

Doctoral (PhD) Dissertation

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Person-oriented approach in personality- and in health psychology

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*Introduction of a new person-oriented method (model based clustering) in researches with  
Alternative Five Factor Model of Personality* Mentor: Prof. Dr. András Vargha, professor

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## 1. BASIC AIMS OF THIS DISSERTATION

In my dissertation I had two main aims: 1: To introduce the Hungarian validation work of a new measurement tool for Alternative Five Factor Model: the Zuckerman-Kuhlman-Aluja Personality Questionnaire (ZKA-PQ); 2: To demonstrate that a new person-oriented method, namely the model based clustering, can provide a modern and useful typological model framework in studies with ZKA-PQ, including cross-cultural ones.

**In the first study**, I examined the *cross-cultural validity* and reliability of the *Zuckerman-Kuhlman-Aluja Personality Questionnaire (ZKA-PQ)* in Catalan and Hungarian speaking populations. Catalan data was provided by Prof. Anton Aluja from University of Lleida. After examining how adequate ZKA-PQ is to unfold basic personality factors, I demonstrated how the model based clustering could be used in the test validation.

**In the second study**, the first aim was to provide a further *cross-cultural(Chinese-Hungarian) validation of ZKA-PQ* by analyzing reliability measures and congruences in factorial structure in student samples. Yet, the main aim in this study was to compare the Hungarian and Chinese *mean profiles* and the *typical personality profiles* and link them to *differences in basic values*.

**In the third study**, I demonstrated how the *probabilistic nature of model based clustering* forms an advantage in *prediction of negative outcomes* (such as alcohol use or smoking) of sensation seeking and how it can provide an *integration of typological and dimensional approaches*.

**In the fourth study**, my aim was to demonstrate the significance of unfolding intraindividual patterns in the examination of relation between religiosity, sensation seeking and subjective life satisfaction. This study had *methodological aims* as well: (1) *Comparison of different clustering methods*, (2) Demonstration of different *visualization* possibilities of clustering, (3) Determination problems of *number of clusters*.

## 2. INTRODUCTION

### 2.1. Basic Universal Personality Dimensions: The Five-Factor model of personality

The most widely used and accepted personality model of Modern Western Psychology is the Five-Factor Model (FFM) of personality (see McCrae & Costa, 1997 for a review). The FFM is based on variable-oriented, correlation-based factor analyses, thus it is a linear model supposing no interactions among the factors.

The generalizability across different languages and cultures have long been debated, as universality is considered one basic evidence for regarding factors as the basic personality dimensions (McCrae, Costa, & Yik, 1996). McCrae et al. (2010) and Schmitt, Allik, McCrae & Benet-Martínez (2007) have noted that there is little convergence between the different Big Five measures in the cross-cultural comparisons.

### 2.2. The Alternative Five-Factor psychobiological model (AFFM) of personality

Zuckerman, Kuhlman, Joireman, Teta, and Kraft (1993) have suggested to follow a theoretical psychobiological framework in test development, in order to have a more stable and less culture-specific trait structure than NEO-PI-R has. Zuckerman et al. (1993) aimed to build such a model that holds for all individuals, and to gain more and more knowledge on the biological background of psychological functioning, including the aim to understand how evolution and genetics determine personality.

The AFFM incorporated Neuroticism-Anxiety (N-Anx), Activity (Act), Sociability (Sy), Impulsive Sensation Seeking (ImpSS) and Aggression-Hostility (Agg-Host).

The AFFM model is an extension of a biological Zuckerman's Sensation Seeking (SS) personality theory and in fact, most psychobiological research has focused on the sensation seeking factor of AFFM (for a summary see Zuckerman, 2005). Sensation seeking has been

considered a personality trait that is characterized by the tendency to seek out varied and novel sensations and experiences (Zuckerman, 1994). Based on correlational studies, Zuckerman stated that there is a 'marriage of impulsivity and sensation seeking made in biology', and he proposed impulsive unsocialized sensation seeking (ImpUSS) to be a basic personality factor, which is a widely studied predictor of a wide array of problem behaviors (Zuckerman, 1994). The role of the impulsivity cluster of traits in dysfunctional behavior has been long and widely studied (Dickman, 1990; Eysenck & Eysenck, 1970; Kane, Loxton, Staiger & Dawe, 2004; Nigg et al., 2004; Hicks, Markon, Christopher, Kreuger & Newman, 2004; Colom, Escorial, Shih & Privado, 2007). It is also consistently associated with alcohol and substance use (Mann, Chassin & Sher, 1987).

Although discrepancies between socialized and impulsive sensation seeking have been mentioned by researchers (Glicksohn and Abulafia, 1998; Zuckerman, 1994, Narbone, 2009), not much attention has been given to this, and rather a general sensation seeking factor has been examined.

### **2.3. New measurement tool for the Alternative Five-Factor psychobiological model (AFFM) of personality**

The Zuckerman-Kuhlman-Aluja Personality Questionnaire (ZKA-PQ) has recently been developed as a hierarchical factor-facet version of ZKPQ (Aluja, Kuhlman & Zuckerman, 2010). The work resulted in a 200-item and 20-facet (4 facets per each factor) version of AFFM.

The fact that the ZKA-PQ has Likert-type, 4-point response items can also improve psychometric properties (see Muñiz, García-Cueto, & Lozano, 2005) and can increase effect sizes (Johnson, Krueger, Bouchard, & McGue, 2002). There have also been changes in the names of original ZKPQ factors: Aggression, Activity, Extraversion, Neuroticism, Impulsive-Unsocialized Sensation Seeking (Aluja et al., 2010).

With regards to sensation seeking, they omitted the items with content involving specific attitudes, activities or interests. Impulsivity items were included into boredom susceptibility and the subscale was named as Boredom susceptibility/ impulsivity.

### **2.4. New measurement tool for the Alternative Five-Factor psychobiological model (AFFM) of personality**

Similarly to basic universal personality dimensions, there have been attempts to give a framework of basic values. In order to link cultural values to basic personality dimensions, it is necessary to have a cross-culturally valid instrument of the basic universal values.

Schwartz (1994) specified 10 motivationally distinct types of values which could be meaningfully interpreted in most societies. Schwartz mentioned spirituality as an eleventh value category that represents the goal of finding meaning in life (e.g., meaning in life, a spiritual life, inner harmony) but which turned out not to be uniformly interpreted across cultures. Therefore, only the 10-value-category system has become widespread in cross-cultural comparisons of values.

### **2.5. Basic personality dimensions and basic values**

Roccas, Sagiv, Schwartz, Knafo (2002) stated that values and personality traits are empirically related, although they are conceptually distinct. Dollinger, Leong, and Ulicni (1996) stated that personality traits and values both can be considered as cross-situationally and cross-temporally consistent individual differences, so it is a meaningful question to analyze their relations.

Most researches examining relations between values and personality have been correlational ones. Roccas et al., for example, (2002) found that Openness was associated with Self-direction, Universalism and Stimulation values; Extraversion with Achievement, Stimulation and Hedonism values; Agreeableness with Benevolence, Tradition and

Conformity values; and Conscientiousness with Achievement and Conformity values. However, these correlations were only small to moderate.

There have not been many studies examining relationships between values and AFFM personality model. However, one interesting study was completed by Próchniak (2011) who found that skydivers scored higher on Impulsive Sensation Seeking, Hedonism, Stimulation, and Self-direction values, while they scored lower on Tradition, Universalism, and Benevolence values in comparison to the control group.

### **2.6. Basic values and subjective well-being (SWB)**

Effects of values on mental health have long been studied by Western scientists who concluded that there are „healthy” and „unhealthy” values (Sagiv & Schwartz, 2000). There is high agreement on self-direction (e.g. autonomy, freedom), benevolence (e.g. responsibility, inter-personal and family relationships) and universalism (e.g. self-awareness, personal growth) and some agreement on achievement and stimulation to be regarded as „healthy” values (Jensen and Bergin, 1988, In: Sagiv & Schwartz, 2000; Strupp, 1980, In: Sagiv & Schwartz, 2000). In contrast, conformity, tradition, security and power values are often considered „unhealthy” (Sagiv & Schwartz, 2000). However, Sagiv & Schwartz (2000) note that this categorization of values is limited and is greatly influenced by Western culture.

### **2.7. Spirituality and subjective well-being (SWB)**

An early version of the value theory (Schwartz, 1992) also included spirituality as the 11th basic value. It was defined by the goal of reaching meaning, coherence, and inner harmony through transcending everyday reality. Later, Schwartz (1994) concluded that spirituality is not a value that has a consistent meaning across cultures and therefore it has been excluded from the universals.

Yet, a recent meta-analysis (Saroglou, Delpierre & Dernelle, 2004) of 21 studies from 15 countries found that religious people can be characterized by a typical pattern of Schwartz's remaining ten values: high importance to tradition, conformity, benevolence and low importance to self-direction, hedonism, stimulation.

Although giving high importance to tradition and conformity has some negative correlates (as mentioned above), religiosity, spirituality and mindfulness are all positively related to psychological well-being by many studies (Ying, 2009).

Religiosity includes not only the belief in of God or in higher power but also includes organized doctrines, values, practices, traditions and rituals (Hodge & McGrew, 2006, In: Ying, 2009). Spirituality has been defined as a belief in and relationship with a higher power, such as God (May, 1982) without defining religious affiliation. Empirical research found religiosity to be significantly associated with positive health and well-being (Koenig, 1997; Pargament, 1997; Steger & Frazier, 2005). Spirituality helps effective coping during stressful situations by fostering meaning making (Fehring, Brennan, & Keller, 1987; Mascaro, Rosen, & Morey, 2004).

Some recent research has tried to identify moderator variables that can be related to both religiosity and mental health. Porta's research (2006) showed that mindfulness had a moderating effect on the relation of religiosity to psychological well-being. Tagay, Erim, Brahler & Senf (2006) aimed to study the influence of religiosity and sense of coherence (Antonovsky, 1993) on mental health and general life satisfaction. Based on their results, sense of coherence but not religiosity may be a protective factor for mental health and well-being.

Gumilar (2011) found that religiosity is inversely related to sensation seeking. He therefore suggests that sensation seeking is not only determined by biopsychological factors, but is also affected by social elements such as religiosity.

## **2.8. Indigenous psychology**

The factor-analytic approach in cross-cultural psychology aims to assess the psychic unity of mankind by unfolding the culture-free basic dimensions of personality, whereas many indigenous psychologists emphasize that studying human behavior and psychological process should be based on indigenous realities (Enriquez, 1993, In: Hwang, 2009) such as native values, concepts, belief system, problem methods, and other resources (Adair, Puhon, Vohra, 1993, In: Hwang, 1999; Ho, 1998, In: Hwang, 1999).

Hwang (1999) therefore states that scientific psychology can and should learn from the teachings of Confucianism, Taoism, Buddhism. In this approach, not the determinants but the ways to cultivate personality are emphasized, and Confucianist self-cultivation has many teachings with regards to one's virtues, to one's personal ethical excellence and perfection by own efforts. Confucius emphasizes possible change in becoming a better and happier person with higher goals, benevolence and higher moral responsibility.

Having few desires and purifying spirit are also emphasized by Taoism, which was first proposed by Lao-tzu (Lao-Zi, 570-490 BC/1993). All these teachings about virtues are characteristics of not only Asian philosophies. Christianity, which is the leading religion in Western countries, places huge emphasis on similar human virtues, as Confucius, Buddha or Lao-Tze did (Dahlsgaard, Peterson, & Seligman, 2005). Dahlsgaard et al. (2005) pointed that there are 'universal' virtues/values that appear in all religious traditions.

Peng, Spencer-Rodgers & Nian (2006) argue that because of Taoist traditions, Chinese reasoning and thinking can be regarded as more contextual, flexible, holistic, and dialectical as compared with Western thinking and reasoning.

Indigenous concept of personality can be linked to dialectical thinking – influenced by Chinese philosophical traditions such as Confucianism and Taoism –, which is based on three basic principles: the principle of change (Bian Yi Lu), the principle of contradiction (Ma Dun Lu), and the principle of holism (Zheng He Lu) (Peng & Nisbett, 1999).

## **2.9. Limitations of factor-analytic approach proposed by person-oriented researchers**

The analytic approach focuses on discrete variables without a holistic approach. The aim of factor-analytic personality models is to unfold distinct underlying factors of human personality. Then, it is assumed that these factors are considered as separate traits, which can be studied separately. Further, even when examining effects of more traits simultaneously with linear – usually regression – models, usually no interaction effects are tested.

Bergman, Magnusson & El-Khoury (2003) have also been emphasizing the need for non-linear analyses as well, stating that assumptions of the linear models are usually not met.

Further, a pre-assumption exists in factor-analytical models: constructs identified in between-person research can be treated also as within-person structures (McCrae, 2005; McCrae & Costa 1996, 1999). However, the importance of differentiating between interindividual and intraindividual levels of analyses has been emphasized by several researchers. Molenaar, Huizenga & Nesselroade (2002) state that a factor structure that describes between-person variation in the population may fail to describe any individual in that population.

## **2.10. The holistic-interactionist person-oriented approach**

Interactionism can be described as an approach, in which models are integrated, and there is reciprocity between its elements (El-Khoury, 2001). A person in such a model is in reciprocal interactions with the environment, thus the person influences the environment but also receives influences from the environment. Holistic interactionism refers to interactions not only between person and environment but also within the individuals: among mental, biological and behavioral factors. Magnusson & Allen (1983) describe this perspective as the



person-oriented approach, which : „ ... takes a holistic and dynamic view; the person is conceptualized as an integrated totality rather than as a summation of variables” (p. 372).

Based on this, Bergman et al. (2003) proposed a holistic model consisting of mental, behavioral, biological aspects of the individual together with the social, cultural and physical aspects of environment. Holistic approach assumes that the operating factors within a system do not function and develop independently of each other, and their roles are determined by the system as a whole (Bergman et al., 2003). The functioning of the operating factors can be described in terms of functional configurations, which are called patterns by Bergman et al. (2003).

They emphasize that research should be focused on typical configurations of values, as there are only a small number of states (emerging types) that are optimal and lead to a stable behavior of the system. The information Gestalt of typical value profiles, patterns of individual characteristics – not the variables – is then at the focus (Bergman & El-Khoury, 1999).

#### **2.11. The person-oriented approach applied on factor analytic personality data**

Asendorpf, Borkenau, Ostendorf, and Van Aken (2001) showed that the 3 personality types can also be identified by replicated cluster analysis of Big Five ratings on 12-year old children. Resilients scored above average on Agreeableness, Extraversion, Conscientiousness, and Openness and below average on Neuroticism. Overcontrollers scored higher than average on Neuroticism but below average on Extraversion. Undercontrollers scored lower than average on Agreeableness and Conscientiousness.

The emerging three types (resilient, under- and overcontrollers) have received much attention in many further researches and were confirmed by Q-factor and cluster analyses (Robins, John, Caspi, Moffitt, and Stouthamer-Loeber, 1996; Schnabel, Asendorpf, & Ostendorf, 2002; Boehm, Asendorpf, & Avia, 2002; Barbaranelli, 2002).

#### **2.12. Classical methods applied in person-oriented approach**

Bergman & Vargha (2012) have pointed out that there is often a mismatch between the scientific problem and the methods used to assess these problems.

Bergman et al. (2003) suggested cluster analyses as a methodological tool for person-oriented approach, which enables the analysis of patterns of data for operating factors (Bergman et al., 2003). Identifying typical patterns by cluster analyses can provide an intraindividual perspective of value configurations of operating factors (Bergman et al., 2003).

However, classical clustering algorithms have several weaknesses:

(1) Everybody is categorized into a type, and a common misinterpretation is attributing the characteristics of the cluster centers to all members of the cluster.

(2) They create clusters with rigid boundaries, which result only in categorical membership variable without probabilistic values of memberships. Then, the cluster mean is applied to all members of the cluster.

(3) Choosing the cluster number is left to the researchers' subjective decision.

(4) We cannot be sure that types revealed are natural emerging types or artificially created categories.

(5) Classical algorithms like k-means and Ward's tend to result in spherical clusters with similar cluster sizes.

#### **2.13. Proposed new method: Model-based cluster-analysis**

Model-based clustering assumes that many members of a particular cluster lie near the cluster center, with progressively fewer individuals farther from the center. The core idea here is searching for dense core points in the multidimensional space that can be regarded as cluster centers. In this case cluster means will more adequately represent the mean value of the corresponding subpopulation density than in case of classical algorithm methods.

Individuals nearer to the cluster centers will be characterized by increased density values. Thus, density scores provide an index of individuals' typicality of a certain cluster.

In the last decade, there has been a renewed interest in latent class (LC) analysis to perform cluster analysis (Magidson & Vermunt, 2002), and the model-based clustering method proposed by Fraley & Raftery (2002) can be considered to belong to this type of analysis.

Model-based approach formally models the data as coming from several subpopulations, via a finite mixture model (Fraley & Raftery, 2007). It is assumed that a mixture of underlying probability distributions generates the data. Each component is modeled by the normal or Gaussian distribution.

This approach allows for precise inference that is impossible with the algorithmic methods: a probability value can quantify the uncertainty. In this way, the clustering process allows for overlapping clusters, producing a probabilistic clustering, which means that individual's posterior class-membership probabilities are computed by maximum likelihood (ML) methods from the estimated model parameters and his observed scores. Individuals can then be assigned to the class for which they have the highest probability, but an uncertainty score about one's membership can also be obtained (Magidson & Vermunt, 2002).

Geometric features (shape, volume, orientation) of the clusters are determined by the covariances of the underlying distributions. A further advantage for Mclust package is that it allows different volumes for the clusters in case the distribution patterns indicate differences in cluster sizes. Model-based clustering allows overlap between clusters. The underlying distributions might overlap each other, yet the peaks of the distributions can indicate different emerging patterns. Another strength of the model-based clustering approach was highlighted by Vermunt & Magidson (2002), namely that the results will be the same irrespective of whether the variables are standardized/ normalized or not. This is important advantage based on the possible problems that might be caused by standardization procedures. The standardizations are almost always applied to the variables separately, and in this way, the variance differences between different variables are eliminated (Bergman & Vargha, 2012).

### **3. Study 1.: Validation of Hungarian and Catalan versions of Zuckerman-Kuhlman-Aluja Personality Questionnaire**

#### **3.1. Aims of study**

The overarching goal of the study was to examine the cross-cultural validity and reliability of the Zuckerman-Kuhlman-Aluja Personality Questionnaire (ZKA-PQ) in Catalan and Hungarian speaking populations. Together with Prof. Aluja, we wanted to compare factorial structure of ZKA-PQ. Additionally, I applied model-based clustering on the data to see what kind of typical patterns arise.

#### **3.2. Methods**

##### **3.2.1. Participants**

The Catalan version of the ZKA-PQ was completed by 1,564 subjects, with 466 men (mean age: 35.39; SD: 12.16) and 1,098 women (mean age: 31.33; SD: 11.27) whereas the Hungarian version was completed by 1,647 subjects, with 1,169 men (mean age: 41.14; SD: 13.24) and 465 women (mean age: 38.93; SD: 12.32).

##### **3.2.2. Instrument**

The original ZKA-PQ was developed and validated simultaneously in English and Spanish (Castilian) by Aluja et al., (2010, see Appendix 20). This instrument contains five factors with four facets per factor: a) AG: Aggressiveness (AG1: Physical Aggression, AG2: Verbal Aggression, AG3: Anger, and AG4: Hostility); b) AC: Activity (AC1: Work Compulsion, AC2: General Activity, AC3: Restlessness, and AC4: Work Energy); c) EX: Extraversion (EX1: Positive Emotions, EX2: Social Warmth, EX3: Exhibitionism, and EX4: Sociability);

d) NE: Neuroticism (NE1: Anxiety, NE2: Depression, NE3: Dependency, and NE4: Low Self-Esteem); and e) SS: Sensation Seeking (SS1: Thrill and Adventure Seeking, SS2: Experience Seeking, SS3: Disinhibition, and SS4: Boredom Susceptibility). Each facet is composed by ten items, making a 200 item instrument with a 4-point Likert-type response format.

The ZKA-PQ was translated from Spanish into Catalan language by Anton Aluja. The ZKA-PQ Hungarian version was translated from English to Hungarian by the first author of this study. The Hungarian version was translated to English by a bilingual professional translator and revised by Marvin Zuckerman (back translation).

### *3.2.3. Procedure*

Both Catalan and Hungarian respondents of ZKA-PQ completed an on-line anonymous questionnaire. Participation at the Catalan version was asked through several Catalan universities mailing lists. Hungarian data collection was completed in 19 different companies in 6 different cities of Hungary

### *3.2.4. Data analyses*

Mean ZKA-PQ scale differences between countries were analyzed by Cohens d. The internal consistency of the ZKA-PQ was assessed by Cronbach's alpha. The factor structure of the ZKA-PQ was studied through Principal Axis analysis (PA) and with the Varimax rotation method. Equivalence between ZKA-PQ factors and mean total were analyzed by Pearson's correlation. Confirmatory factor analyses were also run. Finally, model-based clustering (Fraley & Raftery, 2002) was applied to unfold the typical patterns of values.

The software used included the SPSS, AMOS, R and ALPHATST.

### *3.2.5. Hypotheses*

The development of Zuckerman-Kuhlman-Aluja Personality Questionnaire (Aluja et al., 2010) has followed a psychobiological theoretical framework but has also incorporated a number of factor analytic studies. Based on previous works on cross cultural validation done by Aluja et al. (2010) and Rossier et al. (2012), we assumed ZKA-PQ to be a valid assessment tool for basic, culture-free personality dimensions. Thus, I hypothesized:

- (1) ZKA-PQ will have **good reliability** scores on Hungarian sample too.
- (2) ZKA-PQ will show **similar factorial structure** on Hungarian and on Catalan samples as it did on American, Spanish and French-speaking samples.
- (3) **Mean differences** on ZKA-PQ profiles between Catalans and Hungarians will reflect differences in national characters. Catalans living in Spain are supposed to have a less individualistic and more feminine culture (Hofstede & Hofstede, 2005) with level-headedness and hard-workingness (Curcó, 2005, Keating, 1999). Therefore, we can presume that Catalans will have higher extraversion, lower aggression (based on characteristics related to 'simpatico', Curcó, 2005) and higher activity and lower sensation seeking (based on level-headedness, hard-workingness and following social norms and Christian values).

High uncertainty avoidance and stress factors of work may result in higher scores in neuroticism factor. although high femininity goes together with lower neuroticism scores (McCrae, 2002).

- (4) Cluster analyses will reveal patterns including **overcontrolled, undercontrolled and resilient** types (based on previous cluster analytic work on basic personality factors done by Asendorpf, 2002, Robins, John, Caspi, Moffitt, and Stouthamer-Loeber, 1996, Schnabel, Asendorpf, and Ostendorf, 2002, Boehm, Asendorpf, and Avia, 2002, Barbaranelli, 2002, De Fruyt, Mervielde & Van Leeuwen, 2002, Van Leeuwen, De Fruyt & Mervielde, 2004, Rammstedt, Riemann, Angleitner, & Borkenau, 2004, Caspi and Silva, 1995, Asendorpf, Borkenau, Ostendorf, and Van Aken, 2001), yet I assume that not everybody will fit well into these categories and rather a probabilistic

clustering model should be built.

### 3.3. Results

For Catalan version the Kaiser-Meyer-Olkin measures of sample adequacy were above .83. The total accounted variance was 69.13% (F-I: 25.16%; F-II: 17.68%, F-III: 10.76%; F-IV: 8.20%; and F-V: 7.34% before rotation). There were two secondary loadings above .40 in the Neuroticism dimension: Hostility (AG4; .47) and Positive Emotions (EX1; -.50).

The same factorial procedure was conducted with the Hungarian ZKA-PQ version. The Kaiser-Meyer-Olkin measures of sample adequacy were above .88. The total accounted variance was 69.47% (F-I: 9.63%; F-II: 5.91%, F-III: 17.09%; F-IV: 30.59%; F-V: 6.52%). Similarly with the ZKA-PQ Catalan structure two secondary loadings were above .53 in the Neuroticism dimension: Hostility (AG4: .53) and Positive Emotions (EX1: -.46). The smallest average squared partial correlation was .023, supporting the extraction of 5 factors.

Correlations between factors and dimension scores were superior to .90 in both ZKA-PQ cross-cultural versions and both among males and females. Correlations between dimensions scores by sex and country showed that NE-EX, AG-NE and AG-SS yielded significant correlations.

The Confirmatory Factor Analyses (CFA) of the 20 ZKA-PQ facets were based on five latent variables with the Maximum Likelihood estimation method. Different models of growing complexity were designed and assessed by simple structure, and incorporating secondary loadings for all subjects and age groups (McCrae, Zonderman, Costa, Bond & Paunonen, 1996). In CFAs all the fit indices were unsatisfactory. Only the modest loading models that included covariance – based on the three largest modification indices (MI's) – between errors of three pairs of facets arrived to get minimum satisfactory indexes.

I applied a model-based clustering on the twenty facets of ZKA-PQ. Although, according to the largest BIC value, two clusters were identified, in case of five clusters, there were larger differences between the cluster means and the following clusters were identified: 1) Negative: Hostile, neurotic, introverted with low work energy; 2) Undercontrolled: Restless, verbally aggressive, extroverted sensation seeker with rather high self-esteem, 3) Calm: Non-aggressive, non-exhibitionist low sensation seeker, 4) Around average; 5) Resilient: Positive, kind, extroverted, non-neurotic with high work-energy.

### 3.4. Discussion

The factor analytic results indicated that the questionnaire had a clear structure of 5 factors in both cultures using different methods of factor extraction. Both factorial structures tended to be orthogonal (correlation between factor scores did not exceed .20). However, some dimensions showed significant correlation with each other, for example AG with SS, NE with AG and NE with EX, but most of the correlation coefficients were lower than .50. The lack of representativity limited to draw conclusions about national characters.

As the AFFM was an extension of sensation seeking theory, it is not surprising that groups of low and high sensation seekers could be identified with the clustering. High sensation seekers (undercontrolled type) scored higher than all other groups on three SS scales (TAS, ES, DIS), on verbal aggressiveness (AG2) and restlessness (AC3). They scored higher than three other groups (hostile-neurotic, non-sensation seeker, average groups) on extraversion subscales and on general activity. Low sensation seekers (calm type) scored lowest on SS subscales, but they had significantly lower aggressiveness (AG) and restlessness (AC3) than hostile-neurotic, undercontrolled sensation seeker and average groups.

These types can explain for the correlation between SS factor and AG factor. Although SS and AG arose as different factors, but high sensation seekers and low sensation seekers differed not only in sensation seeking but also in some aggressiveness facets.

Two other clusters ('resilient' and 'negative' ones) included individuals with either extremely low or extremely high scores on Neuroticism. 'Negative' cluster members scored

higher than all other groups on neuroticism and also on aggressiveness (particularly hostility) and scored lower on positive emotions (EX1), social warmth (EX2) and work energy (AC4). While resilient showed exactly the opposite pattern: they scored lower than all other groups on neuroticism and aggressiveness (particularly hostility) but scored higher on positive emotions (EX1), social warmth (EX2) and work energy (AC4).

These patterns can possibly account for the correlations between NE and AG and NE and EX factors. Analyses of these types can explain how AG4 (hostility) and EX1 (positive emotions) have high secondary loadings on neuroticism factor: extremely neurotic individuals are also hostile and lack positive emotions at high probability, while ones with extremely low neuroticism are mainly not hostile and have positive emotions dominantly.

The emerging types of sensation seeking ('calm' vs. 'undercontrolled') and the ones of neuroticism ('negative' and 'resilient') could be visually separated on the first two principal axis factors of the 20 facets. First higher-order factor could be labelled as negativity (including neuroticism along with hostility and lack of positive emotions, sociability, social warmth & work energy). The other factor had highest loadings on sensation seeking, aggressiveness facets and restlessness (AC3).

All this supports that the five factors are not totally independent. There are certain typical patterns, in which scores of facets from different factors show similar values. It is interesting that one activity facet (AC3, restlessness) goes together with sensation seeking facet scores in some patterns, whereas another activity facet (AC4, work energy) goes together with positive emotions (EX1) and lack of neuroticism (NE). This can account for the lower fit of AC factor in confirmatory factor models.

#### **4. Study 2.: A cross-cultural study examining relationship between basic personality, basic values and mood disorders in Chinese & Hungarian cultures**

##### **4.1. Aims of study**

The first aim of this study was to examine the cross-cultural reliability of the ZKA-PQ with samples from China and Hungary. Moreover, I aimed to examine the relations between personality and values. Additionally, I aimed to build a typological model-based on this new instrument by using a modern cluster analytic approach.

##### **4.2. Methods**

###### **4.2.1. Participants**

236 Chinese university students (mean age: 20.53, SD: 1.02) and 221 Hungarian University students (mean age: 20.86, SD: 2.03) participated in the research. All participants were under 26 years of age. 47% of the Chinese and 45.7% of Hungarian respondents were male.

###### **4.2.2. Instruments**

The ZKA-PQ (Aluja et al., 2010, same as in Study 1) and a short version (10-item version, downloaded from [www.worldvaluessurvey.com](http://www.worldvaluessurvey.com)), of Schwartz Value Scale developed by Schwartz (1992, 1994) were used in this study.

###### **4.2.3. Procedure**

Participants were recruited at a Chinese and a Hungarian university. Responses were obtained from students in the university communities.

###### **4.2.4. Data analyses**

Analyses were conducted similarly as in Study 1 examining Catalan-Hungarian comparisons. Correlations were also done between ZKA-PQ factor and facet scores and Schwartz values.

###### **4.2.5. Hypotheses**

The development of Zuckerman-Kuhlman-Aluja Personality Questionnaire (Aluja et al., 2010) has followed a psychobiological theoretical framework but has also incorporated a

number of factor analytic studies. Based on previous works on cross cultural validation done by Aluja et al. (2010) and Rossier et al. (2012), we have assumed ZKA-PQ to be a valid assessment tool for basic, culture-free personality dimensions. Thus, we hypothesized:

- (1) ZKA-PQ will have **good reliability** scores on Chinese and Hungarian sample too.
- (2) ZKA-PQ will show **similar factorial structure** on Chinese and Hungarian and as it did on American, Spanish, Catalan and French-speaking samples.
- (3) **Mean differences on ZKA-PQ** profiles between Chinese and Hungarians will reflect differences in national characters. Chinese are supposed to be more introverted (based on China's high scores on collectivism and long-term orientation, Hofstede & Hofstede, 2005 and previous cross-cultural researches, McCrae et al., 1996, Costa & McCrae, 1992, McCrae, 2002). Further, high power distance in China (Hofstede & Hofstede, 2005) is supposed to be related to high conscientiousness and low openness scores (McCrae, 2002). High collectivism and low masculinity scores are also related to low openness, (McCrae, 2002), and all these might occur in AFFM as low levels of unsocialized impulsive sensation seeking. This is also supported by the Chinese ideal personality incorporating Xinzhai (extreme quietness, emptiness and concentration of mind) and Zuowang (sitting and forgetting all about yourself and the world around you), (Yang & Cai, 2010).
- (4) **Mean differences on Schwartz's value scales** will reveal cultural differences: Hungary being a more individualistic, masculine culture (Hofstede & Hofstede, 2005) will show higher scores on self-enhancement (achievement, power) and openness to change (hedonism, stimulation and self-direction, Schwartz, 1994). Value for security is assumed to be lower among Chinese, as uncertainty is a normal feature of life in China and is accepted by Chinese (Hofstede & Hofstede, 2005). Confucian society has a high respect for tradition and conformity, and therefore we can expect Chinese to give higher scores for these values than Hungarians do. Self-transcendence (including benevolence and universalism) occurs both in Chinese religious traditions (Confucianism, Buddhism, Taoism) and in Christianity, which is the dominant religious tradition in Hungary, therefore no differences are presumed.
- (5) Scores of **'Healthy' values** – self-direction, benevolence, universalism (Sagiv & Schwartz, 2000) – will be related inversely to **Neuroticism**.
- (6) Cluster analyses will reveal patterns including **overcontrolled, undercontrolled and resilient** types (based on previous cluster analytic work on basic personality factors done by Asendorpf, 2002, Robins, John, Caspi, Moffitt, and Stouthamer-Loeber, 1996, Schnabel, Asendorpf, and Ostendorf, 2002, Boehm, Asendorpf, and Avia, 2002, Barbaranelli, 2002, De Fruyt, Mervielde & Van Leeuwen, 2002, Van Leeuwen, De Fruyt & Mervielde, 2004, Rammstedt, Riemann, Angleitner, & Borkenau, 2004, Caspi and Silva, 1995, Asendorpf, Borkenau, Ostendorf, and Van Aken, 2001), yet I assume that not everybody will fit well into these categories and we should rather build a probabilistic clustering model.

#### 4.3. Results

The Average Alpha reliability coefficient was .74 among Chinese and .82 among Hungarians for ZKA-PQ factors and facets. Verbal Aggression (AG2) and Anger [AG3] facets, however, had coefficients lower than .60 for Chinese respondents. On the other hand, alphas for Schwartz value scales showed low reliability (alphas between .24 and .58). As scales for value groups could not be reliably formed, I further did statistics on the separate values and not on value groups.

Hungarians scored significantly higher than Chinese on Sensation Seeking with a large effect size ( $d=-.8$ ) and on Extraversion with a medium effect size ( $d=-.6$ ). Facet level analyses revealed significant country differences of large effect size in work compulsion ( $d=.8$ ) with

higher scores among Chinese. Small to medium effect sizes were found for other ZKA-PQ facets: Hungarians scored higher than Chinese on AC3 Restlessness ( $d=-0.72$ ), SS1 Thrill and Adventure Seeking ( $d=-0.62$ ), EX4 Sociability ( $d=-0.61$ ), AG2 Verbal Aggression ( $d=-0.59$ ), EX3 Exhibitionism ( $d=-0.54$ ), SS4 BS/Impulsivity ( $d=-0.48$ ), EX1 Positive Emotions ( $d=-0.47$ ), EX2 Social Warmth ( $d=-0.44$ ), AC2 General Activity ( $d=-0.36$ ) and SS3 Disinhibition ( $d=-0.34$ ); whereas Chinese students scored higher in NE2 Depression ( $d=0.41$ ), NE3 Dependence ( $d=0.37$ ), AG3 Anger ( $d=0.29$ ), NE4 Low Self-esteem ( $d=0.19$ ) and AG1 Physical Aggression ( $d=0.17$ ). However, when I standardized ZKA-PQ facets on combined samples, mean T scores in both samples were between 45 and 55 in each facet.

Based on results with Schwartz value scale, Proper behavior ( $d=1$ ), Secure surroundings ( $d=0.72$ ), Having a good time ( $d=0.72$ ), Money ( $d=0.68$ ) and Environment ( $d=0.43$ ) were significantly more important to Chinese, whereas Adventure ( $d=-0.46$ ), Tradition ( $d=-0.21$ ) and Religion were more important to Hungarians. By Schwartz's proposed grouping of values, openness to change turned out to be more important to Hungarians ( $d=-.20$ ), whereas self-enhancement, conservation and self-transcendence all received higher value scores among Chinese ( $d=.42$ ;  $d=.66$ ;  $d=.36$ , respectively).

Both Chinese and Hungarian version indicated a five factor structure in accordance with eigenvalue  $>1$ , scree test and Velicer's MAP methods. In confirmatory factor analyses, the model including five factors and 20 facets had satisfactory fit indices only when allowing modest loadings. Further, models built separately for each of the five factors, resulted also in satisfactory fit indices in case of four factors (AG, EX, SS, NE).

The highest correlations between ZKA-PQ and values were observed with regards to sensation seeking, which correlated positively with openness to change (stimulation, hedonism & self-direction, Chinese  $r=.52$ , Hungarian  $r=.61$ ), particularly with adventure (Chinese  $r=.65$ , Hungarian  $r=.69$ ). On the other hand sensation seeking correlated negatively with conservation values (security, tradition & conformity, Chinese  $r=-.29$ , Hungarian  $r=-.51$ ), particularly with values for security (Chinese  $r=-.35$ , Hungarian  $r=-.52$ ).

I applied different model-based clustering models (incorporated into Mclust an R program by Fraley & Raftery, 2006) on the 20 facets. The four clusters with the largest deviations from average were well separable by the two principal axis factors of the twenty facets (negativity and impulsivity). Two clusters (negative, calm) had dominantly Chinese, whereas two other clusters (resilient, undercontrolled) had mainly Hungarian individuals. The comparison of the clusters revealed large differences not only in ZKA-PQ, but also in Schwartz values. 'Calm' cluster was lower than average in anger (AG3), hostility (AG4), restlessness (AC3), exhibitionism (EX3), sociability (EX4), anxiety (NE1) and all sensation seeking facets (SS). Openness to change, particularly stimulation was not valued highly by them. 'Resilient' cluster could be characterized by low anger (AG3), low hostility (AG4), high general activity (AC2) and work energy (AC4), high extraversion (EX), low neuroticism (NE) and moderately high sensation seeking (SS). They valued openness to change, particularly stimulation higher and security lower than 'calm' and 'negative' clusters. 'Undercontrolled' individuals scored high in all aggressiveness (AG) and sensation seeking (SS) facets, but also scored higher on general activity (AC2), restlessness (AC3), and on extraversion scales (EX) except for social warmth (EX2), along with having low scores on neuroticism facets (NE) except for anxiety (NE1). They valued conservation – including security and conformity – and self-transcendence – including both benevolence and universalism – less, but openness to change, particularly stimulation more than at least one other cluster. 'Negative' individuals scored high on anger (AG3), hostility (AG4), neuroticism facets (NE) and scored low on extraversion (EX), general activity (AC2) and work energy (AC4) facets.

#### 4.4. Discussion

The main aim of this study was to validate the ZKA-PQ in Chinese and Hungarian cultures and examine cross-cultural differences.

The internal consistencies across countries were mainly acceptable and the factor analytic results showed a replication of the clear structure of five orthogonal factors proposed by Aluja et al. (2010) in both cultures using different methods of extraction of factors.

Yet, some factor scores were significantly correlated with each other. These were exactly the same as those found in Catalan and non-student Hungarian samples (Surányi & Aluja, submitted): AG with SS and with NE; AC with EX and with NE; EX with NE. The high factor correlations can be explained by some secondary loadings of facets, which were also present in previous researches with ZKA-PQ (Aluja et al., 2010, Rossier et al., in press). Positive emotions (EX1) loaded negatively, while hostility (AG4) loaded positively on Neuroticism factor as well. Furthermore, among Chinese, also Anger had high loadings on Neuroticism. The only new result that was not found in previous analyses was the lack of fit of Restlessness facet on the Activity factor. In both samples it did not have any loading above .40. Confirmatory factor analyses also showed low adequate fit of the AC factor.

An interesting result of this cross-cultural comparison is the dissociation in the Chinese-Hungarian differences with regards to differences in socialized and non-socialized forms of Activity. Chinese scored significantly higher on work compulsion, while Hungarians were significantly more restless and had a higher general activity as well as higher scores on sensation seeking.

There was another dissociation of facet differences in the Aggression factor: Hungarians scored higher in Verbal Aggression, while Chinese students scored higher in Anger and Physical Aggression. We can see that although there is no difference in total aggression level between the two cultures, there are differences in the forms of aggression. All these results support the need to study differences not only at the factor level, but also at the facet level. In case of extraversion, sensation seeking and neuroticism, the same country differences were revealed by all of the facets: Hungarians scored higher than Chinese on sensation seeking and extraversion and lower on neuroticism. The cross-cultural differences are largely consistent with previous Western-Eastern cultural differences found by McCrae, Costa et al. (1996). Differences in sensation seeking are related to differences in cultural values: adventure was much more valued by Hungarians than by Chinese in our research.

Results with regards to values have revealed that there were in fact significant differences between individuals from the two cultures, yet not all differences were in congruence with presumed differences. Conservation (especially security and conformity) were more valued by Chinese students, while openness to change (hedonism, stimulation and self-direction, Schwartz, 1994) was more valued by Hungarian students, as expected. Contradictorily to what was supposed, self-enhancement was more valued also by Chinese who are supposed to live in a more collectivistic culture. Interestingly, Chinese also scored higher in self-transcendence (especially universalism), which may be explained by being a Confucian society, yet, tradition and religion were more important to Hungarians (a question about religion was added to the questionnaire, because Schwartz's original 10 values did not include it).

I also aimed to unfold further cross-cultural differences with examining typical personality patterns of ZKA-PQ in China and in Hungary. There were four clusters that showed large (at least 1 SD) deviation from the average, and these clusters produced the largest differences in the proportions of Chinese and Hungarian individuals. 'Calm' and 'negative' types were much more typical among Chinese, whereas 'resilient' and 'undercontrolled' types were much more typical in Hungary. Thus, there was a positive and a problematic pattern in both countries. The non-problematic pattern in China was the one including rather introverted,



non-aggressive, non-restless, non-anxious individuals with low sensation seeking, which I called 'calm' type. The Chinese typical 'problematic' pattern was the one with high scores in neuroticism and hostility and low scores in positive emotions, general activity and work activity as well. This pattern I called the 'negative' one.

On the other hand, the non-problematic pattern in Hungary – which I labelled as 'resilient' type – included very extraverted and moderately active & sensation seeking individuals with low aggressiveness and neuroticism. The problematic pattern in Hungary was constituted by undercontrollers with high impulsive sensation seeking, restlessness, aggressiveness and along with low neuroticism. This cluster – including exclusively Hungarians – showed largest deviations from average in values. They valued stimulation significantly at a higher, but security, benevolence, conformity and universalism at a lower level than at least one other cluster.

These four presented clusters could be described and discriminated well by constituting two factors out of the twenty ZKA-PQ facets. An interesting result of these two factors, that there were facets that belonged to the same factor in the five-factor system but belonged to different factors in this two-factor system. For example, hostility (AG4) belonged to negativity, whereas physical (AG1) and verbal aggression (AG2) belonged to impulsivity. Lack of positive emotions (EX1) and social warmth (EX2) belonged to negativity, whereas exhibitionism (EX3) belonged to impulsivity. Lack of work energy (AC1) belonged to negativity, whereas restlessness belonged to impulsivity.

The previously published cluster analytic results of FFM (the overcontrolled, undercontrolled and resilient types, Asendorpf, 2002, Robins, John, Caspi, Moffitt, and Stouthamer-Loeber, 1996, Schnabel, Asendorpf, and Ostendorf, 2002, Boehm, Asendorpf, and Avia, 2002, Barbaranelli, 2002, De Fruyt, Mervielde & Van Leeuwen, 2002, Van Leeuwen, De Fruyt & Mervielde, 2004, Rammstedt, Riemann, Angleitner, & Borkenau, 2004, Caspi and Silva, 1995, Asendorpf, Borkenau, Ostendorf, and Van Aken, 2001) can be linked only to the impulsivity dimension, but that system lacks 'negativity' dimension. Another major difference from the previously proposed cluster analytic models that I have found is that besides patterns including large deviations from average, there are also typical patterns around average. Thus, although there are two typical Hungarian patterns and two typical Chinese patterns, not everyone can be categorized into these four types.

Summarizing, my cluster analytic model proposes two major modifications on previous cluster analytic personality models: (1) clusters can be integrated with dimensional approach, as the four clusters can be described by two dimensions (impulsivity and negativity); (2) we can apply a probabilistic membership and not everyone should be categorized.

## **5. Study 3.: Sensation seeking level and types as predictors of problem behaviors**

### **5.1. Aims of study**

My aim was to test whether different sensation seeking profiles at the individual level can be linked to positive or negative outcome variables. I aimed to show how model-based clustering can provide an integration of classical typological and dimensional approaches.

### **5.2. Methods**

#### **5.2.1. Participants**

A survey was carried out in Budapest Hungary, in 70 high schools. Students filled out the questionnaires analyzed in this article as part of a four-semester research study. 3334 high school students (1634 boys & 1639 girls) took part in the survey at least once, and 1150 of them filled out the questionnaires in all four consecutive semesters.

A second study took place at Károli Gáspár University and Eötvös Loránd University in Hungary, where students in psychology courses were asked to participate in a survey. The

sample consisted of 438 students, aged between 18 and 56 (84 males and 354 females with mean age 23.28, SD=6.23) answered the questionnaires anonymously.

### 5.2.2. Instruments

The high-school students filled out a short form of the sensation-seeking scale (Brief Sensation-Seeking Scale (BSSS), consisting of 8 items; see Hoyle et al., 2002) and the CES-Depression scale (Radloff, 1977). The students reported the alcohol use measures of the European School Survey Project on Alcohol and Other Drugs research (Hibbel et al., 2003). The students were asked smoking related questions from the Youth Risk Behavior Survey 2009 (Centers for Disease Control and Prevention, 2009). Additionally, school achievement questions were included as a subjective evaluation of the last and present semester.

The survey for university students included the new 40-item version of the sensation seeking scale from the ZKA-PQ (Zuckerman-Kuhlman-Aluja Personality Questionnaire, Aluja et al., 2010) and a 36-item Self-control questionnaire (Tangney, Baumeister, & Boone, 2004). Additionally, two questions about frequency of alcohol use and smoking in the last 30 days have been administered.

### 5.2.3. Procedure

Respondents filled out the paper-pencil questionnaires during lessons, anonymously.

### 5.2.4. Data analyses

Analyses were completed using SPSS Statistics 19, AMOS 7 and the R statistical package.

In the high-school surveys, on the combined dataset for four semesters, we applied a model-based clustering on 9251 profiles of the sensation seeking items. We analyzed differences between the clusters by ANOVA. We also ran a k-means cluster analysis and a hierarchical Ward's clustering to see whether model-based clustering yielded cluster profiles similar to traditional methods.

Then we restructured the data: All individuals were represented by single cases with four different variables for the four different times for each clustering and outcome variable. Configural frequency analyses and temporal reliability analyses were applied to test the stability of model-based clustering. Finally regression analyses were applied to analyze the relations between SS factor and cluster scores and outcome variables (alcohol, smoking, school performance, depression).

### 5.2.5. Hypotheses

We assumed that

1. Sensation seeking will be positively related to indicators of *problem behaviors* (such as smoking, drinking, school problems, lack of self-control).
2. Not only quantitative differences in sensation seeking level, but also qualitative differences in *sensation seeking patterns* (such as socialized, non-socialized pattern) will be related to problem behaviors.
3. *Model-based cluster analysis* will be an adequate tool to analyze qualitative differences and unfold different sensation seeking patterns.

## 5.3. Results

### 5.3.1. Results of Study on high-school students

Cluster 1 (1487 cases with membership probability  $>.80$ ) had a low sensation seeking profile, while Cluster 5 (1260 cases with membership probability  $>.80$ ) had a high SS profile. Compared to low SS cluster members, high SS individuals scored higher in all BSSS items, in drinking and smoking variables with a large effect size and scored higher in depression and lower in school performance with a small effect size. Cluster 1 had higher school performance compared to Cluster 2 as well. Cluster 5 had also higher alcohol use scores than all other clusters and also higher smoking scores than Cluster 3 and 4.

There were also significant differences in BSSS and outcome variables between the remaining three mid SS clusters. Cluster 2 members had relatively higher scores on

preference of wild parties and being impatient at home and relatively lower scores on preference of bunjee jumping or rafting. They drank and smoked at a higher rate than students in the other two mid SS clusters and in the low SS cluster. Further, they were more depressed compared to all other clusters. We labelled this cluster as 'Home disliker party-fans' (631 cases with membership probability  $>.80$ ). In the mean profile of Cluster 3, preference for bunjee jumping, rafting, traveling without plans and discovering new places were relatively higher than preference for other, non-socialized forms of sensation seeking. They drank and smoked at a higher rate than low SS individuals, but at a lower rate than the two other mid SS or high SS cluster members did. Further, they had better school performance compared to all other clusters. We named the members of this cluster as 'Adventurers' (1146 cases with membership probability  $>.80$ ). The profile of Cluster 4 included scores above average in preference for wild parties, rule-breaking, doing frightening things, bunjee jumping or rafting but included scores below average in other BSSS items. They drank and smoked more than low SS or 'adventurers' but less than high SS members. We labelled this cluster as 'Thrillseekers' (555 cases with membership probability  $>.80$ ).

To test the structural stability, first we conducted a configural frequency analysis on 1150 individuals' pattern of four consecutive temporal state. Out of the 17 identified types, the five most frequent ones were the patterns with no change in cluster membership. 11 out of the remaining patterns had the same cluster membership through three different times.

We ran linear regression models on 3334 individuals who took part in at least one of surveys. If a student filled out questionnaires at different time points, then average scores and average difference scores of the four temporal states were calculated.

We built linear models for alcohol use, smoking, school performance and depression scores based on (1) scores of BSSS and BSSS change, (2) dichotomized (0: not a member-1: is a member) cluster membership variables and changes in membership (-1: became a non-member,0: no change,1: became a member), (3) logarithmized cluster density and density change variables. When applying cluster variables as independent variables, we used variables of four clusters and omitted the one cluster solution (to avoid high collinearity due to the fact that cluster variables of fifth cluster can be described as linear combinations of the other four).

Total BSSS was positively linearly related to alcohol use ( $R^2=25.1\%$ ), smoking ( $R^2=14.3\%$ ) and depression ( $R^2=1.5\%$ ), while it was negatively linearly related to school performance ( $R^2=1.9\%$ ). Prediction with the density variables resulted in higher explained variance of all outcome variables ( $R^2=35.2\%$  for alcohol use,  $R^2=24.4\%$  for smoking,  $R^2=14.4\%$  for school performance,  $R^2=5.2\%$  for depression).

Density values of Cluster 3 (Adventurers) were negatively linearly related to alcohol use, smoking and depression and positively linearly related to school performance. Densities of Cluster 2 (Home disliker party-fans) and Cluster 5 (High SS) showed exactly the opposite pattern: these were positively linearly related to alcohol use, smoking and depression and negatively linearly related to school performance. Densities of Cluster 4 (Thrill-seekers) were positively linearly related to smoking and negatively linearly related to school performance and depression.

### ***5.3.2. Results of Study on university students***

The reliability analyses of the scales showed Cronbach alpha values of .762 for 'Thrill and Adventure Seeking' (TAS), .690 for 'Experience Seeking' (ES), .754 for 'Disinhibition' (DIS), .746 for 'Boredom susceptibility/Impulsivity' (BS/Imp) and .880 for 'Self-Control'. The correlations between the four subscales were significant ( $p<.001$ ) and ranged in magnitude from .457 (ES and BS) to .549 (DIS and ES). Subscales correlated highly with the SS total score (.797, .782, .804, and .771 respectively for TAS, ES, DIS, and BS/Imp) and there was a moderate negative linear relation between self-control and SS (-.369).

We performed an analogous model-based clustering on the four subscale (TAS, ES, DIS, BS/Imp) scores, similar to the analysis conducted on the short SS questionnaire.

An ANOVA showed significant differences not only in SS scales (TAS:  $\eta^2 = .70$ , ES:  $\eta^2 = .62$ , DIS:  $\eta^2 = .65$ , BS/Imp:  $\eta^2 = .69$ ), but also in alcohol-smoking index ( $\eta^2 = .094$ ) and self-control ( $\eta^2 = .142$ ).

Cluster 1 (34 cases with membership probability above 80%) had a low, while Cluster 5 (14 cases with membership probability above 80%) had a high sensation seeking profile. Individuals in Cluster 2 (Moderately high SS, 150 cases with membership probability above 80%) had a bit higher SS than low SS members, but had lower SS than other clusters. Cluster 3 (Non-impulsive, socialized, moderately high SS, 38 cases with membership probability above 80%) and Cluster 4 (Impulsive, moderately high SS, 14 cases with membership probability above 80%) did not differ quantitatively in SS level, but had different SS profile: individuals in Cluster 4 had higher scores in DIS and BS/Imp but lower in TAS compared to Cluster 3 members. Individuals in Cluster 1, 2 & 3 had higher self-control than Cluster 4 & 5 members. With regards to alcohol-smoking index, Cluster 4 members had the highest score, which was significantly higher compared to scores of Cluster 1 & 2.

We built linear models for alcohol-smoking index, self-control, sense of coherence and life meaningfulness scales based on (1) total BSSS scores, (2) dichotomized cluster membership variables, (3) logarithms of cluster density variables (see Table 39). When applying cluster variables as independent variables, we used again variables of the four clusters.

Out of the four SS scales, only Disinhibition turned out to be positively linearly related to health index of alcohol use and smoking ( $R^2=11.4\%$ ). Densities in Cluster 5 (High SS) were positively linearly related, while the density in Cluster 3 (Non-impulsive SS) was negatively linearly related to this health index, yet the total explained variance of density variables ( $R^2=7.6\%$ ) was lower than in case of Disinhibition scale.

Cluster variables did not produce higher explained variances than DIS subscale.

Self-control was about equally well explained by SS subscales (DIS, BS/Imp,  $R^2=18.9\%$ .) and by cluster density variables ( $R^2=18.7\%$ ). Disinhibition and Boredom Susceptibility/Impulsivity were negatively linearly related to self-control. Densities in Cluster 4 (Impulsive SS) and Cluster 5 (High SS) were negatively linearly, while density in Cluster 3 (Non-impulsive SS) was positively linearly related to Self-control.

#### **5.4. Discussion**

The main aim was to examine whether there are only quantitatively or also qualitatively different sensation seeking patterns. Previous research has mainly focused on examinations of quantitatively different patterns: low and high sensation seekers. We also identified these two groups in both of our samples. High sensation seekers drank and smoked more, had worse school performance, were more depressed and had lower self-control than low sensation seekers. In addition to these two groups, we identified three other groups using both the brief, 8-item sensation seeking questionnaire (BSSS) and the new, 40-item questionnaire (ZKA-PQ). The three BSSS additional clusters all had different sensation seeking profiles, although they all had a bit above average sensation seeking. One cluster was characterized by preference for wild parties, another one by preference for adventure travelling and sports and a third one by preference for thrill-seeking activities. The existence of different moderately high SS patterns was also supported by Study 2, where individuals with relatively higher TAS but lower DIS & BS/Imp scores along with higher self-control formed one pattern and individuals with relatively lower TAS but higher DIS & BS/Imp scores along with lower self-control formed another pattern of the same sensation seeking level. The existence of these different typical profiles confirm a possible dissociation between scales, where the socialized (e.g., extreme sports or other TAS activities) and disinhibited (DIS or BS) levels were discrepant. In Study 1, 'adventurers' had higher total BSSS scores than 'home-disliker party

fans', yet they were healthier, less depressed, and had better grades. In Study 2, the 'non-impulsive sensation seekers' and 'impulsive sensation seeker' clusters did not differ in the level of SS, yet the former had higher self-control.

Logarithmized density scores indicating this typicality could be included in regression models predicting external variables. We compared predictive power of the logarithmized density variables to BSSS total score in Study 1 and to the four SS scales in Study 2.

Regression models with the density values showed a higher predictive power of all outcome variables than BSSS total scores did. In Study 1, densities of 'home-disliker party fan', 'thrill-seeker' and 'high sensation seeker' clusters were linked positively, but densities of 'adventurer' cluster was linked negatively to alcohol, smoking and school problems. Another interesting result was that densities of 'home-disliker party fan' and 'high sensation seeker' clusters were positively, but densities of 'adventurer' and 'thrill seeker' clusters were negatively related to depression. In Study 2, densities of 'high SS' and 'impulsive SS' clusters were negatively, while densities of 'non-impulsive SS' cluster were positively related to self-control.

These results indicated that impulsive patterns are linked to negative, but non-impulsive patterns to positive outcomes. Thus person-oriented analyses confirmed the distinction between socialized and impulsive sensation seeking.

## **6. STUDY 4: Relations between spirituality and subjective life satisfaction**

### **6.1. Aims of study**

The aim of the study was to demonstrate the significance of unfolding intraindividual patterns in the examination of relation between religiosity and subjective life satisfaction. In this study I included also those possible moderator variables (mindfulness, sense of coherence, sensation seeking) that have already been shown to influence relation between spirituality and well-being.

This study had methodological aims as well: (1) Comparison of different clustering methods (traditional k-means, model-based clustering and parametric density-based clustering: pdf Clusters), (2) Demonstration of different visualization possibilities of clustering, (3) Demonstration that cluster choice exclusively on BIC (Bayesian Information Criterion) can be problematic.

### **6.2. Methods**

#### **6.2.1. Participants**

Participation was recruited by students of psychology courses. Students themselves and their friends and relatives have filled out the questionnaires. Altogether, they were completed by 471 subjects, with 77 men (mean age: 28.40; SD: 11.25) and 242 women (mean age: 25.54; SD: 9.45) with a global mean age of 26.10 (SD = 9.636), between 18 and 69 years old.

#### **6.2.2. Instruments**

Life satisfaction (Diener, Emmons, Larsen, & Griffin, 1985), Sense of coherence - 13-item version (Antonovsky, 1993), 14 items from Daily Spiritual Experiences (Underwood & Teresi, 2002), Sensation Seeking (Zuckerman-Kuhlman-Aluja Personality Questionnaire, Aluja et al., 2010) and Mindful Attention Awareness Scale (MAAS, Brown and Ryan, 2003, Hungarian translation done by Simor, Köteles, Sándor, Petke, & Bódizs, 2011) have been administered. 198 individuals also filled out Zuckerman-Kuhlman-Aluja Personality Questionnaire (Aluja et al., 2010) along with Meaningful Life Scale (Steger, Frazier, Oishi, Kaler, 2006).

#### **6.2.3. Procedure**

Students filled the paper-pencil questionnaires out during psychology lessons and were asked to recruit additional participants as well. Participation was anonymous.

#### 6.2.4. Data analyses

I applied correlation analyses along with structural equation modelling. I have tested indirect effects of possible moderator. Then, I applied model-based clustering (Fraley & Raftery, 2002) to unfold the typical profiles of spirituality, mindfulness, sense of coherence and sensation seeking that lead to high life satisfaction. The software used were SPSS, AMOS and R.

#### 6.2.5. Hypotheses

1. Spirituality will be positively related to *life satisfaction* (based on metaanalysis of Wong, Rew, Slaikeu, 2006).
2. Spirituality will be positively related to *sense of coherence* (based on results of Tagay et al., 2006), *meaningfulness*, *mindfulness* (based on Porta's results, 2006) and will be negatively related to *sensation seeking* (Based on Gumilar's results, 2011).
3. Sense of coherence, mindfulness and sensation seeking will have a *moderator effect* on relationship between spirituality and life satisfaction (based on Tagay et al., 2006, Porta, 2006 and Gumilar, 2011).
4. *Model-based clustering* can uncover those patterns of spirituality, sense of coherence, mindfulness and sensation seeking that show relation to high life satisfaction.

#### 6.3. Results

We could see that spiritual experiences was in weak linear relationship with constructs of positive psychology like life satisfaction ( $r=.17, p=.000$ ), sense of coherence ( $r=.114, p=.000$ ) and is not linearly related to mindfulness ( $r=.025, p=.586$ ). However, DSE (daily spiritual experiences) is negative linearly related to sensation seeking ( $r=-.247, p=.000$ ), which is negative linearly related to mindfulness ( $r=-.247, p=.000$ ) and sense of coherence ( $r=-.247, p=.000$ ). Mindfulness is positively linearly related to self coherence ( $r=.380, p=.000$ ), and both are related to life satisfaction. Mindfulness showed weaker ( $r=.160, p=.000$ ), sense of coherence a stronger ( $r=.443, p=.000$ ) relation to satisfaction. Based on these, we have built an AMOS model which has produced acceptable fit indices (CMIN/df=1.629, GFI=.999, CFI=.997, TLI=.975 RMSEA=.037 (.000-.135, PCLOSE=.433).

Based on the SEM model, high spirituality seems to be related to high mindfulness through being related to low sensation seeking. Further, low sensation seeking is in relation with high sense of coherence through high mindfulness. Mindfulness is related to life satisfaction through its connection with sense of coherence.

According to test of moderation effect, there was only one significant interaction between moderator and independent variables: when independent variable was sensation seeking, moderator variable was mindfulness and dependent variable was sense of coherence.

Clustering results included many different clustering solutions. When cluster number was strictly decided on BIC values (as it is usually done), only 2 clusters arose: a rather non-spiritual (289 members) and a very non-spiritual cluster (182, see Figure 40). Although this solution has resulted with largest BIC, this solution preserves little of the many possible patterns. The three-cluster solution resulted in an around average (178 members), a Coherent, mindful, non-sensation seeker (75 members) and a non-spiritual clusters (218 members, see Figure 41). The four cluster solution included an around average (191 members), a coherent, mindful non-spiritual (91 members), a Spiritual, coherent, mindful, non-sensation seeker (44 members) and a very non-spiritual cluster (145 members, see Figure 42).

In the six cluster solution there were 109 moderately spiritual and non-coherent, 76 highly coherent, 54 highly spiritual, 142 non-spiritual, 41 highly spiritual and coherent and 49 non-spiritual, non-coherent individuals (see Figure 43-47). I also ran a nonparametric density clustering with pdfCluster. A solution with seven clusters was produced. Comparing k-means clusters, model-based clusters and pdfClusters, I showed that model-based and k-means cluster centroids were highly similar and there was a one-to-one correspondence between the

clusters. On the other hand, there were large differences in cluster sizes. Among k-means and spherical model-based clustering two clusters arose with above average life satisfaction and life meaningfulness (see Figure 57): 'Highly coherent & mindful but non-spiritual' and 'Highly spiritual, coherent, mindful & low sensation seeker'. The latter could also be found among pdfclusters.

#### 6.4. Discussion

Results with correlation analyses indicated that spiritual experiences were only in weak relationship with life satisfaction, sense of coherence and were not related to mindfulness. These results are contradictory to many previous researches on spirituality (Wong et al., 2006, Tagay et al., 2006, Porta, 2006).

Yet, spirituality was negatively related to sensation seeking – similarly to Gumilar's (2011) results –, which was negatively related to mindfulness. Mindfulness being related to sense of coherence moderated the relation between sensation seeking and sense of coherence. Sense of coherence being positively related to life satisfaction support that there is rather an indirect and not direct effect of spirituality on life satisfaction, which is in congruence with results of Porta (2006), Tagay et al. (2006) and Gumilar (2011).

However, all these analyses were between-subject ones, and do not tell anything about within-subject patterns. Therefore I applied different clustering methods.

Methodologically there are several important conclusions about clustering:

According to BIC (Bayesian Information Criterion), the best model was the two-cluster VEV solution with a rather non-spiritual and a very non-spiritual cluster. In the classical clustering tradition, we can label individuals belonging to a cluster by the cluster centroid and we should strictly categorize everybody into a cluster.

The present work demonstrates many drawbacks of this kind of strict clustering into only a few categories, which is typical in personality psychological clustering literature, e.g. in studies of Asendorpf, 2002, Robins, John, Caspi, Moffitt, and Stouthamer-Loeber, 1996, Schnabel, Asendorpf, and Ostendorf, 2002, Boehm, Asendorpf, and Avia, 2002, Barbaranelli, 2002, De Fruyt, Mervielde & Van Leeuwen, 2002, Van Leeuwen, De Fruyt & Mervielde, 2004, Rammstedt, Riemann, Angleitner, & Borkenau, 2004, Caspi and Silva, 1995, Asendorpf, Borkenau, Ostendorf, and Van Aken, 2001).

First, scatter plot visualization of individual profile scores showed that apart from a distinction in spirituality, clusters were not visually separable, distinct 'areas' on the two-dimensional projections of the multidimensional space. Secondly, no high spirituality type has been emerged, though a significant research question was what profiles do high spirituality individuals have. Third problem was that the rather non-spiritual cluster showed large variations also in spirituality and in other dimensions and included one with high spirituality as well. The squared distances from centroids were much larger than in cases of other cluster solution. Fourth weakness of this cluster solution was that producing clusters did not differ from each other neither in well-being (life satisfaction & meaningfulness) nor in personality dimensions (ZKA-PQ facets).

I found that with applying spherical models – which is what also k-means does – in model-based clustering, the resulting patterns reveal more fined and distinct patterns. Moreover, these patterns are similar to the ones revealed by widely used k-means, although cluster sizes differed largely. With regards to cluster sizes, we have to take into consideration two things: first, that model-based clustering we applied allowed differences in cluster sizes, whereas k-means do not. Secondly, model-based clustering allows for a probabilistic membership, thus we can put only those individuals into a given cluster, who have high membership probability. In this way we may not cluster everyone, but we can select and then examine those individuals who show a particular pattern. This has also been suggested by Bergman long time ago (1988), although it did not become part of mainstream psychological methods.

There were two patterns – same ones in model-based and k-means clustering – that could be linked to high life satisfaction. One was coherent, mindful, spiritual sensation seekers, other was coherent & mindful individuals. The former pattern was detected as typical pattern also by a non-parametric density estimation. This pattern appearing was also characterized by high meaningfulness and high work compulsion. The other pattern (coherent, mindful, which was absent in non-parametric clustering) belonged to individuals with high work energy, positive emotions, lack of neuroticism and high social warmth. Life satisfaction of these two clusters did not differ from each other, which shows that a spiritual and a non-spiritual pattern can equally be linked to life satisfaction. It is in congruence with the variable based result that spirituality is not directly related to life satisfaction. Though it is typical that high spirituality goes together with low sensation seeking, high coherence and high mindfulness, another typical pattern with high spirituality have occurred, without high coherence, mindfulness and life satisfaction. This can explain why some studies (see for example metaanalysis of Bergin, 1991) did not find linear relation between spirituality and life satisfaction.

Methodologically there are several important conclusions:

- (1) Choosing automatically the cluster solution with highest BIC might not reveal the most important patterns and might produce large overlapping clusters. Although the multidimensional densities might be well described with two Gaussian distributions, if the distributions have too large standard deviations, the mean profile of the cluster will not be well applied to many members of the clusters.
- (2) Spherical model-based clusters produced similar profiles as k-means clustering did, but a probabilistic membership means an advantage in the former one when we would like to estimate how many individuals there are who can be labelled with high probability by one of the cluster profiles.
- (3) Non-parametric clustering produced patterns largely different from model-based and k-means clustering and resulted in clusters that did not differed much in life satisfaction and life meaningfulness. Yet, an advantage of the procedure is the density-based silhouette graph, which is implemented in pdfClusters (Menardi, 2011).
- (4) Visualization of individuals on two-dimensional projections of the multidimensional space can reveal how separable the clusters are on the different dimensions. In these figures every individual is represented by an own point, and in this way, it is more informative than showing only one point (the mean point) of a cluster. Model-based clustering also allows to visualize those individuals who have high membership probability, and in this way, the typical patterns can be better seen.
- (5) We could see that spherical clusters (both in widely used k-means and in model-based clustering) outperformed non-spherical clusters and non-parametric density based clustering in identifying such typical patterns that showed large differences not only in the clustering variables (spirituality, sensation seeking, mindfulness, coherence) but also in some external variables (life satisfaction and meaningfulness). Such differences in the different clusterings could be well seen in Figure 56 & 57 demonstrating mean profile scores of the different clusters.

Through comparisons of the different clustering methods, we could see that there are large differences in the cluster solution of different methods. Statistical comparisons (like BIC values, squared distances from cluster centroids) can be informative, but should not be exclusively used when determining cluster number. Visualization of the clusters can help us see the distinctness of clusters, the maximum distances from cluster centroids with which individuals are still assigned to the given cluster and the differences in external variables between the clusters.



## 7. Summary

The main aim of the present thesis is to demonstrate how new person-oriented approach can provide a more holistic and interactionist view on personality and health psychological issues than widely used, traditional, variable-oriented analyses.

Interestingly, there has been a paradigm shift in physics from an analytic to a more holistic-interactionist view, which was emphasized by Capra (1982). In fact, Capra has noted that Hippocrate and Ancient Taoist philosophers have followed a holistic approach that was neglected by Cartesian (rationalistic) science. Capra (1982) pointed out “the interrelatedness and interdependence of all phenomena – physical, biological, psychological, social, and cultural” (Capra, 1982, p. 265).

The Alternative Five Factor Personality Model (Zuckerman et al., 1993) – which formed the basis of this dissertation work – assumes to be five independent, culture-free dimensions.

All of my results suggest that a more holistic frame – including biological and cultural aspects as well – are needed to understand inter- and intraindividual differences of personality.

Through the different studies, I demonstrated that factors do interact with each other in developing typical patterns, and that the prevalence of these patterns can show large cross-cultural variations (particularly between Chinese and Hungarian samples).

I also demonstrated that not only the level of factor, but the pattern of facets within the factor should be considered in cross-cultural comparisons and in examining adaptive and maladaptive correlates of personality factors.

Methodologically, the most important result in this dissertation is the proposal of a new person-oriented method, namely the model-based clustering, in applying it in personality and health psychology. Model-based clustering provides a new methodological framework for modern typologies: it allows for a probabilistic clustering and therefore it is able to build a bridge between dimensional and categorical approach.

Model-based clustering offers a method for modern typology that does not categorize everyone strictly but gives each individual typicability scores for each of the clusters. The typicability scores of holistic patterns have been shown to have higher predictive power than single factors.

I hereby would like to emphasize that my thesis work has been not only helped by my mentor, Prof. András Vargha, but also by a lot of Hungarian and international collaborators.

The first study was a result of my personal visit to Prof. Zuckerman, who provided me with the Zuckerman-Kuhlman-Aluja Personality Questionnaire and inspired me to develop Hungarian version. He introduced Prof. Aluja to me, with whom we wrote together an article about Catalan-Hungarian cross-cultural comparison on ZKA-PQ. The first study is the extended version of this article, which I wrote together with Prof. Anton Aluja. When writing the article, I was in charge of providing Hungarian data and writing alone the introduction and Prof. Aluja was in charge of the other parts (methods, results and discussion). Hungarian data were collected in a collaboration with Animarisk Kft. In the article we only presented variable-oriented results for both Hungarian and Catalan data. I (as a first-author) submitted the article to the Spanish Journal of Psychology. In this dissertation, I myself have extended the analyses with model-based clustering, and compared results of person-oriented analyses to variable-oriented analyses.

In the second study, I was in charge of the Hungarian data collection (which was also helped by my colleagues, Lilla Benczúr and Szabolcs Takács, who helped in promoting the research among their students), all of the analyses presented in this thesis and writing alone an article draft based on the results. This is included in the thesis, and no co-author has added parts to it, although Prof. Wang read it and made some comments for possible improvements. In the near future we would like to publish it together.

The third study is an extended version of an article I wrote together with Hungarian and American co-authors. The article consisted of two studies, the data for the first study was provided by Robert Urbán, and the data of the second study were collected by me. The first article draft was written by me, based on some analyses done together with David Hitchcock and some own statistical work. Then, co-authors have made their comments, and I was in charge of the improvements. I became the first author for this article as well, which we submitted to the *International Journal of Behavioral Development*.

The fourth study was helped by Harold Delaney providing spirituality questionnaire, and by Máté Szondy, providing mindfulness questionnaire. All analyses have been done by me, and no articles have yet been published. Yet, we published these results with Máté Szondy and András Vargha partly at Hungarian Psychological Association Conference (2012 30th May – 1st June) and partly at International Conference of Behavioral Development (29th August-1st September, 2012).

In all of the studies presented, I initiated the application of person-oriented methods on research data. In the first two studies, collaborators Prof. Aluja and Prof. Wang had used variable-oriented methods before, so I introduced them these methods. In the third study I applied the new model-based clustering methods I learned at the University of South Carolina from David Hitchcock to research data of Robert Urbán and to my own data. In the fourth study I applied different clustering methods on data collected by myself.

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