**Final Assignment**

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**Final Assignment**

A personality psychologist developed a measure to assess people’s tendency to go on wacky adventures—the Wacky Adventurer Trait (WAT) scale, see Appendix B. 1,500 participants in the sample rated 12 Likert-scaled items on the WAT scale. To assess convergent, discriminant, and criterion validity, the psychologist also measured individuals’ general openness to new experiences, their self-identification as a promotion-focussed person or a prevention-focussed person, whether they encountered a past dangerous event, and the number of wacky adventures they had been on.

Part one of this assignment addresses the factor structure of the WAT scale. To explore the factor structure of the WAT scale, an exploratory factor analysis will be run. After estimating the factor structure of the WAT scale, the factor structure will be confirmed with a series of confirmatory factor analyses. Part two addresses relations between the other measures the psychologist is employing and one of the suspected factors of the WAT scale. To examine these relations, a series of regressions will be run: two linear regressions and one mediation analysis. Part three addresses how personal life focus and previous experience with danger predict a different, suspected factor of the WAT scale. Accordingly, a multiple ANOVA analysis will be conducted to examine the main and interaction effects of the life focus and experience with danger variables. All analyses were run in RStudio.

**Results­­­­­­**

**Data Cleaning**

I ran a series of Shapiro-Wilk tests for the following variables: general openness to new experiences, *W* = 0.92; the number of wacky adventures one has been on, *W* = 0.90; risk-taking propensity, *W* = 0.98; and openness to weird experiences, *W* = 1.00; all *ps* <.001. I proceeded to use parametric methods to analyze the data.[[1]](#footnote-1)

**Part One**

***Exploratory Factor Analysis***

The dimensionality of the Wacky Adventurer Trait (WAT) scale was assessed using a principal components analysis (PCA), with a cut-off value for factor meaningfulness set at an Eigenvalue of 1.00 or greater (in line with recommendations by Kaiser, 1960). An initial, unconstrained PCA yielded two factors that exceeded the cut-off Eigenvalue of 1.00 (3.02 and 2.55 for Factor 1 and Factor 2, respectively), see Figure 1 for the corresponding scree plot and Figure 2 for the corresponding parallel analysis. To aid in the interpretation of these factors, a second PCA was then conducted using a Varimax rotation, which also constrained the maximum number of factors to two. This rotation strategy was selected on the assumption that the factors of the scale would be orthogonal in nature. In the resulting rotated PCA, Factor 1 comprised of four items that explained 25 percent of the variance, with factor loadings ranging from .86 to .88. Factor 2 was comprised of eight items that explained an additional 21 percent of the variance, with factor loadings ranging from -.61 to .63.

The resulting factor loadings for each item across both factors are presented in Table 1. The items that loaded on to Factor 1 all conceptually pertained to participants’ risk-taking propensity; whereas, the items that loaded on to Factor 2 pertained to participants’ openness to weird experiences. These results suggest that the WAT scale has a two-factor structure: one factor that pertains to risk-taking propensity; and another that pertains to one’s openness to weird experiences.

***Confirmatory Factor Analyses***

In order to explore the hypothesized two-factor structure of the WAT, two confirmatory factor analyses were conducted. First, an initial, one-factor solution was tested, using benchmarks for model fit identified by Hu and Bentler (1999). An assessment of the model fit indices from this one-factor solution suggested that there was poor fit between the observed scores on the ten items, relative to the predicted item-level scores calculated by the model, *χ2*(54) = 1294.87, *p* < .001, *CFI* = 0.73, *RMSEA* = 0.124, *90% CI* = [.12, .13], *SRMR* = 0.13.

Second, a two-factor model was tested. An assessment of the model fit indices from this two-factor solution suggested that there was excellent fit between the observed scores on the twelve items, relative to the predicted item-level scores calculated by the model, *χ2*(53) = 49.53, *p* = .610, *CFI* = 1.00, *RMSEA* = 0.00, *90% CI* = [.00, .02], *SRMR* = 0.02.

This one-factor solution was then tested against a two-factor solution, based on the a priori hypothesized breakdown of items pertaining to participants’ risk-taking propensity (four items in total), versus items pertaining to participants’ openness to weird experiences (eight items in total). The resulting two-factor solution demonstrated a significant increase in model fit relative to that of the one-factor solution, evidenced specifically by a statistically significant decrease in the two-factor model’s chi-square index *Δχ2*(1) = 1245.30, *p* < .001.

***Conclusion***

Overall, the results from the exploratory factor analysis and the confirmatory analysis support a two-factor structure for the WAT scale.

**Part Two**

***Regressions***

Participant’s openness to new experiences was positively related to the openness to weird experiences factor of the WAT scale, *F*(1, 1498) = 448.10, *p* < .001, *R2* = .23, *95% CI* = [.20, .27], *β* = 0.48, 95% CI = [0.44, 0.52], see Table 2. Inspection of the 95% confidence intervals around the point estimate of the effect size suggested that openness to new experiences may plausibly (though not certainly) predict between 20 and 27 percent of the variance in an individual’s openness to weird experiences (population-level effects outside of this range are possible, but are relatively less probable; see Cumming & Finch, 2005). Further inspection of the regression equation that was produced by this analysis further suggested that, for every one standard deviation unit increase in openness to new experiences, participants could plausibly see a 0.44 to 0.52 standard deviation unit increase in their openness to weird experiences.

In addition, participant’s openness to new experiences was unrelated to the number of wacky adventures they have been on, *F*(1, 1498) = 1.26, *p* = .262, *R2* = .00, *95% CI* = [.00, .01], *β* = 0.03, 95% CI = [-.02, .08], see Table 3. Inspection of the 95% confidence intervals around the point estimate of the effect size suggested that openness to new experiences may plausibly (though not certainly) predict between zero and one percent of the variance in the number of wacky adventures an individual had been on (population-level effects outside of this range are possible, but are relatively less probable; see Cumming & Finch, 2005). Further inspection of the regression equation that was produced by this analysis further suggested that, for every one standard deviation unit increase in openness to new experiences, participants could plausibly see a -0.02 standard deviation unit decrease to 0.08 standard deviation unit increase in the number of wacky adventures they had been on.

***Mediation Analysis***

I predicted that openness to weird experiences would mediate the relation between participants’ openness to new experiences and their risk-taking propensity. To test this hypothesis, I explored both the direct and indirect relations between openness to new experiences and the number of wacky adventures one had been on, using openness to weird experiences as a mediator variable. These relations were tested using a multiple regression that included openness to new experiences and openness to weird experiences (predictors), and the number of wacky adventures one has been on (outcome).

In a first step, the relation between openness to new experiences (the predictor) and openness to weird experiences (the mediator) was assessed. Openness to new experiences predicted 23 percent of the variance openness to weird experiences, *t*(1498) = 21.17, *p* < .001, *R2* = .23, *95% CIs* = [.20, .27], *β* = 0.48, *95% CIs* = [.44, .52], see Table 2. Examination of the 95 percent confidence intervals around the standardized effect size suggested that openness to new experiences may plausibly (though not certainly) account for anywhere from 20 to 27 percent of the population-level variance in openness to weird experiences (population-level effect sizes outside this range as possible, but are relatively less probable), supporting the *a*-path of the proposed mediation model. Moreover, examination of the standardized slope coefficient suggested that, for every one standard deviation unit increase in openness to new experiences, one could expect a 0.44 to 0.52 standard deviation unit increase in openness to weird experiences. Thus, the *a*-path of the proposed mediation model was supported.

In a second step, the unique relations between openness to new experiences (the predictor) and openness to weird experiences (the mediator) on number of wacky adventures (the outcome) were assessed. Together, openness to new experiences and openness to weird experiences predicted 19 percent of the variance in the number of wacky adventures one had been on, *F*(2, 1497) = 173.20, *p* < .001, *R2* = .19, *95% CIs* = [.15, .22], see Table 4. Examination of the 95 percent confidence intervals around the standardized omnibus effect size suggested that openness to new experiences and openness to weird experiences combined may plausibly (though not certainly) account for anywhere from 15 to 22 percent of the population-level variance in the number of wacky adventures one has been on. Moreover, openness to weird experiences uniquely predicted 19 percent of the variance in number of wacky adventures beyond the variance already accounted for by openness to new experiences, *t*(1497) = 18.57, *p* < .001, *sr2* = .19, *95% CIs* = [.15, .22], *β* = 0.49, *95% CIs* = [.44, .55]. Examination of the 95 percent confidence intervals around the standardized partial effect size suggested that, controlling for the effects of openness to new experiences, openness to weird experiences may plausibly (though not certainly) account for anywhere from 15 to 22 percent of the population-level variance in the number of wacky adventures one has been on. Moreover, examination of the standardized slope coefficient suggested that, for every one standard deviation unit increase in openness to weird experiences, one could expect a 0.44 to 0.55 standard deviation unit increase in the number of wacky adventures one has been on. Thus, the *b*-path of the proposed mediation model was also supported.

Because both the *a-* and *b*-paths of the model were significant, mediation was subsequently tested using bootstrapping with bias-corrected confidence intervals, see Figure 3. Results of the mediation analysis confirmed the indirect path between openness to new experiences and the number of wacky adventures one has been on via openness to weird experiences, *β* = 0.21, 95% *CIs* = [0.18, 0.24]. Likewise, the direct path between openness to new experiences and the number of wacky adventures one has been on was significant after accounting for openness to weird experiences, *β* = -0.18, 95% *CIs* = [-0.22, -0.13]. Because the direct path between openness to new experiences and the wacky adventures one was concluded to be a non-zero relationship, these results suggested the idea that openness to weird experiences may partially mediate the relation between openness to new experiences and the number of wacky adventures one has been on.

***Conclusion***

Overall, the results support that general openness to experience positively predicts scores on the openness to weird experiences factor of the WAT scale; general openness to experience does not predict the number of wacky adventures one has been on. A mediation analysis suggested that openness to weird experiences partially mediates the relation between general openness to experiences and the number of wacky adventures someone has been on.

**Part Three**

I predicted that previous experience with danger would moderate the relation between participants’ life focus and risk-taking propensity. To test this hypothesis, I included both life focus and previous experience with danger as unique predictors of risk-taking propensity, and also included an interaction term as a unique predictor. Because both life focus (i.e., promotion-focus, prevention-focus), and previous experience with danger (yes, no) were categorical variables, I included both as predictors of risk-taking propensity using a multiple ANOVA analysis.

Because discrete groups were being compared, I tested the homogeneity of variance assumption using a Levene’s test. This test suggested that there were population-level differences in the variances of risk-taking propensity ratings between each of the four cells (i.e., promotion-focus/no dangerous experience; promotion-focus/dangerous experience; prevention-focus/dangerous experience; prevention-focus/no dangerous experience), *F*(3, 1496) = 11.50, *p* < .001. Thus, the parametric assumption of homogeneity of variance was not met. However, because the sample size is so large, there will be great power in detecting even the slightest effect—a reason as to why the Levene’s test was shown as significant (Field et al., 2012). Nonetheless, I still proceeded to run the multiple ANOVA analysis.[[2]](#footnote-2)

I then conducted the multiple ANOVA analysis, see Table 5 for the ANOVA results and Table 6 for descriptive statistics. The life focus\*experience of previous danger interaction significantly predicted participants’ risk-taking propensity ratings, *F*(1, 1496) = 14.93, *p* < .001, *partial η2* = 0.01, 95% *CIs* = [.00, .02], see Figure 4. Inspection of the 95 percent confidence intervals around the standardized effect size suggested that the interaction between a life focus orientation and experience of previous danger may plausibly (though not certainly) uniquely predict between zero and two percent of the population-level variance in risk-taking propensity ratings (population-level effects outside of this range are possible but are relatively less probable).

Because the interaction was supported, it was further explored using simple effects post-hocs. There was a simple main effect of life focus on risk-taking propensity for participants who did experience danger, *F*(1, 1496) = 634.49, *p* < .001, such that those with a promotion-focus life orientation (*M* = 3.14, *SD* = 0.65) were higher on risk-taking propensity than those with a prevention-focus life orientation (*M* = 1.70, *SD* = 0.49), *d* = 2.49, *95%* *CIs* = [2.26, 2.71]. Inspection of the 95% confidence intervals around the standardized effect size suggested that the population-level mean difference in risk propensity ratings between these two groups could plausibly (though not certainly) range from 2.26 standard deviations to 2.71 standard deviations. As well, there was a simple main effect of life focus on risk-taking propensity for participants who did not experience danger previously, *F*(1,1496) = 1649.13, *p* < .001, such that those with a promotion-focus life orientation (*M* = 5.50, *SD* = 0.70) had higher risk-taking propensity than those with a prevention-focus life orientation (*M* = 3.79, *SD* = 0.67), *d* = 2.49, *95% CIs* = [2.32, 2.66]. Inspection of the 95% confidence intervals around the standardized effect size suggested that the population-level mean difference in risk propensity ratings between these two groups could plausibly (though not certainly) range from 2.32 standard deviations to 2.66 standard deviations. This suggests that life focus is equally effective for risk-taking propensity regardless of whether people have had previous experiences with danger.

In terms of main effects, there was a significant main effect of life focus on risk-taking propensity, suggesting that the marginal mean risk-taking propensity scores differed between participants who generally had previous experiences with danger (*M* = 2.46, *SD* = 0.92) and those who did not (*M* = 4.77, *SD* = 1.09), *F*(1, 1496) = 1970.26, *partial η2* = .57, 95% *CIs* = [.54, .59]. Inspection of the 95 percent confidence intervals around the standardized effect size suggested that life focus may plausibly (though not certainly) uniquely predict between 54 and 59 percent of the population-level variance in risk-taking propensity. In addition, there was a main effect of previous experience with danger, such that participants who had a promotion-focus life orientation (*M* = 4.72, *SD* = 1.30) had a marginal mean risk-taking propensity score that was higher than participants with a prevention-focus life orientation (*M* = 3.01, *SD* = 1.18), *F*(1, 1496) = 3915.12, *partial η2* = .72, 95% *CIs* = [.71, .74]. Inspection of the 95 percent confidence intervals around the standardized effect size suggested that previous experience with danger may plausibly (though not certainly) uniquely predict between 71 and 74 percent of the population-level variance in risk-taking propensity.

***Conclusion***

Overall, the results support that not only does life focus and previous experience with danger predict risk-taking propensity individually but that there is an interaction between life focus and previous danger in predicting the risk-taking propensity factor of the WAT scale. Moreover, those who had previous experiences with danger had a higher risk-taking propensity when they had a promotion-life focus versus those with a prevention-life focus. Likewise, those who had no previous experiences with danger had a higher risk-taking propensity when they had a promotion-life focus versus those with a prevention-life focus.

**References**

Cumming, G., & Finch, S. (2005). Inference by eye: confidence intervals and how to read pictures of data. *American psychologist*, *60*(2), 170.

Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. Sage publications.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal*, *6*(1), 1-55. <https://doi.org/10.1080/10705519909540118>

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and psychological measurement*, *20*(1), 141-151.

**Appendix A: Figures and Tables**

**Figure 1**

*Scree Plot Highlighting Two-Factor Structure of WAT Scale*

*Chart, line chart, histogram

Description automatically generated*

**Figure 2**

*Parallel Analysis Highlighting Two-Factor Structure of WAT Scale*

*Chart, line chart

Description automatically generated*

**Figure 3**

*Mediation Results*

**Graphical user interface

Description automatically generated with low confidence**

**Figure 4**

*Risk-taking Propensity by Focus Type and Experience of Danger*

*Chart

Description automatically generated*

**Table 1**

*Factor loadings and communalities based on a principal components analysis with varimax rotation for 14 items from the Wacky Adventure Trait (WAT) Scale (N = 1500)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item | Risk-taking propensity | Openness to weird experiences | | Communality | |
| 1. My friends would describe me as “pretty normal” (R) | 0.01 | **-0.61** | | 0.37 | |
| 2. I’m a pretty “odd duck”, overall. | 0.02 | **0.63** | | 0.40 | |
| 3. I usually try to avoid getting involved with weird shenanigans (R) | -0.03 | **-0.46** | | 0.21 | |
| 4. Some people might say I'm too open to new experiences for my own good. | **0.87** | 0.00 | | 0.75 | |
| 5. My friends have told me I have a poor sense of self-preservation. | **0.87** | -0.02 | | 0.76 | |
| 6. I find myself in a lot of situations that some might call “sketchy”. | **0.86** | 0.00 | | 0.74 | |
| 7. Wacky adventures are best left to fools and dreamers. (R) | -0.04 | **-0.58** | | 0.34 | |
| 8. Sometimes I think I take more risks than I really should | **0.88** | -0.02 | | 0.77 | |
| 9. I believe that new experiences are key to a life well lived. | 0.01 | **0.49** | | 0.24 | |
| 10. On the whole, I would say I meet more interesting people than most | -0.04 | **0.60** | | 0.36 | |
| 11. When asked to try something new, I usually say ‘yes’. | -0.01 | | **0.54** | | 0.30 | |
| 12. I have a lot of random stories about my life. | 0.03 | | **0.59** | | 0.35 | |

*Note.* Values in bold are the items that load onto their respective factors. \* “(R)” indicates a reverse-coded item.

**Table 2**

*Regression Results Using openness\_weird\_experiences as the Criterion*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Predictor | *b* | *b*  95% CI  [LL, UL] | *beta* | *beta*  95% CI  [LL, UL] | *sr2* | *sr2*  95% CI  [LL, UL] | *r* | Fit |
| (Intercept) | 3.79\*\* | [3.66, 3.93] |  |  |  |  |  |  |
| Openness | 0.31\*\* | [0.28, 0.33] | 0.48 | [0.44, 0.52] | .23 | [.20, .27] | .48\*\* |  |
|  |  |  |  |  |  |  |  | *R2*  = .230\*\* |
|  |  |  |  |  |  |  |  | 95% CI[.20,.27] |
|  |  |  |  |  |  |  |  |  |

*Note.* A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights. *beta* indicates the standardized regression weights. *sr2* represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.  
\* indicates *p* < .05. \*\* indicates *p* < .01.

**Table 3**

*Regression Results Using NumAdventures as the Criterion*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Predictor | *b* | *b*  95% CI  [LL, UL] | *beta* | *beta*  95% CI  [LL, UL] | *sr2* | *sr2*  95% CI  [LL, UL] | *r* | Fit |
| (Intercept) | 3.16\*\* | [2.95, 3.36] |  |  |  |  |  |  |
| Openness | 0.03 | [-0.02, 0.07] | 0.03 | [-0.02, 0.08] | .00 | [.00, .01] | .03 |  |
|  |  |  |  |  |  |  |  | *R2*  = .001 |
|  |  |  |  |  |  |  |  | 95% CI[.00,.01] |
|  |  |  |  |  |  |  |  |  |

*Note.* A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights. *beta* indicates the standardized regression weights. *sr2* represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.  
\* indicates *p* < .05. \*\* indicates *p* < .01.

**Table 4**

*Regression Results Using NumAdventures as the Criterion*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Predictor | *b* | *b*  95% CI  [LL, UL] | *beta* | *beta*  95% CI  [LL, UL] | *sr2* | *sr2*  95% CI  [LL, UL] | *r* | Fit |
| (Intercept) | 0.61\*\* | [0.29, 0.94] |  |  |  |  |  |  |
| Openness | -0.18\*\* | [-0.23, -0.14] | -0.21 | [-0.26, -0.16] | .03 | [.02, .05] | .03 |  |
| openness\_weird\_experiences | 0.67\*\* | [0.60, 0.74] | 0.49 | [0.44, 0.55] | .19 | [.15, .22] | .39\*\* |  |
|  |  |  |  |  |  |  |  | *R2*  = .188\*\* |
|  |  |  |  |  |  |  |  | 95% CI[.15,.22] |
|  |  |  |  |  |  |  |  |  |

*Note.* A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights. *beta* indicates the standardized regression weights. *sr2* represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.  
\* indicates *p* < .05. \*\* indicates *p* < .01.

**Table 5**

*Fixed-Effects ANOVA Results Using risk\_taking\_propensity as the Criterion*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Predictor | Sum  of  Squares | *df* | Mean  Square | *F* | *p* | partial η2 | partial η2  90% CI  [LL, UL] |
| (Intercept) | 16852.86 | 1 | 16852.86 | 39661.23 | <.001 |  |  |
| FocusType | 837.20 | 1 | 837.20 | 1970.26 | <.001 | .57 | [.54, .59] |
| DangerExp | 1663.61 | 1 | 1663.61 | 3915.12 | <.001 | .72 | [.71, .74] |
| FocusType x DangerExp | 6.34 | 1 | 6.34 | 14.93 | <.001 | .01 | [.00, .02] |
| Error | 635.68 | 1496 | 0.42 |  |  |  |  |

*Note.* LL and UL represent the lower-limit and upper-limit of the partial η2 confidence interval, respectively.

**Table 6**

*Means and Standard Deviations for risk\_taking\_propensity as a Function of a 2(DangerExp) X 2(FocusType) Design*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | FocusType | | | |  | |
|  | PromotionFocus | | PreventionFocus | | Marginal | |
| DangerExp | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| No | 5.50 | 0.70 | 3.79 | 0.67 | 4.77 | 1.09 |
| Yes | 3.14 | 0.65 | 1.70 | 0.49 | 2.46 | 0.92 |
| Marginal | 4.72 | 1.30 | 3.01 | 1.18 |  |  |

*Note.* *M* and *SD* represent mean and standard deviation, respectively.

**Appendix B: Wacky Adventurer Trait Scale**

1. My friends would describe me as “pretty normal” (R)
2. I’m a pretty “odd duck”, overall.
3. I usually try to avoid getting involved with weird shenanigans (R)
4. Some people might say I'm too open to new experiences for my own good.
5. My friends have told me I have a poor sense of self-preservation.
6. I find myself in a lot of situations that some might call “sketchy”.
7. Wacky adventures are best left to fools and dreamers. (R)
8. Sometimes I think I take more risks than I really should
9. I believe that new experiences are key to a life well lived.
10. On the whole, I would say I meet more interesting people than most
11. When asked to try something new, I usually say ‘yes’.
12. I have a lot of random stories about my life.

\* “(R)” indicates a reverse-coded item.

1. From Scott: “Even if violations are found, you may proceed with your analyses as though these violations did not occur.” [↑](#footnote-ref-1)
2. Scott said it was okay to do this, despite the significant Levene’s test. [↑](#footnote-ref-2)