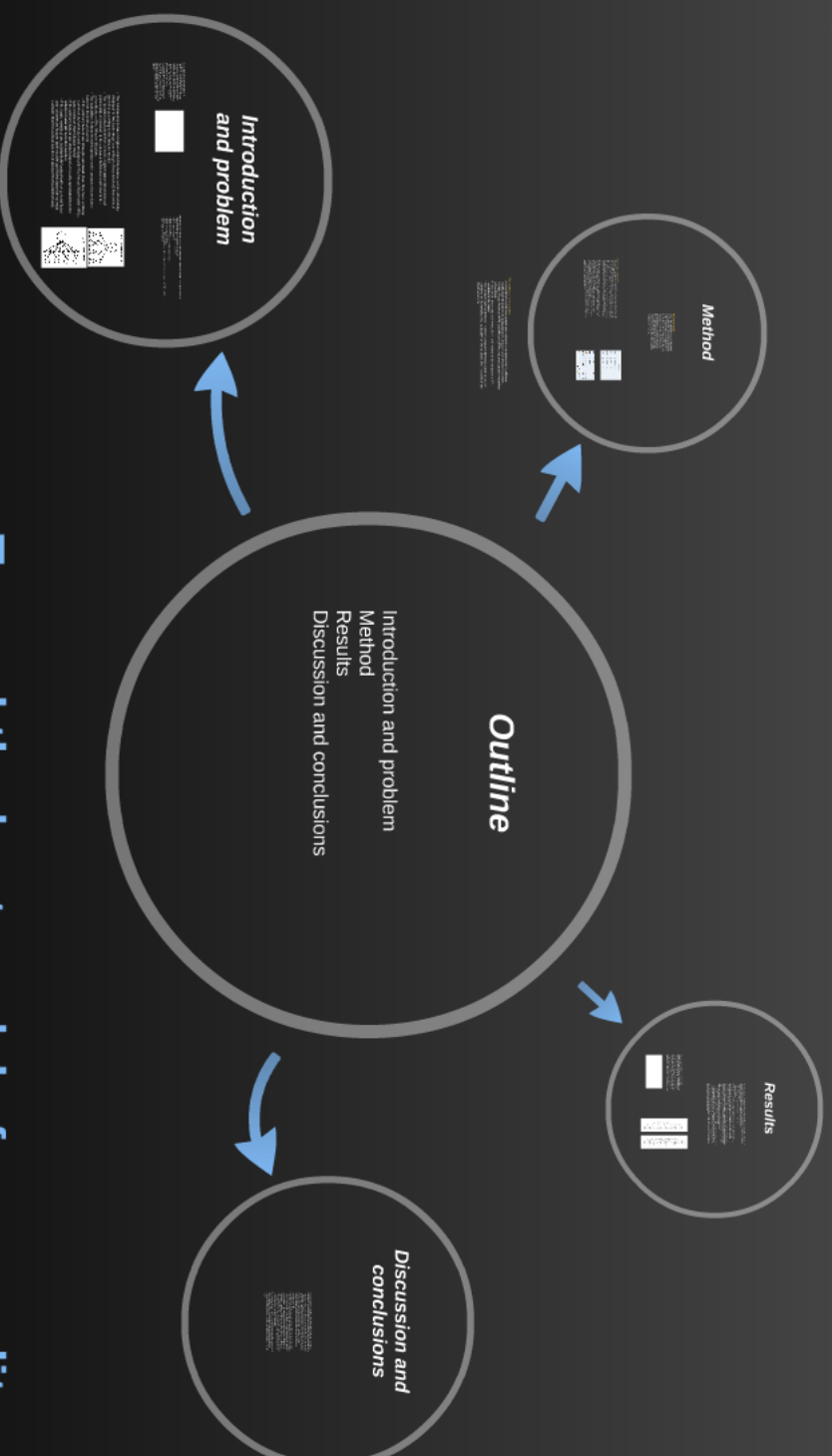


**Toward the best model of personality:
classical hierarchy or bifactor structure?**

Janek Musek, University of Ljubljana



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Outline

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Introduction and problem

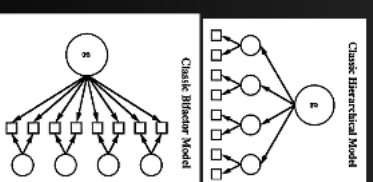
According to the most recent literature models in the field of personality (see Table 1) are organized along two levels of generality: general, which are the basis of personality dimensions like Big Five, and particular, which are the basis of personality factors like Big Three, dependent on the level of generality (Glick, 2017).

Also, according to the results of our research, hierarchically ordered structure exists in the field of personality dimensions and their effects on organizational behavior.

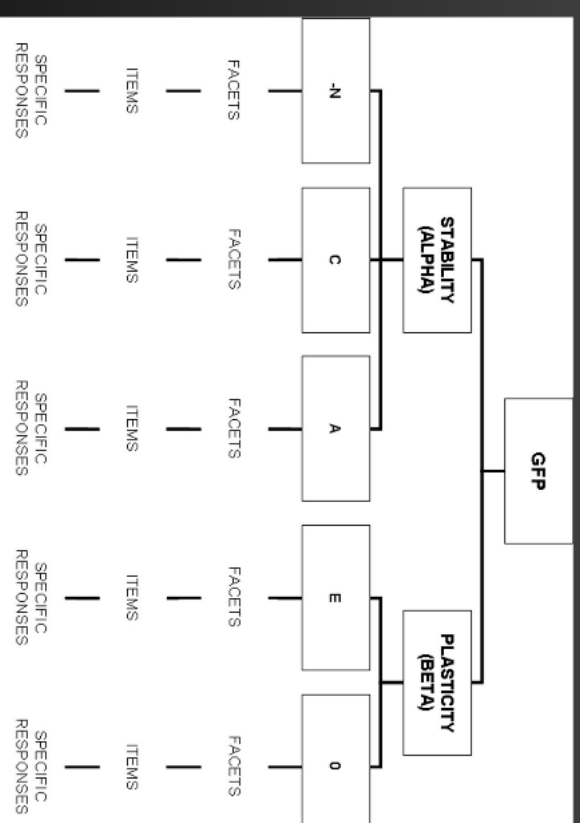
Model	Number of Dimensions	Number of Factors
Big Five	5	5
Big Three	3	3
Big Two	2	2
Big One	1	1

- The relationship between higher-order dimensions can be structurally displayed in two basic ways: according to the (classical) hierarchical model or according to the bifactor model.
- The question arises therefore, how the higher-order dimensions of personality are related: in the classical hierarchical order or in the concordance of the bifactor structure.
- The suitability of either model depends on the amount of correlation between the primary factors:
 - If the primary factors are strongly correlated, then they have a strong common denominator and consequently the hierarchical model will be better solution than bifactor model
 - If the primary factors are uncorrelated or weakly correlated then the bifactor model will be better solution
 - If the basic variables are substantially loaded both on general factor and on primary factors, both models can fit the data (yet we must consider that hierarchical solution is always more parsimonious)

All most popular four-order variables can be included into the extended concept of personality: basic personality dimensions like Big Five, Big Three, Big Two and Big One, dependent of context, dependent of situation, dependent of situation and well-being, dependent of specific context, dependent of personality, intelligence, generalizing, social potency, aggression, individuality, have substance and others.



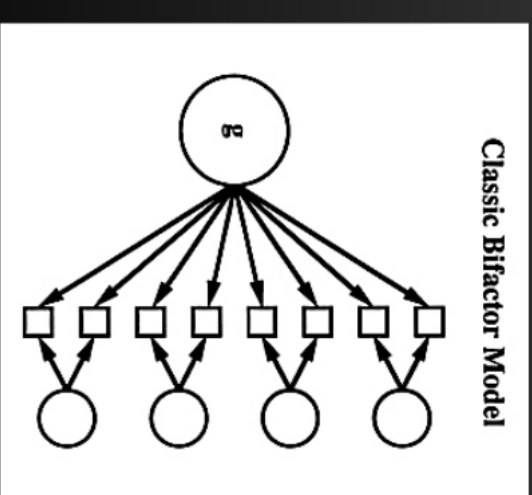
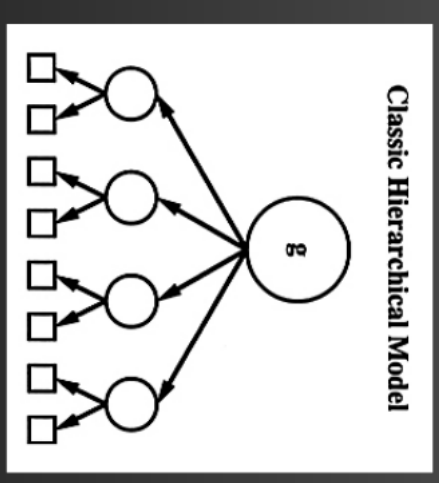
- According to the most recent structural models in the field of personality, the dimensions of personality (personality traits) are organized along five levels of generality: specific units (like the items of personality questionnaires), facets of personality, primary dimensions (like Big Five), superdimensions of personality (like Big Two) and general factor of personality (GFP).
- And, according to the results of our recent research (Musek, 2010, 2014), the similar hierarchically ordered structure exists in the entire extended domain of psychological and personality variables outside the cognitive abilities.



All most important non-cognitive variables can be included into this extended concept of personality:

- basic personality dimensions like the Big Five,
- dimensions of self-concept and self esteem,
- self-construal dimensions,
- dimensions of coping,
- dimensions of emotionality, optimism and well-being,
- dimensions of agency, control,
- dimensions of spirituality, mindfulness, generativity, social potency, aggression, traditionality, harm-avoidance and others.

- The relationship between higher-order dimensions can be structurally displayed in two basic ways: according to the (classical) hierarchical model or according to the bifactor model.
- The question arises therefore, how the higher-order dimensions of personality are related: in the classical hierarchical order or in the concordance of the bifactor structure.
- The suitability of either model depends on the amount of correlation between the primary factors:
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 - If the basic variables are substantially loaded both on general factor and on primary factors, both models can fit the data (yet we must consider that hierarchical solution is always more parsimonious)



Method

Design of study
Thus, the present study is designed to analyze the dimensional structure of the personality including the five basic dimensions of personality (the Big Five) and also the additional psychological variables related to the wider spectrum of personality (dimensions of well-being, coping, control and others).

Variables in the research model

- The data for the analyses were taken from the representative sample of the adult American (MIDUS II).
- The data were collected in the study were collected from the MIDUS II (Miller & the United States II) survey, conducted in 2004-2006 (Furl & Davidson, 2011; Furl et al., 2007).
- The data were performed on a general US national representative sample and the analysis data were obtained from 4983 respondents from two waves (3316 males and 2667 females) in the age range from 28 to 84 years (M = 55.43, SD = 12.48).
- The US data are suitable for the research purposes and can be publicly accessed via WEB site of ICPSR (University Consortium for Political and Social Research) (ICPSR Web Site, 2011).
- A variable from the MIDUS II variable list were selected into our present research model. The list of variables of research in relation to the research problem and their psychometric validity.
- All variable names, the codes for the variables, the names of the respective variables and the references of the sources of the source data are displayed on the following table (Table 1).

Variable Name	Code	Source
Age	AGE	MIDUS II
Gender	SEX	MIDUS II
Marital Status	MARITAL	MIDUS II
Income	INCOME	MIDUS II
Education	EDUCATION	MIDUS II
Health	HEALTH	MIDUS II
Stress	STRESS	MIDUS II
Life Satisfaction	LIFE_SAT	MIDUS II
Optimism	OPTIMISM	MIDUS II
Resilience	RESILIENCE	MIDUS II
Control	CONTROL	MIDUS II
Coping	COPIING	MIDUS II
Well-being	WELLBEING	MIDUS II

Variable Name	Code	Source
Neuroticism	NEURO	MIDUS II
Extraversion	EXTRA	MIDUS II
Agreeableness	AGREE	MIDUS II
Conscientiousness	CONSC	MIDUS II
Openness	OPEN	MIDUS II
Self-esteem	SELFEST	MIDUS II
Life Satisfaction	LIFE_SAT	MIDUS II
Optimism	OPTIMISM	MIDUS II
Resilience	RESILIENCE	MIDUS II
Control	CONTROL	MIDUS II
Coping	COPIING	MIDUS II
Well-being	WELLBEING	MIDUS II



Design of study

Thus, the present study is designed to analyze the dimensional structure of the personality including the five basic dimensions of personality (the Big Five) and also the additional psychological variables related to the wider spectrum of personality (dimensions of well-being, coping, control and others).

Variables in the research model

- The data for the analyses were taken from the representative sample of the adult Americans (MIDUS II).
- The data being analyzed in this study were collected from the MIDUS II (Midlife in the United States II) survey, conducted in 2004-2006 (Ryff & Davidson, 2011; Ryff et al., 2007).
- The survey was performed on a great US national representative sample and the analyzed data were obtained from 4963 participants from both sexes (3316 males and 2647 females) in the age range from 28 to 84 years ($M = 55.43$, $SD = 12.45$).
- The MIDUS II data are available for free research purposes and can be publicly accessed via WEB site of ICPSR (Interuniversity Consortium for Political and Social Research) (ICPSR Web Site, 2011).
- 32 variables from the MIDUS II variable list were selected into our present research model; they were selected on the basis of their relevance in relation to the research problem and their psychometric viability.
- All variable names, the codes for the variables, the names of the respective scales, the MIDUS II document pages and the references of the source data are displayed on the following table (Table 1)

Table 1

Variable names, codes, the names of the respective scales, document pages and references of the source data

Variable	Code	Name of the scale in MIDUS II	Pages in Ryff et al., 2007*	Source references
Life Satisfaction	b1ssatis	Life Satisfaction Scale	10-11	<u>Prenda & Lachman, 2001</u>
Negative Affect	b1snegpa	PANAS Negative adjectives	16-20	<u>Mroczek & Kolarz, 1998</u>
Positive Affect	b1spospa	PANAS Positive adjectives	16-20	
Self-Esteem	b1sestece	Self-Esteem	37-38	<u>Rosenberg, 1965</u>
Neuroticism	b1sneuro	Neuroticism	41-45	<u>Rossi, 2001</u>
Extraversion	b1sextra	Extraversion	41-45	
Agreeableness	b1sagree	Agreeableness	41-45	
Openness to Experience	b1sopen	Openness to Experience	41-45	
Conscientiousness	b1scons2	Conscientiousness	41-45	
Autonomy	b1spwba2	Autonomy	28-32	<u>Ryff, 1989; Ryff & Keyes, 1995</u>
Environmental Mastery	b1spwbe2	Environmental Mastery	28-32	
Personal Growth	b1spwbg2	Personal Growth	28-32	
Positive Relations with Others	b1spwbr2	Positive Relations with Others	28-32	
Purpose in Life	b1spwbu2	Purpose in Life	28-32	
Self-Acceptance	b1spwbs2	Self-Acceptance	28-32	
Agency	b1sagenc	Agency	41-45	<u>Rossi, 2001</u>
Perceived Control	b1sctrl	Perceived Control	33-36	<u>Lachman & Weaver, 1998</u>

Interdependence	b1sinter	Interdependence	39-40	<u>Singelis, 1994</u>
Independence	b1sindep	Independence	39-40	
Well-being	b1smpqwb	Well-being MPQ	46-51	<u>Tellegen, 1985</u>
Social Potency	b1smpqsc	Social Potency MPQ	46-51	
Aggression	b1smpqag	Aggression MPQ	46-51	
Constraint Control	b1smpqcn	Control MPQ	46-51	
Traditionalism	b1smpqtr	Traditionalism MPQ	46-51	
Harm Avoidance	b1smpqha	Harm Avoidance MPQ	46-51	
Personality in Intellectual Aging	b1sintag	Personality in Intellectual Aging	21-22	<u>Lachman, 1986; Lachman et al., 1982</u>
Aging		Contexts Scale		
<u>Generativity</u>	b1sgener	<u>Loyola Generativity Scale</u>	80-81	<u>McAdams & de St. Aubin, 1992</u>
Problem Focused Coping	b1sprcop	Problem Focused Coping	64-69	<u>Carver, Scheier & Weintraub, 1989</u>
Emotion Focused Coping	b1semcop	Emotion Focused Coping	64-69	
Optimism	b1sorien	Optimism Overall	52-53	<u>Scheier & Carver, 1985</u>
Spirituality	b1sspiri	Spirituality	105-110	<u>Garfield, Ryff & Singer, 2001</u>
Mindfulness	b1smndfu	Mindfulness	105-110	<u>Langer & Moldoveanu, 2000</u>

* Main documentation source for all scales included in MIDUS II. It represents a basic reference for the MIDUS-II data sets and provides essential information concerning scale construction and treatment of the scales. Each scale is described in terms of scale construction, coding, missing data treatment, psychometric characteristics (especially reliability) and source articles.

Procedures of data analysis

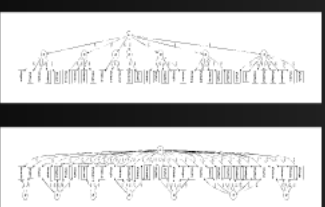
- Hierarchical and bifactor models were tested and compared using different multivariate techniques including Schmid Leiman Transformation procedure , Multiple Factor Analysis (MFA) and different SEM (structural equation modeling) procedures.
- Here, we will focus only on the results of confirmatory factor analyses for 32 variables in the model.
- The analyses were performed in order to compare different possible structural solutions for the variables, yet, especially for two solutions, the hierarchical and the bifactor one.

Results

- The existence of higher-order dimensions of personality was confirmed in a confirmatory factor analysis of the 32 basic variables of the circumplex scales of the GDS-32, forming the structure of the non-cognitive domain of personality.
- the 32 basic variables
 - the primary factors possibly varying in the number, and
 - in the dimensional structure of the non-cognitive personality sphere, the optimal factor (Comprehensive factor of personality or CFP) occupies the apex, the top position in the structural hierarchy. Yet, the question is, how it is related to the other dimensions
- exploring clearly five different models of possible dimensional structures were examined by confirmatory SEM analyses. In these models, the number of primary factors has been varied from 2 to 7. The structural solutions with 7 primary factors yielded best fit indices and therefore only these models will be further considered here. In summary, the best fit indices of the examined models are as follows:
 - 1. 9-factor model (32 variables with one general factor)
 - 2. uncorrelated primary factors model (32 variables with 7 uncorrelated primary factors)
 - 3. correlated primary factors model (32 variables with 7 correlated primary factors)
 - 4. bifactor model (32 variables with one general factor and 7 primary factors)
 - 5. bifactor model (32 variables separately loaded on 6-factor and 7 primary factors)
- Also, the fit indices demonstrating the suitability of all structural models, hierarchical and bifactor, were calculated and compared.

Table 2 provides fit indices for all five tested unmodified models. Although less parsimonious, the 9-factor model (32 variables with one general factor and 7 primary factors) yielded the best fit indices (including the superior fit index) of the hierarchical model; comparative chi-square between both models is 3335.6, $p < 0.001$. According to the one-tailed sign test (Kline, 2011), the bifactor (RMSEA=0.048, $\chi^2=251.996$, $df=251$, $p=0.003$, $TLI=0.97$, $CFI=0.976$),

Model	df	χ^2	RMSEA	CFI	TLI	CFI
9-factor model	251	3335.6	0.048	0.976	0.976	0.976
7-factor model	258	6671.2	0.082	0.917	0.917	0.917
5-factor model	266	10006.8	0.116	0.859	0.859	0.859
3-factor model	274	13342.4	0.150	0.801	0.801	0.801
2-factor model	281	16678.0	0.184	0.743	0.743	0.743



- The existence of higher-order dimensions of personality was confirmed in all confirmatory analyses. Three levels of generality were taken into account in regard of the dimensions forming the structure of the non-cognitive domain of personality:
 - the 32 basic variables
 - the primary factors possibly varying in the number, and
 - the general factor
- In the dimensional structure of the non-cognitive personality sphere, the general factor (Comprehensive factor of personality or CFP) occupies the apex, the top position in the structural hierarchy. Yet, the question is, how it is related to the other dimensions occupying lower levels of this hierarchy.
- In order to clarify this issue, different models of possible dimensional structuration were examined by confirmatory SEM analyses. In these models, the number of primary factors has been varied from 2 to 7. The structural solutions with 7 primary factors yielded best fit indices and therefore only these models will be further considered here. In summary, the following five structural models have been analyzed and compared:
 - 1. g-factor model (32 variables with one general factor)
 - 2. uncorrelated primary factors model (32 variables with 7 uncorrelated primary factors)
 - 3. correlated primary factors model (32 variables with 7 correlated primary factors)
 - 4. hierarchical model (32 variables with 7 primaries and g-factor in hierarchical order)
 - 5. bifactor model (32 variables separately loaded on g-factor and 7 primaries)
- Also, the fit indices demonstrating the suitability of all structural models, hierarchical and bifactor, were calculated and compared.

Table 2 provides fit indices for all five tested unmodified models. Although less parsimonious, the bifactor model most right is significantly better than other models (including the second-best model, the hierarchical model: comparative chi square between both models is 3255.6, $p < 0.001$). According to the omegaSem algorithm (Revelle, 2011), the bifactor model obtained even better characteristics (RMSEA=0.048; srmr=0.003; TLI=0.90; BIC=376.76).

Table 2
Fit indices for different confirmatory models

Model	Variables	Chi square (df)	p	SRMR	RMSEA	BIC	TLI (NNFI)
g	32	18196 (464)	0.000	0.085	0.101	14381	0.663
Uncorrelated primaries	32	24405 (464)	0.000	0.256	0.118	20590	0.545
Correlated primaries	32	12892 (444)	0.000	0.083	0.087	9241.6	0.753
Hierarchical	32	14285 (457)	0.000	0.083	0.090	10527	0.733
Bifactor	32	11029 (432)	0.000	0.068	0.081	7477.2	0.784
omegaSem	32	2785.89 (293)	0.000	0.003	0.048	376.76	0.896

Discussion and conclusions

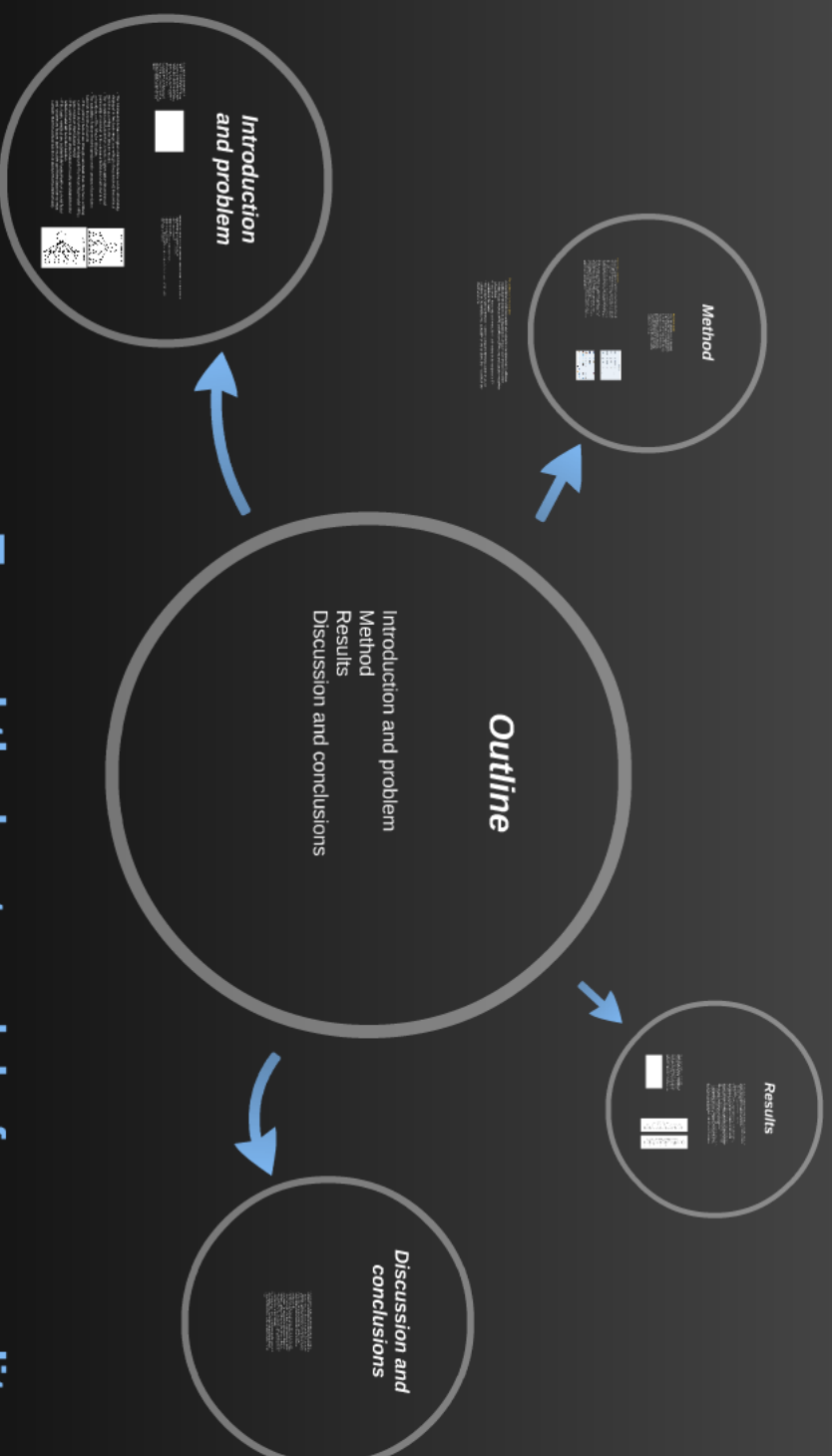
• According to the analyses, the first extracted factor loading 32 variables in the model could be very reasonably interpreted as a general dimension of a series of personality domains that include the GPF as well. This factor accounted for 32 percent of the variance and its strength was also confirmed by the relatively high value of the McDonald's R-squared Omega.

• Nevertheless, the primary factors correlate substantially and it can be reasonably assumed that the real relationships between the variable levels in most fitting structural models (that means something in between of bifactor and hierarchical solution). We can conclude therefore that the confirmatory analyses confirmed the importance of both general factor and primary factors in the model.

• In designing which of best fit structural models (the hierarchical or the bifactor) fitted the data most appropriately, we should choose the bifactor model as the best structural solution for our data.



- According to the analyses, the first extracted factor loading 32 variables in the model could be very reasonably interpreted as a comprehensive (general) factor of personality (CFP) subsuming the general dimensions in a variety of personality domains that include the GFP as well. This factor accounted for 32 percent of the variance and its strength was also confirmed by the relatively high value of the McDonalds Hierarchical Omega coefficient (0.73).
- Nevertheless, the primary factors correlate substantially and it can be reasonably assumed that the real relationships between the variable levels in most fitting structural models (that means general factor, 7 primary factors and 32 source variables) are somehow in between of bifactor and hierarchical solution. We can conclude therefore that the confirmatory analyses confirmed the importance of both general factor and primary factors in the non-cognitive structure of personality.
- In deciding, which of both most suitable models (the hierarchical or the bifactor) fitted the data most appropriately, we should choose the bifactor model as the best structural solution for our data.



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So, that was it!

Thank you very much!

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