

# COGNITIVE MEASUREMENTS FOR THE REPERTORY GRID TECHNIQUE ASSURING QUALITY IN SUBJECTIVE EXPERIENCE EXPLORATIONS

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## ABSTRACT

This article analyses the Repertory Grid Technique (RGT) from its original point of view (constructivist psychology) through cognitive measurements for product and user profiling. This is a cascade profiling system that starts exploring the subjective experience (mixed information about physical, functional and emotional elements obtained from the RGT interview) through product preference profiles and then analyzes the user's cognitive structure through cognitive complexity profiles. It is a procedure that traces implications from a top-down process in order to assure not only the quality of the product, but also the quality of the users' mental models.

**Keywords:** *Repertory grid, cognitive indexes, subjective experience, consumer response, constructivist psychology*

## 1. INTRODUCTION

Subjective experience gathering techniques based in post-modern psychological explorations have been already used in product design market research to obtain subjective, qualitative information for inspiration and information purposes [1]. The Repertory Grid Technique (RGT) [2] has been applied to generate 1) qualitative insights about user experience (user needs, desires and fantasies) to guide the design process [3], and 2) data that has been analyzed with different statistical techniques like cluster analysis, multidimensional scaling, principal component analysis for product benchmarking, consumer preference and requirement analysis [4].

This paper goes further by applying cognitive measures from constructivist psychology, which are mainly used for understanding human-human relations, to the human-machine interactions. Summarizing the way in which interviewees construe their perspectives by

means of several indices increases the analysis potential of the RGT. This approach makes it possible to provide information to assure not only the quality of the product (measures about consumer preference) but also the quality of the users' mental models (measures about consumer response). The selection of these psychological indexes is based on the applied value of the measurements and the support found in psychological literature. In the field of analyzing users' subjective experience, psychological indexes can be used to summarize information about consumer's construction of product preference and their cognitive complexity in order to make comparisons between different participants and different products:

- Consumer construction of product preference is one of the most important concepts of the decision-making process. Psychological indexes can be used to compare attitudes toward products developed through direct experience or from secondary sources such as advertisements or public buzz.
- Cognitive complexity profiles, based on integration and consistency indexes, can be used to compare the quality and reliability (predictive power) of the consumer response from different participants. Complexity and Simplicity profiles are more reliable than Chaotic and Fragmentation profiles because their construction is more consistent and integrated.

The general findings from electronic kitchenware study will be given to illustrate the value of these measurements to validate consumers' information processing systems using the RGT.

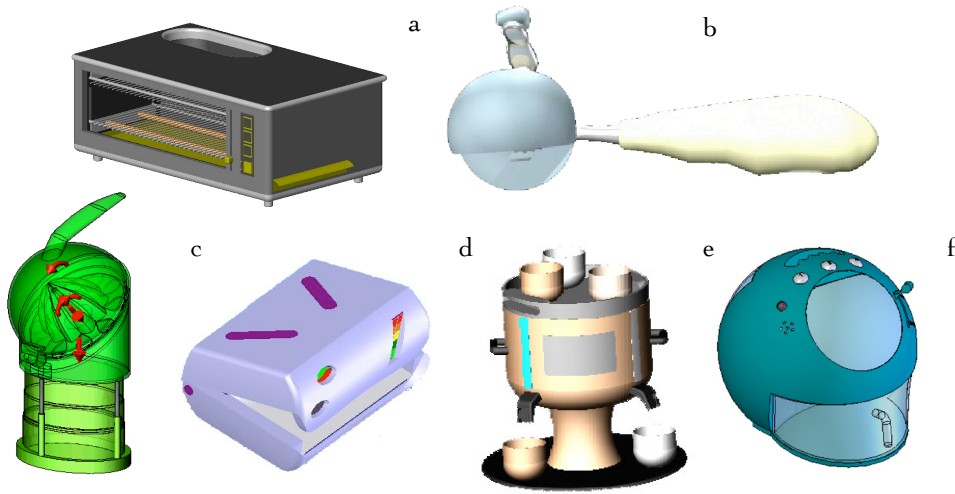
## **2. THE RGT AS A SUBJECTIVE INFORMATION GATHERING TECHNIQUE FOR INFORMATIONAL PURPOSES.**

For informational purposes, the RGT has been used as a semi-structured interview to quantify requirements and plan milestones to achieve during a design process from a user-centric design point of view due to its quantitative and qualitative nature. This is similar to the first step of Quality Function Deployment (QFD). It also has been used to test, compare and validate interaction ideas and product concepts [4]. A possible next step for a deeper understanding of participants' subjective experience is to summarize the way in which the interviewee construes their preferences by means of several indices. The structural characteristics of the construct system, certain cognitive dimensions, as well as the weight of a particular construct have been the focus of a number of grid measures in constructivist psychology.

In this article several indexes are classified in measurements of subjective experience construction of users' product preference and cognitive complexity of consumers' response. This classification stands for two different levels of validating consumers' information processing systems using the RGT (consumer preference and consumer response). These measures were used to analyze the grids obtained from a kitchenware study conducted in the Product Design Engineering course at the Technical University of Catalonia (UPC). The GRIDCOR program (software for analyzing grids in psychotherapy developed by Feixas & Cornejo [6]) was used for this purpose.

In this kitchenware study six groups of five students were told how to run the RGT and apply the results to redesign a product. The redesigned products were (see figure 1): a toaster (a), an opener (b), a juicer (c), a sandwich maker (d), a teapot (e) and a coffeemaker (f).

Each of the 6 groups used three external participants as intended users during the two analysis phases of the project: exploration and evaluation.



**Figure 1:** The six redesign concepts developed in the kitchenware case study.

The exploration of users' subjective experience comprised three RG interviews with six existing products (the "other" psychotherapy element in the GRIDCOR program). In the analysis of these grids an ideal product (ideal psychotherapy element in the GRIDCOR program) was included. The redesigns were evaluated with the same grid (the "self" psychotherapy element in the GRIDCOR program), allowing for the comparison of existing products with the redesigns and the ideal image about how the product should be. This evaluation focused on analyzing consumer's construction of product preference and cognitive complexity of consumer response by means of concept, market and ideal correlations and cognitive integration and differentiation measures. Table 1 shows a partial grid from the analysis of a toaster to be used with the GRIDCOR program. Note that this table shows the adaptation of the psychotherapy elements (self, ideal, others) for this application in product design (new concept, ideal product and the existing products analyzed).

**Table 1:** RG partial results (3 of 14 constructs) from one participant for the toaster analysis (a2) to be used with the GRIDCOR program. GRIDCOR elements are in brackets.

Positive pole	1 (o)	2 (o)	3 (o)	4 (o)	5 (o)	6 (o)	Co. (s)	Id. (i)	Negative pole
Decorative, lively colors. Young and loud character.	5	2	1	3	4	1	1	1	It seems old. Dirty and broken.
Thin, light and technological.	4	3	3	3	3	2	3	1	Bulky, robust and it occupies a lot of space.
The bread is well toasted. It warns you if it burns.	4	2	2	4	5	1	1	1	You have to be aware that it doesn't burn; you don't want it in the morning.

### 3. MEASURES OF SUBJECTIVE EXPERIENCE CONSTRUCTION OF PRODUCT PREFERENCE

Consumers' construction of product preference is one of the most important concepts of consumers' decision-making process. A simplified output of the original RG data from the field of constructivist psychology based self, others and ideal correlations can be utilized to summarize the information in product preference construction profiles.

#### 3.1. Concept, market and ideal correlations

In constructivist psychology the indexes describing the degree of relationship between the three different groups of elements form the grids are the self-ideal, self-others and ideal-others correlations. The self-ideal correlation gives us a quantitative evaluation of how respondents value themselves in their own terms related to effective functioning and a subjective sense of well-being. The self-others and the ideal-others correlations are calculated by creating an artificial others element as the result of averaging the scores of all the elements, excluding the self and the ideal ones. These two correlations are calculated in the distance and correlation matrices of the RG elements. The analysis of consumers' construction of product preference in relation to the self-ideal, self-others and ideal-others correlations can be done considering the concept-ideal, concept-market and ideal-market correlations respectively from the grids (table 2). The concept-ideal correlation relates to the consumers' accomplished expectations with the developed concept. It can be considered a measure of future consumers' acceptance of the product. The concept-market correlation relates to the future positioning of the concept in relation to existing products in the market (the concept-others discrepancy is a measure of the existing differentiation with the existing product offer). The ideal-market correlation relates to the level of accomplished expectations with the existing products. It is a measure of the level of acceptance or satisfaction of the existing products (the ideal-market discrepancy relates to the resentment to the existing products).

**Table 2:** Concept-ideal, concept-market and ideal-market correlations for the kitchenware study.

Correlations	A1	A2	A3	B1	B2	B3	C1	C2	C3
Concept-Ideal	0,963	0,833	0,310	0,459	0,000	-0,226	0,140	0,443	-0,348
Concept-Market	0,228	-0,372	0,576	-0,076	0,885	0,545	0,335	0,148	0,000
Ideal-Market	0,285	-0,142	0,700	0,111	0,162	-0,440	-0,317	0,133	0,332
	D1	D2	D3	E1	E2	E3	F1	F2	F3
Concept-Ideal	0,532	0,886	-0,097	0,540	0,944	0,797	0,953	0,954	0,705
Concept-Market	-0,326	0,391	0,265	0,777	0,672	-0,188	0,016	-0,033	0,327
Ideal-Market	-0,026	0,516	-0,136	0,593	0,631	0,095	-0,134	0,174	0,177

These three different correlations can be used to determine very useful information about the concepts future acceptance, future position in the market in relation to the consumers' perception and the level of accomplished expectations with existing products in the market where it will be placed. Table 2 contains information about the construction of users' product

preference on six different kitchenware redesigns by 3 different participants for each redesign. In this case, information about future consumers' response to different concepts can be used to help to foresee which one will more likely have a successful market launch. For more depth in the analysis of the results look at the following sub-section.

### 3.2. Consumers' product preference construction profiles

In accordance with the research done in the field of constructivist psychology by Feixas & Cornejo [6], a series of product preference construction profiles can be identified based on the concept-ideal, concept-market and ideal-market correlations explored (see table 3 for a brief description of the value of the correlations defining each profile). In order to determine when a correlation can be considered large, medium or small the classification applied by Cohen [7] is used (+/- 1.00, 0.50, 0.30, 0.10). If the correlation is smaller than +/- 0,10 it can be considered neutral. Hence, the other correlations can be used to choose the construction profile.

**Table 3:** Tentative proposal for consumers' product preference construction profiles.

Profiles	Concept - Ideal	Concept - Market	Ideal - Market
Positivity	+	+	+
Superiority	+	-	-
Negativity	-	+	-
Isolation	-	-	+
Resentment	-	-	-

The positivity profile in psychology is an overall positive image of the self and of others where "everything is all right" and there is an absence of conflict. In the user-product relationships, a positivity profile means that the ideal product, the concept developed and the existing products in the market are well perceived by the user. This case reveals a situation where the level of accomplished expectations with existing products is high and the new concept does not make huge improvements in relation to the existing products (but still its future consumers' acceptance is high). This overall situation describes markets that have reached a state of equilibrium marked by the absence of significant growth or innovation (a mature technology market) but still have not reached saturation and there is still space for functional and cosmetic improvements. In the kitchenware study 55,56 % of the redesigns had a positivity profile (table 4).

The superiority profile in constructivist psychology is related to the idea that one is different from others and that others are not how they should be. In user-product relationships, a superiority profile relates to a situation with a high level of accomplished expectations with the existing products, where a concept positioned in a better position than the existing products has a high future consumer acceptance of a new concept. This profile clearly defines an interesting future scenario for a new product that typically occurs in emerging markets with new technologies. The differentiation from existing products could come from technological developments or a better product design or user experience

enhancements. In the kitchenware study (table 4), 22,22 % of the concepts had a superiority profile.

The negativity profile suggests a tendency towards pessimism in constructivist psychology. Both the self and others are perceived negatively. Under these conditions, if the self and others are construed negatively, the person may not be strongly motivated to change. In the user-product relationships, a negativity profile relates to a weak market where existing products do not reach the consumers' expectations nor the new concept, which is perceived at the same level as the other products in the market. This profile defines a need for improvement in terms of product appearance and user-product interaction into the developed concept to reach consumers' expectations and secure success in its market launch. In the analysis of six different kitchenware redesigns (see table 4), 5,56 % of the concepts had a negativity profile.

The isolation profile indicates a double tendency in information processing in constructivist psychology: information relative to the self is biased negatively, whereas information relative to others is biased positively. In user-product relationships, an Isolation profile reflects a situation where the accomplished expectations with the existing products are high but the new concept does not reach the consumers' expectations and, at the same time, it is perceived to be at a lower level than existing products. This case means that the direction chosen in the development of the concept was wrong and a change of direction is needed in relation to characterizing users' requirements to develop an entirely new idea that meets users' needs and desires. In the kitchenware study 5,56 % of the redesigns had an isolation profile.

The resentment profile means (in constructivist psychology) having feelings of anger towards others, perceiving oneself as different from others as well as having a negative opinion of the self. In user-product relationships, a resentment profile relates to a weak market where the existing products do not reach the expectations of the consumer and neither does the new concept, which is perceived as even worse than the other products in the market. This case signifies that the direction chosen in the development of the concept was wrong and a change of direction is needed in relation to market positioning. In this study (see table 4), none of the concepts had a resentment profile.

**Table 4:** Consumers' product preference construction profiles developed in the kitchenware study.

Profile	Neutral	Small	Medium	Large	Total
Positivity	16,67	16,67	11,11	11,11	55,56
Superiority	16,67	5,56	0,00	0,00	22,22
Negativity	0,00	5,56	0,00	0,00	5,56
Isolation	5,56	0,00	0,00	0,00	5,56
Resentment	0,00	0,00	0,00	0,00	0,00
Other	5,56	5,56	0,00	0,00	11,11
Total	44,44	33,33	11,11	11,11	

## 4. MEASURES OF COGNITIVE COMPLEXITY IN CONSUMER RESPONSE

Cognitive complexity in constructivist psychology is related to individual response to personal relationships and the capacity to construe social behavior by a differentiated system of dimensions [8]. Adams-Webber [9] suggests that cognitive complexity is not a single unitary concept but is bi-dimensional, involving both differentiation and integration. Differentiation is understood as the number of functionally independent dimensions available to the subject. Integration is understood as the hierarchical structure that gives the system unity and coherence as a whole. In the following paragraphs, measures associated with the integration and differentiation dimensions closer to the field of application (consumer response) or with the highest Coefficient of Variation (CV) are described and then used to characterize cognitive complexity profiles. In the field of subjective experience, these profiles relate to the quality and reliability (predictive power) of the consumer response.

### 4.1. Cognitive differentiation measures of consumer response

Cognitive differentiation measures applied to consumer response analyze predictive power of the individual. A cognitively complex person can construe events from different points of view and not just from a good-bad, black-white perspective, which would be characteristic of a cognitively simple person [10]. Thus, cognitive differentiation can be associated with the quality of results obtained from the grids.

A Functional Independent Constructions (FIC) score indexes the degree of differentiation in the respondent's system by comparing the ratings of personal acquaintances on each construct with those performed on every other construct. The total FIC score reflects the construct clusters employed by the participant [11]. The greater the FIC score, the greater the degree of differentiation of the individual's construct system [10]. Table 6 presents the RG characterization of 6 different kitchenware studies from the number of functionally independent constructs, elements and the total constructions (constructs and elements together). The total FIC score has a coefficient of variation of 0,3212.

**Table 5:** Functionally independent constructions (constructs, elements and total) from the 6 different kitchenware RG analysis. Note that A3 results were not reliable and are not considered.

FIC (%)	A1	A2	A3	B1	B2	B3	C1	C2	C3
Constructs	15,00	50,00	*	60,00	62,50	28,57	42,86	52,94	63,64
Elements	25,00	37,50	*	50,00	75,00	37,50	37,50	25,00	50,00
Score	17,86	45,45	*	55,56	68,75	31,82	40,91	44,00	57,89
	D1	D2	D3	E1	E2	E3	F1	F2	F3
Constructs	80,00	63,64	40,91	76,92	40,00	45,45	72,73	53,33	26,27
Elements	12,50	62,50	12,50	25,00	25,00	25,00	37,50	37,50	12,50
Score	56,52	63,16	33,33	57,14	34,78	36,84	57,89	47,83	21,74

#### 4.2. Cognitive integration measures of consumer response

Cognitive integration measures in the field of consumer response are related to the integrity or identity of the consumers through the structure coordination or unification of their response. It has a prominent role moderating and focusing the response from personal perception and thought at a higher level of abstraction. Thus cognitive integration can be related to the reliability of results obtained from the grids.

The Percentage of Variance Accounted by the First Factor (PVAFF) score measures the functional similarity between constructs, the participants' construing signs of hierarchical structure. More precisely, the PVAFF score represents the degree of one-dimensionality in the subjects' construing of their interpersonal world. The PVAFF score has a lower coefficient of variation (0,2076) than other integration measures but can easily be mapped to the cognitive integration of the consumer response. The PVAFF describes the percentage of variance accounted for the 1<sup>st</sup> axis of representation of the grid [12]. If this dimension (first factor) accounts for a high percentage of variance, it indicates a degree of one-dimensionality in the subjects' construing of their interpersonal world given that the other factors, or axes, have less weight. On the other hand, if the first axis accounts for only a small percentage of variance, there is room for other dimensions to play relevant roles in the way the subject construes. Table 6 shows the percentage of variance accounted for the first factor from the 6 different kitchenware RG studies.

**Table 6:** Percentage of variance accounted by the first factor from kitchenware study.

PVAFF	A1	A2	A3	B1	B2	B3	C1	C2	C3
%	70,78	54,58	56,21	50,86	65,30	41,58	50,51	38,34	63,56
PVAFF	D1	D2	D3	E1	E2	E3	F1	F2	F3
%	45,72	52,86	53,80	35,24	49,99	74,78	51,30	39,80	62,96

#### 4.3. Cognitive complexity profiles of consumer response

Following Adams-Webber's [9] Freitas [6] outlined four possible theoretical profiles based on the extreme examples of differentiation and integration that constitute cognitive complexity: complexity, chaos, simplicity and fragmentation. Cognitive integration and differentiation values are considered high and low when the mark is above or below 50 %.

High Differentiation, high Integration of consumers' response generates a complex profile in which the participant has access to several dimensions of meaning that are differentiated as well as coordinated. Relating this to subjective experience is indicative of the good predictive capacity of the participant. In the kitchenware study (see table 7), 29,41 % of the participants had a complexity profile, which means that the results obtained from these participants can be considered rich and consistent.

High Differentiation, low Integration of consumers' response creates a chaotic profile in which the subject has several dimensions of meaning that are not sufficiently organized to constitute a whole. Relating this to subjective experience can result in confusion and difficulty in giving events meaning and predictive power as well as making it difficult for



others to predict the person's behavior. In this study, 11,76 % of the participants had a chaotic profile, meaning that the results obtained from these participants can be considered rich, but not consistent.

Low Differentiation, high Integration of consumers' response outlines a profile best described by its simplicity (simplicity profile), in which the participant uses very few dimensions when it comes to understanding and anticipating events. Relating this to subjective experience information gathering techniques, the predictive capacity of these people is limited by the few dimensions that they possess. Their judgments are usually monolithic (all or nothing). In this study, 35,39 % of the participants had a simplicity profile, which means that the results obtained from these participants can be considered basic, but consistent.

Low Differentiation, low Integration of consumers' response is related to the poor integration of the few dimensions that the participant uses to discriminate, suggesting a fragmented profile. Relating this to subjective experience information gathering techniques, the subject goes from one point of view to another without much sense or direction. In this study (see table 7), 23,53 % of the participants had a fragmentation profile, meaning that the results obtained from these participants can be considered basic and not consistent.

**Table 7:** Cognitive complexity profiles of consumer response from the kitchenware study.

Profiles	Complexity	Simplicity	Chaos	Fragmentation
% Users	29,41	35,29	11,76	23,53

## CONCLUSIONS

This article shows how the RGT can provide consistent and accurate information about consumer preference and the underlying cognitive structure of consumer response. On one hand, product preference construction profiles synthesize information about the attachment of a new concept to experience related to existing products and the detachment from the desired experience. These profiles can be used in order to foresee the future acceptance of a new product based on the market situations and plan an strategy: positivity and isolation profiles describe two future situations in saturated markets, superiority profiles relate to emerging markets, negativity and resentment profiles relate to weak markets.

On the other hand, cognitive complexity profiles can be used to assure the quality and reliability of the results. Complexity and simplicity profiles are more reliable than chaotic and fragmentation profiles because their construction is more consistent and integrated. Moreover, the information obtained from complexity profiles have a better quality than simplicity profiles because it is more complex and then has better predictive power. In the kitchenware study 64,7 % of the results obtained with the RGT have a high level of reliability and 29,41 % have a high quality. These results can be considered promising if it is taken into account that the RGT deals with subjective experiences.

However, having outlined the usefulness of these theoretical profiles, we need to consider some limitations. This research involved finding the best indices or ways of measuring the product preference construction and cognitive complexity profiles but these profiles only achieve some descriptive potential when the measurements are differentiated enough. The natural next step to assure the quality and reliability of the results is to focus on the valuation process of product attributes. Valuations provide a numerical standard for comparison among products and product attributes as well as across different studies. Future research will focus on different measures to analyze the cognitive structure of the consumer valuation process.

## ACKNOWLEDGEMENTS

Students from the Product Design Engineering course at the ETSEIB. Toaster (M. Alcarraz, J. Borrell, N. Cabanas, G. Cebollada, E. Ibañez), opener (P. Artieda, A. Bassaganyes, J. Martin, L. Mont, L. Roura), juicer (I. Lopez, M. Caballero, L. Colas, J. Nebot, M. Ll. Puig-Solé), sandwich-maker (J. Colomo, J. Figueras, A. Morales, P. Sans, X. Solà), teapot (E. Prado, A. Bardají, C. Adell, C. Arriaga, R. Simó) and coffeemaker (R. García, C. Verge, P. Lladó). Dr. G. Feixas & Dr. J.M. Cornejo for providing a demo version of the GRIDCOR software.

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