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A Prediction Model for the Type of Consumer Willing to Travel to and Live on Mars

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Technological advancements in space travel have brought the concept of private, commercial space transportation closer to reality. Companies such as Blue Origin and Virgin Galactic are working to offer commercial, low orbit space flights to paying customers, and SpaceX is even considering private trips to Mars. As these developments become closer to reality, an essential and missing gap in the literature relates to identifying what type of person would be willing to travel to and live on Mars. The purpose of this study was to develop and validate a statistical model to identify the significant predictors of a participant's willingness to travel to and live on Mars with 536 participants. The findings from the study indicate that nine of the 18 variables were significant predictors. Model fit was assessed through three measures and found to exist for the statistical model. The paper concludes with a discussion of the significant predictors, practical applications, and recommendations for future research.

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Since the Cold War, space exploration has been a task for national organizations such as the United States' National Aeronautics and Space Administration (NASA) and Canada's Canadian Space Agency. However, with increased contributions from the private sector, some aerospace companies, such as Virgin Galactic and Blue Origin, plan to send private citizens on commercial suborbital space flights (Blue Origin, 2018; Vision, 2018). With recent advances in technology as well as privatization of space travel, the topic of exploring Mars is more of a reality to the public than even ten years ago. However, as much as technological advancements will hypothetically allow the average person to be able to travel to Mars to visit, work, explore, and even colonize it, there has been limited research into what types of factors may predict the kind of person who may be willing to do any of those things. Not knowing those factors may cause difficulties, such as appealing to the wrong demographic of individuals who would be willing and even major setbacks making space exploration more available to the public, since the organizations introducing it to them would not know whom to target. Therefore, the purpose of this study will be to identify which factors are significant predictors of a participant's willingness to travel to and live on Mars.

Human Space Travel to Mars

The reasons why humans wish to travel to Mars can be as unique as each human's opinion. Some possibilities may be scientific development, meeting the desires of exploration and adventure, and possible use of resources for capital gain as well as to mitigate resource shortages on Earth (Ward, 2017). Scientific development is influenced by factors such as necessity, accidental discovery, cultural aspects, and imagination/inspiration (Yurtoğlu, 2018). If humankind were able to travel to Mars, they would need to be able to meet the demands of both the environment of Mars as well as deep space. Both are very different from Earth's troposphere and each other, so scientific development is a necessity for going to Mars. Mars One, a group intended to create a permanent human settlement on Mars, cites three main reasons on why we should go to Mars. They cite the adventure and curiosity of space exploration, similar to our decision to send humans to the Moon (Mars One, 2019). They also highlight the progress that research and development of technologies for space travel have had on life on earth (Mars One, 2019).

Mars may also present solutions to significant issues that humanity deals with on Earth. For example, the obtainment and utilization of resources is a crucial economic factor upon which every society relies. Some of those resources are scarce and even nonrenewable; Mars may potentially present an entire untapped planet's worth of resources to be accessed for the benefit of Earth. An additional advantage of colonizing Mars would be to provide a potential backup home if the Earth ever faces another mass-extinction level event such as a significant asteroid impact. A consistent side effect of space exploration has always been improving the quality of life on Earth by developing new technologies (Rosen, 2009). The demands of space are unique due to its environment, extreme forces, how humans can or cannot deal with them. Technologies that are developed to solve issues presented by those extreme environments can benefit people on Earth as well. LED lights, artificial limbs, fire-resistant materials, infrared (IR) ear thermometers, ventricular assistance devices, anti-icing systems, freeze-drying tech, and powdered lubricants were all invented by NASA for space travel and exploration, and since have been utilized on Earth in commercial, industrial, and technological fields (Northon, 2018).

For many, space exploration, such as travel to Mars, can be a source of great inspiration for cultural and artistic creativity. The popular entertainment genre of science fiction can be seen in cinema, gaming, music, literature, and other areas as well. Those sources of inspiration may contribute to any popularity or social excitement about traveling to Mars. However, it is important to note that frequently the depicting media can portray a fictitious experience of space travel that may not be anything like our current technological capability or be realistic at all (Johnson, n.d.). For example, numerous science fiction movies portray humans as being able to partake in space voyages and live in a low gravity environment for years or even generations without any hazardous side-effects. Alternatively, they represent humans as being able to walk, work, and live on any planet without any hazardous side-effects. This depiction is different from reality, where differences in gravity over long periods can cause lasting musculoskeletal health issues (European Space Agency, 2017). There is a possibility for a warped perception of space-travel based upon science fiction and not science fact. This may, in turn, affect the responses of the participants, as well as any lack of concurrent scientific knowledge concerning space travel or Mars. If not fully understanding the real-world conditions that would be present on a trip to Mars, it is possible that participants' willingness could be impacted. In the current study, the scenario will strive to provide real-world and factual information on what a journey to Mars would be like to help identify an accurate model of willingness.

Affect and the Six Universal Facial Expressions

Emotions are commonly cited as a large part of the decision-making process (Schwarz, 2000). In the current study, a participant's willingness to travel to and live on Mars will be examined. An emotional response from participants may at least partially influence this decision. Previous studies have demonstrated feelings such as happiness, fear, or surprise could be emotions that have predictive value in determining the type of person who may be willing to travel to Mars. Prior studies have also shown that affect can serve as a mediator in the decision-making aspects of participants (Babin & Attaway, 2000; Baker & Cameron, 1996; Rice, Winter, Kraemer, Mehta, & Oyman, 2015; Winter, Rice, & Mehta, 2014).

The six universal facial expressions are an advantageous technique to be able to inquire about a subject due to their universality and nonverbal root (Ekman & Friesen, 1971; Hung, Kim, & Land, 1996). Developed through the work of Ekman and Friesen (1971), these six universal facial expressions are recognizable by people from all types of cultures and languages. Even tribes with minimal contact with the outside world have been able to recognize the emotions represented by the faces depicted in Figure 1. The use of the six universal facial expressions helps to capture participant feelings toward the topic of interest without priming participants by stating the feeling in question. These facial expressions have been used successfully in previous studies (Cremer & Rice, 2015; Rice & Winter, 2015; Winter, Keebler, Rice, Mehta, & Baugh, 2018; Winter, Rice, Tamilselvan, & Tokarski, 2016), which identify emotional effects on participants with a minimization of the priming effect. In the case of the current study, the facial expressions were used to determine the participant's willingness to travel to and live on Mars.

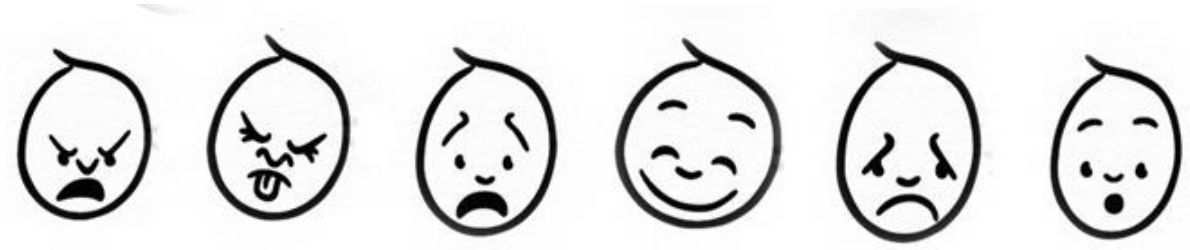

Figure 1. The six universal facial expressions researched by Ekman and Friesen (1971). Depicted in order they are anger, disgust, fear, happiness, sadness, and surprise.

Scales Used in This Study

The current study used four previously validated scales related to consumer perceptions towards autonomous vehicles: familiarity, value, fun factor, and wariness of new technology. These scales each consisted of 5-item responses related to each topic. Participants responded to each statement on a scale ranging from strongly disagree (-2) to strongly agree (2), with a neither disagree nor agree option (0). These scales have been used in an earlier study related to the identification of predictors of patient's willingness to use a dental robot (Rice, Mehta, Winter, Anania, Milner, & Ragbir, Accepted). Since each scale was slightly adapted for their use in the current study of willingness to travel to and live on Mars, each scale was revalidated, and the psychometrics are reported in the results section. A listing of these scales is provided in Appendix B. Similarly, the dependent variable was a modified scale of willingness to fly (Rice et al., 2015) adapted to capture willingness to travel to and live on Mars. The seven-item scale was answered using a Likert scale from strongly disagree (-2) to strongly agree (2), with a neutral option of zero. This scale was revalidated due to its modification, and the psychometrics are reported in the results section. A copy of this instrument can be found in Appendix A.

Willingness

Willingness is defined as "the quality or state of being prepared to do something; readiness" (Oxford Dictionary, 2018, n.p.). Often, factors such as knowledge, emotion, and survival instincts can affect a person's general willingness to do anything. One's willingness to travel to Mars is no different. As previously discussed, how much a person knows about the topic, how they feel about it, and whether or not they care about the health effects would directly influence their willingness of possibly going to Mars. This study examines how the participant's willingness will be reported based on a hypothetical scenario where they would be traveling to Mars. Eighteen possible predictor variables are used to determine which, if any, will be significant predictors of willingness to travel to and live on Mars.

Current Study

The purpose of the current study was to identify the possible factors which predict a person's willingness to travel to and live on Mars. While the technology of taking consumers to space continues to develop, no study for which we are aware has attempted to produce a statistical model which will identify the significant predictors of a passenger's willingness. Therefore, the research question was which, if any, factors significantly predict a participant's willingness to travel to and live on Mars? Eighteen possible predictors, which were grounded

through previous studies (Marte, Anania, Rice, Mehta, Milner, Winter, Walters, Capps & Ragbir, in press; Rice, Winter, Mehta, & Ragbir, 2019) and the literature were included in the model. Due to the exploratory nature of this study, methodological hypotheses were generated for the study:

H_{a1}: At least one of the predictors will be a significant predictor of a participant's willingness to travel to and live on Mars.
H_{a2}: A minimum of 50% of the variance in the data will be accounted for by the statistical model produced in this study.
H_{a3}: The regression model would exhibit good model fit using a secondary and separate sample of participants.

Methods – Stage 1

Participants

An a priori assessment of minimum sample size was determined to be 213 participants with G*Power assuming an estimated effect size of .15, alpha .05, power .95, and 18 predictors. Two hundred and sixty-four participants responded to the questionnaire. An initial screening of the data yielded 237 usable cases (116 females, 121 males) for data analysis. The most common reason for an unusable case was due to missing or incomplete data, and two participants were removed due to excessive Mahalanobis distance values, which will be further described in the Results section. The average age reported by participants was 38.44 (*SD* = 12.23) years old. Participants in the study were recruited from Amazon's ® Mechanical Turk ® (MTurk) platform. MTurk is a worldwide population of participants who are willing to complete HITs or human intelligence tasks in exchange for a small amount of monetary compensation, usually around 25 cents. Previous studies have identified that data collected from MTurk is as valid data collected in traditional laboratory settings (Buhrmester, Kwang, & Gosling, 2011; Germine et al., 2012), and another study (Rice, Winter, Doherty, & Milner, 2017) has identified the advantages and disadvantages for using these online populations for research in aviation. All participants indicated that they were over 18 years old before participating in the study. Additionally, MTurk parameters were set only to allow participants who had completed over 100 prior tasks and who had an approval rating of 98% or better.

Materials and Stimuli

Participants were recruited via a posting on MTurk. They followed a link to Google Forms where they were first presented with a consent form which they signed digitally and verified that they were at least 18 years old. Following this, they were presented with the following information regarding traveling to and living on Mars, *"Organizations are currently exploring the possibility of sending the first humans to Mars. Several companies have started the astronaut application process."* Following this description, participants responded to the familiarity, value, fun factor, and wariness of new technology scale. Each scale had five statements which participants responded to on a scale of strongly disagree (-2) to strongly agree (2) with a neutral option of neither disagree nor agree (0). Participants were then presented with the following scenario, *"Imagine a situation where you have the chance to travel as an astronaut to Mars. The trip to Mars will take between 150-300 days, and once you arrive to Mars, there is*

NO ability to return to Earth. On the trip to and once arriving to Mars, there may also be potential hazards. During the journey, radiation exposure may lead to radiation-related diseases such as sterilization and cancer, and while on Mars, you will most likely not have access to most forms of medical care equipment to treat many conditions which would be treatable on Earth. Given the current technology level of space flight and survival technology, the life expectancy on Mars would likely be under 5 years." Following this, participants were presented with the six universal facial expressions (Ekman & Friesen, 1971) in a randomized order and asked how strongly they felt like the image shown on a scale of "I do not feel this way at all" (1) to "Extremely feel this way" (10). Participants were then asked to complete a Willingness to Travel to and Live on Mars scale. This seven-item scale was adapted from the Willingness to Fly scale (Rice et al., 2015), and it can be found in Appendix A. Participants then reported their gender, ethnicity, age, ideal preference of individuals to work within small groups, income in USD, highest level of education, height, weight, and their nationality. Lastly, participants were debriefed, compensated, and dismissed.

Design

This study was conducted using a quantitative correlational design. There were 18 possible predictors used in this stage of the study: familiarity, value, fun factor, wariness of new technology, anger, disgust, fear, happiness, sadness, surprise, gender, ethnicity, age, small group preference, annual income (in USD), education level, height, and weight. The dependent variable was willingness to travel to and live on Mars. The categorical variables of gender, ethnicity, and education level were dummy coded for the data analysis. Due to the exploratory nature of the study, backward stepwise regression was the statistical analysis used to create the regression equation of significant predictors of a participant's willingness to travel to and live on Mars.

Ethics

The research university's institutional review board provided a review and approval of all procedures before data collection, and all researchers held current certificates to work with human participants from the Collaborative Institutional Training Initiative (CITI).

Results – Stage 1

Stage 1 was designed to produce the regression equation, which would predict a person's willingness to travel to and live on Mars.

Initial Data Analysis

Initial data analysis was conducted first to verify the factor loadings of the scales in the study and second that all items appropriately loaded onto one factor for each scale. A principal components analysis was conducted for each scale using a varimax rotation, and each scale was determined to load on one factor, suggesting concurrent validity of the original scales. A Cronbach's Alpha was calculated of the five scales used in this study resulting in values of .91, .93, .95, .89, and .96 for the familiarity, value, fun factor, wariness of new technology, and willingness to travel to and live on Mars scales, respectively. Additionally, a Guttman Split-Half

test was conducted on the modified dependent variable scale and yielded a coefficient of .94, suggesting good reliability of the modified willingness scale.

A check of the data used for regression yielded two values that exceeded the Mahalanobis' distance critical value of 42.312 (critical value calculated using the number of predictors as degrees of freedom and $p < .001$). Using a *p*-value of .001 to calculate the critical value helps to ensure only extreme cases will exceed the critical value, which could result in removal. As a result, these two data points were removed and not used in the development of the regression equation, resulting in 237 valid data points. The Durban-Watson statistic was reported as 2.006, and since the value is close to 2, it is assumed that the data does not violate the assumption of independence of residuals. Leverage values were all determined to be less than .2, and Cook's distance values were all below a value of 1. All tolerance values were greater than .1, suggesting no issues of multicollinearity within the data. Lastly, the statistical assumptions of normality and homoscedasticity were verified through the use of a residual histogram plot, P-P plots, and standardized residual vs. standardized predicted value plots, and all assumptions appeared to be met.

Regression Equation Development

Backward stepwise regression was completed with the 18 possible predictors to identify which factors significantly predict willingness to travel to and live on Mars. The findings from the study indicated that nine predictors were significant predictors of willingness to travel to and live on Mars: familiarity, fun factor, wariness of new technology, anger, disgust, happiness, sadness, "other" ethnicity, and a master's level of education. The resulting regression was:

$$Y = -1.43 + .08X_1 + .186X_2 + .128X_3 + .031X_4 – .027X_5 + .186X_6 – .041X_7 + .937X_8 – .212X_9$$

Where Y is the predicted willingness to travel to and live on Mars scores and X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, and X_9 are familiarity, fun factor, wariness of new technology, anger, disgust, happiness, sadness, "other" ethnicity, and a master's level of education. These predictors suggest that as familiarity, fun factor, wariness of new technology, anger, and happiness increases, so does willingness to travel to and live on Mars. Those who reported their ethnicity as "other" were also more willing to travel to and live on Mars. As disgust and sadness increased, this resulted in a decrease in willingness to travel to and live on Mars. Lastly, participants who reported holding a master's degree were less willing to travel to and live on Mars. Table 1 provides a summary of the regression weight values. This model accounted for 61.2% (59.6% adjusted) of the variance in willingness to travel to and live on Mars, and the model was significant, $F(9, 227) = 39.76$, $p < 0.001$. Table 2 provides a summary of these values.

Table 1

Summary of Regression Weights for Variables Predicting Willingness to Travel to and Live on Mars from Stage 1 (N = 237)

Variable	*B*	*SE*	*t*	Sig.
Constant	-1.43	0.134	-10.64	.001
Familiarity	0.08	0.044	1.825	0.069
Fun Factor	.186	0.034	5.54	.001
Wariness	.128	0.042	3.01	.003
Anger	.031	.015	2.03	.044
Disgust	-.027	.014	-1.99	.047
Happiness	.186	.018	10.134	.001
Other Ethnicity	.937	.194	4.83	.001
Master's Degree	-.212	.105	-2.01	.045

Table 2

Summary Stage 1 Model (N = 237)

R^2	Adjusted R^2	*df*	*F*	Sig.
.612	.596	9, 227	39.76	.001

Introduction – Stage 2

The purpose of stage 2 was to conduct the model fit of the regression equation developed in stage 1. Model fit was examined through three steps. First, a *t*-Test was conducted between the actual willingness scores reported in stage 2 and the predicted willingness scores of stage 2 participants using the stage 1 regression equation. Second, a Pearson's correlation was conducted between the actual willingness scores reported in stage 2, and the predicted willingness scores of stage 2 participants using the stage 1 regression equation. Finally, a cross-validated R^2 was calculated.

Methods – Stage 2

Participants

A new sample of two hundred and seventy-two participants were recruited to examine the model fit of the regression equation in stage 2. Two hundred and fifty-three (133 females, 120 males) were found to be valid data points for use in stage 2. The most common reason for the deletion of a data point was incomplete data provided by participants. As in stage 1, all participants were recruited using MTurk and the same selection parameters as described in stage 1.

Materials and Stimuli

Participants followed the same procedure and completed the same instrument as in stage 1.

Design

Stage 2 also used a correlational design and was used to assess the model fit of the regression equation from stage 1.

Results – Stage 2

Stage 2 – Model Fit

The regression equation from stage 1 was examined for model fit in stage 2 through three analyzes: a *t*-Test between actual willingness and predicted willingness scores, a bivariate correlation between actual willingness and predicted willingness scores and a cross-validated R^2.

The model fit was first assessed by conducting a *t*-Test of the actual Willingness to Travel to and Live on Mars scores and the predicted Willingness to Travel to and Live on Mars scores calculated for stage 2 participants using the regression equation developed in stage 1. While a check for *t*-test assumptions revealed a violation of the assumptions of normality and homogeneity of variance, due to the large and equal sample sizes, the *t*-test is generally considered robust to these violations (Boneau, 1960). An independent samples *t*-Test found no significant difference between actual stage 2 scores (M = -1.41, SD = 0.98) and predicted stage 2 scores (M = -1.41, SD = 0.73), $t(504) = -0.027$, $p = .978$. Since there were no significant differences between the actual willingness scores and predicted willingness scores, this suggests the original regression equation is a valid model to predict willingness to travel to and live on Mars.

Second, a Pearson's correlation was conducted to compare the actual willingness scores observed in stage 2 with the predicted willingness scores calculated with stage 2 data using the stage 1 regression equation. The data found a statistically significant relationship, $r(251) = .747$, $p < .001$. The significant relationship between actual and predicted willingness scores suggests the original regression equation is a valid model.

Lastly, the cross-validated R^2 was assessed to evaluate the model fit. Cross-validated $R'^2 = 1 – (1 – R^2)[(n + k) / (n – k)]$, where R^2 is the overall R^2 from the stage 1 model, n is the sample size of the stage 1 sample, and k is the degrees of freedom. The calculated $R'^2 = .581$ indicates how well the preliminary model would apply to other samples in the population. As a result of the low difference between the overall R^2 (.612) and the cross-validated R'^2, it appears to support the model fit of the regression equation.

General Discussion

The purpose of the current study was to identify the significant predictors of a person's willingness to travel to and live on Mars. As the development for space travel has shifted from government to private industry, companies such as Blue Origin and Virgin Galactic have plans to launch paying customers to suborbital and low orbital destinations (Blue Origin, 2018; Vision, 2018), and SpaceX is even considering sending passengers to Mars. As this technology develops so must consumer's perceptions on their willingness to participate in these activities, especially a

trip to Mars, which may pose more hazards than is commonly presented or depicted in media portrayals (Johnson, n.d.).

The first hypothesis of this study was that at least one of the predictors would be significant. The data from this study supported the first hypothesis and found that nine predictors were significant: familiarity, fun factor, wariness of new technology, anger, disgust, happiness, sadness, "other" ethnicity, and a master's level of education. The variables of familiarity and fun factor demonstrate that as these two variables increase so does a participant's willingness to fly. Those participants who are most interested in the possibility of space travel may be the ones who would be most familiar and find it the most fun. It is also possible that these individuals also understand the risks and hazards (European Space Agency, 20017) associated with possible space travel to Mars and the effects of living there. A somewhat unexpected finding from the data was the positive coefficient of wariness to new technology, suggesting that as wariness went up, so did willingness. It is possible that a participant could still be willing even if they were wary, especially if the technology is proven over time. However, further research should be conducted to examine this variable in more detail. Ethnicity reported as "other" was a strong predictor of willingness to travel to and live on Mars while a master's degree level of education resulted in a negative relationship with willingness to travel to and live on Mars. It is interesting to note that, at least within the data collected in this study, that the master's level education related to less willingness. Additional research could examine this finding in more detail, such as whether or not certain types of master's degrees would relate to willingness.

Four of the six universal facial expressions (Ekman & Friesen, 1971) were found to be significant predictors. This finding was supported by earlier studies which found how the affective domain influences decision, especially in times of uncertainty (Bechara, 2004; Sayegh, Anthony, & Perrewe, 2004; Schwarz, 2000). As participants felt more sadness and disgust, their willingness went down. These emotions tend to support the direction of this relationship as it is possible that an individual who is sad or disgusted by the thought of traveling to and living on Mars would express a strong willingness. Happiness and anger both demonstrated positive relationships with willingness. While this finding makes more sense with happiness than anger, it is noted that the effect size of anger was rather small. Further research should be completed to provide additional understanding of the relationship between anger and willingness within this context.

The second hypothesis stated that the model would explain at least 50% of the variance in the data. This hypothesis was supported by the data, with over 61% of the variance (59.6% adjusted) being explained by the model. Therefore, these predictor variables account for over half of the variance in the data, but there is still additional variance to be explained in the model. Due to the vast array of reasons for which a person may be interested in traveling to and living on Mars, this allows for an area of continued research to help both replicate the findings of these significant predictors but to also work to identify new predictors which may have a significant influence on the model.

The final hypothesis predicted that a second and independent sample of participants would allow for good model fit to be completed on the regression equation developed in stage 1. The data from the study supported this hypothesis. Using three measures of model fit, a *t*-test,

bivariate correlation, and cross-validated R'^2, all three indicators provided indicates of acceptable model fit. Conducting this step helps to verify, using an independent sample, that the model will be effective on the broader population and does hold predictive capacity.

Practical Applications

The findings from this study provide for some practical applications. First, it is one of the first studies for which we are aware that attempts to identify significant predictors of a participant's willingness to travel to and live on Mars. Therefore, these results help to contribute to a growing body of literature that exists related to consumers and space travel. Four of the nine significant predictors were related to emotions. While this finding is supported by the literature and prior studies (Babin & Attaway, 2000; Baker & Cameron, 1996; Rice, Winter, Kraemer, Mehta, & Oyman, 2015; Schwarz, 2000; Winter, Rice, & Mehta, 2014), it may help companies plan how to control the message and information that is presented to participants. As participants become more educated about space travel, it could result in their decision-making process transitioning from affective to cognitive. Those participants who were also more familiar with space travel and who felt it would be fun expressed higher levels of willingness. These characteristics may help companies differentiate between those consumers who are incredibly interested in and familiar with the concepts of space travel compared to those who may be interested on a superficial level. Lastly, the findings could be helpful in crew selection for Mars missions or other long-duration space expeditions or studies.

Limitations

Certain limitations exist with the current study. First, the study used a convenience sample of participants from MTurk. While data from this source has been demonstrated to be as valid as traditional laboratory data, the use of this population restricts the generalizability of these findings to those types of individuals who complete online human intelligence tasks for monetary compensation. Further research should be conducted to expand the sample to other populations to replicate the findings of the current study and provide greater generalizability of the results. For example, responses may be different for individuals who have placed a down payment to conduct a ride on private space exploration. The data for this study (in both stages) was also collected cross-sectionally over a short period.

Additionally, the researchers could examine how perceptions may change over some time. It should also be noted that extensive space travel may be decades away, and these current participants perceptions may change between now and then. Also, when conducting the coding for categorical variables, it is acknowledged that ethnicity and education variables were limited in unequal cell sizes for some levels. Lastly, the study used a correlational design so that no inferences may be made about cause and effect. Using the information gathered from this non-experimental study, it is possible that future research can attempt to manipulate specific parameters to determine which factors significantly affect a participant's willingness to travel to and live on Mars. Also, due to the novel nature of the study, backward stepwise regression was used to develop the model. This statistical procedure has some limitations as significant predictor variables are assessed through their semi-partial correlational values. In follow-up studies, the

manual entry of variables into the model could be completed to help ground the theoretical aspect of the significant predictors.

Conclusions

The purpose of the current study was to contribute to filling a gap within the literature that relates to a participant's willingness to travel to and live on Mars. While technology has been advancing and private companies are beginning to consider sending consumers on commercial space trips to sub-orbit, Low Earth Orbit or even Mars, it is essential to identify which factors may predict a person's willingness to do such tasks, and in the case of this study, their willingness to travel to and live on Mars. Using two independent stages consisting of over 500 participants, this study developed a regression equation with nine significant predictors of a person's willingness to travel to and live on Mars: familiarity, fun factor, wariness of new technology, anger, disgust, happiness, sadness, "other" ethnicity, and a master's level of education. The second stage used an independent sample of participants to verify good model fit. The study provided a discussion of these significant predictors and practical applications of the findings.

References

Babin, B. J., & Attaway, J. S. (2000). Atmospheric affect as a tool for creating value and gaining share of customer. *Journal of Business Research, 49*(2), 91-99.

Baker, J., & Cameron, M. (1996). The effects of the service environment on affect and consumer perception of waiting time: An integrative review and research propositions. *Journal of the Academy of Marketing Science, 24*(4), 338-349.

Bechara, A. (2004). The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage. *Brain and Cognition, 55*(1), 30-40.

Blue Origin. (n.d.). Retrieved November 19, 2018, from https://www.blueorigin.com/Spacexcmsadmin. (2012, November 28). Careers. Retrieved November 19, 2018, from https://www.spacex.com/careers

Boneau, C. A., (1960). The effects of violations of assumptions underlying the *t* test. *Psychological Bulletin, 57*(1), 49-64.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality data? Perspectives on Psychological Science, 6(3), 3-5.

Cremer, I. & Rice, S. (2015) Which emotions mediate the relationship between type of water recycling projects and likelihood of using green airports? *International Journal of Sustainable Aviation, 1*(4), 299-313. doi:10.1504/IJSA.2015.074725

Ekman, P., & Friesen, W.V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, *17*(2), 124-129.

European Space Agency. (2017, April 26). Musculo-skeletal system: Bone and Muscle loss. Retrieved from https://www.esa.int/Our_Activities/Preparing_for_the_Future/Space_for_Earth/Space_for_health/Musculo-skeletal_system_Bone_and_Muscle_loss

Germine, L., Nakayama, K., Duchaine, B.C., Chabris, C.F., Chatterjee, G., & Wilmer, J.B. (2012) Is the web as good as the lab? Comparable performance from web and lab in cognitive/perceptual experiments. Psychonomic Bulletin & Review, 19(5), 847-857.

Granath, B. (2015, October 01). Why Do We Explore? Retrieved November 1, 2018, from https://www.nasa.gov/feature/the-human-desire-for-exploration-leads-to-discovery

Hung, D. D., Kim, H., & Land, B. (1996, April 20). Project Deidre. Retrieved November 19, 2018, from https://people.ece.cornell.edu/land/OldStudentProjects/cs490-95to96/HJKIM/emotions.html

Johnson, P. R. (n.d.). The Deathworlders. Retrieved November 19, 2018, from https://deathworlders.com/books/deathworlders/

Making Life Multiplanetary | Space Exploration Technologies Corp. (2017). Retrieved November 1, 2018, from https://www.spacex.com/mars

MailOnline, J. O. (2014, October 10). Getting to Mars will ensure the survival of our species, says Nasa chief - and he claims humanity needs to 'get a grip' when it comes to climate change. Retrieved November 1, 2018, from https://www.dailymail.co.uk/sciencetech/article-2786808/Getting-Mars-ensure-survival-species-says-Nasa-chief-claims-humanity-needs-grip-comes-climate-change.html

Mars One (2019). Why should we go to Mars? Retrieved from: https://www.mars-one.com/faq/mission-to-mars/why-should-we-go-to-mars

Marte, D. A., Anania, E. C., Rice, S., Mehta, R., Milner, M. N., Winter, S. R., Walters, N., Capps, J., & Ragbir, N. (In Press). What type of person supports 24/7 police drones over neighborhoods? A regression analysis. *Journal of Unmanned Aerial Systems*.

Northon, K. (2018, January 24). Spinoff 2018 Highlights Space Technology Improving Life on Earth. Retrieved November 1, 2018, from https://www.nasa.gov/press-release/spinoff-2018-highlights-space-technology-improving-life-on-earth

Oxford Dcitionary. (n.d.). Willingness | Definition of willingness in English by Oxford Dictionaries. Retrieved November 19, 2018, from https://en.oxforddictionaries.com/definition/willingness

Overpopulation Causes, Effects & Solutions | Renewable Resources Co. (2016, December 09). Retrieved November 1, 2018, from https://www.renewableresourcescoalition.org/overpopulation-causes-effects-solutions/

Rice, S., Kraemer, K., Winter, S. R., Mehta, R., Dunbar, V., Rosser, T. G., & Moore, J. C. (2014). Passengers from India and the United States have differential opinions about autonomous auto-pilots for commercial flights. *International Journal of Aviation, Aeronautics, and Aerospace, 1*(1), 1-12.

Rice, S., Mehta, R., Dunbar, V., Oyman, K., Ghosal, S., Oni, M.D. & Oni, M.A. (2015, January). *A valid and reliable scale for consumer willingness to fly.* Proceedings of the 2015 Aviation, Aeronautics, and Aerospace International Research Conference.

Rice, S., Mehta, R., Winter, S. R., Anania, E., Milner, M. N., & Ragbir, N. (Accepted). *What type of person is willing to undergo a teeth cleaning with a dental robot?* Poster presented at the 2019 International Symposium on Human Factors and Ergonomics in Health Care, Chicago, Illinois.

Rice, S. & Winter, S. R. (2015). Which emotions mediate the relationship between type of pilot configuration and willingness to fly? *Aviation Psychology and Applied Human Factors, 5*(2), 83-92.

Rice, S., Winter, S.R., Doherty, S. & Milner, M.N. (2017). Advantages and disadvantages of using internet-based survey methods in aviation-related research. *Journal of Aviation Technology and Engineering, 7*(1), 58-65.

Rice, S., Winter, S. R., Mehta, R., & Ragbir, N. K. (2019). What factors predict the type of person who is willing to fly in an autonomous commercial airplane? *Journal of Air Transport Management, 75,* 131-138.

Rosen, S. (2009). How Space Can Improve Life On Earth. Retrieved November 1, 2018, from http://space.nss.org/media/How-Space-Can-Improve-Life-On-Earth.pdf

Sayegh, L., Anthony, W. P., & Perrewe, P. L. (2004). Managerial decision-making under crisis: The role of emotion in an intuitive decision process. *Human Resource Management Review, 14*(2), 179-199.

Schwarz, N. (2000). Emotion, cognition, and decision making. *Cognition & Emotion, 14*(4), 433-440.

Vision. (n.d.). Retrieved November 19, 2018, from https://www.virgingalactic.com/vision/

Ward, P. (2017, April 26). The Earthly Benefits of a Mission to Mars. Retrieved November 19, 2018, from https://theculturetrip.com/north-america/usa/articles/the-earthly-benefits-of-a-mission-to-mars/

Winter, S.R., Keebler, J. R., Rice, S., Mehta, R., & Baugh, B.S. (2018). Patient perceptions on the use of an autonomous emergency medical transport: An affective perspective. *Transportation Research Part F, 58,* 431-441.

Winter, S. R., Rice, S., & Mehta, R. (2014). Aviation consumers' trust in pilots: A cognitive or emotional function. *International Journal of Aviation, Aeronautics, and Aerospace, 1*(1). Retrieved from http://commons.erau.edu/ijaaa/vol1/iss1/2

Winter, S. R., Rice, S., Tamilselvan, G., & Tokarski, R. (2016). Mission-based citizen views on UAV usage and privacy: An affective perspective. *Journal of Unmanned Vehicle Systems 4*, 1-11 doi: 10.1139/juvs-2015-0031.

Yurtoğlu, N. (2018). Thinking About Creativity in Science Education. *Scientific Research, 10*(7), 241-264. doi:10.9737/hist.2018.658

Zimmer, C. (2005). Life on Mars? Retrieved November 1, 2018, from https://www.smithsonianmag.com/science-nature/life-on-mars-78138144/

Appendix A – Willingness to Travel to and Live on Mars Scale. Adapted from the Willingness to Fly scale (Rice et al., 2015).

Please respond to each of the following statement:

1. I would be willing to travel and live on Mars in this situation.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

2. I would be comfortable traveling and living on Mars in this situation.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

3. I would have no problem traveling and living on Mars in this situation.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

4. I would be happy to travel to and live on Mars in this situation.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

5. I would feel safe traveling to and living on Mars in this situation.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

6. I have no fear of traveling to and living on Mars in this situation.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

7. I feel confident traveling to and living on Mars in this situation.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

Appendix B – Four Scales.

Familiarity Scale

Please respond to each of the following statement:

1. I am familiar with issues related to traveling to and living on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

2. I have a lot of knowledge about traveling to and living on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

3. I have read a lot about traveling to and living on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

4. Traveling to and living on Mars has been of interest to me for awhile.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

5. I know more traveling to and living on Mars than the average person.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

Value Scale

Please respond to each of the following statement:

1. Traveling to and living on Mars is something that would be beneficial to me.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

2. Traveling to and living on Mars would be something valuable for me.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

3. I think traveling to and living on Mars is useful.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

4. There would be value in traveling to and living on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

5. If traveling to and living on Mars were possible, I think it would be beneficial to me.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

Fun Factor Scale

Please respond to each of the following statement:

1. I like the idea of traveling to and living on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

2. I think it would be fun to travel to and live on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

3. I am interested in traveling to and living on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

4. I think it would be cool to travel to and live on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

5. I've always wanted to travel to and live on Mars.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

Wariness of New Technology Scale

Please respond to each of the following statement:

1. In general, I am wary of new technology.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

2. New technology scares me.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

3. New technology is not as safe as it should be.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

4. I tend to fear new technology until it is proven to be safe.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree

5. New technology is likely to be dangerous.

Strongly disagree Disagree Neither disagree nor agree Agree Strongly agree