**WORKSHOP ON CARD SORTS  
REFERENCES AND ADDITIONAL READINGS**

[Articles referred to in the presentation are indicated with an \*. Articles that are particularly helpful for those exploring this methodology are highlighted in bold.]

**Fincher, S. and Tenenberg, J. (2005). “Making Sense of Card Sorting Data,” Expert Systems 22 (3): 89-93.**

Among the knowledge elicitation techniques card sorting is notable for its simplicity of use, its focus on subjects’ terminology (rather than that of external experts) and its ability to elicit semi-tacit knowledge. Card sorting involves categorizing a set of pictures, objects or labeled cards into distinct groups using a single criterion. This paper focuses on the challenges associated with analyzing the data that result from card sorts, especially when large data sets are generated. Traditional semantic analysis methods that require direct researcher interpretation of elicited linguistic terms are distinguished from methods that are purely syntactic, and hence can be automated. Each paper within this special issue is summarized and its contribution to card sorting in general, and data analysis in particular, is highlighted. The set of novel computational techniques presented in several of the papers in this issue is examined. The paper concludes by noting that even large-scale data sets can be meaningfully analyzed by combining well-known interpretative methods with the new computational approaches presented within this special issue.

\*Giles, H., Llado, N., McKirnan, D.J., and Taylor, D. M. (1979). “Social Identity in Puerto Rico.” International Journal of Psychology 14: 185-201.

Abstract: This study examines the social identity of 384 high school students from four age levels (10, 12, 15 and 17 years-old) in Puerto Rico. This complex society represents an interesting context because of the potential relevance of a number of dimensions for identity including language, cultural heritage, economic status, religion and political beliefs. An important methodological refinement is introduced in order to permit simultaneous examination of these various dimensions in terms of Puerto Rican identity. Three major dimensions of the students' social identity emerged from multidimensional scaling analyses and these were seen to contrast with previous research on ethnic identity in Canada, the United States and Wales.

Green, R. and Manzi, R. (2002). A comparison of methodologies for uncovering the structure of racial stereotype subgrouping. Social Behavior and Personality 30 (7): 709-728.

Abstract: Our goal was to initiate a series of explorations of the techniques used to investigate person perception and stereotypes. More specifically, do different techniques uncover the same, and assumedly correct, underlying cognitive structure of the perceivers or is our current understanding of social cognition merely a reflection of our data collection and analytic techniques? We also hoped to draw some conclusions concerning White participants' perceptions of Blacks. Participants were given two tasks. One task involved sorting fourteen racial type labels and rating the sorted piles on four scales (e.g., respectable-not respectable). The second task involved generating attributes that described a randomly selected racial type. Both tasks provided data that could be used as input for multidimensional-scaling and hierarchical-clustering analyses. Further, the data from the adjective-generation task was used as in put for a discriminant-function analysis. It was predicted that the different data collection and analysis tasks would produce results that emphasized the importance of evaluation in racial type perception but that the sorting task: would reveal more prejudice against Black targets. The results supported the hypotheses.

Isenberg, D. & Ennis, J.G. (1981). Perceiving Group Members: A Comparison of Derived and Imposed Dimensions. Journal of Personality and Social Psychology 42(2): 293-305.

Abstract: Three studies compared two methods for spatially representing the perceived internal structure of small groups. Bales' Systematic Multiple Level Observation of Groups (SYMLOG) imposes three a priori dimensions of interpersonal behavior—dominant versus submissive, friendly versus unfriendly, and instrumentally controlled versus emotionally expressive. Multidimensional scaling (MDS) derives dimensions on the basis of perceived similarity of group members. Each of three studies demonstrated substantial and statistically significant overlap between the SYMLOG and MDS dimensions. In particular, the first MDS dimension was highly correlated with the axis of greatest differentiation in the SYMLOG space. These findings are discussed in terms of psychological salience and the behavioral attributes underlying the three SYMLOG dimensions. Suggestions for future small group research are made.

\*Lowes, S. (1994). The peculiar class: The formation, collapse, and reformation  
of the middle class in Antigua, West Indies, 1834-1940. Ph.D. diss., Columbia University.

Nielsen, J. “Card Sorting: Pushing Users Beyond Terminology Matches.” Online at <http://www.useit.com/alertbox/word-matching.html>

\*Roos, G. (1998). “Pile Sorting: Kids Like Candy.” In V. D. de Munck and E. J. Sobo, eds., Using Methods in the Field: A Practical Introduction and Casebook. Walnut Creek, CA: Altamira Press.

**Rosenberg, S. & Kim, M.P. (1975). The Method of Sorting as a Data- Gathering Procedure in Multivariate Research. Multivariate Behavioral Research (October).**

Abstract: This study compares two basic variants of the sorting method; single-sort in which each respondent is given only one opportunity to sort the items; and multiple-sort in which the respondent is given several opportunities to sort, each time on a different basis, Kinship terms serve as stimulus materials. Multidimensional scaling solutions show large differences between the two methods with respect to the degree to which the kinship dimensions are used as a basis for sorting. In particular, most respondents ignore. the most obvious dimension (sex of the terms) when they believe they have only one opportunity to indicate the dimensions in the set. Similar observations of pairwise judgments in another stimulus domain (consonant phonemes) suggest the same bias may be present in such judgments. Moreover, in both instances hierarchical clustering completely fails to represent the minority of judges who do not ignore the given dimension. These results indicate that a multiple set of judgments from each set of respondents may be superior to a single set of judgments for certain stimulus domains. Finally, the kinship data also indicate that male and female respondents emphasize different kinship dimensions but that aggregated multiple-sort data do appear to reflect the cognitive dimensions present in any given individual.

**Rugg, G. & McGeorge, P. (1997). The sorting techniques: a tutorial paper on card sorts, picture sorts and item sorts. Expert Systems 14 (2): 80-93.**

Abstract: Although sorting techniques (e.g., card sorts) are widely used in knowledge acquisition and requirements acquisition, they have received little formal repertory grids and laddering. This paper describes the main sorting techniques, then provides a detailed tutorial on one variety (repeated single-sorts), using a worked example. Guidelines for choice and sequencing of techniques are given, both in relation to varieties of sorting technique and in relation to other techniques. It is concluded that the sorting techniques are a valuable part of the elicitor’s methodological toolkit.

Russell, J.A. & Bullock, M. (1985). Multidimensional scaling of emotional facial expressions: Similarity from preschoolers to adults. Journal of Personality and Social Psychology 48(5): 1290-1298.

Abstract: Structural models of emotion represent the fact that we perceive emotions as systematically interrelated. These interrelations may reveal a basic property of the human conception of emotions, or they may represent an artifact that is due to semantic relations learned along with the emotion lexicon. The first alternative was supported by results from a series of scalings of 20 emotional facial expressions, results that could not easily be attributed to word similarity. Similarity data on the facial expressions were obtained from 30 adults and 42 preschoolers. For preschoolers, prior evidence indicates that emotion labels are not readily available; for both groups, we measured similarity without the use of emotion labels by asking subjects to group together people who appear to feel alike. The structure of emotions obtained from both children and adults was as predicted: a roughly circular order in a two-dimensional space, the axes of which could be interpreted as pleasure-displeasure and arousal-sleepiness. The form and meaning of this structure was supported through two additional scalings of the facial expressions with adults: a multidimensional scaling based on direct ratings of similarity-dissimilarity, and unidimensional scalings on the pleasure displeasure and arousal-sleepiness dimensions.

\*Turkay, S., Hoffman, D., Gunbas, N. et al. (2012). Exploring a new approach to visual asset design. In K. Squire, C. Martin, & A. Ochsner (Eds.), Proceedings of the Games, Learning, and Society Conference: Vol. 2. Pittsburg, PA: ETC Press.

Abstract: This paper will present a tool and a method to help game developers make decisions about creating visual assets such as game characters. It will also present results from a series of studies. The first study utilized this research tool to investigate middle school students’ attitudes toward sixty game characters in the area of science, technology, engineering and mathematics (STEM) in commercial games. The second study used the most liked and disliked characters (by gender) determined by the first study in an educational game as science mentors. After presenting the effects of using these characters in motivation of students towards the game, the paper will conclude with research-based implications for educational game designers wanting to maximize motivation through the use of game characters in STEM-related educational games. Readers will also be informed about a method useful for developing visual game assets, and insight about creating characters for STEM educational games.

**Weller, S. and Romney, A.K. (1988). Qualitative Research Methods, vol. 10: Systematic Data Collection. Newbury Park, CA: Sage Publications. See Chapter 3, “Single Sorts,” and Chapter 4, “Successive Sorts.”**

Whaley, A. L. and Longoria, R. A. (2009). “Preparing Card Sort Data for Multidimensional Scaling Analysis in Social Psychological Research: A Methodological Approach.” Journal of Social Psychology 149(1): 105-115.