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The Repertory Grid Technique as a Method for the Study of Cultural Differences

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Culture is typically approached in the field of design through generic, cross-domain constructs. In this paper we provide an alternative methodological approach to exploring cross-cultural differences by studying the idiosyncratic views of individuals with regard to existing products. We operationalize this approach through the Repertory Grid Technique, a structured interview technique motivated by Kelly's Personal Construct Theory, and propose a content-analytic procedure combining quantitative and qualitative information. We further propose the use of three distinct metrics in the analysis of personal constructs: dominance, importance, and descriptive richness. Dominance of a construct is measured through the relative percentage of a construct category over the total sample of constructs. Importance is measured through the elicitation order; this assumes that constructs elicited first are more salient and important to the individual. Descriptive richness relates to the diversity of a class of constructs. Some constructs might be uni-dimensional while others might tap to a number of distinct facets. The use of these indices enables the quantification of the different ways in which individuals perceive and differentiate between products. By identifying how individuals respond to a rich set of stimuli within a given domain, we inquire into their values and the qualities they appreciate within this restricted domain. Cultural values are thus explored in relation to a set of stimuli. We tested this procedure through an exploration of the ways 17 Dutch and 16 Japanese industrial designers valued a set of pens.

Keywords **–** Repertory Grid, Cultural Differences, Designers' Perceptions, Product Attribute Prioritization Measurements.

Relevance to Design Practice **–** This study illustrates how the Repertory Grid Technique can be used to determine differences in product attribute prioritization.

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Introduction

With the emergence of the global marketplace, cross-cultural differences are becoming increasingly recognized as a key factor in the successful adoption of new products (Lee & Harada, 2000). It is thus not surprising that designers have begun to consider the role of culture in design and to develop methods and processes for taking cultural aspects into account when designing new products.

Culture, according to Kluckhohn (1951), is rooted in the values that pervade the historically derived ideas that form a particular tradition. These ideas and values create patterned ways of thinking, feeling and reacting, which constitute the distinctive character of a human group. Culture, however, has been largely approached in the design field through generic, cross-domain constructs such as that of Hofstede's (1984) cultural dimensions and Scwhartz's (1992) cultural values (e.g., Marcus, 2000; Oshlyansky, Cairns, & Thimbleby, 2006; Tong & Robertson, 2008). Schwartz proposed that a taxonomy of seven distinct cultural value types can serve to distinguish different cultural groups. These value types have been found to be universal across cultures, but the relative dominance of each value type differs across different cultural groups. These value types can thus be used to predict attitudes towards external stimuli or behaviors.

These approaches typically involve gathering information about cultural differences through questionnaires or interviews using previously validated and standardized items. One could, however, wonder about the fruitfulness of applying cross-domain cultural dimensions to domain-specific design choices. While an overall differentiation of two groups on a given cross-domain cultural dimension (e.g., the need for autonomy) might have certain design implications for the design of a given product, there might be plenty of other aspects that differentiate these two groups within a specific context.

In this paper we propose a subjective approach to the exploration of culture in product design, based on Kelly's (1955) theory of Personal Constructs. This approach takes individuals' perceptions of products to be a carrier of implicit cultural insight,

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and thus, cross-cultural differences can be explored within a specific context through existing products in the market. The main difference between an objective approach (in which knowledge is seen as a representation of the real world and as something that can be extracted through a hypothetic-deductive process) and a subjective approach (in which knowledge is based on the subject's experiences and actions and can be extracted through an inductive process) to gathering information is the shift from validated items to a validated procedure.

The Repertory Grid Technique was developed by George Kelly (1955) as an application of the theory of Personal Constructs. Since then, it has been widely applied in psychotherapy, and in gathering information about consumer responses, and lately, it has become increasingly popular in the HCI field (e.g., Hassenzahl & Wessler 2000; Tomico, 2007). The Repertory Grid Technique is a semi-structured interview technique that aims at exploring how individuals construct the world around them. In the HCI field, the Repertory Grid Technique is used to explore the ways in which individuals perceive and differentiate between products. Moreover, due to its hybrid qualitative-quantitative nature, it allows for a wide kind of statistical analyses.

For the reasons given above, the Repertory Grid Technique and three measurements to determine differences in product attribute prioritization (*dominance*, *importance* and *descriptive richness*) were used in this study to analyze cross-cultural differences. This procedure allows for a quantitative analysis of the existing data from different grids without loosing the individuality of the results.

The presented approach was applied to a case study that examined how Japanese pens were perceived by Japanese and Dutch designers. Its aim was to explore cross-cultural differences between the product attribute prioritization of the Japanese and Dutch designers. While a wealth of studies has explored how culture influences the way users perceive and interact with products (e.g., Lee & Harada 2000; Hsu, Chuang, & Chang, 2000; de Leur, Drukker, Christiaans, & de Rijk, 2006), we are not aware of any efforts to explore whether designers from diverse cultural groups differ in the ways they perceive products and prioritize design attributes. Such cultural differences would evidently impact decision-making in the design process and therefore the design outcome.

In the following, we elaborate on the theory of Personal Constructs and the Repertory Grid Technique as a methodological approach to exploring the ways that designers perceive products and prioritize design attributes, and we illustrate an operationalization of this approach using the findings of the case study.

Measuring Dominance, Importance and Descriptive Richness for Cross-cultural Analysis

From a constructivist approach (Kelly, 1955), an individual's internal value system mediates that individual's evaluation of external stimuli. For instance, when we meet a new person, we might form a bipolar construct of "*friendly-distant"* in evaluating that person's character. This construct is an evaluative judgment about an attribute (i.e., friendliness) that is of importance to the specific individual that formed the construct. Thus, the bi-polar constructs that an individual forms in differentiating between stimuli can provide a rich understanding not only of the stimuli but also of that individual's internal value system.

Kelly (1955) proposed the Repertory Grid Technique (RGT) as a means for eliciting the personal constructs of individuals for a specific set of stimuli (cf. Hassenzahl & Wessler, 2000; Karapanos, Martens, & Hassenzahl, 2009). The technique consists of a structured interview technique based on triading. During the triading, the stimuli products are presented to the subject in sets of three and the subject is asked to *"think of a property or quality that makes two of the products alike and discriminates them from the third."* This results in a similarity-dissimilarity judgment in which the subject is asked to identify an aspect that groups two of the products (similarity judgment) and an aspect that differentiates them from the third (dissimilarity judgment). By forming different triads (sets of three) out of the larger pool of products and repeating the process, the subject will elicit a number of bipolar constructs (pairs of opposite attributes). The bipolar constructs that appear to dominate for this specific individual and this specific set of products are a Repertory Grid.

Each Repertory Grid is personal and varies for each participant in topic and number. The generated Repertory Grids

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are used to evaluate the products. Each participant's Repertory Grid is his or her personal semantic differential questionnaire and can be used to rate the products. This technique makes the information obtained more reliable and specific, as each Repertory Grid belongs to a different individual, but it makes the comparison between participants (i.e., between different Repertory Grids) more difficult.

In order to overcome the idiosyncratic nature of the results and to create a standardized classification scheme, one possible solution is to apply content analysis (Krippendorff, 2004). Classification schemes can be derived directly from the raw data, i.e., the personal constructs, as described in the conventional content analysis approach of Hsieh and Shannon (2005), and can be combined with existing knowledge if a certain theory exists in the respective field of study.

After applying a classification scheme to the personal constructs, one may apply different indices in order to compare the categories of constructs. In this article we opted to analyze the resulting categories of constructs according to three distinct metrics—*dominance*, *importance* and *descriptive richness*.

The relative percentage for a given construct displays how *dominant* that construct is for a group of individuals when they are differentiating among a set of products. If, for example, one group of participants, when asked to differentiate the products, employs the construct "ease of use" significantly more frequently than a second group of participants, one could conclude that the first group is more concerned with how easy it is to use this class of products.

The second criterion, which can be used for characterizing the *importance* of a personal construct for a specific group, is its elicitation order (Tomico, 2007; Feixas & Cornejo-Alvarez, 2002). The elicitation order has been previously found in Constructivist Psychology to measure the subjective importance of a construct (i.e., its salience) as well as its implication potential (i.e., its importance in preference judgments) (Mcdonagh & Adams-Webber, 1987). The elicitation order is measured through the normalized order in which a construct appears (with constructs reported first being considered more important to the individual than those reported later), and the overall dominance of a construct category may be computed across individuals as the average of the elicitation order of the constructs from the same category.

A third criterion is *descriptive richness,* which can be used to determine the reach of each category. It can be defined as the range of different personal constructs (attributes) elicited within the same category. The different ways in which participants refer to the same categories relate to how the personal constructs elicited are related to each other and how big the clusters of constructs are. For instance, a construct category such as "novelty" might have a single facet relating to the novelty and innovativeness of a product, while a different construct, such as "ease-of-use," might tap to more than one facet, for example understandability, clarity and navigability.

One may thus conduct analyses through the decomposition of repertory grids into: *dominance* (relative percentage), *importance* (elicitation order) and *descriptive richness* of each construct category. These indices can provide valid information for cross-cultural analysis as they allow the merging of information from different grids without loosing idiosyncratic views.

Exploring Cross-cultural Differences between Dutch and Japanese Designers

Designers constantly make decisions. Most of these decisions are unlikely to be grounded in empirical data. Karapanos and Martens (2007) showed how differences in the professional backgrounds of designers on a small design team impacted the prioritization of design goals. In the same vein, a designer's cultural background is likely to influence the product qualities that will dominate in the design process.

This study aimed to explore cross-cultural differences among Dutch and Japanese designers' perceptions of a set of pens. By studying the way these designers perceived and differentiated among a set of products (measured by the metrics of *importance*, *dominance* and *descriptive richness* with regard to the different categories generated), we aimed to understand the sets of attributes they value, and how these values might relate to their respective cultural backgrounds and might motivate their design decisions.

Experiment Set-up

A total of thirty-three individuals (16 Japanese and 17 Dutch) participated in the study. Their ages varied from 23 to 32 years (mean age for the Japanese group was 26.8, for the Dutch group 24.8), three of the Japanese and four of the Dutch participants were female. They were all trained industrial designers, either students of industrial design (accounting for 69.2% of the Japanese, 88.2% of the Dutch) or researchers in the field of design (30.8% of the Japanese, 11.8% of the Dutch) from universities with similar approaches to design practice. Participants from both groups had similar preferences with regard to writing tools. The Dutch participants often used for writing (in order of importance) ballpoint pens, keyboards, fine liners, markers and cell phones. The Japanese participants often used (in order of importance) ballpoint pens, keyboards, mechanical pencils, multifunctional pens, fine liners, drawing tablets and cell phones. The average amount of money paid for a pen by the Japanese participants was 3.6 euros (479 yen) and for the Dutch participants was 5.18 euros (689 yen), with a maximum of 15 euros (2,000 yen) for both the Japanese and Dutch participants.

Six different pens that were designed for the Japanese market were employed as the stimuli products in the study (see Figure 1). The six products used for testing were determined in a previous study with Japanese participants to be the most preferred out of a larger set of 20 products. The objective parameters of the pens are described in Table 1.

Procedure

First, the six products were combined in randomly selected triads, out of a total pool of 15 possible triads. The order in which the three products were presented was randomized. For every triad, participants were asked to *"think of a property or quality that makes two of the products alike and which discriminates these*

two from the third (i.e, an opposite property or quality).” From the first answer, laddering down and up procedures were applied to the positive and negatives poles of each construct to get to the core of the answer. The same procedure was repeated until a point was reached at which no new attributes arose for two consecutive triads. Finally, the subjects were asked to rate all of the products

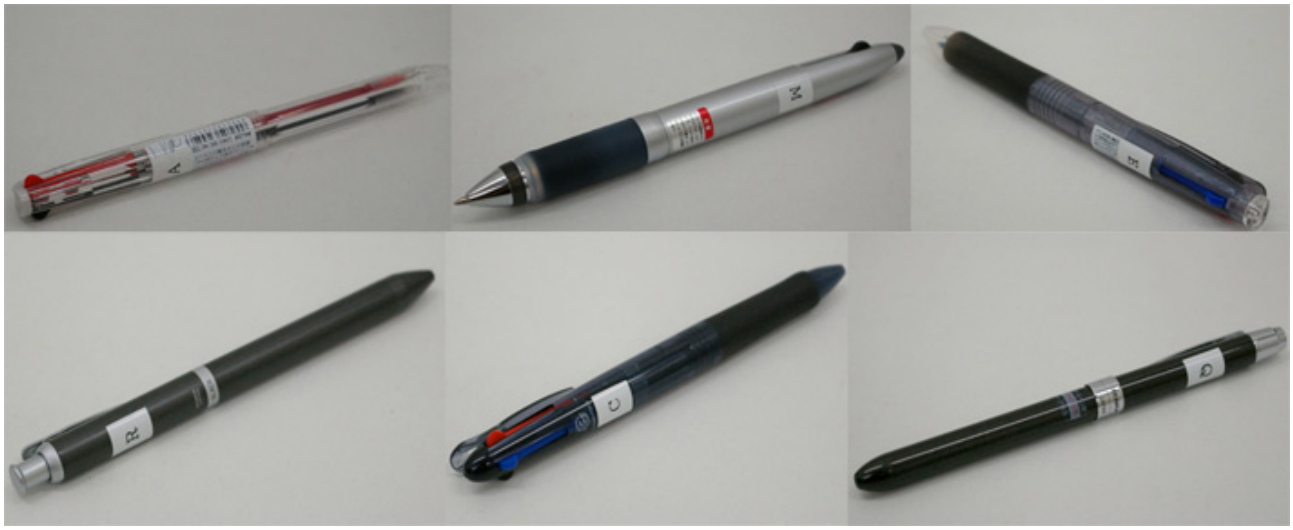

Figure 1. Pens A-M-E (upper row) and R-C-Q (bottom row). Pen A has a transparent plastic cover, pen C and E have semitransparent plastic cover. Pen R has a metallic cover with a matte finish. Pen Q has a metallic cover with a glossy finish.

Table 1. Objective parameters of the six pens used in the study.

	A	M	E	R	C	Q
Length	138.8	146.9	142.8	138.5	142.4	130.8
Weight	8	25	14	25	13	21
Maximum diameter	11	13.7	14.6	10.3	13.1	9.6
Type of ink	Water-based biopolymer	Oil-based	Water-based pigment	Oil-based	Oil-based	Oil-based
Color of pen ink/ size of pencil lead	black, red ink	black, red ink/, 0.5 pencil lead	black, red, blue ink	black, red ink/ 0.5 pencil lead	black, red, blue ink	black, red ink/ 0.5 pencil lead
Grip	None	Soft rubber	Hard rubber	None	Hard rubber	None
Ball point size	0.4 mm	0.7 mm	0.5 mm	0.7 mm	0.7 mm	0.7 mm
Maker	Pilot	Uni	Zebra	Zebra	Zebra	Zebra
Interaction mechanism	Vertical click	Vertical click	Vertical click	Horizontal turning	Vertical click	Horizontal turning

Table 2. Sample from the repertory grid for one of the Dutch participants.

Negative Pole	A	C	E	M	Q	R	Positive Pole
Underneath or below the ideal diameter (1 cm), difficult to handle	4	4	4	2	3	5	Pens are thin for holding, easier to control, more precise
Feels like nothing is in your hand; too light	1	3	3	4	4	4	Relatively heavy; weight resistant
Too light of a plastic pen; no quality	1	3	2	2	4	4	Material has quality; robust, solid
Unattractive patterns, cheap colors; resembling a toy;glittery	1	4	2	3	5	5	Appearance, coloring have professional resemblance; metal, aluminum look
Crappy; lot of force needed; not working properly; weak mechanism	2	4	3	2	4	4	Smooth, proper feedback; clicks properly; quality mechanism
Only one function, one type of writing; too small to hold properly	2	3	3	4	5	5	Multi-functional, with an eraser. All together, 4 separate things; refillable.
Common mechanisms that I see often	3	3	3	4	5	5	Unique switching mechanism
Gel grip, feels too soft, slippery; feels like I’m loosing the grip or like it’s too hard	2	5	4	1	3	3	Rigid grip, soft material feeling but not loose
Feels like you are going over a rough surface; need to apply more force.	4	3	5	4	3	4	It has a fine liner; I can also draw with it, can make clear lines that are smooth, soft

according to their personal attributes using a scale similar to a semantic differential scale. See Table 2 for a sample of the results for one participant.

A total of 190 attributes were obtained for the group of Dutch designers and 201 for the group of Japanese designers (with 7 to 24 attributes per participant). The interviews with the Japanese participants were conducted in Japanese and the results were translated afterwards into English by the interviewers. The interviews of the Dutch participants were able to be conducted in English as all of them had a high level of command of the language. Personal constructs from both cultural groups were first submitted to qualitative content analysis (Hsieh & Shannon, 2005; Krippendorff, 2004). A detailed coding scheme emerged from the data (see Table 3). The elicited categories were then grouped into three overall categories that reflected Hassenzahl's (2004) distinction between pragmatic and hedonic product qualities. Pragmatic qualities refer to the instrumental aspects of a product, such as its usefulness, practicality and ease of use. Hedonic aspects relate to the more experiential aspects of product use and consist of two distinct categories: *stimulation,* which refers to a product's ability to address the human need for novelty and challenge, and *identification*, which refers to a product's ability to address the need for expressing one's self through the objects one owns. Next, each personal construct was then classified into one of the three construct categories (*dominance, importance*, and *descriptive richness*). This classification was done by the first two authors, each working independently. The interrater agreement (Fleiss, Levin, & Paik, 2003) of the classification process was determined to be satisfactory ($k = 0.82$).

Table 3 illustrates the detailed coding scheme together with the breakdown into thematic categories (pragmatic and hedonic), the defining aspects of these categories, and examples of the personal constructs elicited. As evident in the table, the pragmatic aspects were related to utility (i.e., the quality of outcome in using the pen), durability (i.e., the feeling of reliability), ease-of-use (i.e., how easy it was to learn to operate the pen) and the level of comfort experienced while writing with the pen. As for hedonic aspects, *stimulation* was found to be induced by three distinct aspects of the products: unexpected functionality, the aesthetics of interaction (i.e., the degree to which the user related to the expressiveness, richness, and therefore pleasantness of the interactive experience) and the aesthetics of appearance, or visual aesthetics (i.e., the degree to which the user related to the product's form and color). Finally, it was found that constructs relating to *identification* were concerned with the self-image that the pen might potentially communicate about the owner.

This hierarchical classification of the designers' personal constructs enables a decomposition of their perceptual space into semantically distinct and culture-independent dimensions. Next, we explored whether any cross-cultural differences existed

Table 3. Personal constructs broken down into thematic categories, with examples from both the Japanese and Dutch designers.

Category		Examples
Pragmatic	Utility	water-based ink; can write clearly and is easy to read
	Durability	the construction feels sturdy; it feels reliable
	Ease-of-use	Separate click system; the function makes sense
	Comfort	soft grip; you can write without hurting your fingers
Stimulation	Unexpected functionality	Looks like a normal pen but it is three in one!
	Aesthetics of interaction	It changes from a rotating movement to a lateral movement; it is newer and interesting; you can play with it
	Visual aesthetics	limited amount of colors; it looks more stylish
Identification		an exclusive design; it works by turning

Table 4. Personal construct thematic categories: The *dominance* of each category (measured by the relative percentage) and the *importance* of each category (measured by the elicitation order) for the Dutch and Japanese designers. Standard deviations are displayed in brackets.

Category	Dominance (relative percentage %)		Importance (elicitation order)	
	Dutch	Japanese	Dutch	Japanese
Pragmatic aspects	58	69	0.47 (0.32)	0.5 (0.33)
Utility	13	16	0.57 (0.35)	0.55 (0.32)
Durability	11	12	0.4 (0.3)	0.62 (0.33)
Ease-of-use	14	6	0.53 (0.33)	0.45 (0.25)
Comfort	20	34	0.39 (0.29)	0.45 (0.34)
Stimulation	32	28	0.54 (0.3)	0.64 (0.34)
Unexpected functionality	8	2	0.55 (0.32)	0.86 (0.55)
Aesthetics of interaction	9	3	0.53 (0.29)	0.69 (0.33)
Visual aesthetics	15	23	0.55 (0.31)	0.62 (0.33)
Identification	9	3	0.57 (0.31)	0.72 (0.33)

between the Dutch and Japanese designers' perceptions through the calculation of a) the relative percentage (*dominance*), b) the average order elicitation (*importance*) and c) the *descriptive richness* of each construct category for each cultural group. It should be noted that the order elicitation index is the average of the order of all constructs within a construct category and that descriptive richness relates to the different characteristics that define a product category.

Dominance and Importance Measures

Table 4 presents the relative percentages and the average elicitation order for each construct category for both the Dutch and the Japanese groups. A single elicitation order index was derived for each construct category, representing the average order (mean) of the constructs within this category. The order of the constructs was normalized for each participant to a range of 0 to 1 based on the total number of constructs generated (1). A 0 value reflects the first construct that was elicited and an index of 1 reflects the last construct. The standard deviations are included in brackets and are crucial for deriving an estimation of how homogeneous a category of constructs is in the relative order with which its constructs are elicited.

$$order(normalized) = \frac{order - 1}{totalconstructs - 1} \quad (1)$$

It should be noted that pragmatic qualities constituted the designers' most frequent concerns among both the Dutch and the Japanese participants. This resembles findings from the Technology Acceptance literature (Venkatesh, Morris, Davis, & Davis, 2003) and the User Experience literature (Hassenzahl, 2004; Karapanos, Hassenzahl, & Martens, 2008; Karapanos, Martens, et al., 2009), in which the usefulness of a product appears to be the most significant predictor of the user's overall attitude towards the product.

However, the constructs of the Dutch and Japanese designers differed in the dominance of pragmatic and hedonic qualities. While both groups acknowledged pragmatic quality as the dominant quality they looked for in a pen, the Dutch designers gave more weight than the Japanese designers to the hedonic aspects of the product. The Japanese designers seemed to give most importance to pragmatic aspects. They were less concerned than the Dutch designers with the *stimulation* that the user might derive while using the product. They also valued less the products' role in communicating a desired self-identity for the owner to relevant others (i.e., *identification*).

More interestingly, while the Dutch designers seemed to associate pragmatic quality with ease-of-use (i.e., learnability) relatively more than the Japanese designers, the Japanese designers seemed to give more weight to comfort (i.e., long-term usability) and to the product's utility as the major aspects of pragmatic quality. One could argue that the Dutch designers were empathizing with early-use situations, whereas the Japanese designers were more concerned with prolonged use. In the same vein, while the Japanese group mostly associated *stimulation* with aesthetic appreciation derived from visual appearance, the Dutch designers were also concerned with *stimulation* derived from the experience of surprise and the aesthetics of interaction. Overall, the Dutch designers seemed to be more concerned with early experiences, whereas the Japanese designers were more concerned with prolonged interaction.

These findings are enforced if one looks also at the elicitation order. Both the Dutch and the Japanese designers tended to elicit pragmatic aspects earlier than hedonic aspects (*stimulation* and *identification*). However, more particularly, the Japanese designers seemed to elicit constructs related to identification only among the very last of their constructs. This could imply that the identification constructs that were elicited by the Japanese designers are the result of extended use. This reduces even more the prominence of social (i.e., *identification*) influences in the Japanese designers' perceptions of the product. Comfort (i.e., long-term usability) seemed to be the most prominent construct for both the Japanese and Dutch designers, whereas durability appeared to be more prominent for the Dutch designers. Constructs related to the product's ability to stimulate the user appeared to be more prominent for the Dutch designers than for the Japanese designers.

Overall, the Dutch designers appeared to be more concerned with social (i.e., *identification*) considerations of product use, whereas the Japanese designers seemed to place greater importance on the pragmatic aspects (i.e., utility and long-term usability) of the product.

Descriptive Richness

In a final analysis, we aimed for a deeper understanding of the ways in which the two cultural groups of designers referred to product qualities (i.e., the *descriptive richness* of a category). Subtle differences in the individual constructs were considered here of increased importance. In assessing the semantic similarities between constructs, two kinds of information were taken into account. First, qualitative information such as the definition of each pole for the constructs elicited was used. Secondly, every construct was characterized by the participants' ratings for the set of stimuli. Quantitative techniques such as Hierarchical Cluster Analysis provided information related to the cognitive similarity of the constructs (i.e., how similarly two constructs were being used in differentiating the items in the set of products). This was an iterative procedure in which both qualitative and quantitative information were used to inform the grouping process (see Figure 2).

The hierarchical cluster analysis augmented qualitative understanding by highlighting: a) constructs that displayed a high correlation in the ratings, but for which there was no a-priori identified semantic similarity (from the content analysis), and b) the cognitive dissimilarity of two constructs that displayed high semantic similarity. In this sense, for two constructs to be judged as similar, they not only had to agree with regard to semantic information, but also with regard to participants' ratings for the set of products. This process was found to provide a rich qualitative understanding of non-contiguous constructs, in which the opposite pole doesn't constitute a negation or a linguistic opposition (Karapanos & Martens, 2008).

Table 5 characterizes the *descriptive richness* of the different thematic categories. More precisely, it illustrates the diverse ways in which the Dutch and Japanese designers referred to the pragmatic and hedonic qualities of the products.

The results show that both the Japanese and Dutch designers characterized utility by the degree of smoothness experienced in writing with the pen and with its versatility. However, the Japanese group added more detail to their characterization by also considering the thickness of the line produced, as well as the feeling of balance that the pen provided, and the degree of its multi-functionality and adjustability. Ease-of-use was described by both groups in relation to understandability of the functionality and the mechanisms of the pen. The Dutch designers related ease-of-use to efficiency and the Japanese to unity of the pen's form and function. Comfort was commonly defined according to thickness and size of the pen, the softness of the grip and the effort required for usage, but the Japanese designers added more subtle elements such as consistency in shape and size, and the fluency of the pen's mechanism and its lightness. Opposite to this, both groups related durability to the hardness of the material used in the pen's construction, although the Dutch designers also considered reliability, robustness and breakability as other variables to take into account.

The Dutch designers placed significantly greater importance than the Japanese designers on social considerations related to *identification*. Both groups considered value to be the main element driving *identification*, but the Dutch designers added more detail to the concept by talking about the pen's uniqueness, its exclusivity, its style and its degree of innovation.

Furthermore, while the Japanese designers referred to the aesthetics of product appearance more frequently than the Dutch designers, the Dutch group seemed to be more concerned with the aesthetics of interaction. In particular, the aesthetics of appearance were characterized by both groups according to the look of the

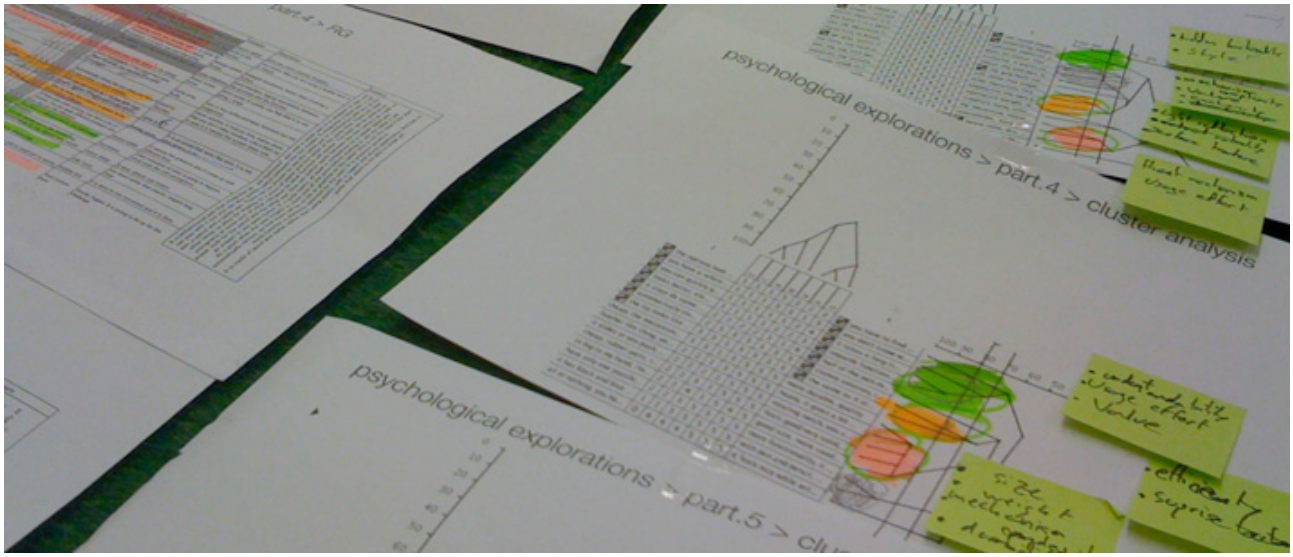

Figure 2. Sample of the information used, combining results from the hierarchical cluster analysis and the content analysis.

Table 5. Characterization of the different personal construct thematic categories (categories with higher descriptive richness are highlighted in bold).

Category		Dutch characterization	Japanese characterization
Pragmatic aspects	Utility	Versatility; smoothness	**Smoothness of writing; thickness of the line; balance; multifunctionality; adjustability**
	Durability	**Solidness; reliability; robustness; breakability**	Hardness of the material
	Ease-of-use	Efficiency; understandability	Understandability of the mechanism; indications; unity
	Comfort	Size; grip softness; usage effort	**Lightness; shape/size consistency; grip surface; usage effort; fluency of mechanism; thickness**
Stimulation	Unexpected functionality	Surprise factor; hidden functionality; special functionality	Fun factor; peculiar sound
	Aesthetics of interaction	**Mechanism complexity; feeling of fluency; invitation to be used**	Mechanism complexity
	Visual aesthetics	Appearance of material; light reflection; colorfulness	**Shape integration; naturalness; colorfulness; appearance of material; texture; light reflection; graphic style; transparency**
Identification		Exclusivity; specialness; style; value; innovativeness	Value if it were lost; exclusivity; style

material that the pen was made from, and the quality of light reflection and colorfulness, but, in addition to this, the Japanese designers focused more on the pen's graphic style, its texture and the integration of shape. Opposite to this, the Dutch designers added more accuracy in their description of the aesthetics of interaction by considering important a feeling of fluency in using the pen and a sense of the pen offering an invitation to be used, besides the commonly agreed-on aspect of the complexity of the pen's mechanism.

Overview of the Results

Analyzing the results from the three indices (see Table 6) helped to obtain a general overview and to analyze categories for which one of the indices had no significant values (cells with one plus or minus instead of two in Table 6). The *descriptive richness* is related to the other two indices, thus adding redundancy to the analysis. It is important to note that in adding this third index, the ease-of-use category turned out to be the only category that had two indices with no significant differences.

The general comparison of the three indices showed that the Japanese designers were more concerned with the pragmatic aspects of utility and comfort (both show a higher degree of *dominance* and *descriptive richness*) and the Dutch designers were more concerned with durability (showing a higher degree of *importance* and *descriptive richness*). Further, while the Japanese designers referred to the visual aesthetics of the products more frequently than the Dutch designers (with higher levels of *dominance* and *descriptive richness*), the Dutch group seemed to be more concerned with the aesthetics of interaction and unexpected functionalities of the product (with higher levels of *dominance, importance* and *descriptive richness*). Finally, the Dutch designers were found to pay more attention (with higher levels of *dominance* and *importance*) than the Japanese to the symbolic qualities of the product, i.e., its ability to communicate a favorable image of the owner.

Conclusions

In this article we have highlighted a shortcoming inherent in many current approaches to exploring cross-cultural differences in design relying on global cross-domain psychological constructs. We have provided an alternative methodological approach to exploring cross-cultural differences by studying individual idiosyncratic views of existing designs (using the Repertory Grid Technique that originated with Kelly's (1995) Personal Construct Theory). We have proposed a content-analytic procedure that aims at uncovering cultural insight, composed of three measures: a) the relative percentage of a construct category over the total sample of constructs, signifying the dominance of a quality for a given product domain, b) the average elicitation order per construct category, relating to the subjective importance (i.e., salience) and implication potential (i.e., importance in preference judgments) for a given product domain; and c) the descriptive richness of the categories generated.

These indices can be easily obtained and can be directly related to any field of design that needs to be assessed, as shown in the case study. The indices improved the reliability of the analysis by providing domain-specific and user-generated product attributes rather than universal items. However, the indices were not directly calculated from the constructs elicited. They refer rather to the categories generated by the content analysis, the reliability of which depends on the expertise of the researchers conducting the analysis. Future work will focus on applying different indices developed in Constructivist Psychology to analyze different Repertory Grids at the same time without any intermediate analysis.

Moreover, in this case study we explored cultural differences between Dutch and Japanese designers by identifying the perceptions of participants with similar professional experience, similar preferences of use and similar attitudes regarding the amount of money they were willing to pay for a product. The designers' idiosyncratic views on the set of products, in this sense, uncovered the qualities that they valued with regard to the existing product domain through measures of the *dominance*, *importance* and *descriptive richness* of their personal constructs. From the results obtained, it is palpable that culture does play a role in those aspects of a product that designers consider important. However, the intention of this case study was to exemplify the procedure proposed and to show that it can generate valid data for analyzing differences in perception and decision-making processes that can relate to cultural influences.

Table 6. Overview of the *dominance, importance* and *descriptive richness* indices for the Japanese and Dutch designers.
Categories marked with one plus or one minus sign are those in which there were no significant differences between the two groups.

Category		Dominance		Importance		Descriptive Richness	
		Dutch	Japanese	Dutch	Japanese	Dutch	Japanese
Pragmatic aspects	Utility	--	++	-	+	--	++
	Durability	-	+	++	--	++	--
	Ease-of-use	++	--	-	+	-	+
	Comfort	--	++	+	-	--	++
Stimulation	Unexpected functionality	++	--	++	--	+	-
	Aesthetics of interaction	++	--	++	--	++	--
	Visual aesthetics	--	++	+	-	--	++
Identification		++	--	++	--	+	-

To sum up, as many design choices are not likely to be grounded in empirical data, designers' cultural backgrounds will evidently be carried over in their design preferences and in the outcomes of their designs. Thus, the three indices presented in this article could be the starting point of a series of measures that could be used to analyze quantitatively subjective information from different participants for a particular product domain. The development of a procedure that retains the idiosyncratic views of the participants increases the focus and level of detail of the analysis compared to previous research that uses questionnaires with standardized items.

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