

CONSIDERATIONS ON MEASUREMENT OF THE BIPOLARITY OF PSYCHOSEMANTIC SCALES*

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Most studies in the field of *psychosemantics* (see Petrenko, 1997) conducted in the past have been using sets of *bipolar scales* introduced by Osgood (Osgood, Suci & Tannenbaum, 1957), *constructs* in terms of Kelly (1955). However, the question arises whether the bipolar scales consisting of two antonymic adjectives are truly *bipolar*, that is, whether a subject is able to recognize and rate an object unambiguously as related more strongly to one of the opposites given and less to the other. For instance, if a person rates some object on the «good vs. evil» scale as «medium», it is usually interpreted by the researcher as «neither (very) good, nor (very) evil». It seems possible though that in the case of two *unipolar* scales («good» and «evil») presented separately the subject might rate the same object either high or low on both scales at once.

The case when the same object is highly rated on two separate antonymic unipolar scales is generally referred to as *ambivalence*. This concept originally appeared in the field of attitude research and several different formulae to measure ambivalence have been suggested since (Scott, 1966; Kaplan, 1972), but the advantages and limitations of particular measures are still being studied (Riketta, 2000). Attitude studies often rely upon different variations of the simple positive vs. negative evaluation scale, whereas psychosemantic research usually uses a much wider set of scales of different nature (evaluation as well as sensory qualities), hence more advanced indices are required in order to mathematically measure and assess the way these scales behave upon different sets of objects.

The results of psychosemantic research are usually represented by a data cube with scales, objects and subjects as dimensions. Suppose $(X_+(s, o, i); X_-(s, o, i))$ is the pair of grades the subject i has given to the same object o on two antonymic unipolar scales which constitute a bipolar scale s . These grades are integer values in the range from 0 to N , where N expresses the «*quality is present to the maximum degree*» opinion and 0 expresses the «*quality is not present at all*» opinion, the

in-between grades corresponding to the different degrees of the quality's presence in the object.

If the extremes of the scales are truly antonymous for the subject i when applied to the object o , the grades should lie upon the line defined by the equation $X_+(s, o, i) = N - X_-(s, o, i)$. Two reservations should be made: 1) in the case the grades' regression curve is not linear, we propose a correction for linearity to be applied, and 2) the bias caused by peculiarities of the subjective evaluation strategy can be eliminated by normalizing the subjective distribution of grades to the mean and standard deviation of the scale.

If the grades are close to the line defined above, this is the case of *bipolarity*. If both grades are above average, the point $(X_+(s, o, i); X_-(s, o, i))$ lying above the line mentioned, this is the case of *ambivalence*. If both grades are below average, the point $(X_+(s, o, i); X_-(s, o, i))$ lying below the line mentioned, this is the case of *irrelevance*. The terms bipolarity, ambivalence and irrelevance are defined for any pair of grades, but can be generalized as properties of the scale, the object or the subject. Measures relevant to each of the three states would allow a researcher to assess, for instance: 1) the relevance (bipolarity) of the scale to a given set of objects; 2) the ambivalence of an object as rated by subjects in general; 3) the ambivalence (as defined in attitude research) of a subject towards certain objects or scales.

The easiest and most practical way to assess bipolarity is by correlating positive and negative ratings. The drawbacks of this method are 1) it can only be applied to two-dimensional data, hence the need for averaging over the third dimension in the data cube; 2) it does not allow to discern between ambivalence and irrelevance. The measures we suggest below 1) can be applied to any pair of values (averages or individual grades) and generalized for any needed (scale, object or subject) dimension of the cube by adding or averaging them, and 2) allow to discern between ambivalence and irrelevance.

The first index we suggest is a measure of ambivalence / irrelevance vs. bipolarity. It uses normalized grades ($=0, =1$) and is defined by the equation:

$$Amb_1(s, o, i) = \sin(2 * \arccos(\frac{X_+}{\sqrt{X_+^2 + X_-^2}}) * \frac{X_-}{|X_-|}) * \sqrt{X_+^2 + X_-^2}.$$

Ambivalence / irrelevance is calculated simply as a function of the angle tangent of the line section which goes from $(0; 0)$ to $(X_+(s, o, i); X_-(s, o, i))$ (which equals -1 in case of extreme bipolarity and 1 in case of ambivalence / irrelevance) and the length of this sec-

tion (which corresponds to the magnitude of the ambivalence observed). Normalization allows to compare the magnitude of the ambivalence observed between the studies using different scales.

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The second index we suggest measures ambivalence vs. irrelevance / bipolarity. It uses raw grades and is defined as follows:

$$Amb^2(s, o, i) = \sin(2 \arcsin(\frac{X_-}{\sqrt{X_+^2 + X_-^2}})) \sqrt{X_+^2 + X_-^2}.$$

The behavior of the two measures is summarized in the table below. By applying the two together to the same data, a researcher can discern between ambivalence, irrelevance and bipolarity:

Grades	Interpretation	Amb ₁ is...	Amb ₂ is...
$X_1 > X, X_2 > X$	ambivalence	$> > \mathbf{0}$	$> > \mathbf{0}$
$X_1 > X, X_2 > X$	indefinite	~ 0	~ 0
$X_1 > X, X_2 > X$	irrelevance	$> > \mathbf{0}$	$< < \mathbf{0}$
$X_1 > X, X_2 > X$	indefinite	~ 0	> 0
$X_1 > X, X_2 > X$	indefinite	~ 0	< 0
$X_1 > X, X_2 > X$	bipolarity	$< < \mathbf{0}$	$< < \mathbf{0}$

In order to assess the validity of our measures, we applied them to the data obtained by Klauer & Musch (1999), who studied the evaluation of 92 German nouns on positive and negative scales. Both Amb₁ and Amb₂ demonstrated high and significant correlations ($r = .71$ to $r = .94$, $p < .001$) with measures proposed by Kaplan and Griffin, as well as with reaction time ($r = .66$ and $r = .51$, respectively, $p < .001$) which was used by the authors of the original research as an external criterion of ambivalence.

The measures were then applied to the data gather in our own psychosemantic research of the values conducted in 2004–2005, in which the subjects (psychology and physics students, $N=159$) were asked to evaluate the values suggested by Rokeach (1973) on a number of unipolar scales (5-point). The most bipolar scales turned out to be those we supposed would be most relevant to values (e.g., «unimportant vs. important», «socially favoured vs. socially disapproved»); most ambivalent were scales we interpreted like truly unipolar (e.g., «masculine vs. feminine» and «personal vs. social»), and the most irrelevant to values were scales of more sensory nature (e.g., «slow vs. fast», «smooth vs. abrupt»). The data processing is still underway, but the results already obtained indicate that the measures we proposed are valid and practical for any researcher who wants to find out which of the scales they chose are the most appropriate for their set of objects.

The measures described above are not final and

definitive; they can be elaborated by any researcher in order to accommodate better the needs of his own research. The statistical criteria similar to normality tests may be developed in order to test hypotheses about bipolarity of the scales, which would allow to compare and combine the data provided by different studies.

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