Effects of Age and Gender on Risk Perception: COVID-19 as a study model

University of Minnesota – Twin Cities
Fall 2020
Ece Kremers

ABSTRACT

Disease epidemics have historically been used to study risk perception in humans. Yet, there is still limited information on how different groups of people (e.g. age and gender) differ in their risk perception. This study took advantage of the ongoing COVID-19 epidemic to study risk perception in a convenience sample. We hypothesized that older individuals and females have higher risk perception compared to younger individuals and males. We developed an anonymous online survey that consisted of 21 questions measuring risk perception in two domains: compliance and fear. The survey was distributed through social media and connections at the University of Minnesota (e.g. class and student groups) between November 9th and November 30th, 2020. A total of 858 completed survey responses were received (Mean age = 25.46 years; 75.29% females). Analyses were performed using JMP version 15. Younger individuals' self-reported compliance with COVID-19 social distancing guidelines were significantly lower than older individuals (t-test: $t_{858} = 4.91$, $P < 0.0001$). There was no significant difference in fear of the pandemic between sexes (t-test: $t_{858} = 1.32$, $P = 0.1887$). Females self-reported compliance (ANOVA: $F_{2,858} = 5.7811$, $P = 0.0032$) and fear of the pandemic (ANOVA: $F_{2,858} = 31.6580$, $P < 0.0001$) were significantly higher than males. Strong predictors of both compliance and fear were subjects' previous history of COVID-19 (compliance ANOVA: $F_{1,858} = 178.7928$, $P > 0.0001$; fear ANOVA: $F_{1,858} = 35.6842$, $P > 0.0001$) and whether or not they believed masks were effective in preventing the spread of COVID-19 (compliance ANOVA: $F_{2,858} = 35.6843$, $P > 0.0001$; fear ANOVA: $F_{2,858} = 27.0480$, $P > 0.0001$). In conclusion, age and gender affect risk perception. Additional factors may also affect risk perception during a pandemic, however additional studies are warranted to determine the strength of the associations found in this study.

1. INTRODUCTION

Risk perception plays an important role in the survival of an individual, and ultimately an entire species (Slovic et al., 2016). Animals that anticipate risk can then avoid possibly dangerous situations, increasing their likelihood to survey and reproduce, thereby passing on their genes to next generations (Chen et al., 2018). For example, a tropical lizard will not travel too far from perches or hiding locations in order to avoid being captured by predators (Drakeley et al., 2015). Because of this, risk perception can be an advantageous trait. However, having too much risk perception can make an animal overly timid, causing it to miss out on advantageous opportunities (Alhakami & Slovic, 1994).

Regarding **age** comparisons, the prefrontal cortex starts to develop during adolescence but is not considered fully developed until 25 years of age or older (Sharma et al., 2013). Studies have shown that the prefrontal cortex plays a part in regulating the amygdala (i.e. which is part of the brain that influences risk aversion (Kuhnen & Knutson, 2015)) expression and activity (Sharma et al., 2013). With an underdeveloped prefrontal cortex, individuals have less inhibition of the amygdala and thus have a lower risk-perception and fear regarding possibly dangerous circumstances (Banks et al., 2017). This makes individuals under the age of 25 more likely to engage in risky behaviors (Teese & Bradley, 2008)

Regarding **gender** comparisons, studies have shown that women typically tend to have higher rates of anxiety and are twice as likely to develop anxiety when compared to men (Remes et al., 2016). And anxiety increases risk perception (Notebaert et al., 2016). The increased level of anxiety found in females is likely attributed to the higher levels of estrogen, also known as the

female hormone, found in higher amounts in females than in males (Hammes & Levin, 2019). Studies have shown that higher levels of estrogen increase fear and anxiety (Morgan & Pfaff, 2001). Additionally, females tend to be more attentive toward others, as increased levels of care of offspring will increase a mother's own overall fitness (Johanna Bick et al., 2013). Having protective instincts and being perceptive to risk or risk adverse will increase the likelihood of survival of offspring and therefore increase the likelihood the mother's genes will get passed on (Johanna Bick et al., 2013).

During pandemics, the most critical problem to tackle is the lack of compliance with social distance guidelines and stay at home orders (Freeman et al., 2020). Large pandemics occur every few decades, such as the 2009 H1N1 virus (Shoals, 2019) and the Spanish flu in 1918 (Humphreys, 2018). As of December 4th, 2020, the COVID-19 pandemic has already killed 253,242 in the United States (Centers for Disease Control and Prevention [CDC] 2020). To slow the spread of disease, various countries and individual US states have implemented safety protocols (Thu et al., 2020). This can ultimately have a major impact on the spread of the disease, the rate of individuals becoming infected, and thus the number of people inevitably needing to be hospitalized with the risk of dying (Sen-Crowe et al., 2020; West et al., 2020). However, individuals' risk perception of the disease has an impact on how they perceive pandemic and how well they follow safety guidelines (Brug et al., 2009).

This study aims to understand how different demographics groups perceive risk. The gap in knowledge comes from a lack of risk aversion testing in humans. For ethical reasons, testing risk perception in humans can be challenging, however, there are plenty of other studies on primates (O'Mara, 2015), rats (Morgado et al., 2015), and birds (Arnold et al., 2007) for example. Disease epidemics have historically been used to study risk perception in humans (Rathfisch et al., 2015; Shook et al., 2019). Therefore, COVID-19 provides a great model to test human risk perception as the entire world population is being faced with a deadly pandemic. This information could also help close the gap in knowledge regarding risk perception in different ages and between sexes, as well as aid in understanding the lack of compliance with safety guidelines during a pandemic (Brug et al., 2009; Freeman et al., 2020). The resulting information could be an important consideration when developing effective preventive measures, both now and in future possible infectious disease outbreaks, which can ultimately save more lives.

This study compares differences in disease risk perception in females and males and in different age groups (specifically 25 years of age and older vs. under the age of 25). The COVID-19 pandemic provides a unique window of opportunity to look at how these risk perceptions differ among these groups.

The Hypothesis for this study is Females and people 25 years of age and older display higher levels of risk perception when compared to males and those under the age of 25. Based on this hypothesis, two predictions were made. The first prediction is that (1) females, confronted with the COVID-19 pandemic, will self-report being more compliant with social distancing guidelines and more fearful of COVID-19 than males. The second prediction is that (2) people 25 and older, confronted with the COVID-19 pandemic, will self-report being more compliant with social distancing guidelines and more fearful of COVID-19 than people 25 and under.

2. METHODS

The testing methods for this study involved a survey to collect data from willing subjects. In order to test for risk perception, the survey measured **compliance** to social distancing guidelines (Mugur, 2020) and **fear** of the virus (Gaynor et al., 2019; Stankowich & Blumstein, 2005), either for themselves or others. Questions were on a numeric scale, making it possible to assign quantitative scores for compliance and fear exhibited by subjects. The distribution of the survey was over social media and through academic environments.

(a) Survey

The survey was created using Google forms. *Many of the questions were taken from and/or are based on previously published COVID-19 surveys, such as the Seale & colleagues measuring hygiene-related and avoidance-related behaviors in Australian adults (Seale et al., 2020).*

The survey was broken down into four parts:

1. Initial questions: regarding approval to use the subject's anonymous data, age, identified gender, current living location, if the subject has worked in health care during the year 2020, and if the subject had/has COVID-19 or not.
2. Compliance: 4 questions, regarding how important or likely it was for subjects to avoid social gatherings, cancel or delay travel, avoid bars and restaurants as well as how well they believed they were adhering to social distancing guidelines. Subjects scored themselves on a scale of 1-10 for these questions. Additionally, there was a question allowing the subject to indicate statements regarding guidelines that applied to them.
3. Fear: 4 questions, regarding how afraid or dangerous subjects felt COVID-19 was to themselves and those around them. Subjects scored themselves on a scale of 1-10 for all the questions. There was another question that allowed the subject to indicate what their biggest fears were regarding the pandemic.
4. Additional questions: regarding information that could be used for future studies. These questions related to beliefs in masks, restaurant or bar attendance, place of origin, ethnicity, and if the subject had health insurance.

The survey and all of the questions can be found in the **SUPPLEMENTARY INFORMATION** section.

(b) Survey Distribution

The survey was anonymous and distributed in multiple ways. My team members and I reached out to current and former professors requesting them to send it out to their current students. We also asked family members to take the survey. We posted it multiple times on our social media, including Instagram, Facebook, Twitter, LinkedIn, and Snapchat. We also requested colleagues and friends send it to their friends and family as well as share it on their social media. The survey was first sent out on November 9th, 2020 and data collection stopped on November 30th, 2020. The total data collection period was three weeks. Gift card incentives were used to encourage participants to take the survey. Over 20 gift cards were donated, free of change, from Insomnia Cookies and Raising Cane's for this study.

(c) Analysis

Once all data were collected, JMP was used to perform data analysis and to determine statistically significant differences between groups as defined by sex and age in social distancing compliance and fearfulness of COVID-19. Each individual was assigned two scores ranging from 4 to 40, one for compliance and one for fear, representing a summary measurement of their self-reported behavior. These scores were generated by adding together the 4 scoring questions of the compliance and fear categories. Rational for this approach is based on accepted approach in questionnaire domains where multiple related questions, relating to a single topic or measurement are either summer or averaged together for a summary statistic (Stochl et al., 2012). This same approach can be seen in other COVID-19 behavioral studies (Seale et al., 2020). For this study, a higher score would indicate greater compliance or fear while a lower score would indicate less compliance or less fear, respectively.

3. RESULTS

The study population comprised a total sample of 858 subjects who approved of their data being used for this study. The age and sex distribution of the study population can be found in Table 1 and Figure 6 in **SUPPLEMENTARY INFORMATION**. The majority of respondents were female (N=646; 75.29%), under the age of 25 (N= 637; 74.24%) and lived in Minnesota (N= 608; 70.86%).

(a) Age

Age was a significant predictor of an individual's self-reported compliance with social distancing guidelines (t-test from a linear regression: $t_{858} = 4.91$, $P < 0.001$). Older subjects reported being significantly more compliant with COVID-19 social distancing guidelines than younger subjects (Figure 1). When comparing age groups, younger individuals under the age of 25 years (mean = 29.4035, std error = 0.33413) were significantly less compliant with social distancing guidelines when compared to individuals 25 years and older (mean = 29.6199, std error = 0.56728) (t-test: $t_{858} = -4.8855$, $P < 0.0001$) (Figure 2). Age was not a clear predictor of an individual's fear of COVID-19 (t-test from a linear regression: $t_{858} = 1.32$, $P = 0.1887$) as variation in self-reported fear of the COVID-19 pandemic was not significantly correlated with age (Figure 1).

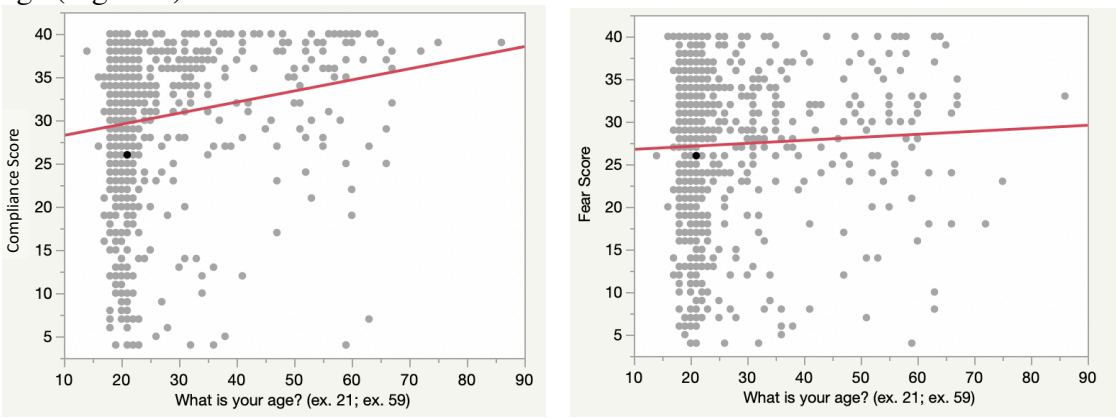

Figure 1. Variation in compliance and fear scores by age. Show on the left is the results of plotting compliance scores (mean = 30.432148, $r^2 = 0.026228$) of subjects based on their age. Results indicate a statistically significant positive relationship between age and compliance with social distancing guidelines (t-test from a linear regression: $t_{858} = 4.91$, $P < 0.001$). Shown on the right are the results of plotting fear scores (mean = 27.29254, r^2 =

0.000851) of subjects based on their age. Results indicate a slight trend between age and fear; however it is not statistically significant (t-test from a linear regression: $t_{802} = 1.32$, P = 0.1887).

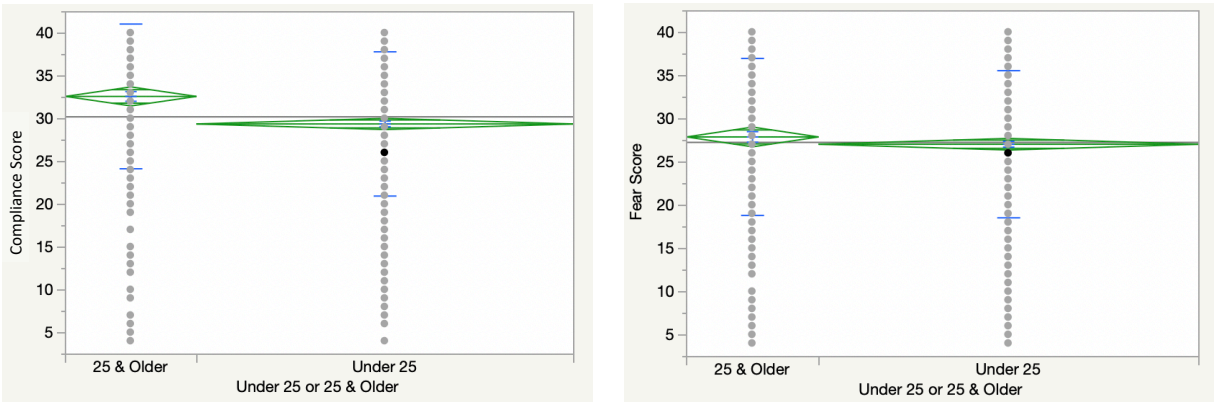

Figure 2. Variation in compliance and fear scores by two age groups (Under 25 on the right and 25 and over on the left). Show on the left are the results of plotting compliance scores of subjects based on their age group (25 & over: mean = 32.6199, std error = 0.5687254; Under 25: mean = 29.4035, std dev =). Results indicate a statistically significant difference between these two age groups regarding self-reported social distancing guideline compliance (t-test: $t_{858} = -4.8855$, P < 0.0001). Shown on the right are the results of plotting fear scores for subjects based on their age group (25 & older: mean = 27.9186, std error = ; Under 25: mean = 27.0754, std error =). Results indicate that there is no statistically significant difference between these two age groups regarding self-reported fear of COVID-19 (t-test: $t_{858} = -1.24659$, P = 0.1064).

(b) Gender

Identified gender was a statistically significant predictor of individual's self-reported compliance with COVID-19 social distancing guidelines (ANOVA: $F_{2,858} = 5.7811$, P = 0.0032) and individual's self-reported fear of COVID-19 (ANOVA: $F_{2,858} = 31.6580$, P < 0.0001). Females self-reported being significantly more compliant with social distancing guidelines and more fearful of COVID-19 (Compliance: mean = 30.7043, std error = 0.3343; Fear: mean = 28.5046, std error = 0.3294) when compared to males (Compliance: mean = 28.6232, std error = 0.5906; Fear: mean = 23.3382, std error = 0.5819) (Figure 3).

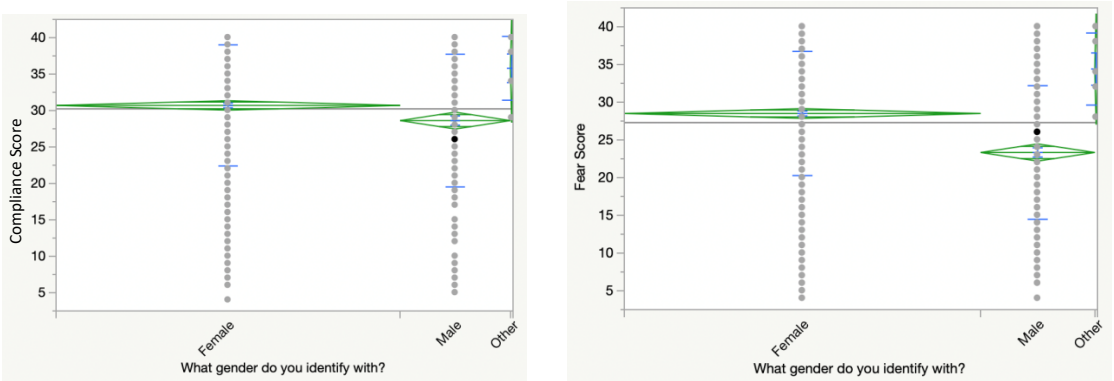

Figure 3. Variation in compliance and fear scores by gender (N = 646 (females), 207 (male), 5 (other). Show on the left are the results of plotting compliance scores of subjects based on their identified gender (Females: mean = 30.704334, std error = ; Males: mean = 28.623188, std error = ; Other: mean = 35.8, std error =). Results indicate a statistically significant difference between females and males regarding self-reported compliance with guidelines strong (ANOVA: $F_{2,858} = 5.7811$, P = 0.0032), with females being more compliant. Shown on the right are the results of plotting fear scores for subjects based on their identified gender (Females:

mean = 28.504644, std error = ; Males: mean = 23.338164, std error = ; Other: mean = 34.4, std error =). Results indicate a statistically significant difference between females and males regarding self-reported fear of COVID-19 (ANOVA: $F_{2,858} = 31.6580$, $P < 0.0001$), with females being more fearful.

(c) Additional Significant Measurements

Whether or not a subject believed masks were effective in preventing the spread of COVID-19 was the largest predictor of compliance (ANOVA: $F_{1,858} = 178.7928$, $P > 0.0001$) and fear (ANOVA: $F_{1,858} = 189.1723$, $P > 0.0001$) as seen in Figure 4 (LogWorth = 38.284, p-value = > 0.00001). Subjects who did not believe masks were effective were less compliant (mean = 17.7639, std error =1.4144297) and less fearful (mean = 14.5417, std error = 1.4148853) than those who did believe in masks (compliance mean = 31.3740, std error = 1.1497116 ; fear mean = 28.4606, std error = 1.1500820). Additionally, whether or not subjects had COVID-19 was a strong predictor of compliance (ANOVA: $F_{1,858} = 35.6842$, $P < 0.0001$) and fear (ANOVA: $F_{1,858} = 27.0480$, $P < 0.0001$) as seen in Figure 5 (LogWorth = 8.467, p-value = > 0.00001). Notably, subjects who have had COVID-19 were less compliant (mean = 24.5655, std error = 1.2742446) and less fearful (mean = 22.0207, std error = 1.2746551) than those who have not had COVID-19 (compliance mean = 31.3843, std error = 1.2290184; fear mean = 28.3647, std error = 1.2294144).

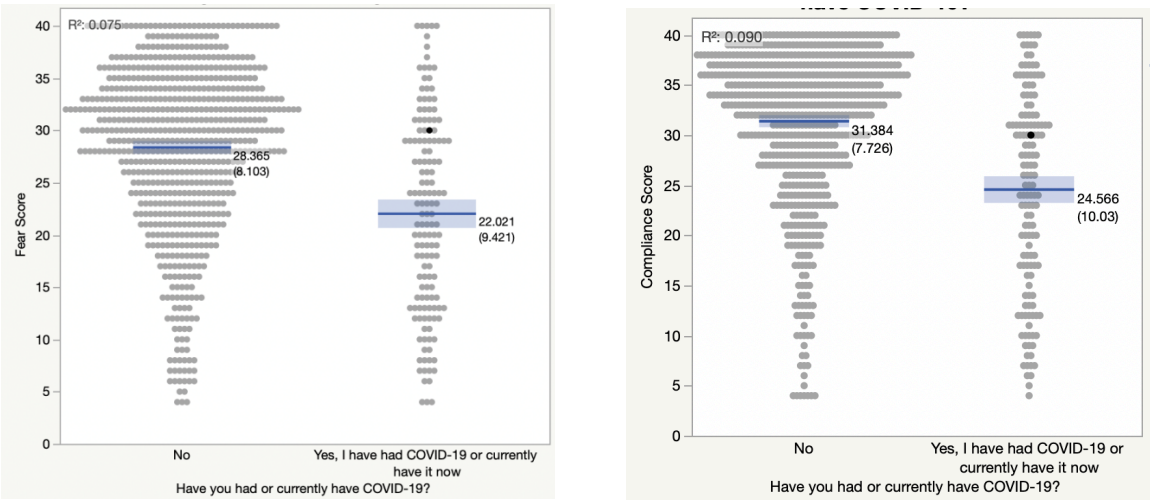

Figure 4. Variation in compliance and fear scores by whether the subject believes masks are effective. Show on the right are the results of plotting compliance scores of subjects based on if they believed masks are effective in preventing the spread of COVID-19 (N= 786, 91.608%) or not (N= 72, 8.392%). Results indicate a statistically significant difference between the two groups ($t_{858} = -13.37$, $P < 0.0001$) with people believing masks are effective having higher compliance than those who do not. Show on the left are results of plotting fear scores of subjects based on if they believed masks are effective in preventing the spread of COVID-19. Results indicate a statistically significant difference between the two groups ($t_{858} = -13.75$, $P < 0.0001$) with people believing masks are effective having higher fear than those who do not.

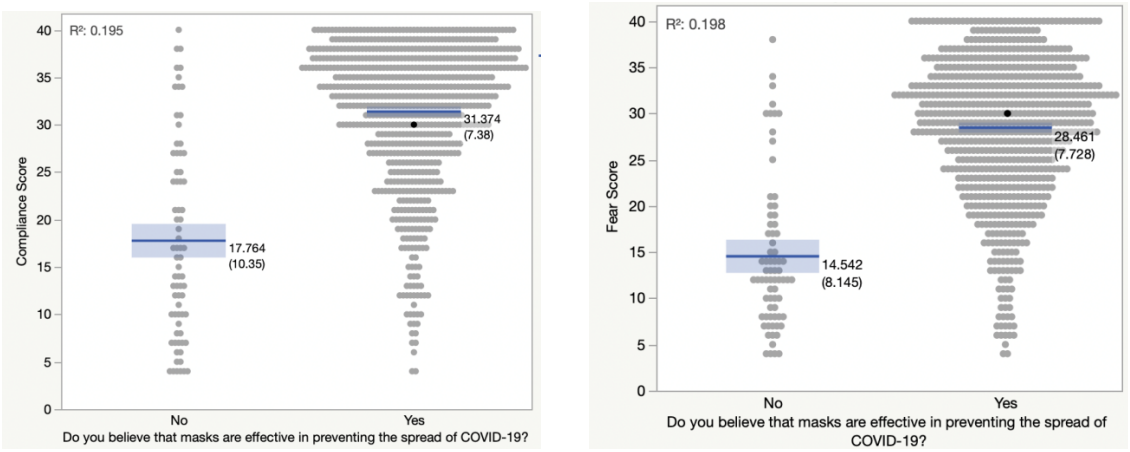

Figure 5. Variation in compliance and fear scores by whether the subject has had COVID-19 or not. Show in the right graph are the results of plotting compliance scores of subjects based on if they have had (or currently have) COVID-19 (N = 145, 16.9%) or not (N = 713, 83.100%). Results indicate a statistically significant difference between the two groups (t-test: $t_{858} = 5.97$, $P < 0.0001$) with people having had COVID-19 having lower compliance than those who have not. Show in the left graph are results of plotting fear scores of subjects based on if they have had COVID-19 or not. Results indicate a statistically significant difference between the two groups (t-test: $t_{858} = 5.20$, $P < 0.0001$) with people who have had COVID-19 having lower fear than those who have not.

(d) Non-significant Measurements

Whether or not a subject worked in the healthcare industry was not a significant predictor of compliance (ANOVA: $F_{5,853} = 0.0724$, $P = 0.7880$) or fear (ANOVA: $F_{5,853} = 0.6420$, $P = 0.4234$) (LogWorth = 0.373, p-value = 0.42342). Subject's location of origin was not a significant predictor of compliance (ANOVA: $F_{5,853} = 1.1651$, $P = 0.1437$) or fear (ANOVA: $F_{5,853} = 1.2575$, $P = 0.0557$) (LogWorth = 1.254, p-value = 0.05570). Subject's ethnicity was not a significant predictor of compliance (ANOVA: $F_{5,853} = 1.6032$, $P = 0.0695$) or fear (ANOVA: $F_{5,853} = 1.2445$, $P = 0.2350$) (LogWorth = 1.158, p-value = 0.06949). Whether or not the subject had health insurance was not a significant predictor of compliance (ANOVA: $F_{5,853} = 0.9514$, $P = 0.3299$) or fear (ANOVA: $F_{5,853} = 2.1883$, $P = 0.1398$) (LogWorth = 0.854, p-value = 0.13981).

4. DISCUSSION

It is important to note that the COVID-19 pandemic is not the focus of this study, but rather used as an opportunity to experimentally examine risk perception. The anonymous survey collected basic demographic data such as age, gender, etc., and specifically tackle the questions related to risk perception through self-reported compliance with social distancing guidelines and fear of the COVID-19 pandemic. The resulting information could help close the gap in understanding the variation in risk perception among humans and possibly lead to more effective guidelines during pandemics.

(a) Interpreting Results

Results from this study partially supported the hypothesis that females and individuals 25 years of age and older display high levels of risk perception. It was found that older individuals self-report being more compliant with social distancing guidelines, indicating higher risk perception. However, there was no significant evidence that people 25 years of age and over are

more fearful of COVID-19 than younger individuals. Results indicated that females self-report being more fearful of COVID-19 and more compliant with social distancing guidelines, indicating that females have higher risk perception than males. It was also found that people who have not had COVID-19 and who do believe that masks are effective in preventing the spread of disease self-reported being more compliant and more fearful than those who have had COVID-19 and who do not believe masks are effective.

Differences in risk perception between age groups can in part be attributed to the underdeveloped prefrontal cortex in younger individuals (Sharma et al., 2013). This is because the prefrontal cortex plays an important role in controlling the amygdala (Sharma et al., 2013), part of the brain that affects risk aversion (Kuhnen & Knutson, 2015). An additional explanation for the age differences seen in compliance, but not in fear can be due to social pressures of wanting to fit in with friends (Lashbrook, 2000), and to combating sadness of social isolation (Cacioppo et al., 2010) due to months of quarantine.

The difference found in risk perception between genders can in part be attributed to higher levels of anxiety (Remes et al., 2016) and in part to higher levels of estrogen (Morgan & Pfaff, 2001) in females when compared to males. An additional explanation for this difference is potentially the benefits of being more cautious and avoiding possibly risky activities among mothers (Johanna Bick et al., 2013). It is important to consider whether the higher level or risk perception found in females is due to them being better in perceiving risk or because they are more risk adverse than males.

Notably, there is a strong correlation between individuals' belief in effectiveness of masks and history of COVID-19 with compliance and fear. However, with the cross-sectional data collected, it was not possible to determine temporality and whether this relationship was causal. Specifically, it is not possible to determine whether individuals are less compliant and less fearful because they had COVID-19 and/or don't believe that masks are effective. Conversely, because individuals have been less compliant and less fearful resulting in them contracting the virus and/or not believing in masks.

(b) Limitations

There were several potential limitations of this study. First and foremost, the sampling of study subjects was not completely random. My group members and I recruited subjects through word of mouth, social media, and academic connections. This may have cut out possible populations that we are not acquainted with and who do not have college connections. The sample was skewed to college age population (i.e. 19-22) and Minnesota as the geographic location. Second, data were entirely self-reported. Self-reported data are not nearly as reliable as observed information since subjects can indicate any behavior independent of their actual behavior (Hu et al., 2020; Soulakova et al., 2021). Third, survey completion was entirely up to the individuals and non-response rate was high. There were plenty of people who were asked to take the survey, but did not follow through or even attempted to complete it. Fourth, the study sample was unbalanced with a higher proportion of females and younger individuals. Finally, this was a relatively short survey. My partners and I intentionally chose a short survey to increase participation. However, not having many questions meant that more weight (i.e. 25%) was placed on each one when generating a compliance or fear score. Questions that do not perfectly measure compliance or fear could affect the data and skew it in a direction different from what it actually is.

(c) Future Directions

Regarding sampling, it would be important to gain a truly random sample of the target population including different age groups, geographical locations, economic status, and races. This would allow the survey findings to be representative of the entire population and lead to more accurate and representative results. It would also be important to have a larger sample size with more power. Increasing sample size increases confidence in results and would also allow subgroup analyses (Lai & Kelley, 2011).

Regarding the survey content, it would be preferable to test the validity of the questions and determine if they truly and accurately measure compliance with social distancing and fear towards the pandemic. If there are better measurements for these characteristics and/or better measurements directly relating to risk perception, those may be more beneficial to use. Additionally, it may be interesting to look at how other individual characteristics affect how subjects self-report compliance and fear during a pandemic. These factors could include socioeconomic status, employment, religious or political beliefs. Testing for additional factors would require additional survey questions and extend the length of the survey.

REFERENCES

Alhakami, A. S., & Slovic, P. (1994). A Psychological Study of the Inverse Relationship Between Perceived Risk and Perceived Benefit [Article]. *Risk Analysis*, *14*(6), 1085–1096. https://doi.org/10.1111/j.1539-6924.1994.tb00080.x

Arnold, K. E., Ramsay, S. L., Donaldson, C., & Adam, A. (2007). Parental prey selection affects risk-taking behaviour and spatial learning in avian offspring [Article]. *Proceedings of the Royal Society. B, Biological Sciences*, *274*(1625), 2563–2569. https://doi.org/10.1098/rspb.2007.0687

Banks, S. J., Eddy, K. T., Angstadt, M., Nathan, P. J., & Phan, K. L. (2017). Amygdala–frontal connectivity during emotion regulation [Article]. *Social Cognitive and Affective Neuroscience*, *2*(4), 303–312. https://doi.org/10.1093/scan/nsm029

Brug, J., Aro, A. ., & Richardus, J. . (2009). Risk perceptions and behaviour: towards pandemic control of emerging infectious diseases: international research on risk perception in the control of emerging infectious diseases [Article]. *International Journal of Behavioral Medicine*, *16*(1), 3–6. https://doi.org/10.1007/s12529-008-9000-x

Cacioppo, J. T., Hawkley, L. C., & Thisted, R. A. (2010). Perceived Social Isolation Makes Me Sad [Article]. *Psychology and Aging*, *25*(2), 453–463. https://doi.org/10.1037/a0017216

Chen, C., Biere, A., Gols, R., Halfwerk, W., van Oers, K., & Harvey, J. A. (2018). Responses of insect herbivores and their food plants to wind exposure and the importance of predation risk [Article]. *The Journal of Animal Ecology*, *87*(4), 1046–1057. https://doi.org/10.1111/1365-2656.12835

Drakeley, M., Lapiedra, O., & Kolbe, J. J. (2015). Predation Risk Perception, Food Density and Conspecific Cues Shape Foraging Decisions in a Tropical Lizard [Article]. *PloS One*, *10*(9), e0138016–e0138016. https://doi.org/10.1371/journal.pone.0138016

Freeman, D., Waite, F., Rosebrock, L., Petit, A., Causier, C., East, A., Jenner, L., Teale, A.-L., Carr, L., Mulhall, S., Bold, E., & Lambe, S. (2020). Coronavirus Conspiracy Beliefs, Mistrust, and Compliance with Government Guidelines in England [Article]. *Psychological Medicine*, 1–13. https://doi.org/10.1017/S0033291720001890

Gaynor, K. M., Brown, J. S., Middleton, A. D., Power, M. E., & Brashares, J. S. (2019). Landscapes of Fear: Spatial Patterns of Risk Perception and Response [Article]. *Trends in Ecology & Evolution (Amsterdam)*, *34*(4), 355–368. https://doi.org/10.1016/j.tree.2019.01.004

Hammes, S. R., & Levin, E. R. (2019). Impact of estrogens in males and androgens in females [Article]. *The Journal of Clinical Investigation*, *129*(5), 1818–1826. https://doi.org/10.1172/jci125755

Hu, S., Laughter, M. R., & Dellavalle, R. P. (2020). Reliability of self-reported data on social media versus National Residency Match Program charting outcomes for dermatology applicants [Article]. *Journal of the American Academy of Dermatology*, *83*(6), 1842–1844. https://doi.org/10.1016/j.jaad.2020.04.052

Humphreys, M. (2018). The influenza of 1918: Evolutionary perspectives in a historical context [Article]. *Evolution, Medicine, and Public Health*, *2018*(1), 219–229. https://doi.org/10.1093/emph/eoy024

Johanna Bick, Mary Dozier, Kristin Bernard, Damion Grasso, & Robert Simons. (2013). Foster Mother—Infant Bonding: Associations Between Foster Mothers' Oxytocin Production, Electrophysiological Brain Activity, Feelings of Commitment, and Caregiving Quality [Article]. *Child Development*, *84*(3), 826–840. https://doi.org/10.1111/cdev.12008

Kuhnen, C. M., & Knutson, B. (2015). The Neural Basis of Financial Risk Taking [Article]. *Neuron (Cambridge, Mass.)*, *47*(5), 763–770. https://doi.org/10.1016/j.neuron.2005.08.008

Lai, K., & Kelley, K. (2011). Accuracy in Parameter Estimation for Targeted Effects in Structural Equation Modeling: Sample Size Planning for Narrow Confidence Intervals [Article]. *Psychological Methods*, *16*(2), 127–148. https://doi.org/10.1037/a0021764

Lashbrook, J. T. (2000). Fitting In: Exploring the Emotional Dimension of Adolescent Peer Pressure [Article]. *Adolescence*, *35*(140), 747–758.

Morgado, P., Marques, F., Ribeiro, B., Leite-Almeida, H., Pêgo, J. M., Rodrigues, A. J., Dalla, C., Kokras, N., Sousa, N., & Cerqueira, J. J. (2015). Stress induced risk-aversion is reverted by D2/D3 agonist in the rat [Article]. *European Neuropsychopharmacology*, *25*(10), 1744–1752. https://doi.org/10.1016/j.euroneuro.2015.07.003

Morgan, M. ., & Pfaff, D. . (2001). Effects of Estrogen on Activity and Fear-Related Behaviors in Mice [Article]. *Hormones and Behavior*, *40*(4), 472–482. https://doi.org/10.1006/hbeh.2001.1716

Mugur, G. (2020). Kansans in the Middle of the Pandemic: Risk Perception, Knowledge, Compliance with Preventive Measures, and Primary Sources of Information about COVID-19 [Article]. *Kansas Journal of Medicine*, *13*, 160–164.

Notebaert, L., Masschelein, S., Wright, B., & MacLeod, C. (2016). To Risk or Not to Risk: Anxiety and the Calibration Between Risk Perception and Danger Mitigation [Article]. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *42*(6), 985–995. https://doi.org/10.1037/xlm0000210

O'Mara, M. T. (2015). Ecological risk aversion and juvenile ring-tailed lemur feeding and foraging [Article]. *Folia Primatologica*. https://doi.org/10.1159/000368275

Rathfisch, G., Rathfisch, G., Güngör, İ., Güngör, İ., Uzun, E., Uzun, E., Keskin, Ö., Keskin, Ö., Tencere, Z., & Tencere, Z. (2015). Human Papillomavirus Vaccines and Cervical Cancer: Awareness, Knowledge, and Risk Perception Among Turkish Undergraduate Students [Article]. *Journal of Cancer Education*, *30*(1), 116–123. https://doi.org/10.1007/s13187-014-0703-1

Remes, O., Brayne, C., van der Linde, R., & Lafortune, L. (2016). A systematic review of reviews on the prevalence of anxiety disorders in adult populations [Article]. *Brain and Behavior*, *6*(7), e00497-n/a. https://doi.org/10.1002/brb3.497

Seale, H., Heywood, A. E., Leask, J., Sheel, M., Thomas, S., Durrheim, D. N., Bolsewicz, K., & Kaur, R. (2020). COVID-19 is rapidly changing: Examining public perceptions and behaviors in response to this evolving pandemic [Article]. *PloS One*, *15*(6), e0235112–e0235112. https://doi.org/10.1371/journal.pone.0235112

Sen-Crowe, B., McKenney, M., & Elkbuli, A. (2020). Social distancing during the COVID-19 pandemic: Staying home save lives. In *American Journal of Emergency Medicine*. https://doi.org/10.1016/j.ajem.2020.03.063

Sharma, S., Arain, Mathur, Rais, Nel, Sandhu, Haque, & Johal. (2013). Maturation of the adolescent brain [Article]. *Neuropsychiatric Disease and Treatment*, *9*, 449–461. https://doi.org/10.2147/ndt.s39776

Shoals, J. (2019). *Epidemics & pandemics* [Book]. Mason Crest.

Shook, E., Curtis, A., Curtis, J., Gibson, G., Vander Horst, A., Little, V., & Woolverton, C. (2019). Assessing the Geographic Context of Risk Perception and Behavioral Response to Potential Ebola Exposure [Article]. *International Journal of Environmental Research and Public Health*, *16*(5), 831. https://doi.org/10.3390/ijerph16050831

Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2016). Affect, Risk, and Decision Making [Article]. *Health Psychology*, *24*(4S), S35–S40. https://doi.org/10.1037/0278-6133.24.4.S35

Soulakova, J. N., Hartman, A. M., Liu, B., Willis, G. B., & Augustine, S. (2021). Reliability of Adult Self-Reported Smoking History: Data from the Tobacco Use Supplement to the Current Population Survey 2002–2003 Cohort [Article]. *Nicotine & Tobacco Research*, *14*(8), 952–960. https://doi.org/10.1093/ntr/ntr313

Stankowich, T., & Blumstein, D. T. (2005). Fear in animals: a meta-analysis and review of risk assessment [Article]. *Proceedings of the Royal Society. B, Biological Sciences*, *272*(1581), 2627–2634. https://doi.org/10.1098/rspb.2005.3251

Stochl, J., Jones, P. B., & Croudace, T. J. (2012). Mokken scale analysis of mental health and well-being questionnaire item responses: a non-parametric IRT method in empirical research for applied health researchers [Article]. *BMC Medical Research Methodology*, *12*(1), 74–74. https://doi.org/10.1186/1471-2288-12-74

Teese, R., & Bradley, G. (2008). Predicting Recklessness in Emerging Adults: A Test of a Psychosocial Model [Article]. *The Journal of Social Psychology*, *148*(1), 105–128. https://doi.org/10.3200/SOCP.148.1.105-128

Thu, T. P. B., Ngoc, P. N. H., Hai, N. M., & Tuan, L. A. (2020). Effect of the social distancing measures on the spread of COVID-19 in 10 highly infected countries [Article]. *The Science of the Total Environment*, *742*, 140430–140430. https://doi.org/10.1016/j.scitotenv.2020.140430

West, R., Michie, S., Rubin, G. J., & Amlôt, R. (2020). Applying principles of behaviour change to reduce SARS-CoV-2 transmission. In *Nature Human Behaviour*. https://doi.org/10.1038/s41562-020-0887-9

SUPPLEMENTARY INFORMATION

Distribution:

		AGE		
		Under 25	25 & Over	**TOTAL:**
IDENTIFIED GENDER	Female	490	156	646
	Male	144	63	207
	Other	3	2	5
	TOTAL:	637	221	**858**

Table 1. Sex and age distribution of the survey responders. A total of 858 people filled out the survey. Of those, 646 were female, and 490 of the females were under the age of 25 years while 156 were over 25 years or older. There were 207 male responders to the survey. A total of 144 of the males were under the age of 25 years while 63 were 25 years or older. A total of 5 people indicated that they did not identify themselves as either female or male. There were a total of 637 respondents under the age of 25 years and 221 responders 25 years or older.

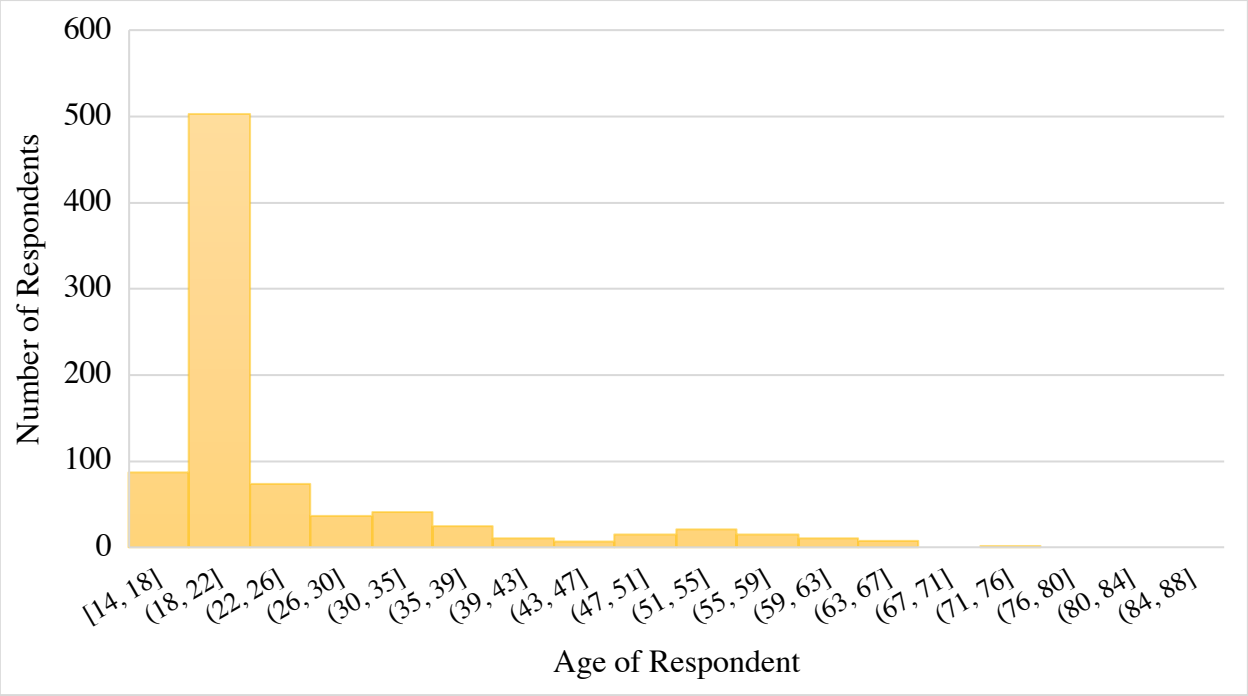

Figure 5. Age distribution of respondents (N=858). The majority of survey responders were between the ages of 18 and 22 years. The age distribution was highly skewed toward the left, indicating younger ages. Only a fourth of the responses came from individuals 25 years or older (N=221; 25.758%).

Survey:

Title: COVID-19 Survey
Description: This form should only take 2 minutes to complete. Your willingness and help with data collection is greatly appreciated.

1. Do you approve of the anonymous data you provide with this form to be used for a class project in Intro to Animal Behavior (EEB 3412W) and potential publication?
    a. Yes
    b. No

2. What is your age? (ex. 21; ex. 59)
    - Text box entry
3. What gender do you identify with?
    a. Male
    b. Female
    c. Other
4. Please indicate where you are living (in the U.S. example: Minneapolis, MN; outside of the U.S. example: Germany)
        Text box entry
5. Have you been working in healthcare at any time between January 2020 to present?
    a. Yes
    b. No

6. Have you had or currently have COVID-19?
    a. Yes, I have had COVID-19 or currently have it now
    b. No

Considering the COVID-19 Pandemic…

7. How important is it for you to avoid large social gatherings?

	1	2	3	4	5	6	7	8	9	10	
Not important at all	○	○	○	○	○	○	○	○	○	○	Very important

8. How likely are you to cancel or delay travel within the country and overseas?

	1	2	3	4	5	6	7	8	9	10	
Not likely at all	○	○	○	○	○	○	○	○	○	○	Very likely

9. How important is it for you to avoid going to bars and restaurants currently?

	1	2	3	4	5	6	7	8	9	10	
Not important at all	○	○	○	○	○	○	○	○	○	○	Very important

10. How well do you believe you adhere to social distancing guidelines?

	1	2	3	4	5	6	7	8	9	10	
Not adherent at all	○	○	○	○	○	○	○	○	○	○	Very adherent

11. Click the checkbox(es) next to the statements that apply to you:

- ☐ I wear a mask when I am inside public buildings (i.e. grocery store, gym)
- ☐ I wear a mask when I am outside in a public place (i.e. park)
- ☐ I wear a mask in shared amenity rooms (i.e. dorm or apartment study lounges, cafeteria)
- ☐ I wear a mask around close friends
- ☐ I wear a mask around acquaintances
- ☐ I wear a mask around strangers
- ☐ None of the above
- ☐ Add Option or add “Other”

12. How afraid are you of getting COVID-19?

	1	2	3	4	5	6	7	8	9	10	
Not afraid at all	○	○	○	○	○	○	○	○	○	○	Very afraid

13. How dangerous do you think COVID-19 is to others around you?

	1	2	3	4	5	6	7	8	9	10	
Not dangerous at all	○	○	○	○	○	○	○	○	○	○	Very dangerous

14. How afraid are you of COVID-19 being contracted by others around you?

	1	2	3	4	5	6	7	8	9	10	
Not afraid at all	○	○	○	○	○	○	○	○	○	○	Very afraid

15. How anxious does COVID-19 make you?

	1	2	3	4	5	6	7	8	9	10	
Not anxious at all	○	○	○	○	○	○	○	○	○	○	Very anxious

16. My biggest fear(s) regarding the COVID-19 pandemic is: (check up to 3)

- ☐ I wear a mask when I am inside public buildings (i.e. grocery store, gym)
- ☐ I wear a mask when I am outside in a public place (i.e. park)
- ☐ I wear a mask in shared amenity rooms (i.e. dorm or apartment study lounges, cafeteria)
- ☐ I wear a mask around close friends
- ☐ I wear a mask around acquaintances
- ☐ I wear a mask around strangers
- ☐ None of the above

- [ ] Add Option or add "Other"

17. Do you believe that masks are effective in preventing the spread of COVID-19?
    a. Yes
    b. No

18. Have you gone to a restaurant or bar within the last three months?
    a. No
    b. Yes – I sat outside
    c. Yes – I sat inside
    d. Yes – I sat inside and outside

19. What is your place of origin? (in the U.S. example: Minnesota; outside of the U.S. example: Germany)
    - Text box entry

20. Please Specify your ethnicity

- [ ] American Indian or Alaska Native
- [ ] Asian
- [ ] Black or African American
- [ ] Hispanic or Latino
- [ ] Native Hawaiian or Other Pacific Islander
- [ ] White
- [ ] Add Option or add "Other"

21. Do you have health insurance?
    a. Yes
    b. No