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ARE OPPOSITES UNIDIMENSIONAL?

Roberto Burro, Ugo Savardi & Ivana Bianchi

Many areas of research in Psychology are based on the implicit assumption that opposites lie at 2 extremes of the same continuum—e.g. semantic differential scales (Osgood, Suci, & Tannenbaum, 1957; Heise, 1970) and Likert scales (1932); just think, for example, of the use of "long" and "short" as parts of the same dimension 'length'. The question of unidimensionality represents an interesting issue not only for methodology, but also, and mostly, represents a point of interest in the Psychology of Perception or Cognition.

From the 1970's onward, the study of opposites in Experimental Psychology has coincided, in particular, with the analysis of antonyms, shifting attention thereby from the empirical-perceptual foundations of this relation to linguistic rules. Savardi & Bianchi (1997, 2000, 2003, 2004a) have recently proposed an investigation on the perception of opposites that focuses on the phenomenal structures of experience, by starting from Gestalt assumptions concerning the direct perception of relations. Hence, it is within this frame of reference that the present study examined whether pairs of opposite properties do or do not lie on the same dimension.

In 1967, Mosconi raised the issue of the fundamental difference that exists between phenomenal opposites (high and low, near and far, etc...) and the unidimensional structures that are used in their place in certain contexts (e.g., height and distance, with respect to the above examples). He maintained that these properties are not actually unidimensional in everyday language and phenomenal use. In a similar vein, Kennedy (2001) analyzed and interpreted the distribution of antonym adjectives in comparative linguistic constructions and proposed a model in which degrees of a property are considered scale intervals.

There has long been a need (Campbell, 1920; Wright & Masters, 1982) to use psychometric instruments to validate the true dimensionality of a given construct. In the present work, we used a metrical measurement method, based on concrete objects, to examine whether the opposite pairs of *high-low*, *wide-narrow*, *long-short*, and *large-small* would emerge as unidimensional scales (Luce, Krantz, Suppes, & Tversky, 1990).

Our model

The Extended Logistic Model (ELM, Andrich, 1978a, b; 1988; Rasch, 1960/80) was selected, as this method makes it possible to define which objects incorporate a given characteristic (e.g., "length"), and the extent to which they do so, and quantifies the probability that an object positions itself on an interval logit scale (see Burro, 2006). These scales are obtained by asking participants to express separate judgements for both poles of each pair, i.e. to indicate the degree of "length" and the degree of "shortness" that the same objects show on a graduated scale (ranging from 0 to 7). In this way we obtained 8 measurement scales, one for each property examined. Each degree on each scale is represented by objects that the ELM has determined to be fit in that specific dimension. The ELM calculates two indexes on the same continuum: a β value indicating the participants' discriminative ability, and a δ value which represents the ease/difficulty of experimental objects to convey a specific spatial characteristic (Andrich, 1978a, 1978b). Bond (2001) proposed a procedure that starts from the β-logit values - e.g., for the spatial dimensions of "long" and "short" - and converts the ones into the others. Then it estimates the degree to which these values approach the y=x identity function. When it significantly approximates the identity function, we can conclude that the two compared scales measure the same quality and lie at opposite poles of the same dimension; when it significantly deviates from the identity function beyond a specific confidence interval, we can conclude that the two opposites measure different qualities.

The Experiment

Phase 1: 43 university students (aged 18 - 57 years) were shown 24 photos of objects (grey scale, 6 x 5 cm each) presented on two A4-size sheets of paper. The task required that participants attribute a score expressing the extent to which the property was shown in each drawn object (the drawing was used as an "evoker" of real objects of that type). The ELM application to the data made it possible to conclude that 19 of the 24 objects examined were good measurers of at least one property. It is important to note that "good measurer" does not necessarily mean having a great quantity of a given property, but that the property is expressed in some way.

Phase 2: The above-described experimental procedure was repeated with aim of increasing the number of "good measurer objects" available for the 8 dimensions, by presenting 24 drawings to a different group of participants (38 university students, aged 18 - 45 yrs.). Nineteen of the drawings were the same as used in Phase 1 (the ones found to be "good measurers"), and 5 drawings were new. The ELM application to the data confirmed that all 24 objects examined were considered good measurers for at least one of the examined properties.

Results

The responses provided in the two phases yielded 8 scales upon which participant ability to capture a given/specific spatial characteristic and ease/difficulty of the objects to express that property were localized and expressed in logit. Bond's above-described procedure was applied to these eight metrical scales, in order to compare the opposite pairs.

As shown in the graphs, no identity relation was found for the opposite pairs examined: each of the linear functions calculated and shown in the figure fell outside the critical range (in Figure 1, the area lying between the hatched lines)--i.e., outside the area of an acceptable 95% probability that the two compared spatial dimensions measure the same dimensional continuum. These results suggest that the opposite dimensions examined do not represent the extremes of a single spatial dimension, but

refer rather, to independent dimensions. Therefore, to measure two opposite spatial dimensions, it is necessary to use the two distinct scales—in the same way we use a thermometer to measure temperature and yardstick to measure distance.

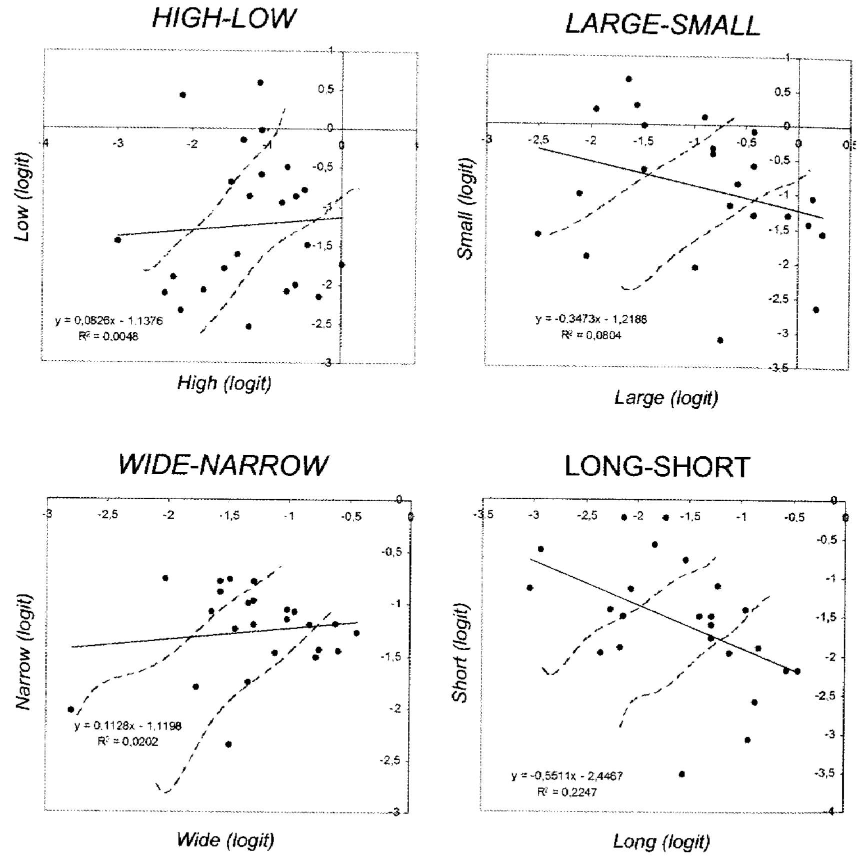

Fig. 1 - Relationship between the contraries "high" and "low", "large" and "small", "wide" and "narrow", and "long" and "short" (in β–logit). In each graph the area in between the broken lines represents the area of acceptance of the hypothesis that the two scales measure the same quality.

Conclusions

Our findings point to new perspectives for investigating the behavior of perceived opposites, which also have specific consequences for psychometric methods that use scales based on pairs of opposite adjectives. Yet, it is important to note that our verification of the absence of unidimensionality for all 4 pairs of opposites means acknowledging the existence of a separation between the two dimensions, but *not* the absence of relation between the two.

Summary

Research on the pairs: high-low, big-small, narrow-wide, and long-short was carried out to verify the validity of the assumption that bipolar scales are unidimensional. The results reveal that these opposite properties do not seem to lie in unidimensional continuums.

Zusammenfassung

Ein Versuch mit den Paaren hoch-niedrig, groß-klein, schmal-breit und lang-kurz wurde durchgeführt, um die Gültigkeit der Annahme zu überprüfen, dass bipolare Skalen eindimensional sind. Die Ergebnisse weisen darauf hin, dass diese gegensätzlichen Eigenschaften nicht auf einem eindimensionalen Kontinuum liegen.

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See Contribution *Contrariety as a Perceptual Relationship* in this Volume