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COVID-19 information overload: Intolerance of uncertainty moderates the relationship between frequency of internet searching and fear of COVID-19

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ABSTRACT

The COVID-19 pandemic has led to unprecedented levels of uncertainty for people around the world. Research suggests that internet searching resulting in contradictory information can lead to increased levels of distress, particularly for people who have a high intolerance of uncertainty (IU). In the present correlational study, U.S. undergraduate students (N = 317) indicated their IU, the frequency with which they search for COVID-19 related information online, their overall health anxiety, their fear of COVID-19 (FCV-19), and engagement in prevention behaviors. Consistent with previous research, individual differences in IU moderated the relationship between internet searches and FCV-19 such that for people high in IU, more internet searching was associated with greater fear. In turn, we also found that greater FCV-19 predicted more social-distancing behaviors. These findings are important in both future mental health and public health initiatives.

1. Intolerance of uncertainty

Intolerance of uncertainty (IU) is the difficulty in handling ambiguous information that is associated with uncertainty (Carleton, 2016). It is thought of as an individual, stable, trait-level or dispositional fear of the unknown (Carleton et al., 2012; Dugas et al., 1997; Fergus, 2013). Research has shown that IU is a transdiagnostic variable, meaning that it is present across a range of psychiatric disorders (Freeston et al., 2020; McEvoy & Mahoney, 2012; Talkovsky & Norton, 2016). Specifically, high levels of IU are correlated with anxiety disorders, including, but not limited to, generalized anxiety disorder (Carleton, Collimore, & Asmundson, 2010; McEvoy & Mahoney, 2012; Talkovsky & Norton, 2016), social anxiety disorder and social phobia (McEvoy & Mahoney, 2012; Talkovsky & Norton, 2016), panic disorder and agoraphobia (McEvoy & Mahoney, 2012; Talkovsky & Norton, 2016) and obsessive-compulsive disorder (Carleton, Collimore, & Asmundson, 2010; McEvoy & Mahoney, 2012; Tolin et al., 2003). IU can also lead to impairments of daily life functioning (Ladouceur et al., 1997). Furthermore, research suggests that targeting IU-related biases are related to a decrease in symptoms across multiple disorders including social anxiety, generalized anxiety, and depression (Dugas & Ladouceur, 2000; Mahoney & McEvoy, 2012; McEvoy & Erceg-Hurn, 2016; van der Heiden et al., 2012). This suggests the importance of addressing IU as a strong predictor of various psychiatric disorders.

Additionally, IU is related to health anxiety (Fergus, 2013), which stems from misinterpretations of perceived bodily sensations as being more unhealthy than they actually are (Asmundson & Taylor, 2020; Jungmann & Witthöft, 2020; Warwick & Salkovskis, 1985). When excessive, health anxiety can lead to adverse behaviors (Asmundson & Taylor, 2020) such as overuse or avoidance of medical services, hoarding medical items, and mistrust in public health officials.
respond to internet searching during the COVID-19 pandemic may be... higher in IU use and online about the symptoms and risks has been ever-changing as new data... lead to an overload of information that can increase, rather than conflicting (Asmundson... uncertainty, along with situation specific IU, will correlate with variances in the uncertainty, and thus, moderating perceptions of threat and uncer... unknown situations, those with high levels of IU tend to remain consistent in their behavior regardless of new information (Morriss, Zuj, & Mertens, 2021) and may generalize threats to safe conditions by expecting the worst outcome (Morriss, Zuj, & Mertens, 2021). In relation to the COVID-19 pandemic, IU might be a factor in people following safety protocols and mandates, but when these protocols (e.g., wearing masks outside when social distancing is possible) are no longer necessary for public safety, people high in IU may struggle in readjusting their behavior.

One way in which people may try to control their health anxiety is by searching for medical information on the internet (e.g., Fergus, 2013). Internet searching for medical information has become widespread in modern daily life (Starcevic, 2017); WebMD, for example, has 75 million unique visitors to their website each month (WebMD, 2018). Internet searching for health information has become a common checking behavior for those high in IU who desire to reduce distress levels (Cailata, Zufferey et al., 2017; Jungmann & Wittfoht, 2020; Tolin et al., 2003). In some cases, internet searches can help reassure people that their symptoms do not amount to life-threatening conditions, and can help reduce any uncertainty that surrounds specific symptoms (Fergus, 2013). A recent meta-analysis (McMullan et al., 2019) found that health anxiety predicts both online health information-seeking and cyberchondria (i.e., excessive searching; Starcevic, 2017). The excessive searching cycle of cyberchondria has the potential to be an unhelpful safety strategy and increase uncertainty, which therefore heightens health anxiety for people with high IU (Bottesi et al., 2021; Fergus, 2013; Jungmann & Wittfoht, 2020; Morris & van Reekum, 2019; Starcevic, 2017; Starcevic et al., 2021; White & Horvitz, 2009). One way in which this happens is that people may come to falsely believe that harmless symptoms actually signal grave medical conditions because they misunderstand medical diagnostic information found online (Fergus, 2013; Jungmann & Wittfoht, 2020; White & Horvitz, 2009). During the COVID-19 pandemic, this could be particularly likely considering that COVID-19 symptoms often overlap with that of the common cold or allergies (Jungmann & Wittfoht, 2020; Ornell et al., 2020). Furthermore, research has shown that people high in IU have increased sensitivity to information about threats and safety (Morriss & van Reekum, 2019). Due to the fact that IU is associated with a decreased ability to tolerate the absence of information, any threat of uncertainty is noted as aversive, even under situations where safety is high (i.e. information about safety is provided) (Freeston et al., 2020; Morris, Bell, et al., 2021). Another way in which repeated internet searching can increase uncertainty is when the information found online is inconsistent or conflicting (Asmundson & Taylor, 2020; Starcevic et al., 2021). This can lead to an overload of information that can increase, rather than decrease anxiety for those with high IU (Starcevic et al., 2021).

Since the onset of the COVID-19 pandemic, the information available online about the symptoms and risks has been ever-changing as new data and sources of information become available. As such, examining how internet searching about COVID-19 and IU interact to predict health anxiety and the fear of COVID-19 is of utmost importance. Bottesi et al. (2021) demonstrated that while IU was correlated with health anxiety pre-pandemic or during the initial COVID-19 lockdown, cyberchondria only played a role in this relationship during the COVID-19 lockdown. This provides initial evidence that how people higher in IU use and search online about COVID-19 and IU interact to predict health anxiety (Akbari et al., 2021), and overall well-being (Bakiglu et al., 2020). Satcici et al. (2020) found that those with high levels of IU during the COVID-19 pandemic also had higher levels of FCV-19; because IU led to more rumination about COVID-19. In a similar study, researchers found that IU mediated the relationship between FCV-19 and health anxiety (Akbari et al., 2021). Taken together, this suggests that FCV-19 can both be an outcome of IU, and lead to IU. Notably, research has also found a link between FCV-19 and engagement in COVID-19 prevention behaviors such as staying home, mask wearing, social-distancing, and hand-washing (Breakwell et al., 2021; Melki et al., 2020). Thus, while a FCV-19 is associated with worse mental health outcomes, it is also associated with better adherence to preventive behaviors (CDC, 2020).

3. The present research

The goal of the present research is to examine the relationship between individual differences in IU, health anxiety, FCV-19, and frequency of COVID-19 related health information searches. In a correlational, cross-sectional study, we measured the effect of frequency of COVID-19 related health information searches on both health anxiety and FCV-19 and the moderation effect of IU on this relationship. We also measured the mediation effect of FCV-19 on the relationship between frequency of COVID-19 related health information searches and social-distancing behavior with IU as a moderator. Consistent with previous research (Fergus, 2013), we used negative affect (NA) and exposure to COVID-19 as covariates. We predicted that greater frequency of COVID-19 related internet searching would positively predict health anxiety and FCV-19. Furthermore, we predicted that IU would moderate this relationship, such that people with a higher intolerance of uncertainty would show a stronger relationship between internet searching and these outcomes. Finally, consistent with other research, we predicted that an increased FCV-19 would mediate the relationship between internet searches, IU, and COVID-19 prevention behaviors.

4. Method

4.1. Participants and design

Undergraduates (N = 317) from a mid-sized Western U.S. private university participated in exchange for partial course credit. Recruitment began in Fall 2020 and concluded in Spring 2021 once the COVID-19 vaccine became available to all participants; we made the a priori decision to recruit as many participants as possible during this time. This study obtained IRB approval (20-08-1492) and all participants provided consent for beginning the study. Participants were on average 19.37 years of age (SD = 2.32), and were predominantly women (68.5%). Participants self-identified their race as white (47.5%), Asian (29.7%), Latinx (16.1%), Black (3.8%), Native Hawaiian or Pacific Islander (3.2%), or other races (3.3%). Only 12.3% of participants had been diagnosed with COVID-19, but 85.2% knew someone who had been diagnosed.
4.2. Materials and procedure

First, participants completed the 12-item Intolerance of Uncertainty Scale (Carleton et al., 2007; $\alpha = 0.90$ in the current sample). Participants indicated whether they respond with distress to uncertain and ambiguous situations (e.g., “Unforeseen events upset me greatly”; 1 = not at all characteristic of me, 5 = entirely characteristic of me). Scores were averaged to create an aggregate in order to account for missing data; higher scores indicate more IU. Next, participants completed a 10-item Negative Affect scale (Watson et al., 1988; $\alpha = 0.87$ in the current sample) in which they responded to which word descriptors corresponded to how they felt on a five-point scale (e.g. “scared”, “nervous”; 1 = very slightly or not at all, 5 = extremely). Scores were averaged to create an aggregate; higher scores indicate greater negative affect.

Participants then completed the 18-item Short Health Anxiety Inventory (SHAI; Alberts et al., 2011; Salkovskis et al., 2002; $\alpha = 0.85$ in the current sample). Consistent with previous research (Alberts et al., 2011; Fergus, 2013), only the first 14 items of the 18-item SHAI were used because they directly assess health anxiety (Alberts et al., 2011). Participants responded to statements assessing their health anxiety independent of actual physical health status over the past six months (e.g. “I spend most of my time thinking I have a serious illness”; 0 = I do not, 3 = I spend most of my time). Scores were averaged to create an aggregate; higher scores indicate increased levels of health anxiety.

Then, participants responded to a single item question and indicated how frequently they search for online COVID-19 health information (0 = Never, 6 = Several times a day; adapted from Baumgartner & Hartmann, 2011; Fergus, 2013; Muse et al., 2012). Participants completed the 7-item Fear of COVID-19 Scale (Aboursou et al., 2020; $\alpha = 0.89$ in the current sample). Participants indicated their agreement with several items about fears about COVID-19 (e.g. “I am afraid of losing my life because of COVID-19”; 1 = strongly disagree, 5 = strongly agree). Scores were averaged to create an aggregate; higher scores indicate a greater FCV-19. Participants then completed several other measures including a measure of financial anxiety, as well as several exploratory questions, but these analyses will not be reported here.

Finally, participants responded to two different mitigation behaviors. They indicated whether they or someone they know personally had been diagnosed with COVID-19, and indicated whether they practice prevention behaviors such as social-distancing or wearing masks in public (1 = yes, 2 = no). Following this, participants were thanked and debriefed.

5. Results

Descriptive statistics and correlations for the study variables are displayed in Table 1. As seen in the table, frequency of internet searching is correlated with FCV-19 and health anxiety. Similarly, IU is correlated with FCV-19 and health anxiety. Furthermore, there is a correlation between FCV-19 and social-distancing practices.

5.1. Primary analyses

We conducted a series of centered-regression analyses using the PROCESS macro for SPSS, Model 1 (Hayes, 2017) to test the moderation effects with 5000 bootstrap samples. The predictor variable ($x$) was internet searches, the outcome variables ($y$) were SHAI and FCV-19 and the moderating variable ($w$) was IU.

5.1.1. Short health anxiety inventory

The overall model was significant for the Short Health Anxiety Inventory, $R^2 = 0.16, F(3,310) = 19.34, p < .001$. There was a significant main effect of frequency of internet searches for COVID-19 health information on SHAI ($\beta = 0.10, SE = 0.02, t = 5.34, p < .001, 95\% CI = [0.06, 0.14]$) such that more searching predicted greater health anxiety. There was also a significant main effect of IU on SHAI ($\beta = 0.16, SE = 0.03, t = 4.83, p < .001, 95\% CI = [0.09, 0.22]$) such that greater IU predicted greater health anxiety. The frequency of internet searches for COVID-19 health information x IU interaction was not significant ($\beta = 0.00, SE = 0.02, t = 0.17, p = .86, 95\% CI = [-0.44, 0.52]$.)

5.1.2. Fear of COVID-19 Scale

The overall model was significant for the Fear of COVID-19 Scale, $R^2 = 0.50, F(3,310) = 34.20, p < .001$. There was a significant main effect of frequency of internet searches for COVID-19 health information on FCV-19 ($\beta = 0.27, SE = 0.04, t = 7.52, p < .001, 95\% CI = [0.20, 0.34]$). There was also a significant main effect of IU on FCV-19 ($\beta = 0.33, SE = 0.06, t = 5.46, p < .001, 95\% CI = [0.21, 0.45]$). Additionally, as predicted, the frequency of internet searches for COVID-19 health information x IU interaction was significant ($\beta = 0.10, SE = 0.05, t = 2.28, p = .02, 95\% CI = [0.01, 0.19]$). See Fig. 1. Simple slopes analysis revealed that for participants high in IU, a higher frequency of internet searches for COVID-19 health information was strongly associated with a greater fear of COVID-19 ($\beta = 0.35, SE = 0.05, t = 6.86, p < .001, 95\% CI = [0.25, 0.45]$). For participants low in IU, a greater frequency of internet searches for COVID-19 health information was also associated with greater fear of COVID-19 ($\beta = 0.18, SE = 0.05, t = 3.45, p < .001, 95\% CI = [0.08, 0.28]$). In other words, higher frequency of internet searches is associated with higher fear for everyone; but the magnitude of the effect is greater for people higher in IU.

\[\text{Table 1} \]

| Variable | Possible | Mean (SD) | N | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----------|----------|-----------|---|---|---|---|---|---|---|---|---|
| 1. Internet searching frequency | 1-7 | 3.30 (1.30) | 315 | – | – | – | – | – | – | – | – |
| 2. Intolerance of Uncertainty Scale | 1-5 | 2.84 (0.78) | 316 | 0.10 | – | – | – | – | – | – | – |
| 3. Short Health Anxiety Inventory | 1-4 | 2.04 (0.48) | 314 | 0.31** | 0.28** | – | – | – | – | – | – |
| 4. Fear of COVID-19 Scale | 1-5 | 2.40 (0.95) | 315 | 0.40** | 0.31** | 0.54** | – | – | – | – | – |
| 5. Social Distancing Practices | 1-2 | 1.10 (0.31) | 315 | –0.05 | 0.01 | –0.01 | –0.15** | – | – | – | – |
| 6. Mask Wearing Practices | 1-2 | 1.00 (0.06) | 315 | –0.06 | 0.08 | –0.04 | –0.08 | 0.17** | – | – | – |
| 7. Negative Affect (NA) | 1-5 | 2.79 (0.77) | 315 | 0.15** | 0.44** | 0.47** | 0.43** | 0.02 | –0.10 | – | – |
| 8. COVID-19 myself diagnosed | 1-2 | 1.98 (0.33) | 316 | –0.01 | 0.07 | 0.06 | 0.10 | –0.12* | 0.02 | 0.02 | – |
| 9. COVID-19 personally know diagnosed | 1-2 | 1.14 (0.35) | 315 | –0.09 | 0.10 | –0.06 | 0.07 | –0.05 | 0.14* | 0.01 | 0.13* |
\[\text{** All } r \text{ values significant at } p < .01 \text{ (2-tailed).} \]
\[\text{* All } r \text{ values significant at } p < .05 \text{ (2-tailed).} \]
outcome variable (y) was social-distancing, the predictor variable (x) was frequency of internet searches, the described interaction and COVID-19 prevention behaviors, we used 5.1.3. Moderated mediation

**Note: Please position this caption under the figure so it is consistent with the formatting of Fig. 2.**

Fig. 1. Moderating effect of intolerance of uncertainty (IU = Intolerance of Uncertainty Scale-12-item version) on the relation between frequency of Internet searches for COVID-19 health information and fear of COVID-19 (FCV-19 = Fear of COVID-19 Scale).

*=Note: Please position this caption under the figure so it is consistent with the formatting of Fig. 2.

5.1.3. Moderated mediation

To test whether FCV-19 mediated the relationship between the above described interaction and COVID-19 prevention behaviors, we used PROCESS (Hayes, 2017) model 8 to run a moderated mediation in SPSS. The predictor variable (x) was frequency of internet searches, the outcome variable (y) was social-distancing, the moderating variable (w) was IU, and the mediating variable (M) was FCV-19. See Fig. 2. Moderated mediation would be determined if IU moderated the link between frequency of internet searching and either FCV-19 or social-distancing.

![ModeratedMediationModel](image)

**Fig. 2. Moderated Mediation Model: Social Distancing (IV), Fear of COVID-19 (Mediator), Frequency of Internet Searches (DV), Intolerance of Uncertainty (Moderator)**

Note. *p < .05, **p < .01. Solid lines indicate paths significant at p<.05, while dashed lines indicate non-significant paths. B values displayed.

The index of moderated mediation was significant (0.08, SE = 0.05, 95% CI = [0.01, 0.19]). As described above, there was a significant effect of frequency of internet searches for COVID-19 health information on levels of fear of COVID-19 and, the interaction between frequency of internet searches for COVID-19 health information and IU was significant. Furthermore, Fear of COVID-19 significantly predicted social-distancing (β path), β = 0.74, SE = 0.26, Z = 2.79, p < .001.

The conditional direct effect of frequency of internet searching for COVID-19 health information on social-distancing behavior was not significant (c path), β = −0.07, SE = 0.15, Z = −0.49, p = .62, 95% CI = [−0.37, 0.22]. Furthermore, IU did not moderate the effect of frequency of internet searches for COVID-19 health information and social-distancing behavior, β = −0.02, SE = 0.17, Z = −0.11, p = .91. The conditional indirect effect was greater in people with high IU (0.26, SE = 0.11, 95% CI = [0.07, 0.52]) and weaker in people with low IU (0.13, SE = 0.06, 95% CI = [0.04, 0.28]). In other words, people with high levels of IU that engage in more internet searching about COVID-19 are more likely to have increased FCV-19, and therefore engage in more social-distancing behavior.

6. Discussion

The results of this study suggest that individual differences in intolerance of uncertainty is an important factor to consider when examining people’s fear of COVID-19. Consistent with previous research, our data suggest that on its own, greater IU predicted more health anxiety, a greater FCV-19, and more social-distancing behaviors. As predicted, IU also moderated the relationship between searching for COVID-19 related information on the internet and FCV-19. That is, frequent internet searches about COVID-19 led to greater FCV-19, especially for people higher in IU. Notably, IU did not moderate the relationship between internet searching about COVID-19 and general health anxiety. Furthermore, these findings were consistent when controlling for NA and direct or second hand experience with COVID-19, which illustrates the impact of IU specifically. This strengthens the study as these results cannot be contributed to other confounding variables.

Interestingly, we also found that FCV-19 mediated the relationship between frequency of internet searches for COVID-19 health information and IU, and social-distancing. That is, the increased FCV-19 that was predicted by frequent internet searching and higher IU, in turn predicted more social-distancing behaviors. While variables like IU and FCV-19 are normally associated with negative mental health outcomes (Carleton, Collimore, & Asmundson, 2010; Fitzpatrick et al., 2020; Ornell et al., 2020; Tolin et al., 2003), this study provides evidence that they might be beneficial for public health during the COVID-19 pandemic. Our data suggests that people with higher levels of IU and FCV-19 are more likely to engage in social-distancing behaviors, which may help slow the transmission of COVID-19. Future research should test how to achieve improvements in public health initiatives through these variables, but with close attention to mental health outcomes.

While IU is not generally targeted in anxiety interventions (Freeston et al., 2020), research has shown methods that are effective in reducing IU, and therefore anxiety in general (Fergus, 2013). For example, in looking at cognitive strategies, clinicians can teach clients that definite explanations are not always possible, thus increasing their tolerance for uncertainty (Abramowitz & Braddock, 2008). Behavioral strategies could also be used by clinicians to increase a client's tolerance for uncertainty, such as exposure to an uncertain situation without the means to engage in checking behaviors (Einstein, 2014; Knowles & Olatunji, 2010).

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2 We had initially planned to aggregate social-distancing with mask wearing, however, 99% of our sample reported engaging in mask wearing, likely because of strict local masking laws, so the two variables were not strongly related (r = 0.11).
In applying this to our research, people who have high levels of IU should be cognizant of the amount of information they are exposed to regarding COVID-19. For example, people high in IU could set aside a specific amount of time per day that they allow themselves to search COVID-19 related health information. It is important to stay up to date with public health mandates, but not become inundated and obsessed with the information available on the internet. Furthermore, individuals should fact check the information they are being exposed to as misinformation and misunderstanding is associated with psychological distress (Lin et al., 2020). Public health officials should create campaigns that promote COVID-19 awareness, but not initiate fear of COVID-19 for individuals.

6.1. Limitations

The findings of the present study should be considered with various limitations. First, our sample was undergraduate students in the Western U.S. This constricted age range is particularly important for COVID-19, as age is considered one of the biggest risk factors of the disease (CDC, 2020). With greater demographic variability, including individuals from outside of the U.S., this research could have broader implications for the public. For example, our undergraduate pool of students was predominately white. National data shows that Black and Latinx people are more affected by COVID-19 in the U.S.; they are almost three times more likely than whites to be hospitalized and twice as likely to die from COVID-19 (CDC, 2021). Additionally, research has shown that non-Hispanic Black adults have had an increase in experiences of anxiety or depression disorders in relation to the pandemic (Fitzpatrick et al., 2020; Panchal et al., 2021). With a broader demographic sample, this could be looked at more closely. Furthermore, since the onset of the pandemic, young adults (18–24) have had an increase in symptoms of anxiety, depression, substance abuse, and suicidal thoughts (Panchal et al., 2021). Since our population was undergraduate students within this age range, our results might have been more extreme than results with a greater age range. Finally, the majority of our sample were women who in previous research, have been shown to have higher levels of anxiety in general compared to men (Bahrami & Yousefi, 2011; Craske, 2003); this could have affected our results. Researchers should take into account these demographic limitations when conducting future research. Additionally, our sample came from a university in a U.S. state with incredibly strict COVID-19 policies relative to other U.S. states, regarding things like masking in indoor public spaces. This limited our ability to test whether variables like IU or FCV-19 actually influence these behaviors. Moreover, preventative measure variables (social-distancing and mask wearing) were measured on a binary scale, with response options as either yes or no. This limited the nuance of possibilities from participants. For example, it may be possible that some participants wear masks, but only when required. Similarly, specifically with the undergraduate student population, participants may only practice social distancing when in classrooms, but not when on campus. Therefore, the response options constrain the variety of possible responses. Future research should include more items with likelihood scales (versus just “yes, no” responses), as well as ask additional questions related to preventative behaviors relating to frequency, duration, and environment to increase the reliability of these findings. Finally, it is important to note that this study is limited due to its correlational design. One alternative hypothesis is that perhaps FCV-19 actually causes more checking behaviors and information seeking (and not the other way around).

Similarly to how information seeking is used as a coping mechanism, but can also contribute to greater IU (Fergus, 2013; Jungmann & Witthöft, 2020; Starcevic, 2017; Tolin et al., 2003; White & Horvitz, 2009). Future research should include a longitudinal study to establish temporal precedence, or an experimental study in which people are given more or less information about a new strain to mimic online searching before measuring FCV-19 as an outcome.

6.2. Conclusion

The COVID-19 pandemic for many people has led to an increase in adverse mental health disorders, substance use, and suicidal ideation (Czeisler et al., 2020). With so much unknown surrounding the pandemic, individual differences in IU are important to address so that clinicians can better understand mental health outcomes. Furthermore, this research is important for public health as it sheds light on the relationship between individual differences in IU, frequency of internet searches for COVID-19 health information, FCV-19 and social-distancing behavior. While there are negative mental health outcomes associated with high levels of IU and FCV-19, there may be positive public health outcomes that could be used in public health initiatives addressing the transmission of COVID-19.

Declaration of competing interest

The authors have no conflict of interest to report.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2022.103534.

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