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Working Memory as a Predictor of Social Distancing and Face Mask Compliance During COVID-19 Pandemic

Cassandra Jean Kemmel
Missouri State University, Kemmel418@live.missouristate.edu

WORKING MEMORY AS A PREDICTOR OF SOCIAL DISTANCING AND FACE MASK COMPLIANCE DURING COVID-19 PANDEMIC

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Cassandra Kemmel

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ABSTRACT

The COVID-19 pandemic has brought about many changes in daily lives around the world. In the United States, face masks and social distancing rules have been suggested and even enforced in areas throughout the country. Compliance with these regulations will in turn, hopefully, reduce transmission and therefore the threat of the COVID-19 virus. Working memory (WM) has been found to be an integral part of the decision-making process, by assessing costs and benefits, both individually and for others. In May 2019, Xie, Campbell, and Zhang (2020) found that WM capabilities were predictive of social distancing compliance. The purpose of this research project was to do a partial replication of Xie et al. (2020) by investigating the predictive validity of WM, perceived benefits over costs, and anxiety on social distancing and face mask compliance. Two hundred-fourteen participants were recruited via Amazon M Turk. Participants completed a visual working memory localization task (VWMLT), a series of questionnaires on demographics, social distancing compliance, face mask compliance, a perceived benefits over costs analysis of compliance, and anxiety. Two hierarchical multiple regression analyses and two tests for mediation were employed to best explain individual differences in compliance behavior. Working memory capacity was found to be a significant predictor of social distancing compliance when accounting for anxiety ($b = 0.65$, $p < .01$), but was not for face mask compliance ($b = 0.11$, $p > .05$). Perceived benefits over costs did not mediate the relationship between WM capacity and either social distancing or face mask compliance. The results of this project contribute to our understanding of individual differences in cognitive processing and how such differences relate to human behavior considering a global pandemic. Given an understanding of the link between WM and social behavior may then provide a means to further research the connection between the theoretical basis of WM in decision making.

KEYWORDS: working memory, anxiety, social distancing, face mask compliance, COVID-19

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Approved:

D. Wayne Mitchell, Ph.D., Thesis Committee Chair

Leslie Echols, Ph.D., Committee Member

Melissa D. Fallone, Ph.D., Committee Member

Julie Masterson, Ph.D., Dean of the Graduate College

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INTRODUCTION

The COVID-19 Pandemic first reached the United States in early 2020 and has changed drastically how daily life carries out. According to the US Centers for Disease Control and Prevention (2020), COVID-19 is spread through physical contact between people, specifically within 6 feet. For this reason, the CDC issued immediately guidelines regarding both social distancing and wearing of face masks to slow the spread. As the months have carried out since initial lockdowns beginning in March 2020, a variety of government officials have mandated one or both practices to assist in the control of the virus spread. These mandates have varied across state, county, and even city boundaries. Compliance with these mandates varies widely as well. There has been virtually no systematic research on the effects of compliance with these mandates. However, there was one report by Ginther and Zambrana (2021) that non-mandated mask wearing counties had a significant increase in COVID-19 cases compared to the mandated counties whose COVID-19 case rate remained stable. In sum there was a 50% increase in COVID-19 case rate for counties that did not wear masks. This finding supports that compliance in mask wearing can be effective in reducing the spread of COVID-19. However, more research is needed to understand individual differences in compliance behavior. Individual differences in compliance behavior can be explained partially by decision-making skills that underly cognitive processing and working memory (WM) capacity. The goal of the following sections is fourfold: (1) to provide selected theoretical discussion of WM; (2) to provide a link between WM and the decision-making process; (3) to describe briefly how the continued influence effect (CIE) and anxiety could impact WM; and (4) to put forth a rationale for the study of individual differences

in COVID-19 compliance behaviors. Identifying factors that account for said differences could provide a better understanding of "everyday" cognition.

Working Memory

WM was coined in the 1970s after much debate that a traditional dichotomous approach of short- and long-term memory was not sufficient in explaining all memory capabilities. Since then, the vocabulary of "short-term" memory has been moved away from and instead toward the vocabulary of "working memory." Even though WM is multi-functional and adaptable to the perceptual surrounds, it does have a limited capacity and functioning. Some models of WM classify memory capacities into temporal categories such as short term and long term, while others focus on the type of information being perceived, referred to as modules. These modules are sorted by type of information, for example, verbal, auditory, and visuospatial. The theories involving a modular organization suggest that when a single module is completely utilized, information can still be processed using other, available modules. Other theories propose a temporal model of WM, which proposes that when the blended, functional areas of WM are occupied, continued stimulus information will not be processed within the WM (Adams et al., 2018). The most widely accepted model of WM today involves a three-component model of WM with a partial modular setup. It is composed of the central executive, phonological loop, and visuospatial sketchpad (Baddeley 1992).

The visuospatial sketchpad has proven to be more difficult to research the other components. The process of visual encoding can happen concurrently with visual memory, or it can be interrupted by visual memory (Baddeley 1996). Bays et al. (2011) found two limits on recall precision of working memory: encoding rate and storage limit. The findings demonstrated

the limited capacity of working memory, in such that as number of items increased, precision of recall decreased because the WM storage limit was met or exceeded. If however, length of stimulus is decreased so much to be a brief flash of the stimulus, the end results are a function of how quickly the information of the stimulus can be transferred into WM for active processing, interpretation, and recall. As length of time of stimulus display decreased, precision also decreased due to incomplete WM processing. (Bays et al. 2011).

The use of stimulus information to match correctly to a sample response relates to the quantity and accuracy of these items in the WM perceptual process. If information is not available to accurately make a decision, a guessing process is undertaken (Hardman & Cowan 2015). This guessing rather than thought-through decision making may be an explanation for the reasoning behind noncompliance to a task, or mandate in the case of current research. Participants are said to use information ideally in a match-to-sample or change-detection task when they accurately select the change using information regarding either the color or shape of the stimulus. Using this reasoning, they are utilizing WM capabilities to accurately select the change. An inaccurate change selection may be the result of a lower WM capacity, potentially due to attentional distractions on that specific item, which then in turn leads to guessing. A strong correlation was found by Hardman and Cowan (2015) between the WM capacity for objects of change-detection and the proportion of trials in which a participant ideally used the information to detect changes from the stimulus. This information can translate then into how decision-making depends on an attentive and size-varying WM capacity.

Decision-Making Process

The decision-making process that is carried out, typically unconsciously, to comply can be better understood by examining the relationship of WM and decision making. In research conducted by Missier et al. (2013), participants completed a variety of decision-making tasks, and it was found that three such tasks had a positive relationship specifically to WM: resistance to framing, applying decision rules, and under/over confidence. Multi-processing tasks such as these require active processing of information that is done so via WM. The resistance to framing task requires participants to choose between a risky decision and certain outcome, differing in positive versus negative language used, although the outcome is the same for both decisions. An example of this is phrasing a package of ground beef as 80% lean versus 20% fat. They both mean the same thing, but the 80% lean is positively worded while the 20% fat is negatively. In the task of applying decision rules, participants are given a set of guidelines they must make match a virtual player to, such as their physical features. The more correct decisions made to match the appropriate features to the guidelines, the higher participants scored. In under/over confidence, participants were asked to rate true versus false for a list of general statements, then rating how sure they were on their decision from 50% (could go either way) to 100% (extremely certain). Each of these tasks require active memory processing to be completed successfully, therefore demonstrating that positive relationship with WM. Furthermore, the more complex nature of the resistance to framing task provides further evidence that the decision-making process is most successfully carried out while actively utilizing WM.

The Continued Influence Effect

A phenomenon known as the continued influence effect (CIE) is of particular interest for current WM research. The CIE occurs when even after being presented with facts of the misinformation of a topic, the original, now disproved beliefs are still held. In this case, the contradictory yet accurate new information is not integrated into the existing misinformation (Lewandowsky et al. 2012). The mechanism of the CIE is theorized to relate to the memory retrieval process. It is suggested that the existing information is automatically retrieved given a certain cue for retrieval without thorough assessment and attention to the accuracy of the information for the particular event. If new, correct information is introduced at one point in time but not fully processed, encoded, and accepted through the memory process, it will not be retrieved once said cue is introduced in the future. A large part of CIE is the misinformation. The misinformation surrounding the COVID-19 pandemic has stemmed from many sources including rumors, the government, and politicians, and most well-known, the media. When the media becomes the prime source of information for much of the public, a phenomenon known as selective exposure becomes a concern. In selective exposure, the more media coverage options a person has, the more biased toward their values their selection of media coverage will be. This can lead to confirmation bias. Selective exposure is particularly concerning in such a politicized lens that COVID-19 has had in the media (Lewandowsky et al. 2012). Brydges et al. (2018) found that WM served as a significant predictor of the CIE, potentially due to a lack of mental manipulation and reintegration of the new information, which are primary processes of WM. Those with lower WM capabilities were more likely to continue believing the misinformation presented, even after they had been presented with the corrected information.

The concern then for current WM researchers is whether those with the lower WM capabilities are more prone to believing misinformation, such as pseudoscience of the effectiveness of these behaviors, regarding social distancing and mask compliance guidelines, even after being presented with updated knowledge about the success of these practices in preventing the spread of COVID-19. The lack of reintegration of the new mandate information potentially could lead to noncompliance of the mandates then. Therefore, research focusing on the prediction of these compliance behaviors from WM performance, could contribute to the existing information and provide new methods to improve compliance of behaviors in the case of future global health crises related to the overcoming the inevitable release of misinformation.

Anxiety and WM

Moran's (2016) meta-analysis on the relationship between anxiety and WM provided evidence that both trait and state anxiety had a negative impact on WM, regardless of the WM paradigm or content. These findings indicate that allocation of attentional resources can suffer with increased anxiety. Stawski et al. (2006) and Brose et al. 2012) demonstrated that anxiety can compromise cognitive activity due to intrusive thoughts, increased avoidance behaviors, reduced motivation, and lack of attentional control. Over the past 9 months, via the various press reports and social media, there have been several contradictions and misinformation regarding the effectiveness and application of social distancing and mask wearing mandates, issues of unemployment, travel restrictions, as well as variability in everyday observed compliance behavior. Given such variability in information, one's allocation of attentional resources to COVID-19 would increase to update cognitively this information as it pertains to one's everyday life. And moreover, the general anxiety regarding contracting COVID-19 and subsequent

hospitalization or death would be expected to increase. Although Fellman et al. (2020) found that COVID-19 anxiety decreased significantly from March 2020 to May 2020, the magnitude of reduction was less than 1 scale point ($\eta_p^2 = .019$), the negative correlation between anxiety and WM remained (average $r = -.18$, $p < .05$).

Purpose of this Study

Recently, using WM tasks, compliance to social distancing was investigated by Xie et al. (2020). A visual WM localization task developed by Xie et al. (2020) was found to be predictive of social distancing compliance. Individuals with higher WM capacity reported higher social distancing and mask wearing compliance than individuals with lower WM capacity. Xie et al. (2020) found WM to be a predictive component of social distancing compliance in the COVID-19 pandemic. The perceived costs and benefits of choosing to comply were found to be correlated with visual WM capacity, in such that higher WM capacity is predictive of higher perceived benefits of compliance to social distancing practice. Furthermore, when participants weighted the benefits of compliance over the costs of compliance, it served as a partial mediator for the relationship between WM capacity and social distancing compliance (Xie et al. 2020). It may be possible that when participants are more aware of the benefits over costs of social distancing compliance, they are more likely to comply overall. Moreover, Xie et al. assessed the relationship between social distancing compliance and a variety of demographic, personality, depression, and anxiety variables. Although the personality, depression, and anxiety variables were correlated with social distancing, WM remained a significant predictor of social distancing when controlling for those covariates.

The purpose of this study is to conduct a partial replication of Xie et al. (2020) and Fellman et al. (2020) by investigating the predictive validity of WM, cost-benefit analysis, and state anxiety on social distancing and face mask compliance nine months out from the first COVID-19 wave. Face mask compliance was not assessed by Xie et al. (2020). Given that since the research by Xie et al. (2020) was conducted, wearing of face masks has further been implemented at the state, county, and city levels. The CDC released guidelines for face mask wearing indicating they do not replace social distancing guidelines. Compliance with face mask protocols is seen as an additional tool to fight the spread of COVID-19. As a result, face mask compliance will be integrated into this study.

Correlational Hypotheses

Hypothesis 1. Performance in the visual working memory localization task will have a strong positive linear relationship with social distancing and face mask compliance.

Hypothesis 2. Compliance to social distancing mandates and face mask mandates will have a strong positive linear relationship.

Hypothesis 3. Anxiety will be correlated negatively with WM, social distancing, face mask compliance, and perceived benefits over cost.

Analytical Model Hypotheses

Models 1 and 2 will be identical hierarchical multiple regression analyses differing with the outcome DV. In Model 1 the DV will be Social Distancing Compliance whereas in Model 2 the DV will be Face Mask Compliance.

Model 1. Model 1 will be a be a hierarchical regression analyses with WM and Perceived Benefit Over Cost entered on step 1 and Anxiety entered on step 2 as predictors of Social Distancing Compliance.

Model 2. Model 2 will be a be a hierarchical regression analyses with WM and Perceived Benefit Over Cost entered on step 1 and Anxiety entered on step 2 as predictors of Face Mask Compliance.

Models 3 and 4 will be identical to replicate Xie et al.'s (2020) test for mediation. In Model 3 the DV will be Social Distancing Compliance whereas in Model 4 the DV will be Face Mask Compliance.

Model 3. Model 3 will be a mediation test as to whether Perceived Benefits Over Costs will serve as a mediator in the relationship of Working Memory Capacity and Social Distancing Compliance.

Model 4. Model 4 will be a mediation test as to whether Perceived Benefits Over Costs will serve as a mediator in the relationship of Working Memory Capacity and Face Mask Compliance.

METHOD

Participants

Approval for the current research was granted by the IRB Review Board (Approval number: IRB-FY2021-407; Approval date: 01-12-2021; See Appendix A for approval). In total, 214 participants were recruited from the online Amazon Mechanical Turk (mTurk) platform. The study was only accessible to those living inside the United States, and above the age of 18. Consent was obtained and followed by administration of the study. Frequencies of demographic information are displayed in Table 1 below. A total of 136 participants were left after removing incomplete submissions and trial cut off scores. The final sample was comprised of males (n = 92) and females (n = 44), ranging in education and income levels. Most participants identified as Caucasian (n = 79), had completed a form of a college degree, and reported that their incomes were in the average range for their age group in the United States.

Procedure

This study was comprised of 4 phases, each of which is discussed in turn.

Phase I (Consent and Demographics). This phase consisted of obtaining participant consent by explaining the participants' rights and they were provided with a brief explanation about the study (see Appendix B for consent form). Once consent was obtained, participants were be asked to complete a demographics questionnaire which included information on age, gender, ethnicity, annual income, and highest degree of education (see Appendix C for the demographics questionnaire). The participant response options for highest degree of education included Primary School, Middle School, or equivalent, High school or equivalent, Associate

Table 1. Demographics of participants

	Frequency (*n*)	Percent %
Gender		
Female	44	32.35
Male	92	67.65
Ethnicity		
African/African American	12	8.82
Caucasian	79	58.09
Latino/Hispanic	14	10.29
Asian/Pacific Islander	6	4.41
Native American	5	3.68
Asian	14	10.29
Other	6	4.41
Education level		
Primary school	0	0.00
Middle school or equivalent	1	0.73
High school or equivalent	12	8.76
Associate College degree or 2 Year Technical Degree	14	10.22
Undergraduate College degree	74	54.02
Master's College degree	34	24.82
Doctoral College or Medical degree	0	0.00
Annual income ("for my age group")		
Far below average for my country	11	8.09
Below average for my country	20	14.71
Average for my country	86	63.24
Above average for my country	19	13.97
Far above average for my country	0	0.00
Total	136	

College degree or 2 Year Technical Degree, Undergraduate College degree, Master's College degree, and Doctoral College or Medical degree.

Phase II (Visual Working Memory Localization Task). In Phase II, participants completed a visual working memory localization task (VWMLT) which consisted of 5 practice trials and 20 experimental trials. Each VWMLT trial consisted of the onset of an image with 5 colored blocks for 2500ms, then a blank delay screen for 1000ms, and an identical image to the onset, except one of the blocks colors was an alternative color. Each block was be labeled with a letter (Ex: A, B, C, D, E). Participants selected the appropriate letter of the block that changed color from initial image to the secondary image. The color choices of the blocks included red, yellow, magenta, lime green, blue, green, cyan, and brown. The locations of the blocks were be counterbalanced in 5 locations of 16 possible locations. There were no more than 5 blocks on the screen at one time. Working memory capacity as the dependent variable is quantified as K [(proportion correct x set size) – 1], which has been found to be a reliable and valid measure of visual WM capacity (Kyllingsbaek, & Bundesen, 2009).

The VWMLT began with the presentation of response latency trials in which a similar task to the color block task was introduced to assess participant's response latencies of answering. The task included an onset of a single letter on the screen from the choices of A, B, C, D, or E for 2500ms, followed by a brief delay of 1000ms, followed by a response screen with all letters displayed. The participants were instructed to select the appropriate letter answer option that was displayed previously. Response latencies were measured in seconds, based on click count and latency to first and last click in Qualtrics. Then, the VWMLT task instructions were followed by the 5 practice trials. Participants were not given feedback as to whether their response was correct. Participants were required to answer at least three of the five trials

correctly to be included in further analyses. Participants who failed to meet the practice trial criteria were excluded from the study.

Phase III (Self-report Measures). In Phase III, participants were asked to complete a series of 4 questionnaires. The presentation order of questionnaires was assigned randomly through survey flow in Qualtrics. Each of the questionnaires are discussed below.

Social Distancing Compliance. Participants completed a self-report Social Distancing questionnaire on how often they follow social distancing protocols with a variety of social distancing behaviors such as "I have intentionally avoided social gatherings because of COVID-19." The participants answered on a scale from 1 (*I did not follow*) to 4 (*I followed very frequently*). An overall summary score was computed to get an overall social distancing compliance score in which higher scores indicate higher social distancing compliance. The derived summary scores could range from 8 to 32. This scale was developed by Xie et al. (2020) and had a reliable internal consistency (Cronbach's α = .83).

Face Mask Compliance. Participants completed the self-report Face Mask Compliance questionnaire on how often they follow face mask protocols with a variety of face masking policy behaviors. The participants answers will be taken on a scale from 1 (*I did not follow*) to 4 (*I followed very frequently*). Participants reported if their state, county, or city of residency has a face mask mandate in place or has at one point since March 2020. Summary scores were computed to get an overall face mask compliance score in which higher scores indicate higher face mask policy compliance. The derived summary scores could range from 4 to 16. The scale is adapted from the Social Distancing Compliance scale developed by Xie et al. (2020).

Perceived Benefits over Costs**.** Participants completed an adapted cost and benefit analysis of COVID-19 and practices such as social distancing, wearing face masks, and

sanitation practices that have become more prominent during the pandemic. Participants rated on a scale from 1 (*I don't think it is true*) to 4 (*I think it is very true*) on how true they think each statement is. A composite score was calculated with higher scores indicating weighing benefits over the costs of social distancing and face mask compliance in the COVID-19 pandemic. The composite scores could range from 16 to 64. This scale was developed by Xie et al. (2020) and has reported moderate internal consistency (Cronbach's α = .61).

Anxiety. Participants completed the Spielberger State Trait Anxiety Inventory for adults. The participants reported their current general level of anxiety according to 20 statements (e.g., "I feel secure") on a 4-point Likert scale from 1 (*Not at all*) to 4 (*Very much*). Higher scores indicate higher state anxiety. The Spielberger State Trait Anxiety Inventory assesses both trait anxiety (20 questions; Cronbach's α = .73 to .86) and state anxiety (20 questions; Cronbach's α = median of .90), but only state anxiety was included in the current research. Composite summary scores were derived for the state subscale and could range from 20 to 80.

Phase IV (Debriefing). In Phase IV, the participants were thanked for their participation and provided a debriefing statement (see Appendix D for the debriefing statement). Altogether the study took participants 20-30 minutes to complete.

RESULTS

Data Cleaning and Preliminary Analyses

Before any analyses, the data was screened to assess accuracy, missing data, outliers, order effects, and the violation of normality assumptions prior to computing the analyses. Participants who did not correctly complete at least two of the five VWMLT practice trials were excluded from further analyses. Performance on each variable measure was graphed onto the normal distribution to assess for outliers. Order effects were not directly assessed in the preliminary analyses; however, the four measures were randomly sorted using the survey flow function in Qualtrics so that the order of each measure was random, and all four were displayed to participants. The normality assumptions were assessed using the Shapiro-Wilk test and were found to not be violated.

Primary Analyses

Four levels of analyses were conducted: (1) Assessing group differences on the self-report measures and VWMLT performance. (2) Correlational analyses that included the zero-order correlations to assess the linear relationship between IVs and DVs, assess the multivariate normality, check for multicollinearity and homoscedasticity. (3) Two hierarchical multiple regression analyses were conducted assessing the degree that WM, Perceived Benefits over Costs, and Anxiety predict social distancing and then repeated to predict face mask compliance. (4) Two tests for mediation to replicate Xie et al.'s (2020) findings. Each of these levels of analyses will be discuss in turn.

Assessing Group Differences. Demographic group differences on all variable measures were assessed using an independent samples *t*-test or One-Way between subjects ANOVA. Group summary statistics are presented in Tables 2 and 3.

Working Memory Capacity: Differences in WM Capacity between all factors and levels were assessed via independent *t*-tests or One-Way ANOVAs. Based upon the results of an independent samples *t*-test, there were no significant differences in WM Capacity between males (M = 2.45, SD = 1.48) and females (M = 2.67, SD = 1.39; $t(134) = -0.81$, $p > .05$; $d = -.15$). There were no significant differences of WM Capacity between different education levels ($F(3,130) = 2.08$, $p > .05$, $\eta^2 = .05$) and income level ($F(3,132) = 0.55$, $p > .05$; $\eta^2 = .01$). According to the results of a One-Way between subjects ANOVA, there were significant differences in WM Capacity between race/ethnicity ($F(6, 129) = 2.73$, $p < .05$, $\eta^2 = .11$). Tukey's *post hoc* test further indicated that participants who identified as African American (M = 1.19, SD = 1.74) had significantly lower WM Capacity than those who identified as Caucasian (M = 2.73, SD = 1.29; $t(129) = -3.55$, $p < .05$) and as Latino/Hispanic (M = 2.89, SD = 1.76; $t(129) = -3.10$, $p < .05$). It is important to note however the large differences in sample size between groups, which may produce unrepresentative, significant differences between groups.

Social Distancing Compliance. Based upon the results of an independent samples *t*-test, males (M = 24.44, SD = 4.25) had significantly less compliance to social distancing behaviors than females (M = 26.25, SD = 3.84; $t(134) = -2.40$, $p < .05$, $d = -0.46$). According to the results of a One-Way between subjects ANOVA, there was a significant difference in social distancing compliance across education levels ($F(3,130) = 3.38$, $p < .05$, $\eta^2 = .04$). Tukey's *post hoc* tests indicated those with a high school education (M = 27.17, SD = 4.67) have significantly greater social distancing compliance than those with a master's degree (M = 23.56, SD = 4.08; $t(130) =$

2.64, $p < .05$). As mentioned, the sample sizes of these groups were largely unequal, potentially influencing the magnitude of difference found. There were no significant differences between groups of race/ethnicity and income level.

Face Mask Compliance. No significant differences were found between groups of gender, race/ethnicity, and income level. According to the results of a One-Way between subjects ANOVA, there was a significant difference in face mask compliance between education levels ($F(3,130) = 2.72$, $p < .05$, $\eta^2 = .06$). Using a series of Tukey's *post hoc* tests, participants whose highest level of education is high school ($M = 10.42$, $SD = 4.70$) were found to be significantly less compliant to face mask behaviors than participants with a Bachelors ($M = 12.89$, $SD = 2.44$; $t(130) = -2.80$, $p < .05$).

Perceived Benefits over Costs. There were no significant differences found between groups of gender and income level of participants. Based on the results of a one-way between subjects ANOVA, there was a significant difference in score between race/ethnicity levels ($F(6, 129) = 2.32$, $p < .05$, $\eta^2 = .10$). Tukey's *post hoc* tests however do not indicate any significant differences between groups, indicating a potential Type I error. This may be due to the unequal group sample sizes. An additional One-Way between subjects ANOVA indicated a significant difference between education level groups ($F(3,130) = 5.22$, $p < .01$, $\eta^2 = .11$). According to Tukey's *post hoc* tests, participants with a master's degree ($M = 47.47$, $SD = 8.72$) scored significantly higher than those with a bachelor's degree ($M = 43.39$, $SD = 5.92$; $t(130) = -2.89$, $p < .05$) and those with a high school education only ($M = 39.08$, $SD = 7.49$; $t(130) = -3.67$, $p < .05$).

Anxiety. No significant differences in state anxiety were found between groups of gender, race/ethnicity, and income level. According to the results of a One-Way between

subjects ANOVA, there is a significant difference in state anxiety between those with a high school education and those with a master's degree ($F(3,130) = 3.86$, $p < .05$, $\eta^2 = .08$). Tukey's *post hoc* tests indicate that those with a high school education ($M = 33.25$, $SD = 13.94$) have significantly lower state anxiety than those with a master's degree ($M = 43.68$, $SD = 10.01$; $t(130) = -2.88$, $p < .05$).

Zero-order Correlational Analyses. Following the assessment of demographic group differences, zero-order correlations were conducted for all measures. The strength and direction of the linear relationship between all measures was assessed using a Pearson's correlation matrix (See Table 4). There was a significant weak, positive relationship between social distancing compliance and face mask compliance ($r(134) = .42$, $p < .001$), as well as with WM Capacity ($r(134) = .28$, $p < .001$). Social distancing compliance also had a weak, negative relationship with STAI scores ($r(134) = -.31$, $p < .001$). There was no significant relationship to Perceived Costs over Benefits. Perceived Benefits over Costs had a weak, positive relationship with face mask compliance ($r(134) = .36$, $p < .001$), as well as a weak, positive relationship with the State Trait Anxiety Index ($r(134) = .23$, $p < .01$). There was a weak, negative relationship between WM Capacity (K) and the STAI ($r(134) = -.26$, $p < .01$). Multivariate normality was assessed using the Shapiro-Wilk Test, and indicates the null hypothesis of multivariate normality may be rejected ($p < .001$).

The first of the correlational hypotheses was partially supported. While there was a significant relationship between performance in the VWMLT, measured as K, and social distancing compliance, it was a weak relationship. There was no significant relationship between performance in the VWMLT and face mask compliance. The second correlational hypothesis investigated the relationship between Social Distancing Compliance and Face Mask Compliance

Table 2. K, Social distancing compliance, and face mask compliance descriptive statistics of demographic groups

Demographic Group	Working memory capacity (K)	Social distancing compliance	Face mask compliance
		M (*SD*)	
Gender			
Female	2.67 (1.39)	26.25 (3.84)	12.98 (2.97)
Male	2.45 (1.48)	24.44 (4.25)	12.34 (2.88)
Ethnicity			
African/African American	1.19 (1.74)	24.00 (3.67)	13.25 (1.91)
Caucasian	2.73 (1.29)	24.56 (4.36)	12.28 (3.03)
Latino/Hispanic	2.89 (1.51)	27.21 (3.62)	13.43 (2.41)
Asian/Pacific Islander	1.62 (1.82)	23.33 (3.27)	12.83 (3.37)
Native American	2.40 (1.76)	27.00 (5.39)	12.60 (4.39)
Asian	2.64 (1.57)	25.36 (3.37)	12.57 (2.90)
Other	2.29 (1.50)	27.33 (4.32)	12.17 (2.99)
Education level			
Primary school	-	-	-
Middle school or equivalent	-	-	-
High school or equivalent	2.96 (1.08)	27.17 (4.67)	10.42 (4.70)
Associate College degree or 2 Year Technical Degree	2.70 (1.17)	26.71 (3.91)	12.21 (3.45)

Table 2 continued

Undergraduate College degree	2.70 (1.35)	25.14 (4.01)	12.89 (2.44)
Master's College degree	2.06 (1.67)	23.56 (4.08)	12.74 (2.59)
Doctoral College or Medical degree	-	-	-
Annual income			
Far below average for my country	2.30 (1.70)	25.91 (4.48)	12.91 (3.05)
Below average for my country	2.89 (1.35)	26.70 (3.87)	12.80 (3.41)
Average for my country	2.47 (1.47)	24.84 (4.08)	12.67 (2.78)
Above average for my country	2.47 (1.35)	23.58 (4.56)	11.47 (2.86)
Far above average for my country	-	-	-

scores. Although they did not have a strong relationship, the measures did have a weak to moderate strength, and positive relationship. This finding does add to the research conducted by Xie et al. (2020) who assessed the relationship of WM and social distancing compliance early in the COVID-19 pandemic. The relationship of anxiety with WM Capacity (K), social distancing compliance, face mask compliance, and perceived benefits over costs was the target of the third correlational hypothesis. There was a significant relationship between anxiety and all other measures except for Face Mask Compliance. The direction of these significant relationships however was not uniform and therefore, provides some insight into how state anxiety incorporates into the decision-making process. The relationship of state anxiety with social distancing compliance and WM Capacity was negative, indicating that as anxiety increased, the other two measures decreased.

Table 3. Perceived benefits over costs and STAI descriptive statistics of demographic groups

Demographic group	Perceived benefits over costs	State anxiety (STAI)
	M (SD)	
Gender		
Female	45.52 (7.20)	38.98 (11.38)
Male	43.48 (7.11)	39.46 (11.03)
Ethnicity		
African/African American	45.67 (6.32)	38.42 (7.40)
Caucasian	42.38 (7.04)	37.20 (11.66)
Latino/Hispanic	45.57 (6.10)	44.21 (10.10)
Asian/Pacific Islander	48.17 (6.43)	42.83 (11.86)
Native American	45.40 (2.30)	35.20 (11.45)
Asian	48.36 (8.65)	45.43 (8.79)
Other	46.00 (7.54)	42.83 (9.20)
Education level		
Primary school	-	-
Middle school or equivalent	-	-
High school or equivalent	39.08 (7.49)	33.25 (13.94)
Associate College degree or 2 Year Technical Degree	44.21 (5.12)	35.21 (12.93)
Undergraduate College degree	43.39 (5.92)	38.77 (10.11)
Master's College degree	47.47 (8.72)	43.68 (10.01)
Doctoral College or Medical degree	-	-
Annual income		
Far below average for my country	41.18 (7.61)	41.55 (11.34)
Below average for my country	42.15 (7.97)	35.35 (10.42)
Average for my country	45.05 (6.02)	39.02 (11.32)
Above average for my country	43.84 (10.12)	43.42 (9.77)
Far above average for my country	-	-

Table 4. Zero-order correlations of variable measures

Variable	1.	2.	3.	4.	5.
1. Social Distancing Compliance	-	-	-	-	-
2. Face Mask Compliance	0.42***	-	-	-	-
3. Perceived Benefits over Costs	0.06	0.36***	-	-	-
4. STAI	-0.31***	-0.06	0.23**	-	-
5. Working Memory Capacity (K)	0.28***	0.01	-0.11	-0.26**	-

$N = 136$, * $p < .05$, ** $p < .01$, *** $p < .001$

Regression Analyses. Two identical hierarchical multiple regression analyses were conducted to assess to the degree that WM, Perceived Benefits over Costs, and Anxiety predict social distancing and then repeated to predict face mask compliance. Working Memory and Perceived Benefits over Costs were entered first into the model, followed by State Anxiety, to predict either Social Distancing or Mask Compliance as the dependent variables. The assumptions of multicollinearity homoscedasticity were assessed and were not violated for both hierarchal multiple regression models.

The first analytical model hypothesis investigated a hierarchal regression predicting Social Distancing Compliance from WM Capacity (K), Perceived Benefits over Costs, and STAI. A hierarchal linear regression was performed to predict Social Distancing Compliance score from WM Capacity, Perceived Benefits over Costs, and State Anxiety. Working Memory Capacity (K) and Perceived Benefits over Costs score were entered into the model first, followed by Trait Anxiety score. In the first step overall, the model was significant ($R^2 = .09$, $F(2,135) = 6.46$, $p < .01$). Working Memory Capacity (K) was a significant predictor of Social Distancing

Compliance (b = .85, p < .001). For every one-point increase of WM Capacity (K) score, Social Distancing Compliance scores increased by .85 points. Perceived Benefits over Costs was not a significant predictor of Social Distancing Compliance (b = .06, p > .05). At scores of zero of WM Capacity (K) and Perceived Benefits over Costs, Social Distancing Compliance score is equal to 20.43 in this model. If the WM Capacity (K) and Perceived Benefits over Cost scores are centered around their mean, then at average WM Capacity (K) and average Perceived Benefits over Costs, Social Distancing Compliance is equal to a score of 25.02.

At the next step, when State Anxiety is included in the model, the model had a stronger fit, and was still significant (R^2 = .16, F(3,135) = 8.66, p < .001). Working Memory Capacity (K) continued to be a significant predictor of Social Distancing Compliance (b = .65, p < .01). Perceived Benefits over Costs was still not a significant predictor of Social Distancing Compliance (b = .09, p > .05), while the STAI was a significant predictor of Social Distancing Compliance (b = -.11, p < .001). When WM Capacity (K), Perceived Benefits over Costs, and STAI scores are equal to zero, Social Distancing Compliance is predicted to be 23.73. Once these predictor variables are centered around their mean, at average WM Capacity (K), Perceived Benefits over Costs, and STAI score, Social Distancing Compliance scores are expected to be equal to 29.36.

The findings of Xie et al. (2020) were replicated in that WM Capacity (K) was a significant predictor of Social Distancing Compliance, partially supporting the Model 1 hypothesis. Since there was no significant linear relationship between Perceived Benefits over Costs and Social Distancing Compliance, so it is not unrealistic for there to be no predictive power of the measure on the outcome variable. Once anxiety was included into the first hierarchal regression model, the model had a stronger fit and anxiety was a significant predictor

of Social Distancing Compliance. This replicates previous research and supports the weak, negative linear relationship between these two variables. It is important to note that only state anxiety was predictive of Social Distancing Compliance. Trait anxiety was not assessed, although it is predicted the results would indicate the same findings if it were.

A second hierarchal linear regression was performed to predict Face Mask Compliance from WM Capacity (K), Perceived Benefits over Costs, and State Anxiety. Working Memory Capacity (K) and Perceived Benefits over Costs were entered into the model first, followed by State Anxiety as done previously for Social Distancing Compliance. Contrary to Model 1 predictions, in Model 2, WM Capacity (K) was not predictive of Face Mask Compliance, but Perceived Benefits over Costs was. Overall, the first step of the model was significant (R^2 = 0.13, $F(2,135) = 10.16$, $p < .001$). Unlike the Social Distancing Compliance Model, WM Capacity (K) was not a significant predictor of Face Mask Compliance ($b = .11$, $p > .05$) but Perceived Benefits over Costs was a significant predictor ($b = .15$, $p < .001$). When WM Capacity (K) and Perceived Benefits over Cost scores are equal to zero, Face Mask Compliance is predicted to be a score of 5.72. If the WM Capacity (K) and Perceived Benefits over Cost scores are centered around their mean, then at average WM Capacity (K) and average Perceived Benefits over Costs, Face Mask Compliance is equal to a score of 12.54.

In the second step, when State Anxiety is introduced into the model, the model remains significant, and a very small amount of variance is newly accounted for ($R^2 = .15$, $F(3,135) = 7.86$, $p < .001$). Working Memory Capacity (K) is still not a significant predictor of Face Mask Compliance even when accounting for State Anxiety ($b = .04$, $p > .05$). Perceived Benefits over Costs continues to be a significant predictor even when accounting for State Anxiety ($b = .16$, $p < .001$). State Anxiety is not a significant predictor of Face Mask Compliance in the model (b = -

.04, $p > .05$). When WM Capacity (K), Perceived Benefits over Costs, and State Anxiety are all equal to zero, Face Mask Compliance is expected to be a score of 6.87. Once these predictor variables are centered around their mean, at average WM Capacity (K), Perceived Benefits over Costs, and STAI score, Face Mask Compliance scores are expected to be equal to 14.05.

Test for Mediation. To further replicate Xie et al.'s (2020) findings, two identical mediational analyses were performed differing in the DV, Social Distancing or Face Mask Compliance. The first mediation analysis included WM Capacity as the predictor, the Perceived Benefits over Costs as the mediator and Social Distancing Compliance as the outcome variable (see Figure 1). First, the relationship between these three variables were assessed using the Pearson's correlations conducted in the previous steps to assess whether a mediation analysis would be appropriate to conduct with the data. The only significant relationship between variables was for WM Capacity (K) and Social Distancing Compliance as mentioned previously ($r = 0.28$, $p < .001$). Since the relationship between both variables and Perceived Benefits over Costs are nonsignificant and weak, a mediation analysis typically would not be appropriate to conduct. It was conducted in this case to further analyze the results and gain a better understanding of the relationship between the variables.

The association between WM Capacity and Social Distancing Compliance was not mediated by Perceived Benefits over Costs ($b = -.03$, $p > .05$, 95% CI [-.10, .04]. Perceived Benefits over Costs does not explain a significant amount of the association between WM Capacity and Social Distancing Compliance. There was a significant direct effect of WM Capacity on Social Distancing Compliance after accounting for the indirect effect of Perceived Benefits over Costs ($b = .85$, $p < .001$, 95% CI [.38, 1.32].

The second mediation analysis conducted included WM Capacity (K) as the predictor, the Perceived Benefits and Costs as the mediator and Face Mask Compliance as the outcome variable (see Figure 2). The Pearson's correlation coefficients of the relationships between the three variables were assessed to determine if a mediation analysis is most appropriate to conduct. As mentioned previously, the only significant relationship between the variables is a moderate to weak, positive relationship between Perceived Benefits over Costs and Face Mask Compliance ($r = .36$, $p < .001$). Since the predictor does not have a significant relationship with the other two variables, a mediation analysis would not be appropriate but was done so to further analyze the data.

The association between WM Capacity and Face Mask Compliance was not mediated by Perceived Benefits over Costs. Without accounting for the mediator, there was no significant association between WM Capacity and Face Mask Compliance ($b = .02$, $p > .05$, 95% CI [-.31, .36]). There was not a significant direct effect of WM Capacity on Face Mask Compliance ($b = .11$, $p > .05$, 95% CI [-.21, .42]). The indirect effect of WM Capacity on Face Mask Compliance was not significant ($b = -.08$, $p > .05$, 95% CI [-.21, .05]).

To summarize, WM Capacity is significantly associated with Social Distancing Compliance, but only has a direct pathway ($c = 0.82$) rather than through mediation of Perceived Benefits over Costs ($c' = 0.85$). Working Memory Capacity however is not significantly associated with Face Mask Compliance through a direct path ($c = 0.02$), or an indirect through Perceived Benefits over Costs ($c' = 0.11$). There is however a significant association between Perceived Benefits over Costs and Face Mask Compliance ($b = 0.15$).

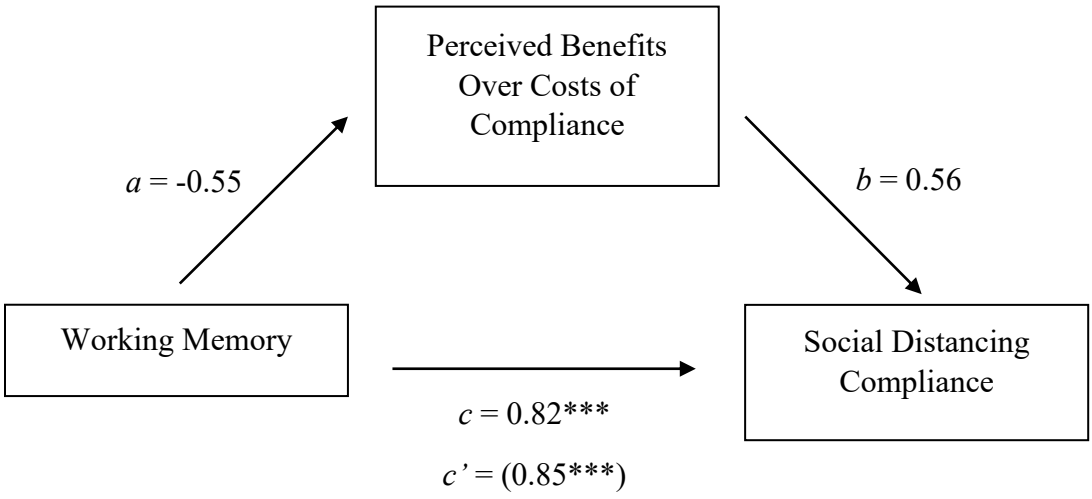

Figure 1. Mediation model of Social Distancing Compliance with Path Direct and Indirect Effects

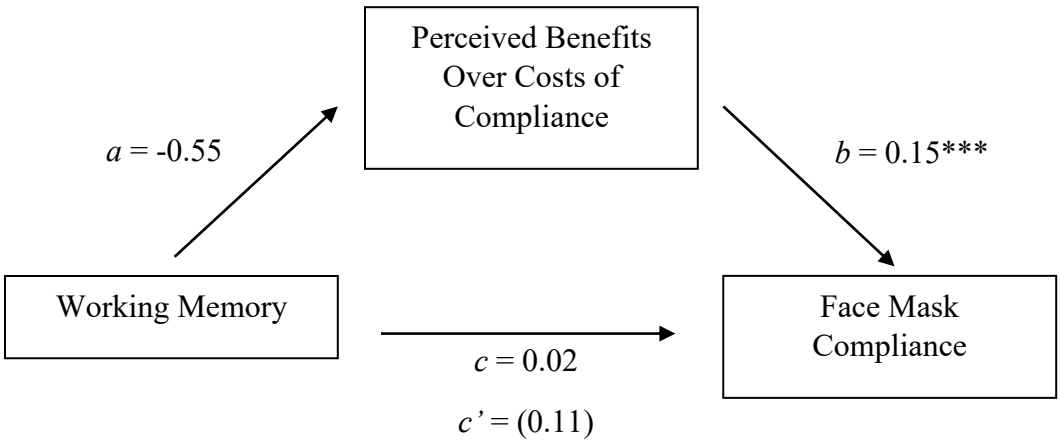

Figure 2. Mediation model of Face Mask Compliance with Path Direct and Indirect Effects

Internal Consistency Analyses of Measures

Although previous researchers have determined and/or replicated the internal consistency (ranges from α = .61 to .90) of the questionnaires to be employed in this study, Cronbach's alpha was calculated for each of these measures based upon the obtained sample of participants.

Working Memory Capacity. The internal consistency of success or failure for the value of K as a function of WM Capacity on all 20 experimental trials was assessed using trial-by-trial correlations. According to the trial comparisons, all except two had a significant linear relationship. The two comparisons that did not have a significant linear relationship were between Trial 7 and Trial 14 ($p = .05$), as well as Trial 7 to Trial 3 ($p > .05$).

Social Distancing Compliance. The Cronbach's alpha of this measure was calculated using all eight items as developed and was equal to .68. The internal consistency would increase slightly to .69 if either or both of Items 7 and 9 were dropped from the measure.

Face Mask Compliance. The internal consistency of the four face mask compliance items was at an acceptable range as it was for the Social Distancing Compliance measure (α = .72). If item 1 were to be dropped, internal consistency would increase to a Cronbach's alpha of .75. Due to the measure only having four items, more items could be added to potentially increase its internal consistency.

Perceived Benefits over Costs. The internal consistency of the measure included all 16 items and was equal to a Cronbach's alpha of .73. It was recommended that items 1, 3, 4, 5, 10, 12, 13, and 16 should be reverse scored. These items were not reverse scored prior to primary analyses. Once those items are reverse scored, internal consistency does increase but not substantially (α = .79).

Anxiety. Overall, the STAI had the highest internal consistency of all measures, and there were no recommendations to reverse score or remove any items for a higher value (α = .91). The State Anxiety component does meet field standards for high item reliability.

Item analyses, via item-total correlations, were conducted for each of the questionnaires. An understanding of the internal consistency of these questionnaires for the obtained sample was important especially if there was a failure to replicate. Overall, the internal consistency of measures utilized in existing research were similar to, if not better, than found previously.

DISCUSSION

This study was employed to further investigate how WM capacity could possibly predict behaviors relating to compliance to health and safety measures during a global health crisis. Of the several hypotheses investigated, there is some evidence of support for each one representing three key findings. Overall, many findings clarify how WM can be used as a tool to predict cognitive and behavioral decisions. First, the relationship between VWMLT with Social Distancing Compliance demonstrates that those with higher WM Capacity and functioning exhibit greater compliance to behaviors through a critical decision-making process. Second, the Perceived Benefits over Costs of direct-contact behaviors can be predictive of compliance with wearing a face mask for the health and safety of yourself, and others. Third, state anxiety present in the decision-making process may be able to explain and account for individual differences in compliance to social distancing behaviors.

The failure to find a linear relationship and association between WM Capacity and Face Mask Compliance could be because many of the lower performing participant submissions were excluded from further analysis due to their low scores on the task. The low performers may have had corresponding low social distancing and face mask compliance, which if included, could have strengthened the relationship.

As compared to past research by Xie et al. (2020) that only employed the Social Distancing Compliance measure, in this study a Face Mask Compliance measure was developed and employed. The addition of the Face Mask Compliance measure provided evidence that there is a positive linear relationship between complying to both or neither safety measures during a global health crisis. If compliance to health and safety measures is the target behavior, these

results provide some evidence that if there is compliance to one behavior, there potentially could be to other target behaviors.

As hypothesized, the relationship of state anxiety with social distancing compliance and WM Capacity was negative, indicating that as anxiety increased, the other two measures decreased. These findings support those of Moran (2016) in that increased anxiety harms the functioning of WM processes due to shifting allocation of attention. The STAI measure was administered to participants after the VWMLT, so it is possible that the task and uncertainty of how well they were performing on the task did increase their anxiety. The negative relationship could also be explained by because of increased state anxiety before starting the study, performance on the VWMLT was hindered. Furthermore, the negative relationship of state anxiety with social distancing compliance supports the existing evidence that as the need for reallocation and reintegration of media and health information increases, those who can do so successfully will have decreased anxiety levels. If one can reintegrate the constantly updating information, they are expected to experience less anxiety while complying to the social distancing behaviors.

Consistent with previous research of the use of WM on the decision-making process, the ability to perform well on the VWMLT demonstrates thorough decision-making and attention allocation skills that in current research, directly translate over to skills needed for compliance to social distancing practices. Low task performance therefore displays a lack of attention to detail and reintegration of new information as seen in the VWMLT, which predicts a low compliance to social distancing practices.

These findings provide evidence for the modular theoretical basis of WM. While multiple modules of functioning such as attention, decision-making, and concentration were being utilized

concurrently by the VWMLT, the capacity limit of WM inhibited full, accurate processing of the task at hand. Whether the capacity limit was met or was exceeded may vary by individual, which may explain individual differences in success versus failure on a trial-by-trial basis. These individual differences may also be explained by the theoretical foundations of a temporal processing limit. The stringent time limit for the VWMLT limited time to process each stimulus properly and to accurately detect the block color change. The time length of extended attentional focus and other modular functioning needed for the task may also have met or exceeded the limits of individual participants as well.

Contrary to previous findings by Xie et al. (2020), Perceived Benefits over Costs was not a significant predictor of Social Distancing Compliance. The lack of variance accounted for by Perceived Benefits over Costs could be due to a lack of understanding of questions on the measure, or due to measurement error. Based on the reliability analysis of the Perceived Benefits over Costs measure, several items should have been reverse scored. The measure was directly adapted from previous research done by Xie et al. (2020), but it may need to be revised to best assess the constructs it is intended to.

The results of the present study are in concordance with previous research by Lewandowsky et al. (2012), regarding the influence of the media. The findings of Model 2's hierarchal regression performed for Face Mask Compliance could be because there was more of a nationwide emphasis and enforcement of face mask policies versus social distancing policies. The face mask mandates across city, county, and state guidelines were generally enforced more vigorously than social distancing mandates. Social distancing mandates may be more difficult to enforce only because the distance changes with every step each person takes towards or away from one another. Therefore, the perceived benefits over costs of complying to face mask

policies may be more apparent than when applied to social distancing policies due to the social influence of face mask compliance. A major media push has been placed on wearing a face mask and it is a more readily obvious behavior to notice compliance. The social influence of noncompliance may weigh more heavily than on the costs of noncompliance. The lack of predictive capabilities of the effect of anxiety on face mask compliance however is an unexpected result. It could be that state anxiety levels were low when participating in the study whether it be due to not being in an environment where a face mask is required, or that face masks have begun to be required less in businesses across the nation as guidelines are lifting.

Although Xie et al. (2020) found a significant mediation of Perceived Benefits over Costs on the association between WM Capacity and Social Distancing Compliance, current research did not. Therefore, because of the nonexistent predictive capabilities and linear relationship of variance in Social Distancing Compliance by Perceived Benefits over Costs, the mediation analysis performed for this model was not necessary. The results of both performed mediation analyses can be utilized to further confirm the findings of the relationships between measures as seen in the correlations and hierarchal regressions. Model 3, a mediation analysis of assessing the association between WM (K) Capacity and Social Distancing Compliance, mediated by Perceived Benefits over Costs was not supportive of the corresponding hypothesis and previous research.

Limitations

There were several limitations of the current research and therefore multiple areas of improvement readily apparent. First and foremost were the weak internal consistencies of the compliance measures (α ranges .68 to .73). Further questionnaire-scale developed should be

conducted as well as subsequent exploratory and confirmatory factor analyses would be appropriate to strengthen the reliability of the compliance measures. As mentioned, only the state anxiety subscale of the STAI was used for the current research. For future research, it would be suggested to use the trait anxiety subscale as well to build upon the evidence of anxiety's role in the decision-making process and reallocation of attention and resources.

A second limitation or conflict more so with current research involves the gain of public access to the COVID-19 vaccine throughout the process of the IRB approval, proposal, and employment of the survey to participants. As of early 2021, various pharmaceutical companies had developed and released a COVID-19 vaccine to the public over the course of several months and phases of eligibility. The vaccine release was expedited and is a very politicized topic in the United States then and currently. The CDC has updated social distancing and face mask guidelines because of the vaccine roll-out which therefore may have affected the scope of participant's responses. Instructions to the Social Distancing Compliance and Face Mask Compliance measures were updated to inform participants to think back to their behavior during most of the time since March 2020 at the start of the COVID-19 pandemic. However, it is possible they either did not read these instructions carefully and therefore responded based on their behaviors currently, or they did not truly reflect to that time point for a variety of reasons. Due to the main focus of using the VWMLT as the theoretical foundation behind a predictive tool of compliance, political affiliation relating to COVID-19 facts versus fiction, and political opinion on the COVID-19 vaccine was not gathered.

A third limitation present is a lack of reliable and valid response latency information for the VWMLT. Throughout the thesis background development, there was hope of gathering participant data in an in-person research lab facility, but due to time, resources, and COVID-19

policies at the time, the current research was gathered completely electronically, at the convenience of the Amazon mTurk sample. Response latencies of the VWMLT were gathered using the Qualtrics timing feature, but it has its limitations. The timing feature only allows administrators to view timing of clicks of the mouse on each screen, frequency of clicks, and auto-time slides to progress forwards. Response latency data was gathered based on these capabilities but was too unreliable to include for the current report of results. Inclusion of this information, gathered more reliably and valid, could have provided more insight into the underlying cognitive processes occurring within each participant. These response latencies could have been utilized for additional hypotheses relating to existing research on attention and response latency.

Future Research

It is important for future research to gain a better understanding of how WM capacity can be used to predict cognitive decision making and subsequent compliance behavior in everyday socioenvironmental activities. Not only did the findings of this study extend the work of Xie et al. (2020) but bolsters the importance of using reliable and valid measures of response latency during a VWMLT, which in turn could advance theoretically the function of WM Capacity as a predictor of compliance behavior. This will require participant responses to occur in a physical research lab. These improved measures would allow for patterns of response accuracy and corresponding response latency to be assessed to add to the existing predictive capabilities of WM Capacity (K) on Social Distancing Compliance. It may then too potentially provide evidence for predictive capabilities of WM Capacity (K) on Face Mask Compliance that were not found in current research.

It would also be beneficial to incorporate the effects of COVID-19 vaccination compliance on decision making processes. With the relax of social distancing and face mask policies that are occurring due to the vaccine roll-out, understanding how the decision to get vaccinated versus not getting vaccinate may provide an explanation for an additional portion of the variance in the hierarchal regression models. One potential complication with this extension would be the relaxing of social distancing and face mask policies across the country. WM however could be used to predict future COVID-19 behaviors such as the option to be vaccinated, reactions to mandatory proof of vaccination by private businesses such as air travel, and comfort levels regarding traveling internationally after the panic of COVID-19 is over.

Overall, the current research did support previous research in some respects but did find new and differing results based on inclusion of additional measures. The knowledge gained can be used to continue the process of using WM as a predictor of cognitive and behavioral decisions across a variety of situations and platforms. Ideally, the COVID-19 pandemic will pass and as a country, the research gained through this time will be used to grow and build on existing knowledge to employ similar methods in other applied everyday cognitive decision making venues.

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APPENDICES

Appendix A. Human Subjects IRB Approval

Date: 6-25-2021

IRB #: IRB-FY2021-407
Title: Working memory as a predictor of social distancing and mask compliance during COVID-19 Pandemic
Creation Date: 1-12-2021
End Date:
Status: Approved
Principal Investigator: D Mitchell
Review Board: MSU
Sponsor:

Study History

Submission Type	Review Type	Decision
Initial	Exempt	Exempt

Key Study Contacts

Member D Mitchell	Role Principal Investigator	Contact waynemitchell@missouristate.edu
Member Casandra Kemmel	Role Primary Contact	Contact kemmel418@live.missouristate.edu

Appendix B. Informed Consent

This study is part of the Missouri State University Psychology Graduate Program-Experimental Track designed to give us more information and to fulfill a thesis requirement for Cassandra Kemmel. The following information is provided so that you can decide whether you wish to participate in this study. If you agree to participate, you will be asked to complete a Visual Match-to-Sample and complete a series of questionnaires regarding COVID-19. The study will be conducted using Qualtrics and a computer and is estimated to take 30-40 minutes.

Please be assured that if you agree to participate, you are free to withdraw from the study even after you have provided consent. If you wish to withdraw, simply stop, and exit Qualtrics.

Since it is our policy to protect the confidentiality of all our participants, your answers will be sent to a link at Qualtrics where data will be stored in a password protected electronic format. Qualtrics does not collect identifying information such as your name, email address, or IP address. Therefore, your responses will remain anonymous. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study.

HOW WILL MY DATA BE PROTECTED? The informed consent forms for this study are confidential and only the investigators will have access to the information which will be securely stored. Your name or personal identifying information will not be used in any published reports of this research. If questions arise after you have left the research laboratory, feel free to contact Cassandra Kemmel418@missouristate.edu or D. Wayne Mitchell, Ph.D. at WayneMitchell@missouristate.edu. We do not anticipate any risk to you as a result of participating in this study, but it is unlikely that this study will provide you with any direct benefits. Your participation will, however, make an important contribution to our scientific knowledge, and we very much appreciate your cooperation.

If you feel you have not been treated according to the descriptions in this form, or that your rights as a participant in research have not been honored during the course of this project, or you have any questions, concerns, or complaints that you wish to address to someone other than the investigator, you may contact the Missouri State University Institutional Review Board at 901 S. National Avenue, Springfield, MO 65897, or by telephone at 417-836-5972 OR 417-836-4132.

Please select your choice below. If you wish to print a copy of this consent form for your records, right-click while on the informed consent page and click print.

Clicking on the “Agree” button indicates that you have read the above information, that you agree voluntarily to participate, and you are 18 years of age or older.

- o Agree (1)
- o Disagree (2)

Appendix C. Demographic Form

1. What is your gender?
    a. Male
    b. Female
    c. Non-binary
    d. Prefer not to respond

2. What is your age, in years?
    a. _____

3. What is your race/ethnicity?
    a. African/African American
    b. Caucasian
    c. Latino/Hispanic
    d. Asian/Pacific Islander
    e. Native American
    f. Asian
    g. Other

4. Education
    a. Primary school
    b. Middle school or equivalent
    c. High school or equivalent
    d. Associate College degree or 2 Year Technical Degree
    e. Undergraduate College degree
    f. Master's College degree
    g. Doctoral College or Medical degree

5. Annual Income (***for my age group***)
    a. Far below average for my country
    b. Below average for my country
    c. Average for my country
    d. Above average for my country
    e. Far above average for my country

Appendix D. Thank You and Debriefing Statement

Thank you for your participation in this experiment. The goal of this study was to explore the relationship between working memory and compliance to face mask and social distancing mandates. The researcher is interested in assessing whether working memory could predict compliance to face mask and social distancing mandates.

The nature of the phenomenon investigated required minor deception; for instance, it was not disclosed the fact that the study is investigating compliance to face mask and social distancing compliance. This information was excluded because knowledge of the true purpose of the study could have affected the results.

Your participation is greatly appreciated by the researcher. If you have any questions about this study, please contact Cassandra Kemmel at Kemmel418@live.missouristate.edu or D. Wayne Mitchell, Ph.D. at WayneMitchell@missouristate.edu.

Finally, you are urged not to discuss this study with anyone else who is currently participating or might participate at a future point in time. As you can certainly appreciate, the relationship between working memory and compliance to face mask and social distancing mandates cannot be examined effectively in participants who know about the true purpose of the project beforehand.
Thank you!