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VALIDATION OF MEASUREMENT INSTRUMENTS Open Access

Do the PVQ and the IRVS scales for personal values support Schwartz's value circle model or Klages' value dimensions model?

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Abstract

The paper compares the theoretical implications of two popular scales for the measurement of personal values, the Portrait Values Questionnaire (PVQ) of Schwartz et al. (J Cross-Cult Psychol, 32:519–542, 2001) and the IRVS of Hermann (Werte und Kriminalität: Konzeption einer allgemeinen Kriminalitätstheorie [Values and criminality: conception of a general theory of criminality], 2003; Zusammenstellung sozialwissenschaftlicher Items und Skalen, 2014). These scales come from psychology and sociology, respectively. They were developed, independently of each other, to serve different purposes, are based on different theories, and use different statistical models. We here study the validity of each scale for either theory. It is shown that using the PVQ methodology leads to similar and robust model solutions for data collected with either scale. Conversely, using the methodology that is standard for Individual Reflexive Value Scale (IRVS) data confirms the theoretical predictions for PVQ data but leads to unstable solutions for IRVS data. Nevertheless, the IRVS suggests "peace of mind" as an additional basic value and items that serve to complement the PVQ value circle. "Religion" is found to also fit into the structure of basic PVQ values but it contains a unique component.

Keywords: Personal values, Value circle, Value scale, PVQ, IRVS

Introduction

Various scales exist for measuring personal values. The most popular ones in psychological research are the Schwartz Value Survey (SVS) and the Portrait Values Questionnaire (PVQ), both developed, in various versions each, by Schwartz and his collaborators (Schwartz et al., 2000, 2001). Both scales have been constructed to measure "universals" in values, i.e., values that are similar in content and structure across different cultures and countries. In terms of content, the SVS and the PVQ address the same issues, but the scales differ radically in the formatting of their items. The SVS items ask the respondent to assess a value (e.g., "PLEASURE (gratification of desires)") "as a guiding principle in your life" on a scale from 0 (not important) to 7 (of extreme importance), with an (odd but rarely used) additional score of − 1 "opposed to my values". In contrast, the more recent PVQ consists of items that briefly describe a particular person in terms of his/her goals, aspirations, and desires. Each such "portrait" reflects a particular personal value such as power or hedonism (see Table 1). Participants are asked to compare the portrait to themselves, using a 6-point response scale from "very much like me," "somewhat like me," etc. to "not like me at all."

Despite the formatting differences, the SVS and the PVQ lead to highly similar results (Schmidt et al., 2007): (1) There are ten "basic" values. (2) Their intercorrelations can be represented as distances among points on an approximate circle using multi-dimensional scaling (MDS). (3) On this circle, the points representing the basic values are ordered as power – achievement – hedonism – stimulation – self-direction – universalism – benevolence – tradition – conformity – security – power. (4) The basic values form certain oppositions[1] of

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Table 1 PVQ and IRVS items. Items coded according to Schwartz's basic and higher-order values (left-hand side columns), IRVS items coded into Hermann's "subscales," and marker items for Klages' value dimensions

Basic values	Higher order values	PVQ	IRVS	Subscales	Value dim.
UN	Tra	3. He thinks it is important that every person in the world be treated equally. He wants justice for everybody, even for people he does not know.	6. Helping socially disadvantaged groups	SA	KE
			9. Respecting opinions that you really do not agree with	PT	KE
			35. Showing moral courage	EA	
		19. He strongly believes that people should care for nature. Looking after the environment is important to him.	36. Respecting others	EA	
			37. Tolerance	EA	
BE	Tra	12. It's very important to him to help the people around him. He wants to care for other people.	17. Having a partner one can rely on	SI	
			18. Having good friends who respect and accept you	SI	
		18. It is important to him to be loyal to his friends. He wants to devote himself to people close to him.	19. Having lots of contacts with other people	SI	
TR	Con	9. He thinks it's important not to ask for more than what you have. He believes that people should be satisfied with what they have.	14. Adhering to traditions	CC	
			16. Being proud of German history	–	
		20. Religious belief is important to him. He tries hard to do what his religion requires.			
(RE)	Con	–	24. Religion and religious faith	RO	
			26. Living according to religious norms and values	RO	
CO	Con	7. He believes that people should do what they're told. He thinks people should follow rules at all times, even when no-one is watching. 16. It is important to him always to behave properly. He wants to avoid doing anything people would say is wrong.	13. Doing what others are doing	CC	DK
SE	Con	5. It is important to him to live in secure surroundings. He avoids anything that might endanger his safety. 14. It is very important to him that his country be safe from threats from within and without. He is concerned that social order be protected.	5. Striving for security	NA	DK
			20. Living health-consciously	EA	
PO	Enh	2. It is important to him to be rich. He wants to have a lot of money and expensive things. 17. It is important to him to be in charge and tell others what to do. He wants people to do what he says.	3. Having power and influence	SM	HM
			2. Having a high standard of living	SM	HM
			7. Asserting one's needs and prevailing over others	SM	HM
AC	Enh	4. It is very important to him to show his abilities. He wants people to admire what he does.	8. Working hard and being ambitious	NA	DK
			32. Being hard and tough	SM	
		13. Being very successful is important to him. He likes to impress other people.	33. Having quick success	SM	
			34. Being clever and more cunning than others	SM	
HE	Ent/Cha	10. Having a good time is important to him. He likes to spoil himself.	11. Enjoying the good things in life	HO	HM
			30. A life full of enjoyment	HO	
		21. He seeks every chance he can to have fun. It is important to him to do things that give him pleasure.			
ST	Cha	6. He likes surprises and is always looking for new things to do. He thinks it is important to do lots of different things in life.	28. Living an exciting life	HO	
		15. He looks for adventures and likes to take risks. He wants to have an exciting life.			
SD	Cha	1. Thinking up new ideas and being creative is important to him. He likes to do things in his own original way.	4. Using one's own ideas and creativity	SA	KE
		11. It is important to him to make his own decisions about what he does. He likes to be free to plan and to choose his activities for himself.	12. Living and acting on one's own responsibility	PT	

Table 1 PVQ and IRVS items. Items coded according to Schwartz's basic and higher-order values (left-hand side columns), IRVS items coded into Hermann's "subscales," and marker items for Klages' value dimensions *(Continued)*

Basic values	Higher order values	PVQ	IRVS	Subscales	Value dim.
(PM)	–	–	1. Respecting law and order	NA	DK
			15. Living a good family life	–	
			23. Behaving environmentally conscious	EA	
			25. Having a clear conscience	–	
			27. Living so that others are not harmed	–	
			31. Inner peace and harmony	EA	
–		–	10. Engaging oneself in politics (dropped)	PT	KE
			21. Being guided by emotions when making decisions (dropped)	EA	
			22. Being independent of others (dropped)	EA	
			29. Living an easy and comfortable life (dropped)	SM	

AC achievement, *BE* benevolence, *CC* conservative conformism, *CE* creativity and engagement, *Cha* openness to change, *CO* conformity, *Con* conservation, *DK* duty and convention, *EA* ecological-alternative orientation, *Enh* self-enhancement, *HE* hedonism, *HM* hedonism and materialism, *HO* hedonistic orientation, *KE* creativity and engagement, *NA* norm-oriented achievement ethics, *PO* power, *PM* peace of mind, *PT* politically tolerant orientation, *RE* religion, *RO* religious orientation, *SA* social altruism, *SC* security and convention, *SD* self-direction, *SE* security, *SI* social-integrative orientation, *SM* sub-culturally materialistic orientation, *ST* stimulation, *TR* tradition, *Tra* self-transcendence, *UN* universalism

"higher-order values," i.e., self-enhancement (PO, AC) vs. self-transcendence (BE, UN) and openness to change (HE, ST, SD) vs. conservation (TR, CO, SE), as predicted by (Schwartz, 1992).

The PVQ is recommended by Schwartz (2003) as today's scale of choice (see also Sandy et al., 2016, for short and ultra-short versions of the PVQ), primarily because its items are more concrete and cognitively less complex than the SVS items. This makes the PVQ suitable for use with all segments of the population, including those with little or no formal schooling. The PVQ also does not offer the odd "– 1" response scale category as an admissible answer.

The SVS and the PVQ both rest on the same theoretical foundation, a set of arguments on how individuals generate value judgments. Schwartz and Bilsky (1987) argued that the relations among values are determined by practical and psychological conflicts and compatibilities. Values are compatible if they guide similar perceptions, preferences, and behaviors. For example, self-direction and stimulation values are compatible because both guide a preference for new experiences. Values are conflicting if they guide opposing perceptions, preferences, and behaviors or if the pursuit of one value prevents the pursuit of the other value. For example, pursuing security values by avoiding risks necessarily prevents the pursuit of new experiences expressed in self-direction and stimulation values. Value judgments, therefore, can be modeled in the sense of an unfolding model (Coombs, 1964), where values form a continuous circular scale (similar to a color circle, for example) and the individual finds a position within this circle so that the distances to particular points on the value circle correspond to the person's compromise preferences for these values. When aggregating the individuals' ratings for the values by correlating across persons, the unfolding model simplifies to become a multidimensional scaling (MDS) model that predicts a circular pattern of values. This "value circle" has been found in numerous studies using MDS on samples from many different countries and using a variety of questionnaires (e.g., Schwartz & Bilsky, 1987; Döring, Schwartz, Cieciuch, Groenen, & Glatzel, 2015; Lee et al., 2008; Schwartz, 1992, 1999; Borg et al., 2017a).

Other value scales besides the SVS and the PVQ exist too, in particular, lexicographic scales such as the Estonian Value Survey (Aavik & Allik, 2002) or the Austrian Value Questionnaire (Renner, 2003). They also lead to comparable statistical structures (Borg et al., 2016) but emphasize, by design, more culture-specific than universal values. Neither of these scales has been applied much in value research.

This is clearly different for the Individual Reflexive Value Scale (IRVS) (Hermann, 2003, 2014) which has been used frequently in criminology and sociology. The IRVS (Table 1) is closely related to studies on societal

value change. In this context, Klages and Herbert (1981, 1983) proposed an inductively developed collection of items focusing on "goal categories of shaping one's life" which later became known as the "Speyerer Werteinventar." This inventory was originally meant to widen Inglehart's (1977) one-dimensional "narrow value space" (Pöge, 2017) of material and post-material values by adding political, historical, individual-hedonistic, and other goal categories as well as switching from Inglehart's ranking to a rating format in order to increase the predictive power of value measurements. This led to time- and context-related values from other life domains such as "sexual freedom," "performance-related pay," "equal rights for women," or "government capable of acting" but also to "universal" values in the sense of Schwartz, (1992) such as striving for power or adhering to traditions.

In a series of studies using primarily exploratory factor analysis, the Speyerer Werteinventar was developed further, leading to items with clear loadings on two orthogonal factors: "kon values" (duty, acceptance, security) and "non-kon values" (self-actualization, social/unsalaried engagement). They served to distinguish four value types (Franz & Herbert, 1986; Held et al., 2009): The pure value types with high emphasis on virtually all kon values ("conservative conventionalists") or non-kon values ("non-conformist idealists") but also two mixed types ("value generalists") with either low emphasis on both dimensions ("the disadvantaged and disillusioned") or with high emphasis of both dimensions ("active realists" who combine "old" and "new" values). Klages and his coworkers felt that their "unexpected discovery" (Klages & Gensicke, 2006) of active realists was particularly important, because, as Klages (2001, p. 10) argues, active realists are able to respond pragmatically to very diverse challenges while reaching a high level of rational self-efficacy and self-responsibility with a strong success orientation. On the other hand, Roßteutscher (2004, p. 407) remarks that the value profile of active realists "contradicts the basic assumption of value theory in general: according to Parsons, Rokeach, and Inglehart, the competent, rational, and 'better' citizen is seen as an individual who is able to assign clear priorities to the diverse and contradictory range of modern values." This criticism challenges not only the answer format of value items (ranking vs. rating) but also the entire dimension system because any combination of dimensional coordinates is possible and there are no "contradictory" values other than the poles of each dimension. Empirically, however, active realists are often the most frequently observed value type (Klages, 2001; Held et al., 2009).

In later studies using repeatedly adapted items, the value space was expanded to three (slightly oblique) dimensions by adding the newly found hedonism-materialism dimension (Herbert, 1988): SC = security and convention, CE = creativity and engagement, and HM = hedonism and materialism. Combinations of these three value dimensions lead to a typology with eight different value types, but three of these were later dropped.[2] The resulting typology with five subsets became well known and consists of the four previously mentioned groups extended by the new value specialist type "hedo-materialist." What remains is that Klages' theory of basic values consists of a rather small set of linear dimensions rather than a value circle. Yet, when taking a closer look at the content of the three final dimensions, one notes that they are similar to a three-cluster version of Schwartz's four higher-order values. What disappears in Klages' system is "openness to change": This higher-order value is split and partly allocated to HM (namely the basic value HE = hedonism and ST = stimulation) and partly to CE (namely SD = self-direction). On the value circle, these three value clusters would, however, not be independent, so that highly striving for all three of them, for example, seems impossible. That does not mean that giving high ratings to all these higher-order values is impossible if one is willing to use centered data. Klages' typology is based on statistically partitioning a sample into value types on the basis of dimensional mean scores *across persons*. The value circle model, in contrast, argues that certain values are incompatible relative to the mean rating *within each person*. This means that it is not impossible for a person p to assign high ratings to X and also to values opposite to X. In that case, his/her centered ratings would simply be quite similar and the person would be a "value generalist." The mean of the person's ratings itself can also be meaningful, corresponding to what Borg and Bardi (2016) have termed "value-guidedness," a variable that is markedly positively correlated with the persons' optimism, with their feeling of having a clear direction in life, and with their subjective well-being.

The centering issue also means that when comparing the validity of the PVQ and the IVRS with respect to the underlying theoretical models, one must pay attention to how the data are pre-processed within these models before their structure is studied. One also needs to use equivalent statistical models, of course: The Schwartz scales all rest on a distance model (i.e., two-dimensional MDS) while the IRVS is intimately related to vector models (i.e., exploratory oblique factor analysis with two or three dimensions). In addition, the theoretical coding of the items has to be studied closely. Basic values such as "security" (SE) appear in both scales (see Table 1), but only one of the two items in either scale is essentially equivalent. Hence, security seems to get a different emphasis on these two scales on the item side.

The co-existence of the two scales, the PVQ and the IVRS, that are both frequently used in different fields of

social science research and that operate with a set of similar verbal labels for personal values, leads to a number of questions. In particular, one can ask whether data collected using a particular scale, if viewed through the methodological lens of the original model of individual value judgments, better support the value circle model (with a particular order of the points representing basic values and with the higher-order values oppositions) or Klages' theory of value dimensions. The obvious hypothesis is that the PVQ scale fits better to the value circle theory, and the IVRS fits better to the value dimensions theory, because the scales have been developed out of these theories. Previous research (Bilsky & Hermann, 2016; Borg et al., 2017b, 2017c) has shown that the IRVS fits well into the value circle framework. What has not been tested is whether the PVQ fits into Klages' value dimensions. Since both theories are intimately connected to particular methodologies, testing the theory fit of each scale requires that one uses the data processing and modeling of the respective theory.

If both scales fit adequately into a particular model, one can ask whether combining the scales is possible to yield additional insights into personal values and their structure. This question requires answers on two levels: First, the inter-correlations of the combined set of value items should be representable in the particular value model, and the model should also hold within individuals, exhibiting the various properties of the value model and replicating established relations of the model solution to external variables such as gender and age.

Various other questions exist. For example, when combining both scales, do we arrive at a deeper understanding of how individuals generate their value judgments? And do these analyses suggest improvements on how to measure personal values? Are there particular values that are missing in either scale, and, if so, how would they fit into the structure of the given values?

Method

Sample

Our data come from a survey on crime prevention drawn in November 2016. The sample is a random sample of 9.998 persons, representative of all persons aged 14 and over, resident in private households in the city of Mannheim (register). The survey material was sent out by mail. 3.272 persons returned filled-out questionnaires (36% returns, not counting wrong postal addresses). The demographics of the participants (gender, age, residential district, German-born vs. immigrants) largely matched the population statistics, except that citizens not born in Germany were clearly under-represented (18% vs. 35% in the population) (for further details, see Hermann, 2017).

Instruments

The survey was designed to collect data useful for crime prevention. The substantive items covered the respondents' experiences, opinions, attitudes, and actions with respect to different forms of delinquency. In addition, personal values were measured by both the PVQ21 and also by Hermann's IRVS. The items of both scales are given in their full wording in Table 1.

The PVQ formatting is described above in the "Introduction" section. The items of the IRVS are introduced as follows: "People have certain ideas that govern their life and their thinking. We are interested in your ideas. Please consider what you are really after in your life: Then, how important are the things and life orientations that we have listed here? Please take a look at the various issues and mark on a scale from 1 to 7 how important they are for you. 'Seven' means that it is very important, and 'one' means that it is completely unimportant. With the values in between, you can grade the importance of the issues."

Table 1 shows Bilsky and Hermann's (2016) codings[3]—based on inter-rater agreement of experts in value research—of the IRVS items in terms of Schwartz's Theory of Universals in Values (TUV) into 10 "basic values" and into 2 extra value types, "peace of mind" and "religion," added by Borg et al. (2017b). The 33 items are culled from the 37 IRV items (dropping 4 items because raters did not reach agreement on their coding, as shown in Table 1).

Table 1 also exhibits the coding of the IRVS items according to Hermann (2014) into the "sub-scales" HO = hedonistic orientation, CC = conservative conformism, NA = norm-oriented achievement ethics, EA = ecological-alternative orientation, PT = politically tolerant orientation, RO = religious orientation, SA = social altruism, SI = social-integrative orientation, and SM = sub-culturally materialistic orientation. Twelve of the IRVS items were selected as "marker items" by Klages and Gensicke (2005) to identify the three value dimensions DK = duty and convention, KE = creativity and engagement, and HM = hedonism and materialism.

Data analysis

The standard data analysis method used by Klages and his coworkers is exploratory factor analysis.[4] Their final typology rests on three factors. Thus, to follow Klages and his coworkers closely, we here analyze both the PVQ and the IVRS data using oblique factor analysis (PCA) of the inter-correlations of the observed (i.e., absolute or uncentered) ratings, expecting that both scales replicate the basic dimensions of the Speyerer Werteinventar.

The standard method used by Schwartz and his coworkers is (ordinal, two-dimensional) multidimensional

scaling (MDS[5]). What is not always clear is whether absolute or centered ratings are used as data. On the one hand, it is argued that "what really interests us is the relative importance of the ten values to a person, the person's value priorities." However, for multidimensional scaling, … use the absolute scores for the 21 items or 10 value means," because "the exact linear dependence among items, created by centering, is problematic" (ESS Edu Net, 2013, p. 4). We predict that for mostly positive item inter-correlations, centering or not centering does not make much difference, because if all correlations are positive, one can show that such transformations do not affect the distances in ordinal MDS (Borg & Bardi, 2016; Borg, 2018; Lingoes, 1971). To test this prediction, we ran MDS analyses with both types of data.

To study the value structure within individuals, we used unfolding[6] on the PVQ and the IRVS value indexes after adjusting the 6- and 7-point response scales to equal length and orientation. We also used centered ratings as data rather than the absolute (observed) ratings to eliminate the first principal component that only represents the persons' mean ratings rather than the structure of the variables (Borg & Bardi, 2016).

All data analyses and graphics were done within the R environment (R Core Team, 2016). In particular, we used the SMACOF package (De Leeuw & Mair, 2009; Borg et al., 2018) to run MDS and unfolding, and the PSYCH package (Revelle, 2018) for factor analysis.

Results

Item inter-correlations

The PVQ items' inter-correlations range from − .20 to .55, with a mean of .15; 90% of the correlations are positive. Hence, persons who rate a particular value highly also tend to rate other values highly. For the IRVS items, the coefficients range from − .15 to .81, with a mean of .19, and 90% are positive. This implies a strong first principal component in both cases, as expected.

Factor analyses of PVQ and IRVS items and indexes

Exploratory factor analyses (PCA) of the PVQ items with three components led to solutions that clearly replicate Klages' final three-factor theory (Klages & Gensicke, 2006), with factors SK, security and convention; CE, creativity and engagement; and HM, hedonism and materialism. The components are slightly non-orthogonal (with a maximal correlation of .17 using oblimin rotation). However, the usual criteria for the number of factors (eigen value > 1, Cattell's scree test, and parallel analysis; see Hayton et al., 2004) all indicate that the solution space should be four- or even five-dimensional. When running the PCA again with four dimensions, the HM component "falls apart," with the hedonism items forming their own component. The four components are characterized by items (see Table 1 for the item numbers) with loadings of about .50 or higher as follows[7]: F1 = {2, 4, 13, 15, 17}, F2 = {5, 7, 14, 16, 20}, F3 = {3, 8, 12, 19}, and F4 = {6, 10, 11, 21}. This corresponds to Schwartz's higher-order values self-enhancement, conservation, self-transcendence, and openness-to-change.

Factor analyses (PCA) of the IRVS items led to similar but structurally less robust results. Again, all number-of-dimension rules clearly suggest at least four- to five-dimensional solution space. One reason is that the items on religion (24 and 26 in Table 1) form a component of their own. When dropping these items from the item set, a four-dimensional solution roughly replicates the Schwartz higher-order values. However, one rather comprehensive component emerges with loadings of at least .50 for values such as partner (17), family life (15), friends (18), security (5), good conscience (25), peace, and harmony (25). Moreover, the Klages' factor "hedonism and materialism" partially emerges once more in the solutions, with its hedonistic focus on "stimulation" but not on "enjoy life." One can drop items from the IRVS set of items and/or run the factor analyses allowing for more and more components: This eventually leads to the various "subscales" reported in Table 1.

Multidimensional scaling of IRVS and PVQ items and indexes

Using MDS[8] to model the inter-correlations of the 33 (centered) IRVS items generates the solution in Fig. 1. Its fit is good (stress = .181) and significant ($p = 0.00$ in a permutation test; Mair et al., 2016). It also replicates previous findings and is theory-compatible (Borg et al., 2017b). The configuration in Fig. 1 shows convex hulls around point sets representing items coded by the 10 + 2 system of Table 1 (Schwartz's ten basic values, plus religion and peace of mind). One notes that the items of the same content category are situated in close neighborhoods, showing internal consistency of the value items. The various neighborhoods are themselves positioned along a circle that was optimally fitted to the points, with items 5, 8, and 19 pulled somewhat to the center of the circle. The tightness of the neighborhoods differs, with the UN and the AC environment being most scattered.

Next, the ratings of the IRVS items were aggregated to 12 indexes measuring the 10 Schwartz values and 2 additional values (religion, peace of mind), as shown in Table 1. Figure 2 shows the MDS solutions for 10 + 2 value indexes based on centered and on un-centered IRVS ratings.[9] Both solutions are obviously highly similar. This is also evident from circles fitted independently to the two configurations. Thus, centering or not centering the ratings does not impact the MDS solution very much, as predicted. Both solutions also have an almost equally good fit to the data, with small stress values

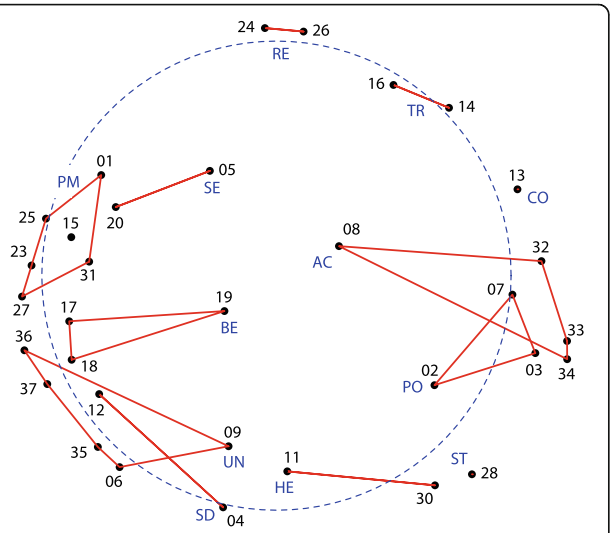

Fig. 1 IRVS items (see Table 1) in MDS space. Convex hulls around items of the same type in Schwartz's ten basic values system, plus "religion" and "peace of mind." AC = achievement, BE = benevolence, CO = conformity, HE = hedonism, PM = peace of mind, PO = power, RE = religion, SE = security, SD = self-direction, ST = stimulation, TR = tradition, UN = universalism

(.079 in case of centered items, .069 for uncentered items) and permutation test probabilities of $p = 0.00$. The tripod in the center of Fig. 2 partitions the plane into three sectors. Each sector contains only items that belong to one of the three value dimensions reported by Klages and Gensicke (2005).

Figure 3 shows the MDS solution for the 10 PVQ indexes compared to the MDS solution for the 12 IRVS indexes. The stress is excellent and significant in each case (.029 and .079, respectively). Both solutions show almost the same value circles. The PVQ indexes are somewhat more clustered (in terms of the higher-order values) than the IRVS-based indexes, but both configurations can be perfectly partitioned into the two opposite groups of higher-order values, self-transcendence vs. self-enhancement, and openness to change vs. conformity, respectively, as theoretically predicted. One notes, however, that the value security (SE) is clearly closer to the self-transcendence items BE and UN in case of the IRVS, while for the PVQ data, it is close to PO and AC. This may reflect that the security items focus on different aspects of security in the different scales.

Joint MDS of IRVS and PVQ indexes

When scaling the inter-correlations among all PVQ and IRVS basic values in a joint MDS analysis, one obtains Fig. 4. The stress of this 22-point solution is excellent (.09)

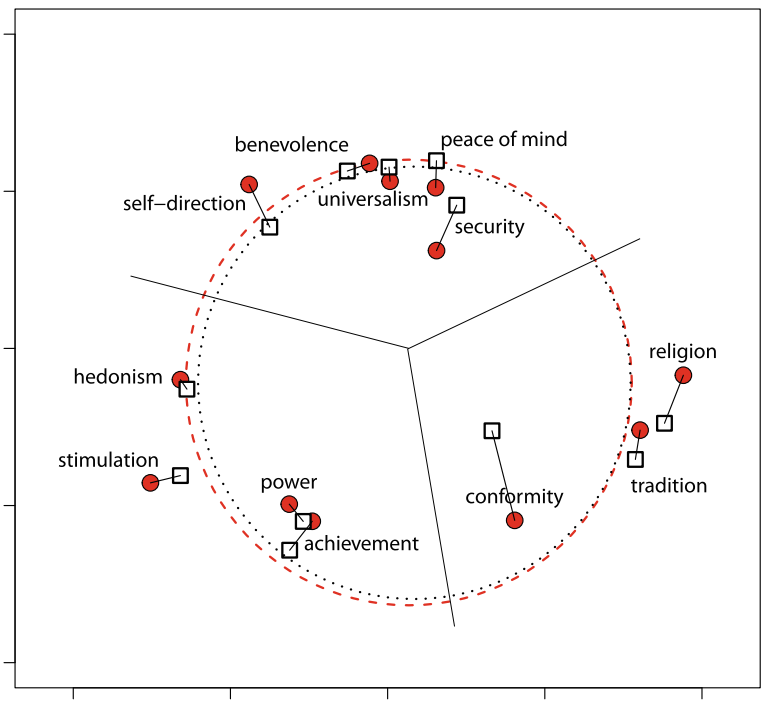

Fig. 2 Twelve IRVS personal values in MDS representations based on inter-correlations of centered (solid points, dashed circle) and on absolute (open squares, dotted circle) rating scores, resp.; configurations Procrustean fitted; corresponding points in configurations connected by line segments; tripod in center partitions plane into Klages' value dimensions

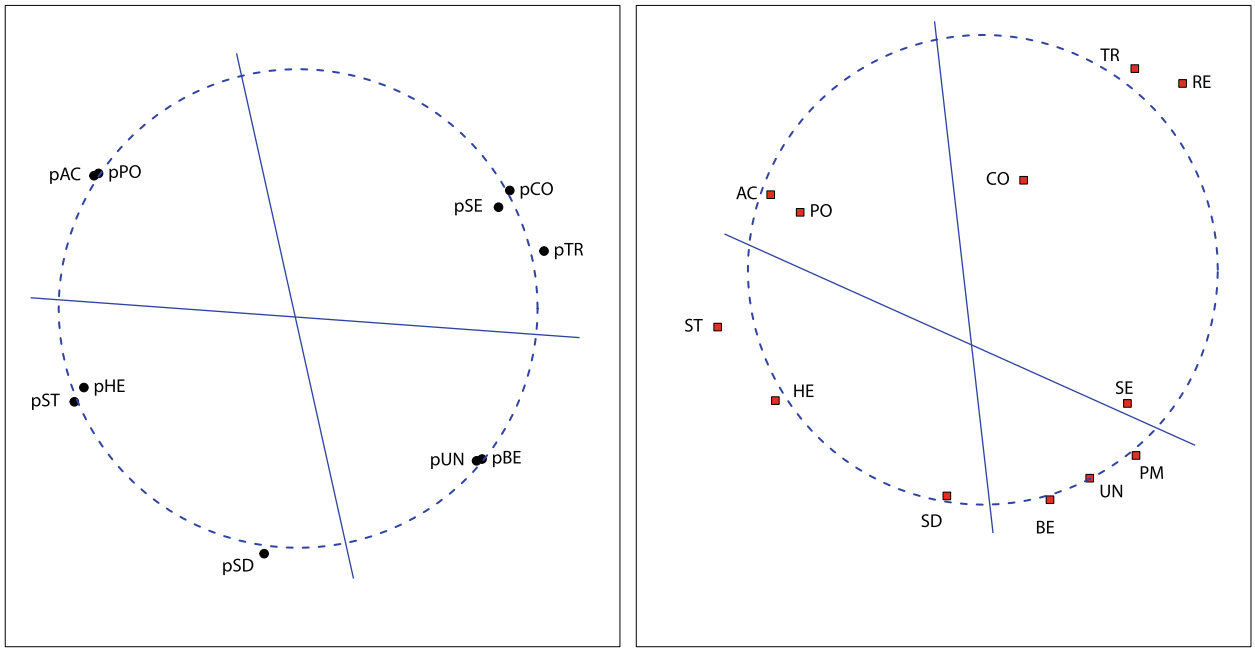

Fig. 3 MDS representations of 10 basic values based on PVQ items (left panel; with items labels preceded by "p") and 12 basic values based on IRVS items (right panel); circles optimally fitted to configurations; straight lines partition configurations into opposite higher-order value groups self-enhancement vs. self-transcendence and openness to change vs. conformity, respectively

and significant ($p = 0.00$). The ten pairs of points with equivalent TUV (Theory of Universals in Values) codes are connected by line segments. This shows that substantively equivalent points are close in MDS space. Only CO, TR, and SE, in particular, exhibit larger discrepancies. This reflects that the respective items that measure the basic values focus on somewhat different issues. Overall, the configuration with its 22 points is almost perfectly circular. Note that we did not enforce circular constraints onto the MDS[10]: Rather, we let the data "speak for themselves," and so the resulting circle "is in the data."

Figure 5 shows 95% confidence regions for the various points in the MDS solution (Jacoby & Armstrong, 2014).

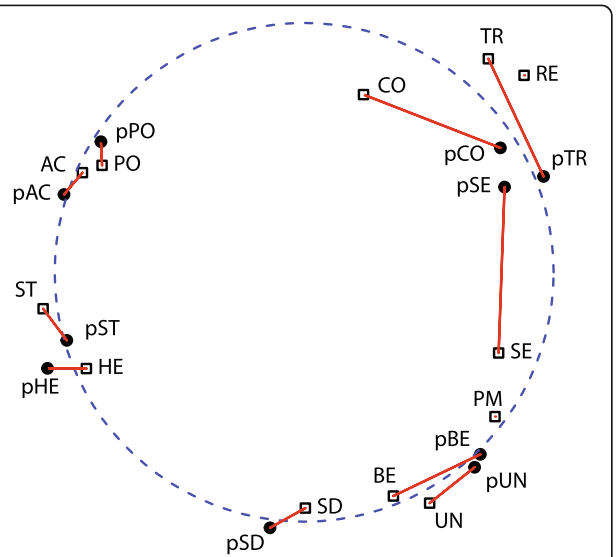

Fig. 4 Joint MDS configuration of 12 IRVS values and 10 PVQ values (labeled with "p" tags); based on inter-correlations of indexes; line segments connect corresponding points

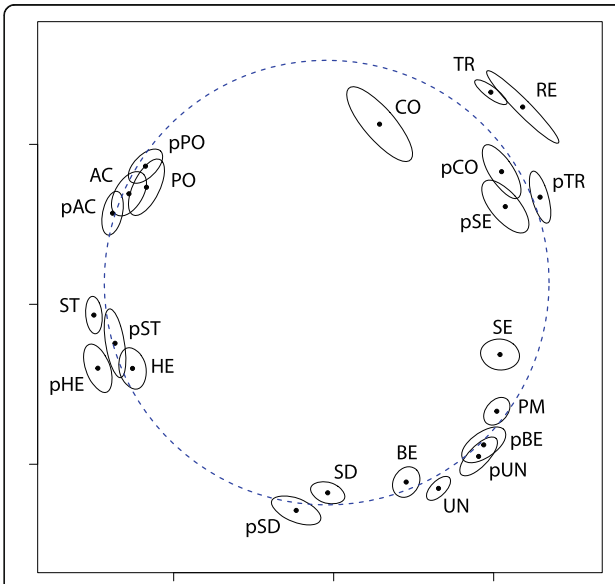

Fig. 5 Joint representation of Fig. 4, with 95% confidence regions for each of the 22 personal values. The points labeled with a "p" are based on the PVQ; all other points are based on IRVS-items

All confidence regions are quite small. Hence, the configuration can be considered statistically reliable.

When breaking down the global fit measure (stress) into its components in Fig. 6, one notes that religion contributes by far the most to overall stress. That is, RE fits clearly worst in the MDS structure. The other 21 value items exhibit a rather continuous distribution of stress-per-point coefficients with no outliers.

Figure 7 shows the (metric) unfolding solution for the combined PVQ and IRVS data (stress = .17; $p = 0.00$). Each of the unlabeled points in the circle's center represents one of the respondents. The distances from each person point to the various value points (points with labels TR, pTR, etc.) correspond closely to the observed rating scores. That is, the closer a person point is to a value point, the more this person strives for this value.

The two inserted lines in Fig. 7 are the discriminant of gender (females are more at the bottom of the plot; significant separation of genders on this line by t test) and the line that optimally represents the age distribution of the sample (dashed line, with older persons more towards the right of the plot; inserted scale correlates with .50 with the external age variable). The two inserted lines correspond to what has been found before with

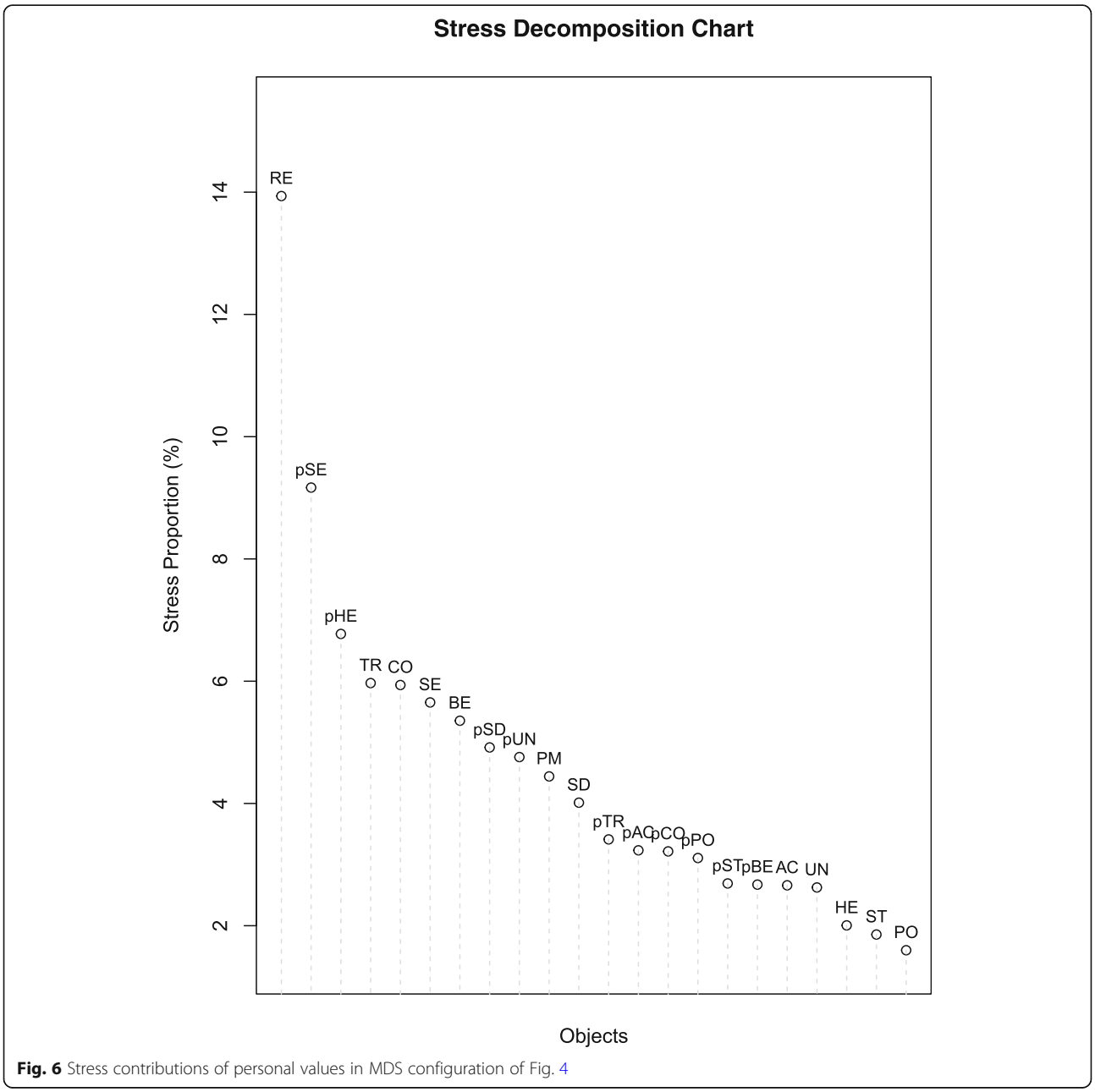

Fig. 6 Stress contributions of personal values in MDS configuration of Fig. 4

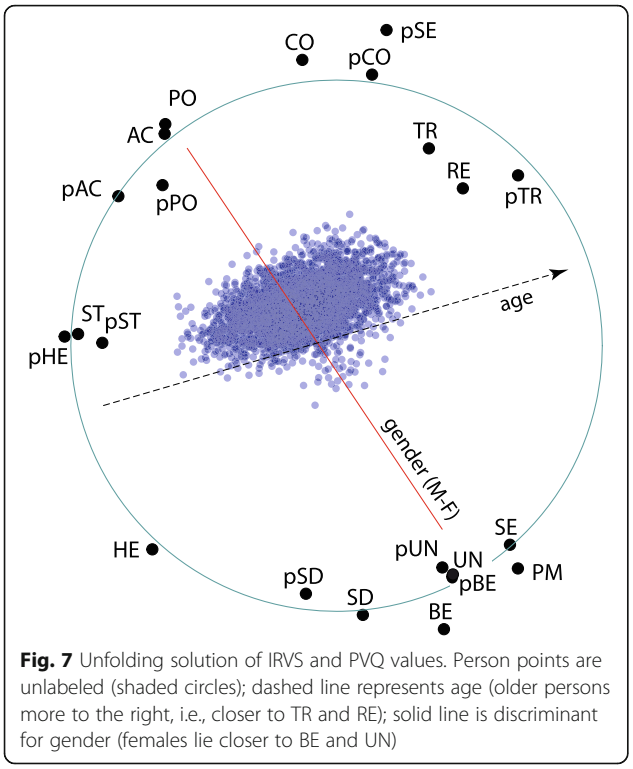

Fig. 7 Unfolding solution of IRVS and PVQ values. Person points are unlabeled (shaded circles); dashed line represents age (older persons more to the right, i.e., closer to TR and RE); solid line is discriminant for gender (females lie closer to BE and UN)

respect to gender and age (Schwartz & Rubel, 2005; Borg et al., 2017c) which supports the validity of the solution.

Figure 8 shows the stress contributions of individuals and of values. One notices that religion is again the greatest contributor to the model's overall stress. The plot on the left-hand side demonstrates that most persons fit well into the unfolding solution: The expected stress contribution of each individual is .034%, and 97% of the respondents' contributions to the global stress are within two standard deviations (sd = .022) of the stress-per-person distribution. The numbered persons in the plot can be considered outliers. Person #1291, for example, strives for conformity as measured by the IRVS but not for conformity as measured by the PVQ. Since CO and pCO are close neighbors in the unfolding value circle (i.e., most persons see these values as highly similar), this is incompatible with the model.

Discussion

The results show that the IRVS and the PVQ data can both be represented well in the value circle model. The stress is small and significant for both data, and the MDS configurations are robust, highly similar, and exhibit the theoretically expected circular arrangement of value points. Centering or not centering the observed importance ratings makes almost no difference for MDS. The reason is that the inter-correlations of the value items or value indexes (i.e., the scores of basic values) are predominantly positive. Thus, the data vectors essentially lie in a positive cone, and MDS therefore simply represents the distances among the vector endpoints on the flattened dome of this cone.

Unfolding demonstrates that the value circle also holds within individuals. This is the ultimate test of the value circle model because it corresponds to the underlying theory of how individuals generate value judgments. The fit of the unfolding model is excellent, the stress is small and significant, and the value configuration again satisfies the value circle predictions. Moreover, the person points are distributed in space in a way that replicates studies on age and values, and gender and values. This supports the validity of the unfolding solution.

What differs between the IRVS- and the PVQ-based MDS results is, in particular, the location of the security values. This finding can be explained by the items used to measure security. The IRVS items ask about the importance of health as a value, and about security in general as a goal, while the PVQ items focus on secure surroundings, social order, and safety from threats provided by the state. One can surmise that the respondents of this particular German sample understand the notion of striving for security largely in the sense of striving for material security (job security, income, risk avoidance). This would explain the close neighborhood of security and peace of mind. On the other hand, it is remarkable that the IRVS notion of security is only shifted on the value circle towards the self-transcendence values and away from self-enhancement, but it is not moved to a different value region.

A value that is harder to integrate into the value circle is religion. It exhibits by far the highest relative contribution to the overall stress of the MDS solution in Fig. 4. In PCA, the items on religion always form a unique factor. This cannot be explained by the relatively low mean ratings for religion, by the number of missing values, or by the left-skewed distributions of the religion items, because other values (e.g., "doing what others do as well" or "being clever and more cunning than others") are even more extreme in their (small) means, number of missing ratings, and (left-skewed) distributions. Rather, it seems that religion is simply an issue that is partly unique, and that does not relate that systematically to the standard basic values for most persons. On the other hand, a part of religion still fits well into the structure of the value circle: The RE point sits in a neighborhood (tradition, conformity, security) that makes sense in terms of content in Fig. 4.

Peace of mind, on the other hand, is completely contained in the two-dimensional value circle structure. It seems to be a value that complements the structure of universal values in a meaningful way. This shows that the TUV represents a value framework that is open for

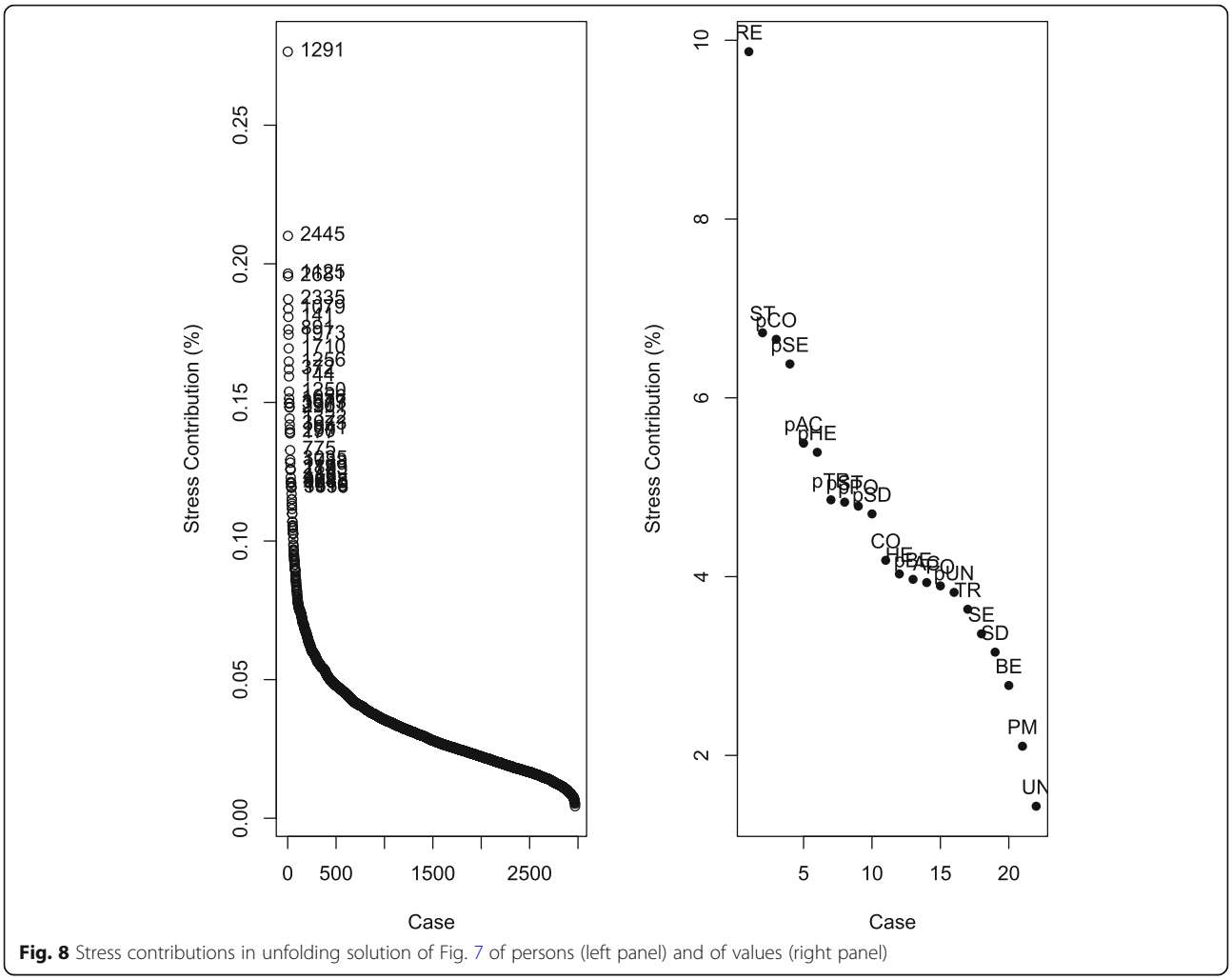

Fig. 8 Stress contributions in unfolding solution of Fig. 7 of persons (left panel) and of values (right panel)

additions. That is, the value circle *easily admits additional values* (or allows for more refined values; see Schwartz et al., 2012) *without changing its structure*, while Klages' dimensional model simply additively adds more and more factors resp. components if additional values are introduced. Borg et al. (2016) also report cases of culture-specific values that complement the TUV values and the value circle.

When analyzing the IVRS and the PVQ data by using the factor analysis approach, the results replicate the predictions of three value dimensions of the Klages' value space for the PVQ data, but, surprisingly, not so clearly for the IVRS data which are based on this theoretical framework. Three dimensions are not sufficient by all standard criteria for the number of factors. Adding more dimensions does not explain much additional variance, but the factors become clearer. However, in the end, factor analysis simply identifies the basic values as a collection of more or less unrelated dimensions: The circular structure of values remains hidden since factor analysis is aiming at "understanding" the value space in terms of dimensions that span the space, not in terms of geometric figures and manifolds within it (Guttman, 1976, p. 103).

In any case, the Klages' value space rests on somewhat arbitrary criteria, namely statistical cutoff criteria for the number of dimensions and not on a psychological theory about how individuals generate value judgments. On the other hand, the value type "active realists"—which was considered an important "discovery" by Klages and his coworkers—does not even require this assumption. If one uses centered ratings, individuals who rate all values highly (relative to the sample mean) also fit into the value circle model, and if one uses uncentered ratings, they would simply be displaced from the plane by a distance that (inversely) corresponds to their mean importance ratings for the various values (Borg & Bardi, 2016).

Numerous versions of the Speyerer Werteinventar exist, and the IRVS set of items is just one example. When analyzing these item batteries by factor analysis, one does not arrive at particularly robust structural insights (Pöge, 2017). Moreover, when we used somewhat

different item subsets of our IRVS data, we always ended up with an additional factor, i.e., with religion. In the MDS analyses, the religion items can at least be roughly embedded into the value circle. This is also true for the peace of mind items. Thus, what the value circle shows is that forming different factors of items may not be the best answer to building a robust theory. Rather, what we find through MDS is that these categories are but markers on a *continuum* of values.

Conclusions

This paper has shown that the PVQ and the IVRS, both developed independently of each other for different purposes, are both valid for either value model, the Schwartz's value circle and the Klages' value dimensions. However, not only the PVQ (which is based on Schwartz's model) but also the IVRS (which is based on the Klages' dimensions) has a better fit to the value circle model. Hence, data collected by either scale should better be interpreted in the sense of the value circle model. This is actually an advantage because the value circle model has various established properties: It not only states a set of universal basic values, but also a particular order of these values on the circle and, in addition, two higher-order groups of values with form opposite arcs on the circle. That does not mean that the values of the PVQ cannot be complemented with additional values such as peace of mind or religion. Such values, however, may be valid for particular groups or for particular cultures only.

Endnotes

[1]Note that these oppositions are sometimes incorrectly called dimensions. "Dimensions," however, imply a two-dimensional real space model that is not compatible with a one-dimensional circular scale or with a circumplex (Borg & Bilsky, 2015).

[2]The reasons for this modification remain unclear, both theoretically and methodologically, see Pöge (2017) for a thorough discussion.

[3]Because we here have 12 and not just 10 basic values, a few items were coded differently. In particular, the items referring explicitly to religion were shifted from UN to RE. Also, item #01 was assigned to PM from previously CO, because adhering to rules does not necessarily mean that this is what others do as well.

[4]Klages and his coworkers actually ran PCA analyses (with varimax or oblique rotations) rather than common FA, even though in their writings they use the term "factor analysis" (not uncommon in those days; see Jolliffe, 1986). In the more recent studies, Klages et al. used PCA with subsequent *k*-means cluster analyses with a given starting configuration on the PCA scores (Klages & Gensicke, 2005). However, the details are not clearly documented. We here also run PCA rather than common FA to be consistent.

[5]MDS is a statistical method that optimally represents proximity data (here, the inter-correlations among value items) as distances among points of an n-dimensional geometric space (here, $n = 2$), see Borg and Groenen (2005) and Borg et al. (2018).

[6]Unfolding is a statistical method that optimally represents preference data as distances among the points representing the persons and the values, respectively, in an n-dimensional space (here, $n = 2$). A person points lies the closer to a value point, the higher the person rates the value's importance. The strongest, most testable, and most robust version of the model considers the data to be ratio-scaled (see Borg et al., 2018). This is the model we used.

[7]The details of the results of the PCAs can be found in Additional file 1.

[8]Technically, we used ordinal MDS with an idealized value circle with equidistant neighboring points on the circle as an initial configuration ("weak confirmatory MDS"). However, not using this initial configuration and starting with random configurations or with one of the usual rational configurations leads to the same results. The global model fit is always assessed in terms of Stress-1, as it is standard in MDS (Borg et al., 2018).

[9]Differences were optimally minimized by Procrustean methods. A Procrustean transformation fits one configuration to another by means of rotations, reflections, and central dilations/shrinkages. It therefore eliminates meaningless (i.e., not data-based) differences between these configurations (see Borg & Groenen, 2005). Such cosmetic transformations make it easier to compare two configurations.

[10]If a perfect circle is enforced in a confirmatory way using spherical MDS (see Borg et al., 2018), the configuration changes little and its stress goes up from .09 for the exploratory solution to .14 for the perfectly circular solution for the 22 points. Theoretically, however, there is no reason to request a perfect circle but only a "circular" configuration (with a particular order of points). And statistically, one needs to admit measurement errors too.

Additional file

Additional file 1: The details of the results of the PCAs. (DOCX 26 kb)

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Availability of data and materials

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Authors' contributions

The authors' contributions correspond to the order in which the authors are listed. All theory construction, writings, and statistical analyses were done by IB. DH contributed the data. WB contributed to the critical readings of various versions of this paper. AP provided expert advice on Klages' model. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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