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Barbara S. Chaparro, Editor

Card-Sorting: What You Need to Know about Analyzing and Interpreting Card Sorting Results

Veronica Hinkle

Summary: This article provides general guidelines for card sorting analysis and interpretation. Tips include how to deal with dual group membership, individual differences, effects of semantic clustering, and items in a miscellaneous group.

INTRODUCTION

Card sorting is a methodology that can be used to capture users' mental models of how information is organized in a software interface. For software and website content, the results also lead to suggestions for navigation, menus, and possible taxonomies (see Courage and Baxter, 2005, for a detailed overview of card sorting). Card sorting requires that participants sort a pile of items (cards) into groups and then name those groups (see Figure 1). Card sorting results typically are summarized across participants to determine what items are being grouped together and what names are being assigned to these groups.

Figure 1. Card sorting exercise.

The following are general guidelines for conducting card sorts:

- Determine what type of card sorting is the most appropriate for what you are trying to accomplish. For example, open card sorting is appropriate to determine what categories users will create and what terms they will use to name them. Closed card sorting is used to validate an existing set of category names and the items that go into each category.
- Choose an appropriate method to collect results. One way to automate card sorting is to use a software application. Our own usability studies have shown us that it is crucial to make sure the application you choose is easy-to-use and intuitive to your target audience.
- Recruit participants who are representative of your user groups. For example, it is important to include users that have varying experience levels with technology and with the content they are sorting.
- Use about 15 users for each cardsorting project, and twice as many participants for big projects (Nielsen, 2004). The number of users will depend on the method of analysis you are planning to

use and the number of user groups you need to consider.
- Determine adequate time for participants to sort the cards based on the number of cards to be sorted. A estimation for 100 cards would be about one hour of sorting. Keep in mind that 100 cards may not a feasible project for online card sorting.
- Provide clear instructions for the card sorting exercise and make the goals for sorting the cards very explicit since the participant's background and experience will affect how they group items together (Medin et al., 1997).
- Ask the participants for their rationale on any dual placement of items and placement into a "Miscellaneous" group.

Conducting a Card Sort

While most cards are easily categorized, there are always a few items that users struggle to place. For example, they may want to place an item into more than one category or they may decide that it does not fit into any category. Alternatively, they may sort the items in a way contrary to the goals of the sort. The following are some ways to deal with these issues:

- **Dual group membership.** Dual group membership means that the participants believes an item belongs to more than one group. The best way to handle dual group membership is to look at the participant's comments on how they assigned dual group membership and their goal for sorting items into groups. This will help you establish why participants are placing items into two different groups. Some ways to implement these findings may require renaming the item or the group. If there are enough items with dual membership, then you should consider creating a new group that will include these items. You should also consider whether the items and group functions are too ambiguous. If they are, then they should be redefined to be more exclusive.
- **Miscellaneous Group.** It is typical for participants to put ambiguous items into a "Miscellaneous" group. Collect and record comments from the participants as to why they put items in such a group. In many cases, this may be indicative of the item names being unclear and that they may be interpreted differently by different users.
- **Individual Differences.** Individual differences, such as experience and level of expertise, often contribute to the different rules that individuals use when sorting cards into groups (Simon et al., 1995). Less experienced individuals, for example, might tend to lump items into more general groups, whereas experts may place items into groups and subgroups analogous to a more complex classification structure. Including participants that represent a wide range of experience will ensure that many mental models are represented in the information structure. In our card sorting studies, we have compared dendograms of item groupings for each of the different experience user groups. This comparison enabled us to see what menu items were particularly salient based on technology experience so that we could include them for that particular group as part of the menu structure.
- **Semantic Clustering.** Words have semantic meanings that force some people to group words by similarity of meaning rather than according to the goal of the sorting exercise. This is likely to happen if there are many items to group. For example, suppose a participant is sorting titles of articles into groups (with the ultimate design goal of creating an intuitive table of contents). They may read the titles (or names), sort items based on the goal, and then revert to semantic clustering out of habit. The goal of the card sort needs to be emphasized so that participants are aware of natural tendencies to cluster words by their semantic meaning. One way to minimize semantic clustering effects is to provide a definition for the card in addition to the name. This is particularly important if you are using terminology to create a menu structure for which there are no set "standards," such as with cell phone menu structures.

Analyzing Card Sorting Results

There are many ways to analyze item groupings ranging from simple frequency counts to complex statistical analyses.

- **Frequency.** This is as simple as adding all the items participants put in a group and then doing a frequency count. Items with similar group names should be added into one big group with a representative name. If there is no consistency in group naming, then it is best to group these items as a Miscellaneous group and make note of some of the names participants used to describe the groups.

- **Hierarchical cluster analysis.** This is typically used to create a proximity matrix or a dendogram, and it is the most common method used to analyze card sorting results. Proximity matrixes provide a measure of how close or similar two items are to each other. They are very useful when there are less than 10 items to compare. However, when there are more than 10 items, it is much more difficult to see how close items are to each other and determine whether they belong in the same group because the matrix table gets cumbersome. See Table 1 for an example of a simple 4-item proximity matrix.

Table 1. Simple proximity matrix

	Cat	Dog	Bird	Lion
Cat	1	.5	.01	.7
Dog	.5	1	.01	.3
Bird	.01	.01	1	.01
Lion	.7	.3	.01	1

Proximity matrixes can be used to create a tree diagram or dendogram. This is a more useful method to analyze cardsorting results because it lets you visualize how items are grouped. It allows for simple “sensemaking” of the information, and the analysis becomes more intuitive. Depending on the software program, tree diagrams or dendograms may be adjustable, such as in EZSort™, a program originally developed by IBM. See Figure 2 for an example of a tree diagram or dendogram from EZSort™.

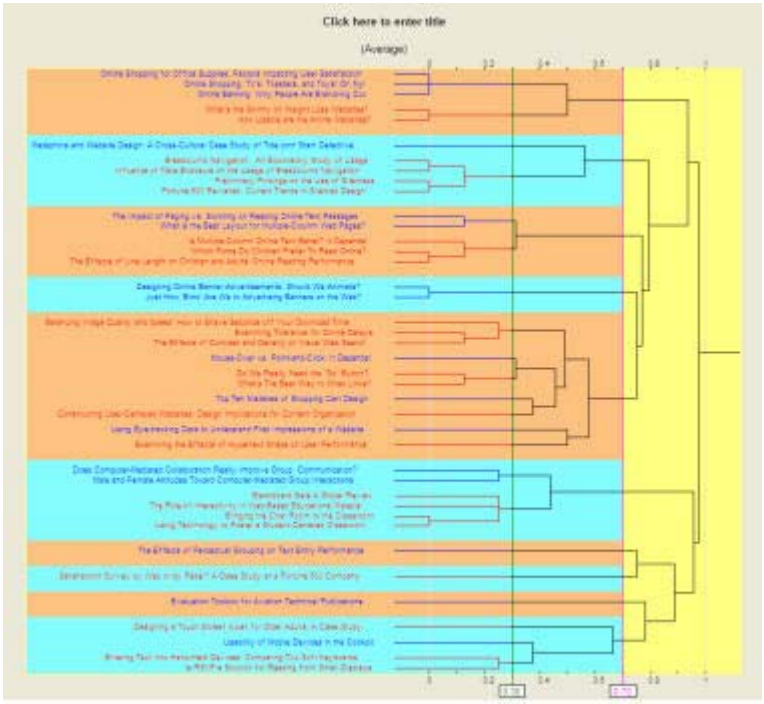

Figure 2. Tree diagram from EZSort™

Proximity matrixes, dendograms, and tree diagrams help create a taxonomical hierarchy for the items being grouped. During analysis, it is important to keep in mind that the artificiality of taxonomies makes it very difficult to define exact rules for determining group membership.

Because hierarchical cluster analysis operates under the assumption of exclusive group membership, it is not possible to enter dual placement of items as part of the data. This requires that one keep track of the dual placements by hand and incorporate this information when interpreting the results.

- **Factor Analysis.** This technique is useful when the card sorting results represent a large, complex system with many groups and subgroups because it allows for dual group membership (see Christian et al., 2004 and Capra, 2005). This means that they can offer more specific representations of groups, subgroups, and items that users may place in more than one group.

  One drawback is that Factor Analysis requires more technical knowledge of the statistics involved, as well as knowledge of the assumptions required to make the analysis sound. Failure to understand the limitations of Factor Analysis and meet its assumptions compromises the validity of the results. (See Chapter 1 of Catell, 1978, and Preacher & McCollum, 2003, for more information on Factor Analysis.) Capra (2005) explains step-by-step how to prepare open card sorting data for factor analysis and interpret the results
- **Hybrid method.** If the system or website that you are designing is very large or complex, and the idea of using factor analysis seems too daunting, you can use a 4-stage model for card sorting of 500 items proposed by Nakhimovsky, Schusteritsch, and Roden (2006). Nakhimovsky et al. first researched the current uses for the Google Adword Help Center, and then asked domain experts (usability analysts and customer service representatives) to sort all of the cards. Once the domain experts sorted the cards, they created a subset of cards for end-users to sort. This subset of cards was selected because of dual group membership or because the domain experts were not sure where to put them so that it would make sense to the end users. The sort conducted by the end users was critical to ensuring that groups were created based on the end users' mental models. The researchers entered the card sort results by experts and end users into spreadsheets to prepare the data for analysis. One spreadsheet contained each item with an assigned ID while the others contained the card sorting results from domain experts and end users. The category, subcategories, and dual membership were noted on these spreadsheets. The results were analyzed by printing lists from these spreadsheets and identifying patterns and common issues within categories.

Traditional Methods for the Analysis of Card Sorting Results

Domain complexity, time, effort, and ease of use influence what tool you choose to analyze card sorting results. Special consideration should be given to how the software program presents the results, since this determines how efficiently they can be analyzed. Deciding what software application to use to create proximity matrixes and dendograms or conduct factor analyses is not as easy as it seems. As a general rule, it is best to choose software that allows you to manipulate the number of clusters for the dendograms and has good explanations for the output generated.

There are many free and commercial card sorting applications available through the Internet that use hierarchical cluster analysis to analyze results, such as OpenSort (www.themindcanvas.com), OptimalSort (www.optimalsort.com), CardSort (www.cardsort.net), CardZort (www.cardzort.com), WebSort (http://www.websort.net), and XSort (http://www.ipragma.com). All of these applications vary in interface design, the number of items they can sort, and the outputs they generate. Statistical software such as SPSS, SAS, or R is needed to conduct a cluster or factor analysis. There are many electronic card sorting applications available to practitioners today. A summary of these programs are provided in Table 2.

Table 2. Electronic Card Sort Applications

Application (URL)	Platform	Availability
CardZort (www.cardzort.com)	Windows	Commercial product
WebSort (www.websort.net)	Web-based	Commercial service

OpenSort (www.themindcanvas.com)	Web-based	Commercial service
OptimalSort (www.optimalsort.com)	Web-based	Commercial service
SynCaps (www.syntagm.co.uk/design/syncapsv2.shtml)	Windows	Commercial product
xSort (www.ipragma.com/xsort)	MAC OS X	Commercial product
WebCAT (zing.ncsl.nist.gov/WebTools/WebCAT/)	Windows/ UNIX	Free
USort/EZCalc (IBM)[1]	Windows	Free but now archived; no longer supported

[1]While no longer supported, USort/EZCalc has been the model for many of the currently available card sort applications. It is also still used by many practitioners.

CONCLUSION

Interpreting the results of card sorting may seem fairly intuitive yet there are some potential issues that may arise during analysis. Knowing ahead of time how to address issues such as dual group membership, miscellaneous groups, individual differences, and semantic clustering will maximize the benefits of card sorting. This paper provides suggestions on how to identify appropriate ways to analyze and interpret card sorting results. Factor analysis and hybrid methods are alternatives to cluster analysis that are not widely used, but are viable alternatives.

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