

Card Sorting Analysis Techniques

706.414 Seminar-Project

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Agenda

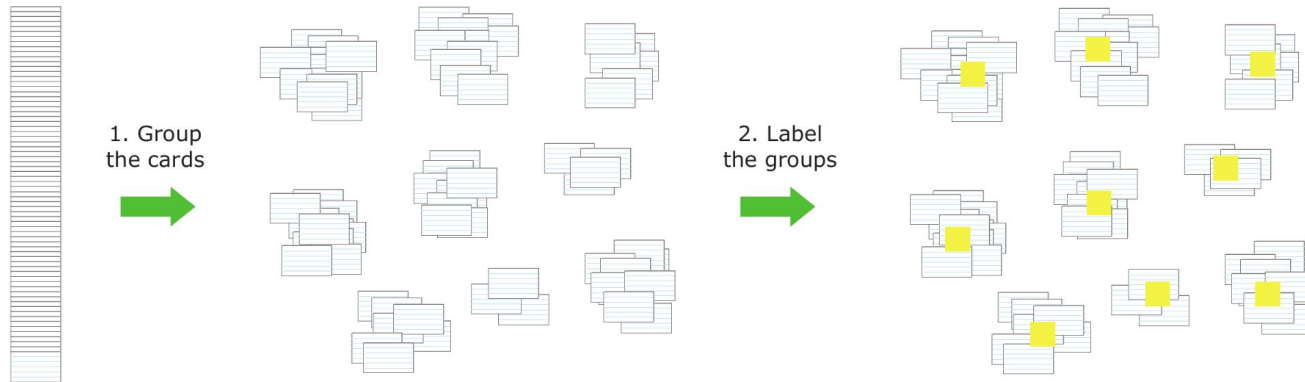
- Introduction
- Manual Analysis
 - Preprocessing
 - Category Standardisation
 - Mindset Management
 - Participant, Card, and Category Statistics
- Statistical Analysis:
 - Similarity and Co-Occurrence Matrix
 - Similarity Map
 - Dendrogram
 - Label Suggestions

Introduction

- What is card sorting? What problem does it solve?
- Create information hierarchies.
- Collaborative technique
- Sort and organise cards into meaningful groups.
- Gives good insight into how users think.
- Open card sorting.
- [Closed card sorting.]

Card Sorting

- Give participants unsorted stack of cards.
- Ask participants to sort cards into meaningful groups
- Ask participants to label the groups.
- Ask participants to explain sorting strategy (mindset).



Used with kind permission of Keith Andrews. Information Architecture and Web Usability. Course Notes. Graz University of Technology, Austria, 17 Oct 2023. <https://courses.isds.tugraz.at/iaweb/iaweb.pdf>

Raw Card Sorting Data

- A typical card sorting result dataset:

Individual sorts of each participant

#	Card	Sort 1	Sort 2	Sort 3	Sort 4
1	Sausages	Fleischwaren	Wurst	Fleischiges	Fisch, Fleisch, Geflügel
2	Beer	Getränke	Getränke Alkohol	Alkohol	alkoholische Getränke
3	Parsley	Gemüse	Gewürze	Gemüse	Gewürze
4	Mustard	Gewürze	Gewürze	Würzen	Essig, Öl, Saucen
5	Hand Cream	Toilettartikel	Hygiene	Körperpflege	Pflegeprodukte
6	Teabags	Grundnahrungsmittel	Getränke alkoholfrei	Tee & Kaffee	nicht alkoholische Geträ
7	After Shave	Toilettartikel	Hygiene	Körperpflege	Pflegeprodukte
8	Honey	Süßigkeiten	Gewürze	Frühstück	Frühstück
9	Whipping Cream	Süßigkeiten	Milchprodukte	Kühlregal	Milchprodukte
10	Biscuits	Süßigkeiten	Nascherei	Naschen	Naschen
11	Strawberries	Obst	Obst	Obst	Obst
12	Walnuts	Nüsse	Nüsse u.ä.	Backen	Nüsse
13	Cucumbers	Gemüse	Gemüse	Gemüse	Gemüse
14	Beef	Fleischwaren	Hauptspeisen	Fleischiges	Fisch, Fleisch, Geflügel
15	Kitchen Roll	diverse	Hygiene	Haushalt	Sanitärbedarf
16	Apple Juice	Getränke	Getränke alkoholfrei	Anti-Alkohol	nicht alkoholische Geträ

List of all used cards

Category labels

Card Sorting Analysis Goals

- Spot key patterns in your data.
- Derive useful insights for your project.
- Improve your information architecture.
- Understand how your users think.
- People group items in a way that makes sense to them.
- Understand the user's mindset.

Types of Card Sorting Analysis

- Manual analysis:
 - Intuitive and creative.
 - What groups do people form? (categories)
 - Identify the user's mindset (grouping strategy).
 - What labels and descriptions were used?
 - Card placement - which card is placed into which group?
 - How accurately participants have grouped the cards?
- Statistical analysis:
 - Identify most consistent pattern.
 - Compare results from different groups of people.
 - Justify a recommendation.
 - Use of statistical methods (e.g. hierarchical clustering, k-means).

Manual Analysis

Card Sorting Analysis Process

- Exclude outlier sorts.
- Identify the participants mindset:
 - Participants may have used a different grouping strategy.
 - Split data by mindset (= grouping strategy).
 - Analyse one mindset at a time.
- Category standardisation:
 - Merge similar groups and give them a single meaningful name.
- Standardised matrix for each mindset:
 - Sorts of this mindset with standard category names.

Exclude Outlier Sorts

- Outlier sorts can negatively affect results:
 - e.g. participants, who did not make a serious attempt.
- Hard to spot outlier sorts, some rules of thumb:
 - Number of categories: Too few or too many, compare to average.
 - Vague category labels (e.g. “stuff”, “miscellaneous”).
 - Duplicate or synonymous category labels.
 - Time taken: Unusually short or long time.

Participant Statistics

<input type="checkbox"/>	Participant	Status	Time taken	Question responses	Cards sorted	Categories created	Categories named	
<input type="checkbox"/>	Participant 1	Completed	23:16	0	100%	17	100%	Exclude from results
<input type="checkbox"/>	Participant 2	Completed	28:13	0	100%	26	100%	Exclude from results
<input type="checkbox"/>	Participant 3	Completed	13:00	0	100%	10	100%	Exclude from results
<input type="checkbox"/>	Participant 4	Completed	14:39	0	100%	17	100%	Exclude from results
<input type="checkbox"/>	Participant 5	Completed	9:43	0	100%	17	100%	Exclude from results

Screenshot taken from Optimal Workshop
<https://www.optimalworkshop.com/>

Card Statistics

Analyse card placement:

- Categories: # categories each card sorted to.
- Frequency: # participants who placed each card in a category.
- Position: Average position (rank) of card in group [optional].

Card	Sorted into	Categories	Frequency	Position
After Shave	1 category	Personal hygiene	5	6.2
Almonds	3 categories	Fruits	3	4.0
		Nuts	1	1.0
		Fruits and Vegetables	1	17.0
Apple Juice	2 categories	Beverages	4	6.3
		Breakfast	1	5.0
Apples	2 categories	Fruits	4	8.3
		Fruits and Vegetables	1	18.0
Bananas	3 categories	Fruits	3	3.7
		Fruits and Vegetables	1	2.0
		Breakfast	1	7.0

Screenshot taken from Optimal Workshop
<https://www.optimalworkshop.com/>

Mindset Management

#	Cards	Sort 1	Sort 2
1	Muesli	Breakfast	Staple food
2	Yoghurt	Breakfast	Milk products
3	Bananas	Breakfast	Fruits
4	Bread Rolls	Breakfast	Staple food
5	Ham	Breakfast	Meat
6	Kitchen Roll	Cooking	Household items
7	Olive Oil	Cooking	Sauces & Spices
8	Salt	Cooking	Sauces & Spices
9	Pepper	Cooking	Sauces & Spices
10	Vinegar	Cooking	Sauces & Spices
11	Potting Soil	Gardening	Household items
12	Cat Litter	Pet-keeping	Pet supplies
13	Dog Food	Pet-keeping	Pet supplies
14	Cat Food	Pet-keeping	Pet supplies
15	Pencils	Workplace	Office supplies
16	Copier Paper	Workplace	Office supplies
17	Sticky Tape	Workplace	Office supplies
Mindset		Activities	Groceries in a Supermarket

- Identify grouping strategy (mindset) used for each individual sort.
- For example: shelf in supermarket, activity of use, ingredients for recipe, country of origin, ...
- Ask user to explain their mindset:
 - In-person (supervised), or post-study question (unsupervised).

Screenshot taken from Keith Andrews; *Card Sorting Analysis Spreadsheet: 100 Products*; Information Architecture Course, FH Joanneum Graz, SS 2016. Unpublished.

Category Standardisation

- Participants use similar but not identical words to describe things.
- Create a list of all categories created by participants.
- Merge categories with similar names or ideas.

Original Category	Standard Category (DE)
Körperpflege	Hygieneartikel
Pflegeprodukte	Hygieneartikel
Sanitärbedarf	Hygieneartikel
Hygieneartikel für den Körper	Hygieneartikel
Hygieneartikel	Hygieneartikel
Artikel-Hygiene	Hygieneartikel
Hygiene/Waschartikel	Hygieneartikel
Körperpflege	Hygieneartikel
Körperpflege	Hygieneartikel
Hygieneprodukte	Hygieneartikel
Toilette-Artikel	Hygieneartikel
hygiene	Hygieneartikel
Drugstore items	Hygieneartikel

Original Category	Standard Category (DE)
Lang haltbare Nahrung	Dosenkonserven
Dosenprodukte	Dosenkonserven
Non-perishable foods	Dosenkonserven
Dosengemüse	Dosenkonserven
Konserven	Dosenkonserven
Dosenprodukte	Dosenkonserven
Vorratskammer	Dosenkonserven
Haltbares (Vorratsschrank)	Dosenkonserven
stored food	Dosenkonserven
stationery	Dosenkonserven
Lang-haltbare Lebensmittel	Dosenkonserven
Cans	Dosenkonserven

Screenshot taken from Keith Andrews; *Card Sorting Analysis Spreadsheet: 100 Products*;
Information Architecture Course, FH Joanneum Graz, SS 2016. Unpublished.

Category Standardisation

Standardized category name

Animal supplies

Agreement

42%



Update your standardized category by including or excluding participant categories.

Categories

Select a category name to show which cards your participant sorted into this category.

Cards

Select a card to show which categories your participants sorted this card into.

Include	Unique Cards	Frequency
<input checked="" type="checkbox"/> Pets	3	Sausages 1
<input checked="" type="checkbox"/> Pet supplies	3	Beef 1
<input checked="" type="checkbox"/> Pet supplies	3	Cheese 1
<input checked="" type="checkbox"/> Animal-based food	10	Butter 1
<input checked="" type="checkbox"/> Animal supplies	3	Milk 1
		Ham 1
		Dog Food 4
		Yoghurt 1
		Eggs 1

- Attention:
 - Always check category's content!
 - Similar name does not necessarily mean similar idea!
- Agreement:
 - Measure of agreement among participants about which cards should belong to a (standardised) category.

Screenshot taken from Optimal Workshop
<https://optimalworkshop.com/>

Category Standardisation

Standardized category name

Animal supplies

Agreement

100%



Update your standardized category by including or excluding participant categories.

Categories

Select a category name to show which cards your participant sorted into this category.

Include Unique Cards

<input checked="" type="checkbox"/>	 Pets	3
<input checked="" type="checkbox"/>	 Pet supplies	3
<input checked="" type="checkbox"/>	 Pet supplies	3
<input type="checkbox"/>	 Animal-based food	10
<input checked="" type="checkbox"/>	 Animal supplies	3

Cards

Select a card to show which categories your participants sorted this card into.

Frequency

Dog Food	4
Cat Food	4
Cat Litter	4

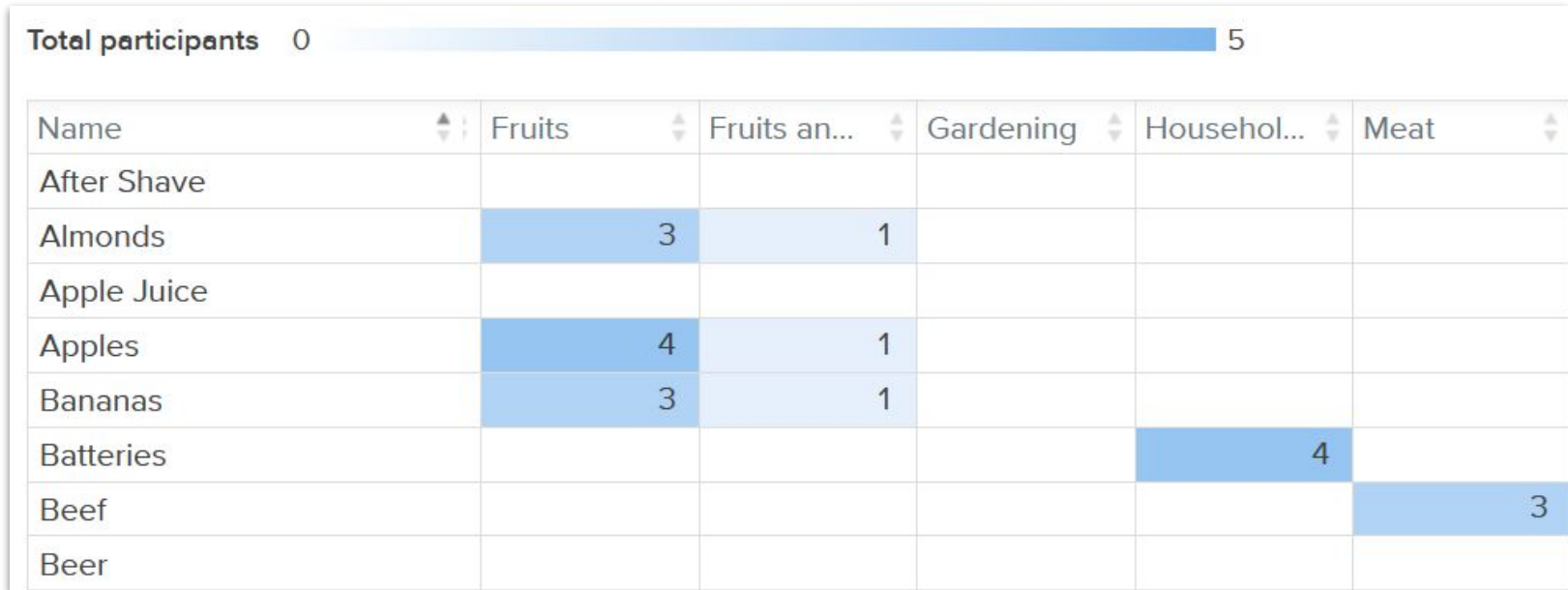
Cancel

Create

Screenshot taken from Optimal Workshop
<https://www.optimalworkshop.com/>

Correlation Count (Standardisation Grid)

- How many participants have sorted a card into a certain category:

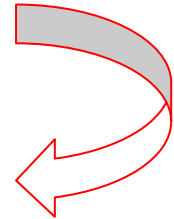


Standardised Matrix

- Transform raw card sort data into standardised matrix.

#	Card	Sort 1	Sort 2	Sort 3	Sort 4
1	Sausages	Fleischwaren	Wurst	Fleischiges	Fisch, Fleisch, Geflügel
2	Beer	Getränke	Getränke Alkohol	Alkohol	alkoholische Getränke
3	Parsley	Gemüse	Gewürze	Gemüse	Gewürze
4	Mustard	Gewürze	Gewürze	Würzen	Essig, Öl, Saucen
5	Hand Cream	Toilettartikel	Hygiene	Körperpflege	Pflegeprodukte
6	Teabags	Grundnahrungsmittel	Getränke alkoholfrei	Tee & Kaffee	nicht alkoholische Geträ
7	After Shave	Toilettartikel	Hygiene	Körperpflege	Pflegeprodukte
8	Honey	Süßigkeiten	Gewürze	Frühstück	Frühstück
9	Whipping Cream	Süßigkeiten	Milchprodukte	Kühlregal	Milchprodukte
10	Biscuits	Süßigkeiten	Nascherei	Naschen	Naschen

#	Card	Sort 1	Sort 2	Sort 3	Sort 4
1	Sausages	Meat	Meat	Meat	Meat
2	Beer	Drinks	Alcoholic Drinks	Alcoholic Drinks	Alcoholic Drinks
3	Parsley	Vegetables	Sauces & Spices	Vegetables	Sauces & Spices
4	Mustard	Sauces & Spices	Sauces & Spices	Sauces & Spices	Dressings
5	Hand Cream	Hygiene	Hygiene	Hygiene	Hygiene
6	Teabags	Staple Food	Non-Alcoholic Drink	Coffee & Tea	Non-Alcoholic Drinks
7	After Shave	Hygiene	Hygiene	Hygiene	Hygiene
8	Honey	Sweets	Sauces & Spices	Breakfast	Breakfast
9	Whipping Cream	Sweets	Milk Products	Fridge	Milk Products
10	Biscuits	Sweets	Sweets	Sweets	Sweets



Screenshot taken from Keith Andrews; *Card Sorting Analysis Spreadsheet: 100 Products*; Information Architecture Course, FH Joanneum Graz, SS 2016. Unpublished.

Standard Category Statistics

1	Standard Category (EN)	Sorters who used this	Total cards in this category	Unique cards	Agreement
2	Alcoholic Drinks	20	112	7	0.80
3	Baking	7	30	13	0.33
4	Breakfast	18	73	26	0.16
5	Canned Food	7	17	19	0.13
6	Cereals	2	5	7	0.36
7	Coffee & Tea	6	13	3	0.72
8	Convenience Products	7	24	24	0.14
9	Dressings	8	32	12	0.33
10	Drinks	12	106	26	0.34
11	Fresh Food	1	14	27	0.52
12	Fridge	3	18	37	0.16

Screenshot taken from
Keith Andrews' spreadsheet

- Agreement = Total cards / (Sorters * Unique cards)
- E.g. 100 % = $12 / (3 * 4)$
 - All 3 participants have sorted the same cards into this category.

Demos

Manual Analysis with Optimal Workshop

https://youtu.be/hN_LNSXIF5Y

The screenshot shows the 'Your categories' section of the Optimal Workshop software. It displays a list of categories with their respective counts and participant numbers. For example, 'Whisky' has 2.0 counts and 1.0 participants, while 'Vodka' has 1.0 counts and 2.0 participants. The interface includes various navigation tabs like 'Cards', 'Categories', 'Standardization grid', and 'Similarity matrix'.

Manual Analysis with Keith Andrews' Spreadsheet

<https://youtu.be/MYGymRESLE>

The screenshot shows a detailed spreadsheet with columns for 'Number', 'Card', and various category codes (F01-FF2). Each row lists a card number and its corresponding category, such as '1 Kneippbeleg' under F01-FF1 and '1 Pack Fleisch, Geflügel' under F03-FF2. The spreadsheet is organized into a grid that allows for manual analysis and categorization of items.

Mindset Management with Keith Andrews' Spreadsheet

<https://youtu.be/3hgqBimqKNc>

The screenshot shows a spreadsheet with columns for 'Number', 'Card', and various category codes (F01-FF2). The rows contain text-based exercises or feedback, such as '94 Fish Fingers' under F01-FF1 and '100 Canned Peas' under F02-FF2. The spreadsheet is used for mindset management and reflection on the analysis process.

Statistical Analysis

Similarity Matrix

- Shows how often two cards are sorted into same category.

	A	B	C	D	E	F	G	H
1	Cards	Sausages	Beer	Parsley	Mustard	Hand Cream	Teabags	After Shave
2	Sausages	38	1	3	3	0	4	0
3	Beer	1	38	0	0	0	9	0
4	Parsley	3	0	38	16	0	2	0
5	Mustard	3	0	16	38	0	4	0
6	Hand Cream	0	0	0	0	38	2	38
7	Teabags	4	9	2	4	2	38	2
8	After Shave	0	0	0	0	38	2	38

Screenshot taken from Keith Andrews; *Card Sorting Analysis Spreadsheet: 100 Products*; Information Architecture Course, FH Joanneum Graz, SS 2016. Unpublished.

Total number of sorts: 38

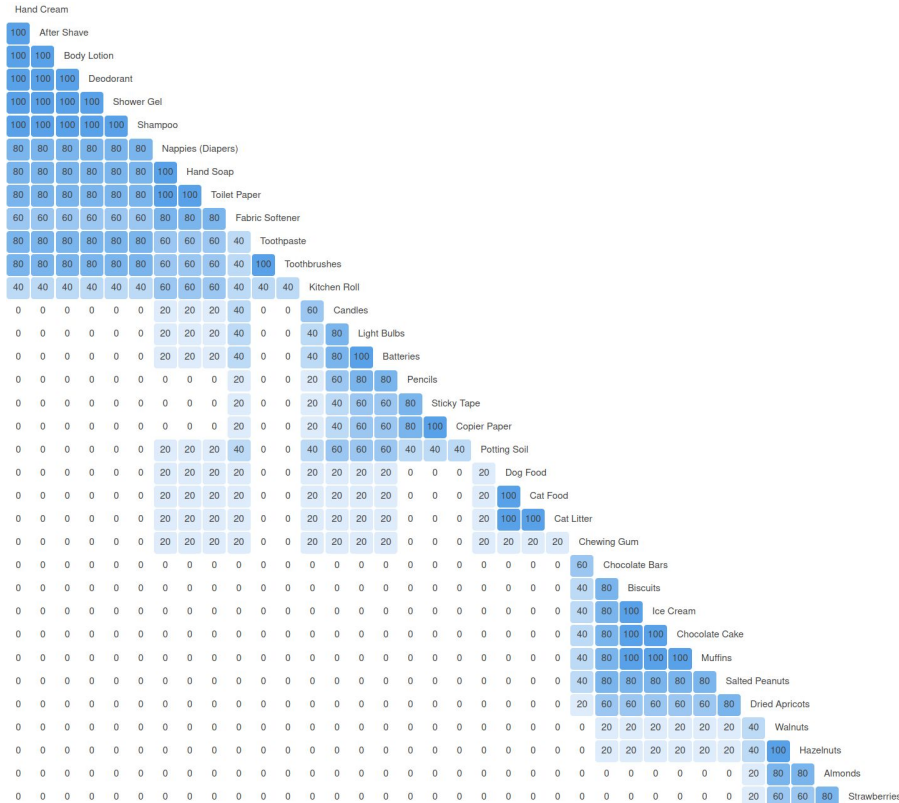
Co-Occurrence Matrix

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1			Sausages	Beer	Parsley	Mustard	Hand Cream	Teabags	After Shave	Honey	Whipping Cream	Biscuits	Strawberries	Walnuts	Cucumbers	Beef	Kitchen Roll	Apple Juice	Red Wine	Frozen Pizza	Body Lotion	Bread Rolls	Strawberry Jam	Ice Cream	Candles	Vinegar	Chocolate Bars	Orange Juice
2	38																											
3	1	Sausages	Sausages																									
4	2	Beer	3%	Beer																								
5	3	Parsley	8%	0%	Parsley																							
6	4	Mustard	8%	0%	42%	Mustard																						
7	5	Hand Cream	0%	0%	0%	0%	Hand Cream																					
8	6	Teabags	11%	24%	5%	11%	5%	Teabags																				
9	7	After Shave	0%	0%	0%	0%	100%	5%	After Shave																			
10	8	Honey	8%	0%	24%	34%	0%	26%	0%	Honey																		
11	9	Whipping Cream	16%	0%	11%	8%	0%	5%	0%	21%	Whipping Cream																	
12	10	Biscuits	5%	0%	3%	3%	0%	11%	0%	34%	16%	Biscuits																
13	11	Strawberries	3%	0%	3%	3%	0%	0%	0%	0%	5%	0%	Strawberries															
14	12	Walnuts	3%	0%	5%	5%	0%	8%	0%	18%	16%	26%	0%	Walnuts														
15	13	Cucumbers	5%	0%	61%	8%	0%	3%	0%	3%	5%	0%	13%	3%	Cucumbers													
16	14	Beef	92%	3%	8%	13%	0%	11%	0%	11%	13%	3%	3%	3%	5%	Beef												
17	15	Kitchen Roll	0%	0%	0%	0%	32%	5%	32%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
18	16	Apple Juice	5%	32%	3%	3%	0%	39%	0%	0%	3%	0%	3%	0%	3%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
19	17	Red Wine	3%	100%	0%	0%	0%	24%	0%	0%	0%	0%	0%	0%	0%	3%	0%	32%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
20	18	Frozen Pizza	16%	0%	11%	8%	0%	8%	0%	5%	11%	3%	3%	3%	5%	18%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
21	19	Body Lotion	0%	0%	0%	0%	100%	5%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
22	20	Bread Rolls	13%	3%	5%	16%	0%	29%	0%	45%	8%	13%	0%	8%	3%	16%	0%	3%	3%	3%	5%	0%	0%	0%	0%	0%	0%	0%
23	21	Strawberry Jam	5%	0%	5%	16%	0%	26%	0%	79%	21%	39%	3%	18%	3%	8%	0%	0%	0%	0%	5%	0%	47%	0%	0%	0%	0%	0%
24	22	Ice Cream	3%	0%	8%	3%	0%	0%	0%	32%	26%	50%	3%	16%	3%	3%	0%	3%	0%	0%	39%	0%	0%	37%	0%	0%	0%	0%
25	23	Candles	0%	0%	0%	0%	5%	5%	5%	0%	0%	0%	0%	0%	0%	0%	0%	74%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%
26	24	Vinegar	5%	0%	37%	62%	0%	8%	0%	32%	5%	3%	0%	5%	3%	11%	0%	0%	0%	0%	3%	0%	16%	13%	0%	0%	0%	0%
27	25	Chocolate Bars	0%	0%	3%	3%	0%	5%	0%	32%	13%	87%	0%	26%	0%	0%	0%	0%	0%	0%	0%	3%	37%	50%	0%	0%	3%	0%

- % of participants who grouped two cards together.
- = normalised similarity matrix.
- Colour coding: start manual grouping with darker shades of blue.

Screenshot taken from Keith Andrews; *Card Sorting Analysis Spreadsheet: 100 Products*; Information Architecture Course, FH Joanneum Graz, SS 2016. Unpublished.

Co-Occurrence Matrix



- Matrix permutations: most closely related pairings clustered along diagonal.
- Clusters of related cards appear.
- Can be used to visually separate cards into categories.
- Darker color means higher % similarity.

Screenshot taken from Optimal Workshop
<https://www.optimalworkshop.com/>

Similarity Map 3D

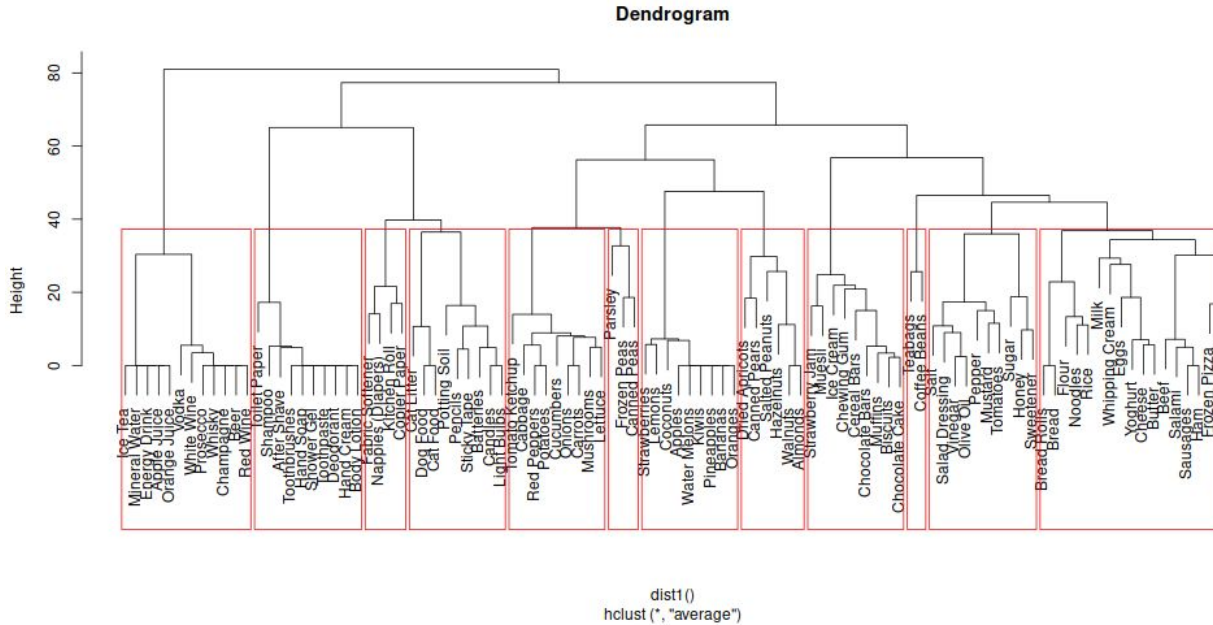
3D cluster view ?



Screenshot taken from Optimal Workshop
<https://www.optimalworkshop.com/>

- Similarity visualised as 3D spatial relationship.
- Multidimensional Scaling:
 - Translate a table of similarities into a 3D map.
 - Dimension reduction preserving similarity.
- Potential categories are marked as polygons.

Dendrograms



- Hierarchical clustering
- Cards grouped into clusters depending on similarity.
- Start with N clusters (each card).
- Recursively merge clusters.
- Choose granularity: # categories.

Screenshot taken from *Enhanced Card Sorting Analysis in R*
Michaela Kargl, Ajdin Mehic, Zoran Prodanovic, and David Seywald
706.057 Information Visualisation SS 2018, Graz University of Technology
<https://courses.isds.tugraz.at/ivis/projects/ss2018/ivis-ss2018-g5-project-r-card-sort.pdf>

Label Suggestions

- Show category name suggestions for each resulting cluster.
- Frequency of category:
 - # participants who used a specific category for each item.
 - Show top 3 category labels.

Drinks:68.7%, Alcoholic Drinks:25.2%, Non-Alcoholic Drinks:6.1%
Beer
Apple Juice
Red Wine
Orange Juice
Energy Drink

Spices:35.4%, Food:34.9%, Meat:29.7%
Sausages
Mustard
Teabags
Honey

Hygiene:97.6%, Household:1.9%, Fruit:0.5%
Hand Cream
After Shave
Body Lotion
Deodorant

Vegetables:47.4%, Fruit:39%, Fruit and Vegetables:13.6%
Parsley
Strawberries
Walnuts

Screenshots taken from *Enhanced Card Sorting Analysis in R*
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Demos

