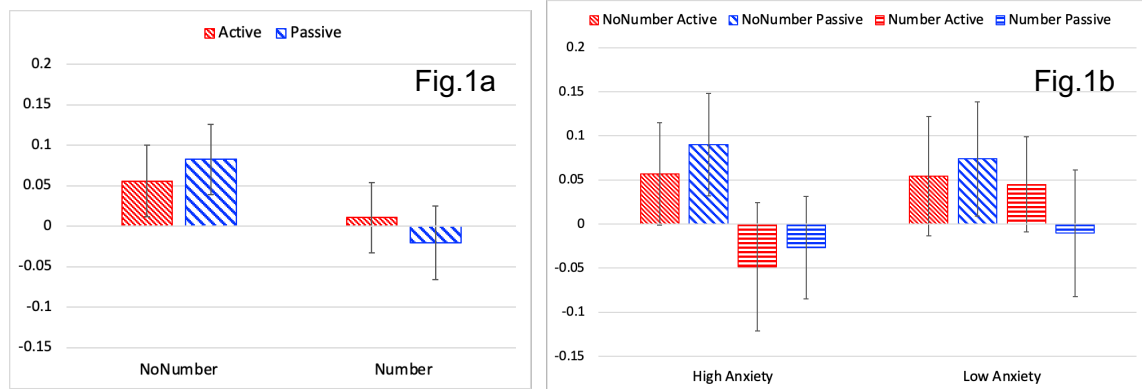
**Exp2 (Behaviors)** tests order-of-mention and perspective effects on message persuasiveness. 73 U.S. English speakers read advice about behaviors related to masks and social distancing and rated how convincing each is (1=not at all convincing, 6=very convincing). We manipulated (i) whether the agent or behavior is mentioned first, and (ii) perspective cues from pronouns (*you*, *we*, *people/everyone* (*‘general’*), Table 2). **Predictions:** The **ordering** options’ effectiveness may depend on the health threat (Glowacki et al. 2016); we test what works for COVID. **Pronouns:** ‘You’ addresses the reader, activates an agentive perspective (Brunye et al. 2009), predicting higher persuasion than ‘we’ or general ‘people/everyone’. Given COVID’s politicization in the US, political views (e.g. common good/individualism) may also matter here.

**Results:** Persuasiveness ratings show order-of-mention x perspective x political views (democrat/non-democrat) interactions ( $p$ 's $<0.02$ ); no effects of anxiety score. Self-identified democrats ( $n=37$ ) rate ‘you’ most persuasive in Behavior-first conditions (in line with our prediction) but, intriguingly, favor the ‘general’ perspective in Agent-first conditions (maybe due to a belief that everyone should follow health guidelines, details in Table 3, Fig.2). Non-democrats ( $n=36$ ) show no significant sensitivity to perspective manipulations ( $p$ 's $>0.24$ , Fig. 2).

**In sum:** For those looking to create effective COVID health messages, our results pose a challenge: There is no one-size-fits-all solution, people perceive the messages through different ‘glasses.’ For psycholinguists, our results suggest that order-of-mention can interact with other aspects of language and cognition (perspectival cues, political views). Given the complex nature of these interactions and substantial variability in the data, we emphasize the need for more studies on a larger scale to assess the reliability and generalizability of these findings.

**Table 1.** Exp 1 design and example item (between-subjects design, 36 targets)

|                     |   |
|---------------------|---|
| Active + no number  | The <b>coronavirus</b> has afflicted millions of Americans.               |
| Passive + no number | Millions of Americans have been afflicted <b>by the coronavirus</b> .     |
| Active + number     | The <b>coronavirus</b> has afflicted over 25 million Americans.           |
| Passive + number    | Over 25 million Americans have been afflicted <b>by the coronavirus</b> . |

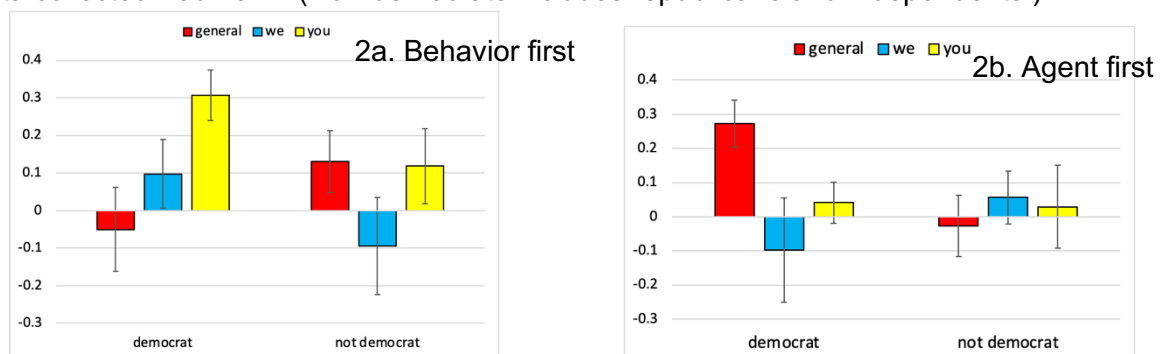


**Fig.1 Exp.1 Fear Ratings (z-scores):** Fig.1a: All participants, Fig.1b: High vs. Low anxiety participants (Median split based on a battery of questions we asked about people’s COVID-related anxiety levels.) Data collected Jan-Feb 2021. (All error bars show +/- 1 SE).

**Table 2.** Exp 2 design and example item (b/w-subjects, 14 mask / social distancing targets) (The general condition uses expressions like *people*, *everyone*. In agent-first sentences, the subject is followed by *should* or *can*.)

|                          |   |
|--------------------------|---|
| Behavior first + you     | <b>Wearing a face mask</b> at all times in public can help <b>you</b> protect everyone around you in case you need to cough or sneeze.      |
| Behavior first + we      | <b>Wearing a face mask</b> at all times in public can help <b>us</b> protect everyone around us in case we need to cough or sneeze.         |
| Behavior first + general | <b>Wearing a face mask</b> at all times in public can help <b>people</b> protect everyone around them in case they need to cough or sneeze. |
| Agent first + you        | <b>You</b> should wear a face mask at all times in public to protect everyone around you in case you need to cough or sneeze.               |
| Agent first + we         | <b>We</b> should wear a face mask at all times in public to protect everyone around us in case we need to cough or sneeze.                  |
| Agent first + general    | <b>People</b> should wear a face mask at all times in public to protect everyone around them in case they need to cough or sneeze.          |

**Fig.2: Exp.2 Persuasiveness ratings (z-scores)** Fig.2a Behavior-first, Fig.2b: Agent-first. Data collected Feb 2021. (Non-democrats includes republicans and independents.)



|                 | Behavior first           | Agent first       |
|-----------------|--------------------------|-------------------|
| You vs. general | t =2.859, p=0.005        | t =1.681, p=0.113 |
| You vs. we      | t =1.779, p=0.076 [marg] | t =0.884, p=0.390 |
| General vs. we  | t =1.328, p=0.186        | t =2.246, p=0.04  |

**Table 3.** Planned comparisons between perspectival conditions for self-identified democrats