FROM QUESTION TO CONCLUSION:

THE EFFECT OF STATISTICAL ANALYSIS CHOICE

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From Question To Conclusion: The Effect of Statistical Analysis Choice

Many people, researchers and students alike, assume that as long as the data are collected well and the results are significant, reliable, and valid, then the study is successful. They assume the original research question was answered. However, especially for those people who are not as familiar with statistics, very few actually go back and assess the reality of this assumption. The problem with this is that depending on the kind of hypotheses made, and the type of statistical analysis chosen, a data set can yield different results (Kahane, 2008; Myers & Well, 2003). The significance of this problem lies in the implications and conclusions drawn from research results. If the conclusions we make depend on the results, and the results depend on the type of hypotheses and statistical analyses used, then more emphasis needs to be placed on making sure we are choosing the correct analyses that will accurately and appropriately answer the type of questions we are asking (Tabachnick & Fidell, 2005; Thompson, 2004).

This research paper will shed some light on this issue by providing a demonstration of what can happen when the same data set is analyzed using several different statistical methods (ANOVA, Univariate & Multivariate Regression, and MANOVA). The purpose is to show that different patterns of results can be obtained and that these results can lead to different conclusions about the variables in question. Here, the variables will be Personality and Music Preference. The data used here was

previously obtained and used in an independent research study I previously conducted (Higdon & Stephens, 2008). Here, it will be used to conduct four different analyses: Univariate Analysis of Variance (ANOVA), Univariate Regression, Multivariate Analysis of Variance (MANOVA), and Multivariate Regression.

Data Background

Music is an important part of the lives of human beings. Music helps people (especially adolescents) validate their feelings and comforts them with the affirmation that they are not emotionally alone (Schwartz, 2004). From this notion, much research has been done on psychological *reactions* to certain types of music- from changes in heart rate, facial expressions, and respiration to changes in emotional states and behavior (Nater, Krebs, & Ehlert, 2005; Ravaja & Kallinen, 2004; Schwartz, 2004; Weisskirch & Murphy, 2004). However, there is substantially less research on whether people with certain psychological traits tend to *prefer* certain types of music. The study from which the current project data was obtained used the five-factor model of personality to examine this concept (Higdon & Stephens, 2008).

The five-factor model was originally developed from the major themes that recur in personality descriptors in both natural languages and scientific theories. Costa & McCrae (1992) believed that personality should *begin at the top and work down*. They identified the broadest possible domains of traits from these recurring themes and then analyzed each to identify the most important/useful traits to measure- later organized into 30 *facets*. This research led to the development of the NEO Personality Inventory or NEO-PI. The five domains- Neuroticism (N), Extraversion (E), Openness to experience (O), Conscientiousness (C), and Agreeableness (A)- have shown consistent reliability and

validity. In fact, it is one of the few instruments that has demonstrated that it does measure enduring dispositions (by self-report or ratings of spouses/peers). A longitudinal study lasting six years was conducted on the N, E, and O scales (Costa & McCrae, 1992). This study showed stability coefficients ranging from .68 to .83 in both inventories that were filled out by the participant and inventories that were filled out by the spouse (about the participant). A similar longitudinal study lasting seven years assessed peer ratings and found stability coefficients ranging from .63 to .81 for the five domain scales- with the acceptable range being .30 - 1.00 (Costa & McCrae, 1992). Through extensive comparisons with other psychological tools such as the State-Trait Personality Inventory (STPI), the Personality Research Form (PRF), and the Minnesota Multiphasic Personality Inventory (MMPI), statistically significant correlations have been found to demonstrate the convergent and discriminant validity of the NEO-PI with r values for all 30 facets ranging from .45-.68 (STPI), .32-.71 (PRF), and .34-.66 (MMPI) (Costa & McCrae, 1992). Basically, it measures what it intends to measure by showing commonalities where there should be and differences where they actually occur. The NEO-PI with its reliable and valid five factors served the previous study well when combined with questions about musical preference (Higdon & Stephens, 2008).

In addition to the personality and music preference variables, "Sensation Seeking" has previously been found to correlate and was also investigated in the previous study (Higdon & Stephens, 2008). Sensation Seeking was described by Zuckerman (1990, as cited in McNamara & Ballard, 1999) as a "trait characterized by the need for 'varied, novel, and complex sensations and experiences, and the willingness to take physical and social risks for the sake of such experiences'" (p. 313). Sensation Seeking relates to both

Extraversion (being assertive and excitement-seeking) and Openness to experience (being creative and enjoying change) in that high sensation seekers tend to display four sets of characteristics in their search for optimal arousal: thrill and adventure seeking, experience seeking, disinhibition, and susceptibility to boredom (Loas, Verrier, & Flament, 2001; McNamara & Ballard, 1999; Weisskirch & Murphy, 2004; Weiten, 2004). Expanding on this relationship, Kopacz and Malgorzata (2005) conducted a study that combined these three variables and found that Openness to experience, Extraversion, and Sensation Seeking are associated with stronger musical preferences. Rawlings, Hill, Marshall, & Ziv's findings (2003) suggested that this is due to the "emotion-inducing" qualities of music- further emphasizing that people use music for emotional validation and comfort. This explains why multiple studies have found "hard rock" music to be strongly correlated to Openness to experience and Sensation Seeking traits (Rawlings, Vidal, & Furnham, 2000; Weisskirch & Murphy, 2004). The qualities of this type of music (and more recently punk) most effectively validate the emotions that more open, extraverted people experience. Nater, et al. (2005) agree. They found that Sensation Seeking was indeed associated with the psychological experience of aggressive and arousing music. This psychological connection was the basis for making Sensation Seeking a second independent variable in the previous study (Higdon & Stephens, 2008).

In another study, McManus & Furnham (2006) found that Openness to experience was also associated with enjoyment of and involvement in aesthetic activities such as reading, drawing, painting, and listening to music. This suggests that people who are more open to experience are likely to be more expressive in their music preference. For example, someone scoring high on the Openness (O) domain would more than likely

prefer music that was highly emotional with very descriptive lyrics. Their study also suggested that people with Agreeableness and Conscientiousness traits were likely to choose less expressive music (less emotional, very concrete thoughts and ideas) and be less actively involved. This is supported by a positive correlation that exists between creative personality traits and musical experience, forming yet more foundation for the previous study (Goncy & Waehler, 2006; Higdon & Stephens, 2008).

These foundations led to the hypothesis for the previous study that participants higher on the E and O domains would be higher in Sensation Seeking and prefer harder forms of music (such as heavy metal, hard rock, and rap) than those who scored lower on the E and O domains (Higdon & Stephens, 2008). Extraverts have been associated with choosing music characterized by strong rhythms, discordant harmonies, and fast tempo which not only correlates with harder forms of music but has correlations with the types of music sensation seekers prefer as well (Rawlings, et al., 2000). High sensation seekers tend to prefer music that is intense, emotional, complex, loud, and dissonant (Weisskirch & Murphy, 2004; Schwartz, 2004). People with higher scores on the E & O domains and Sensation Seeking scales have indeed been found to prefer music genres like heavy metal, punk, grunge, electronic jazz, techno, and hard rock presumably because it provides the arousal that they seek (Rawlings, et al., 2000; Weisskirch & Murphy, 2004; McNamara & Ballard, 1999). Similar results were expected in the previous study (Higdon & Stephens, 2008).

Method (Higdon & Stephens, 2008)

Participants

One hundred seventy students from a liberal arts university in the southeast

participated. There were 97 females and 73 males ranging from 18 to 24 years old. The survey was given in five sections of a Basic Psychology class. This course was a general education requirement and therefore yielded the most diverse group of participants possible. The students were also told in their classes the week before about the study in an attempt to obtain maximum attendance for the study. All participants were given the proper informed consent forms prior to the survey being administered (Higdon & Stephens, 2008).

Materials

Personality was measured using a shortened version of the NEO Personality Inventory (NEO-PI) called the IPIP Five Factor Personality Inventory (Costa & McCrae, 1992; Murray, Rawlings, Allen, & Trinder, 2003; Buchanan, 2001). This is a 41-item inventory that measures the five factors N, E, O, C, and A (FormyDuval, Williams, Patterson, & Fogle, 1995). The NEO-PI has shown good internal consistency (values for N, E, O, A, and C being .87, .80, .77, .75, and .85) as well as acceptable test-retest reliability (values ranging from .80 to .87 across all five domains at six months and .62 to .79 at 30 months) (Murray et al., 2003). The IPIP Inventory has shown similar reliability scores: .74, .84, .88, .76, and .83 for O, C, E, A, and N domains, respectively (Buchanan, 2001). This tool was created to assess the five domains of the Five-Factor Model based on the IPIP inventory developed by Goldberg (1990). The reasoning behind selecting this tool was that it addresses the same domain constructs as the NEO-PI, but is shorter and much more practical. The NEO-PI is a 240-item inventory and the IPIP is only 41-items. Length can become a confound if participants get bored or lazy with a survey that is too long. Time constraint is also an issue in a college classroom. This was taken into

consideration when choosing the IPIP inventory (Higdon & Stephens, 2008).

Sensation Seeking was measured using the "Interest and Preference Questionnaire" developed by Zuckerman (1979). This is a 40-item inventory developed to measure individual differences in stimulation and arousal needs. The reliability and construct validity for this tool has been well established (Loas, et al., 2001). In a study by Roberti, Storch, & Bravata (2003), correlations with a similar Sensation Seeking scale (The Zuckerman-Kuhlman Personality Questionnaire - Impulsive Sensation Seeking Subscale) ranged from .43 to .61 (Higdon & Stephens, 2008).

Musical preference was determined using a similar method to that used by Schwartz (2004). All of the studies mentioned previously defined music preference as genre when doing their research (i.e. Rock, Hip-Hop, Pop, etc.). However, this study focused on the *characteristics* of the music as the dependent variable in a similar way Schwartz did. In her study, instead of simply asking the participants to list their favorite types of music, the questions asked about specific qualities of music that they preferred. The qualities were then associated with their corresponding forms of music (Schwartz, 2004; Weisskirch & Murphy, 2004; Werner, Swope, & Heide, 2006). In addition to these questions, the survey also asked which genres they liked the most for further clarification in data analysis. Using both the qualities of the music and the genres helped to minimize variance due to differences in participants' definitions of specific music genres. The genres used in the questionnaire were Pop, Hard Rock, Easy-listening, Heavy Metal, Oldies, Punk, Gospel, Electronic/Dance, Jazz, Rap, Country, and Alternative. Rawlings, Vidal, & Furnham's (2000) findings show that this portion of the survey should be reliable. In their study, the category participants *said* they preferred and then *heard* was

strongly correlated. For example, if the student specified that they preferred Blues music, they were also more likely to be able to identify Blues music accurately when played an excerpt (Higdon & Stephens, 2008).

Procedure

The consent form was administered first, followed by the survey. The survey began with the demographics portion. The order of the 3 sections of the survey (Personality, Sensation Seeking, and Music Preference) was counterbalanced to avoid any confounds that may have resulted from one consistent order. The entire survey was administered on paper in the classroom setting. The participants were told to be honest because it was anonymous. They were assured that there were no right or wrong answers because the purpose was simply to observe different personality types and musical preferences. The participants were told that they had 50 minutes to complete the survey, but all participants finished within 30 minutes. After completing the survey, the participants were allowed to ask any questions they might have had pertaining to the study and were thanked for their cooperation (Higdon & Stephens, 2008).

Scoring

Personality was scored using the IPIP Scoring Key. The survey used a five-point Likert scale ranging from *very accurate* (5) to *very inaccurate* (1). There were 7 Openness questions and 9 Extraversion questions. This meant E/O scores could range from 7 to 35 for Openness and 9 to 45 for Extraversion (actual range: 11-35 and 15-45, respectively). Sensation Seeking was scored using the Sensation Seeking Scale. Points were given according to which answer choice the participant selected (A or B) for each question. The total number of points possible then was 40 (actual range: 2-34). Once

calculated, these scores were labeled Low (0-15), Medium (16-24), or High (25+). They were then able to be compared to the personality and musical preference scores. For the musical preference part of the survey, the participants were asked to rate each quality and genre using a 5-point Likert scale, ranging from *strongly like* (5) to *strongly dislike* (1). The scores were obtained by adding up the numbers circled. However, the questions that correspond with the lighter forms of music were reversed-scored (where 1=5, 2=4, 3=3, 4=2, 5=1). These questions alternated with the heavier music questions. Scores, then, could range from 25 to 125 (actual range: 48-102). Lower scores indicated a preference for lighter forms of music and higher scores indicated a preference for heavier forms of music (Higdon & Stephens, 2008).

Current Study

Results

The current study here aimed to compare the results of three different analyses (ANOVA, Regression, and MANOVA) on the same data set in order to demonstrate the importance of choosing the correct the analysis for the research question/hypothesis of interest. The results of these analyses are below. The hypothesis here is that the three results will yield different patterns of results because they are examining the research question, *How are personality traits and music preferences related?,* from different perspectives.

ANOVA

Analysis of Variance is typically used to determine simply whether differences between group means exist (Kahane, 2008). Therefore, the hypothesis for the ANOVA would be that the different levels (high, medium, low) of the personality traits Sensation

Seeking, Extraversion, and Openness would have different group means on music preference. More specifically, participants scoring higher in Sensation Seeking, Extraversion, and Openness were predicted to prefer harder forms of music (score higher) than those who scored lower in these traits.

A 3 X 3 X 3 factorial ANOVA was conducted with music preference as the dependent variable, and Sensation Seeking (high, medium, low), Extraversion (high, medium, low), and Openness (high, medium, low) as the independent variables. A factorial ANOVA was chosen because there were three independent variables and no covariates or within subjects factors. The assumptions for this test include: independence, normality, homogeneity of variance, and scale of measurement. Independence and scale of measurement were met because the subjects were randomly sampled and the dependent variable was measured on an interval scale. Descriptive statistics revealed that the scores were normally distributed with skewness at .388 and kurtosis at .054. A Levene's test of equality of variances was not significant (p = .556), meeting the last assumption of homogeneity of variances. The results of the three-way ANOVA indicated that there was not a significant interaction (not that there was expected to be one). This allowed for the interpretation of the main effects. There was a significant main effect for sensation seeking $F(2, 157) = 8.26$, $p < .01$, with those High (M=78.70, SD=9.81), Medium (M=73.58, SD=9.41), and Low (M=67.92, SD=9.52) sensation seekers all scoring significantly different from each other on their music preferences, as indicated by a Tukey's post hoc test. Pairwise comparisons were chosen because there is not enough theory in this specific area to support an a priori prediction. There was also a significant main effect for Openness to experience, $F(2, 158) = 6.84$, $p < .01$. A Tukey's post hoc

test revealed those High (*M*=77, *SD*=10.55) in Openness scored significantly higher in music preference than those in the Medium (*M*=71.47, *SD*=9.39) and Low (*M*=70.99, *SD*=10.46) groups (with Medium and Low groups not scoring significantly different from each other). This means that those participants scoring the highest in Openness tended to prefer harder forms of music. There was no significant main effect for Extraversion, $F(2, 158) = .56$, $p > .05$, unless the interval between the High, Medium, and Low groups was made significantly larger. However, this made the High and Low groups contain too few participants (*N*=15) and the Medium group contain too many (*N*=138). Overall, the ANOVA indicated that those participants higher in Sensation Seeking and Openness to experience seemed to indicate a preference for harder forms of music, partially supporting the hypothesis.

Regression

For the regression analysis, the hypothesis was a little different: The personality traits of Extraversion, Openness, and Sensation Seeking can be used to predict music preference. This is because regression analysis is typically used to predict scores on a particular variable (dependent variable) from scores on one or more variables (independent variables) (Kahane, 2008).

The correlations between all variables provided an initial tentative confirmation for the hypothesis. Sensation Seeking had the highest correlation with the dependent variable of Music Preference ($r = .443$, $p = .000$). Openness was significantly correlated with Music as well ($r = .239$, $p = .002$). As mentioned previously, theoretically this seems accurate. These correlations now provide statistical evidence that these two variables should be good predictors. Although not significant, Extraversion was weakly correlated

with Music as well (r = .125, p = .107). This is enough to include it in the model mostly because theory suggests it could potentially be a good predictor. The only potential problem here is the issue of multicollinearity. Sensation Seeking is significantly moderately correlated with Extraversion (r = .405, p = .000) and significantly weakly correlated with Openness (r = .160, p = .038). As one does not generally want the predictors to be related to each other because they can struggle to explain the same portion of variance in Music Preference, attention will need to be paid to this when evaluating the assumptions. The only demographic variable significantly correlated with Music was Gender (r = -.239, p = .002). As a result of this initial information, these four variables were used in the model to predict Music Preference: Predicted Music Preference = Sensation Seeking + Openness + Extraversion + Gender. This model was run as a Hierarchical regression (with one predictor per block) because this would reveal what each variable added to the model's ability to account for the variance in Music Preference. It made sense to look at them each individually because, as mentioned previously, there is conflicting research on how much influence each trait really has on music preference. In addition, because Gender is a nominal variable, a dummy code was used to re-label it Female (0 = Male, 1 = Female).

Being a hierarchical regression, there were actually four models- with each model adding an additional variable to the previous model in the following order: Female, Sensation Seeking (SS), Openness, and Extraversion. Of the four models, Model 3 (with Female, SS, and Openness) was the best. To elaborate, all four models were technically predicting a significant amount of the variance in Music Preference (p = .002, .000, .000, .000, Models 1-4 respectively). Models 2 (Female and SS) and 3 did predict a significant

amount more variance than the models before, but Model 4 (with all 4 variables) did not (R^2 change = .171, .034, .002; p = .000, .007, .484, respectively). This means that adding Sensation Seeking, and then Openness, as predictors made each new model better. However, adding Extraversion did not. Model 4 did not account for significantly more variance in Music Preference than Model 3 (indicated by the non-significant R^2 change, p = .484). Extraversion, then, does not seem to be a significant predictor of Music Preference. This, again, suggests that Model 3 is probably the best fit. The Standard Error of the Estimate also suggests that Model 3 is the best fit. The value is 8.85952, which is the smallest of the four models (9.954, 9.034, 8.859, 8.873, Models 1-4, respectively) and is in the same scale as the Music Preference variable. Looking back at the minimum and maximum, this means that between 48 and 102 points, Model 3 is only making about 8.859 points of error on average by predicting Music Preference from the three predictor variables. This is less than one standard deviation (s = 10.219). Sensation seeking was the strongest predictor with a standardized Beta coefficient of .384. Gender and Openness seem to be about the same as far as predictability with standardized Betas of -.197 and .188, respectively. This seems to follow the pattern of correlations with Music Preference as well- remembering that Sensation Seeking had the strongest correlation(r = .443) and Gender and Openness were the next strongest with similar strength correlations (r = -.239 and .239). This also suggests Model 3 is the likely best fit.

Examining the slope coefficients, a regression equation can be constructed to gain a greater understanding of how the predictor variables are related to Music Preference: Predicted Music Preference = -4.050(Gender) + .570(Sensation Seeking) + .438(Openness). The positive coefficients in the regression equation reveal that those

who score higher on Sensation Seeking and Openness are predicted to have higher scores on Music Preference (meaning that they prefer harder forms of music). The negative Gender coefficient reveals that having a lower Music Preference score is predicted by being female. This means that women tended to prefer softer (rather than harder) forms of music in general. Although the model as a whole is only accounting for 24.8% of the variance in Music Preference, this model does seem to be a good fit overall. As always, assumptions should be checked before full conclusions can be made.

To assess the assumption of Linearity, the matrix scatter plot for all variables was considered. There was no evidence of a nonlinear relationship between the dependent variable (Music Preference) and each of the predictors. All three relationships were relatively linear (Extraversion was a weak relationship, but most importantly did not look nonlinear). The assumption of linearity, then, was met.

The next assumption of regression is multicollinearity. As mentioned previously, multicollinearity issues were a possibility. First, there were intercorrelations between three of the predictor variables, the most potentially problematic of which was the moderate correlation between Sensation Seeking and Extraversion ($r = .405$). This could be problematic if the predictors are overlapping in the variance they are trying to account for in Music Preference. The ideal would be to explain unique variance in the dependent variable for each predictor variable. Secondly, slope coefficients had to be considered to see if the model has non-significant or changing direction slope coefficients that do not make much sense. However, this does not seem to be an issue for this model. As mentioned above, the slope coefficients seem to follow the same pattern (strength and direction) of the initial correlations with Music Preference. In addition, Extraversion was

neither a significant correlate, nor a significant predictor of Music Preference. This suggests that Multicollinearity was likely not an issue. Lastly, the Tolerance statistics had to be considered. These are a measure of the variance in one predictor unaccounted for by using the other predictors. For example, using Gender and Sensation Seeking as predictors leaves 96.5% of the variance in Openness unaccounted for. This number should be as close to 100% as possible because predictors should be as independent as possible. To put it another way, the 96.5% means that Gender and Sensation Seeking only account for 3.5% of the variance in Openness. This is excellent because the predictors should not predict each other well. The other two Tolerance statistics were also ideal (Female = .973, Sensation Seeking = .950). These Collinearity Statistics, together with the sensible slope coefficients, suggest that the assumption of multicollinearity was met. It is important to note here that these statistics were for Model 3. This is because Model 4 did not turn out to be as good of a model. In fact, the Collinearity statistics agree with this assessment, as they decrease in Model 4 (.958, .794, .962, .820). This suggests there was a multicollinearity issue when Extraversion was added (which makes sense based on the intercorrelation between Sensation Seeking and Extraversion).

The next assumption is normality of residuals. For normality to hold, the residuals should look normally distributed in the histogram of the Music variable, look linear on the P-P plot, and be clustered around zero on the scatter plot (meaning lots of small errors and very few large errors being made). These diagrams revealed the assumption of normality to be met with the residuals in the P-P plot falling mostly along the 45 degree line (where observed score is exactly equal to expected) and the residuals of the scatter plot mostly concentrated toward zero (and within 3 standard deviations).

For the assumption of homoscedasticity, the residuals should be equally variable around all the predicted values (of Music Preference) in the scatter plot. This was observed here. Although not a specific parameter of Homoscedasticity, examining the Residuals Statistics table can also be helpful in identifying any problems with the model. These revealed that there were not any significant outliers. Cook's Distance and Leverage values were much less than 1 (Minimum = .000, .005; Maximum = .064, .091, respectively) which means that there were not any significantly unusual cases. This evidence confirms the assumption of homoscedasticity is met.

For the independence of errors assumption to hold there should not be a visible pattern in the residuals scatter plot. The same amount of error should be made across the board (the plot should look as random as possible). Fortunately, there was no pattern to the graph for the model. The Durbin-Watson statistic (2.179) confirmed that the assumption of independence of errors is met as well.

To conclude, this regression model (Predicted Music Preference = -4.050(Gender) + .570(Sensation Seeking) + .438(Openness)) seemed to fit the best and make the most sense conceptually (from the correlations and from the research). All of the assumptions were met and more information was gained about which predictors were better than others (Sensation Seeking having the largest Beta coefficient). It is worth noting that Extraversion was not a significant predictor despite the hypothesis. This is likely due to some extraverts being sensation seekers and some not. Some are more stimulated by the characteristics of harder music and some are not. Extraversion and Sensation Seeking are clearly related (evident in the correlation, r = .405, and the characteristics of each trait), but that does not necessarily mean all extraverts will engage in the same extraverted or

sensation seeking behaviors. There are other ways to receive that stimulation besides music. Perhaps this is also why the model was only able to significantly predict 24.8% of the variance in Music Preference scores (and why the correlation between predicted and actual Music Preference scores was only R = .512). There is clearly more to Music Preference than these personality traits (and gender). There are certainly other personality traits to consider, as well as other outside factors that could help predict Music Preference. More research would need to be done and more models developed to know what these factors are. This would likely a yield a model that explains more of the variance in Music Preference.

MANOVA

Going back to the research question, *How are personality traits and music preferences related?*, it is easy to see that there are several ways to approach finding an answer. The first two analyses (ANOVA and Regression) emphasized the influence of the multiple independent personality variables on a single dependent variable: music. However, as mentioned previously, the music preference scale actually contains two sections: Music Genres and Music Qualities. Another perspective, then, on answering this research question could be the extent to which the relationship between personality and music preference is influenced by the preferred genre of music and the extent to which it is influenced by the qualities of the music participants prefer. This would require running multivariate analyses because there are now two dependent Music variables.

First, a Factorial Multivariate Analysis of Variance (MANOVA) was chosen because this would directly mirror the ANOVA chosen above. All parameters of the analysis were identical to the ANOVA, with the exception of the multivariate component:

the two dependent variables- Music Genre and Music Qualities. MANOVA is typically used when there are multiple dependent variables because running multiple ANOVAs inflates the Type I error rate and ignores correlations among the dependent variables, which also lowers power. In addition, if the dependent variables represent different facets of the same construct (music preference), then it would make more sense conceptually to test the facets together. Thus, a Factorial MANOVA seemed appropriate here. The hypothesis for this analysis, then, would be similar to the ANOVA hypothesis in that the different levels (high, medium, low) of the personality traits Sensation Seeking, Extraversion, and Openness would be expected to have different group means on music preference, specifically on each of the facets of music preference: Genres and Qualities.

The first assumption for MANOVA is independence of subjects. This can be considered met because there were no conditions that dictated a need for random assignment and there were no significant demographic variables. The participants, then, are assumed to be independent in terms of their values on the dependent variables (once you account for the independent variables). The second assumption for MANOVA is multivariate normality. This can be assessed using Q-Q Plots. If normality is met, these plots will be linear. Both of the Q-Q Plots for the Music Preferences variables suggest that these variables meet this assumption. The last assumption for MANOVA is homogeneity of group covariance matrices. This can be assessed using Box's M test. This test was not significant (p = .787). Fortunately, this means that the covariances are equal and that this assumption is met as well.

Being a factorial MANOVA, any possible interactions needed to be assessed first. There were no 3-way or 2-way interactions (p = .891, .949, .354, .686). Interpretation,

then, moved onto main effects. There was a significant main effect for Sensation Seeking ($F(4, 284) = 3.410$, $p = .010$) and for Openness ($F(4, 284) = 3.503$, $p = .008$). There was not a significant main effect for Extraversion ($F(4, 284) = 1.877$, $p = .115$). This means that how high or low participants scored on Sensation Seeking and Openness to experience mattered in terms of what type of music they prefer. However, the partial-eta squared values revealed that Sensation Seeking and Openness only account for 4.6% and 4.7% of the variance in music genre and qualities scores. This is less than ideal.

To tease apart the group differences further and gain a better understanding of how these variables are related, a descriptive discriminant analysis was conducted for each of the significant variables (Sensation Seeking and Openness). For Sensation Seeking, the group means revealed that Sensation Seeking had a little more influence on Genre scores than Qualities scores (*total mean difference across groups*: 6.22 and 4.8, respectively). However, the influence of Sensation Seeking on both Music Preference variables makes sense conceptually, specifically the increase in preference scores from the Low Sensation Seeking group to Medium and to High (Qualities: $M = 34.90, 38.01, 39.70$; Genre: $M = 32.78, 35.55, 39.0$). This means that being in a higher group in terms of Sensation Seeking is related to a preference for harder forms of music. In addition, the discriminant analysis revealed that there was a slightly larger difference between Medium and High groups for the Music Genre variable (*M difference* = 3.45), than between Low and Medium groups (*M difference* =2.77). This means that participants with Low and Medium Sensation Seeking scores are not quite as different in their Music Genre preference as those with High Sensation Seeking Scores. The standardized weights and the structure coefficients also revealed that, while both Genre and Qualities were

important in differentiating the Sensation Seeking groups, Genre appeared to be a little more strongly associated with the difference in Sensation Seeking scores (Genre: r = .934, W = .662; Qualities: r = .849, W = .450). These results seems to fit with the above mentioned findings about high sensation seekers preferring harder forms of music and does support the Sensation Seeking portion of the hypothesis here (Weisskirch & Murphy, 2004). For Openness to experience, the results of the discriminant analysis were similar to Sensation Seeking in that Openness appeared to have more influence on Music Genre then Music Qualities (*total mean difference across groups*: 4.47 and 1.06, respectively). However, the means for Music Qualities did not make sense conceptually here. Specifically, the Qualities scores decreased from the Low Openness (M = 37.49) group to the Medium group (M = 36.39), instead of increasing as would be expected. As in the Sensation Seeking analysis though, the results did indicate a bigger difference for Music Genre scores between Medium and High Openness groups (*M difference* = 4.08) than between Low and Medium groups (*M difference* = 0.39). This, again, suggests that participants with Low and Medium Openness to experience scores are more similar (than High scorers) in the qualities of music they prefer. In other words, participants with High Openness to experience scores tended to prefer qualities of harder music (i.e. “loud and played at a great volume”, “played with many guitars/drums”, etc.) as opposed to those in the Low and Medium groups. Also, the structure coefficients and standardized discriminant weights revealed a similar pattern of results in that Music Genre scores were more strongly associated with the significant MANOVA result for Openness than Music Qualities scores. Technically however, Music Qualities was somewhat important too in differentiating between the High, Medium, and Low Openness groups (r > .30).

Overall, these results partially support the hypothesis. Sensation Seeking and Openness to experience groups (High, Medium, and Low) were both significantly related to differences in scores for both Music Genre and Music Preference. In addition, the discriminant analysis revealed that Music Genre seemed to dominate the variance in Music Preference that was related to the different groups of these two personality variables because it was shown to be more important to the relationship (between the independent and dependent variables) than Music Qualities. However, as with other analyses here, the unsupported portion of the hypothesis was that Extraversion was not found to be significant.

Multivariate Regression

For this regression analysis, the hypothesis was again a little different: The personality traits of Extraversion, Openness, and Sensation Seeking can be used to predict music preference in terms of music genre and music qualities. Just like the univariate analysis, multivariate regression uses scores on independent variables to predict dependent variable scores, but with multivariate, these score predictions are for multiple dependent variables (Kahane, 2008). This means that the model here would be Predicted Music Genre + Predicted Music Qualities = Sensation Seeking + Openness + Extraversion. The assumptions for multivariate regression encompass the assumptions from the univariate regression (linearity, multicollinearity, normality of residuals, homoscedasticity, and independence of errors) as well as the multivariate assumptions from the MANOVA (independence of subjects, multivariate normality, and equality of group covariance matrices). As all of these assumptions were discussed and found to be met above, it is not necessary to discuss them again here.

Similar to the other analyses, the initial results for this analysis indicated that Sensation Seeking ($F(2,163) = 18.05$, $p = .0001$) and Openness to experience ($F(2,163) = 6.52$, $p = .0019$) were significant predictors of music preference (Music Genre and Music Qualities combined). Extraversion was not a significant predictor ($F(2,163) = .57$, $p = .5668$). Examining the slope coefficients can shed some light on which variables are more important in predicting Music Genre and Music Qualities scores individually. For Music Qualities, it appears that Sensation Seeking is the most important and only significant predictor ($b = .3207$, $p < .0001$). This suggests that participants who score higher on Sensation Seeking were predicted to prefer the qualities of harder music (i.e. "wild and violent", "loud and played at a great volume", "played with many guitars/drums", etc.). For Music Genre, Sensation Seeking ($b = .356$, $p < .0001$) and Openness to experience ($b = .3187$, $p = .0009$) were both significant predictors that seemed to contribute relatively equally to explaining the variance in Music Genre scores. This means that participants with higher Sensation Seeking and/or higher Openness to experience scores were predicted to prefer harder genres of music (i.e. Heavy Metal, Rap, Electronic/Dance, Alternative, etc.). While the results of this model seemed to fit with theory, the three predictor variables together only accounted for 23.2% of the variance in Music Genre and only 16.3% of the variance in Music Qualities. There is clearly more to music preference than these three personality variables.

Overall, the results did partially support the hypothesis. Sensation Seeking was a significant predictor of both Music Genre and Music Qualities, and Openness to experience was a significant predictor of Music Genre. Unfortunately, Extraversion was not a significant predictor of either Music Preference variable.

Discussion

The purpose of this paper was to demonstrate that the type of hypotheses made and the statistical analyses chosen in research matters. More specifically, the same data set was analyzed using four different statistical analyses with four corresponding hypotheses to demonstrate the similarities and differences in the results obtained and the interpretations concluded.

Mathematically, ANOVA and regression analyses are equivalent. This can be seen in the results obtained in all four analyses: Sensation Seeking and Openness to experience were significant and Extraversion was not. In addition, if the assumptions were met for one analysis, they were met for all of the analyses. Again, being equivalent mathematically, this makes sense. However, once the Music Preference variable was separated into two facets (Music Genre and Music Qualities), these results became a little less straightforward. For example, in the multivariate regression analysis, Openness to experience was no longer significant for Music Qualities. While this corresponds to findings that suggest that the qualities of harder forms of music validate the feelings that high sensation seekers experience, this obviously is not the same interpretation offered by the univariate regression (Rawlings, 2003; Nater, et al., 2005). Had a researcher stopped with the simpler univariate analysis, this piece of the information about the relationship between the variables would have been missed. This part of the theory would not have been corroborated. Similarly, the MANOVA discriminant analysis provided more insight into the relationship between Sensation Seeking (and Openness) and the Music Preference variables. If a researcher was more interested in investigating which facets of Music Preference are more associated with these personality variables, then this analysis

would have been much more beneficial than the other analyses.

However, as mentioned above, the main difference between analysis choice lies in the interpretation of these results. For the ANOVA and MANOVA, the relationship between personality and music preference can only be interpreted in terms of group differences. This is often referred to as the independent variables causing an effect in the dependent variable(s). In reality though, from these analyses we can only say that participants belonging to the High Sensation Seeking group and/or the high Openness group were more likely to prefer harder forms of music when compared to the Medium and Low scoring groups. The regression analyses provided a slightly different interpretation. Here we can say that part of what makes up music preference can be significantly predicted by Sensation Seeking and Openness to experience scores. More specifically, higher Sensation Seeking scores and or higher Openness scores can significantly predict a preference for harder forms of music. One can see that the arbitrary groups created for the two analyses of variance create a difference in what a researcher can say about how a set of variables are related.

In the end, the choice of statistical analyses all depends on the researcher and what he or she wants to learn from the study. Hopefully, analysis comparisons like this and further advances in the understanding of statistics and research methods will promote an awareness of proper analysis selection. This will inevitably lead to more valid and proper interpretations of research results, and, therefore, a better understanding of the relationships between variables and constructs in the world around us.

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