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Título artículo / Títol article:	Relationship between meanings, emotions and product preferences. Application to ceramic tile floorings
Autores / Autors:	María Jesús Agost, Margarita Vergara
Revista:	Applied Ergonomics Volume 45, Issue 4, (July 2014)
Versión / Versió:	Preprint de l'editor
Cita bibliográfica / Cita bibliogràfica (ISO 690):	AGOST TORRES, M. J.; VERGARA MONEDERO, M. Relationship between meanings, emotions and product preferences. Application to ceramic tile floorings. Applied Ergonomics Volume 45, Issue 4 (July 2014), pp. 1076–1086
url Repositori UJI:	http://repositori.uji.es/xmlui/handle/10234/124783

Relationship between meanings, emotions and product preferences. Application to ceramic tile floorings

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Abstract

This work aims to validate several hypotheses that emerged from a conceptual framework which establishes the main relationships between subjective elements in human-product interaction, such as meanings, emotions, product preferences, and personal values. The study analyzes the relationships between meanings and emotions, and between these and preferences, as well as the influence of personal values on such relationships. The study was applied to ceramic tile floorings.

A questionnaire with images of a neutral room with different ceramic tile floorings was designed and distributed via the web. Results from the study suggest that both meanings and emotions must be taken into account in the generation of product preference. The meanings given to the product can cause emotions to be generated, and both types of subjective impressions give rise to product preferences. Personal reference values can modify these relationships between subjective impressions and product preferences.

Keywords: Affective design; product preferences; personal values.

1.   Introduction

A review of the concepts, models, and tools related to human-product interaction and affective design allows different types of subjective impressions to be identified. Although the techniques of affective design are largely based on the principles of the Semantic Differential (Osgood et al., 1957; 1969), which analyzes the meanings given to the product, other proposals (Desmet, 2002) focus on the study of emotions (triggered within the individual and referring to her/him). Only a few proposals (such as Desmet and Hekkert, 2007, or Crilly et al., 2004) consider and distinguish both concepts. Although they refer to different elements (product and individual, respectively), the meanings and emotions generated by a product probably maintain some kind of relationship between them. Some authors (Desmet and Hekkert, 2007; Crilly et al., 2004) assume that the elicitation of emotions is subsequent to the generation of product meanings (and a consequence of it).

Several types of meanings can be distinguished in a product, including aesthetics, functionality, symbolic values, etc., which have been given different denominations in the literature, such as product messages (Monö, 1997), communicative functions (Bürdek, 1994) or roles of product appearance (Creusen and Schoormans, 2005). The aesthetic function is often considered as a separate aspect (Desmet and Hekkert, 2007) and not as a part of the semantic dimension (Bürdek, 1994). Other authors (Crilly et al., 2004) apply the denomination "semantic interpretation" only for what the product says about functionality performance, efficiency, and ergonomics. On the other hand, the semantic components are sometimes included in the aesthetic value of the product (Quarante, 1992).

Regarding emotions, some authors (Norman, 2004; Jordan, 2000) relate affects (emotions are considered to be a type of affect) with the communicative functions mentioned above. There is no consensus on which emotions can be considered product emotions; while some sources distinguish between primary and secondary emotions, or use terms such as emotional features (Chakrabarti and Gupta, 2007), others do not take into account these distinctions when it comes to selecting product emotions. The classification proposed by Desmet (2002, 2003), based on the type of assessment that generates the emotion, is one of the most complete, and it has since been adopted in other works (Crilly et al., 2004).

The elicitation of meanings and emotions (from now on, subjective impressions) is part of the process of communication between the individual and the product, and the senses are the starting point (Fenech and Borg, 2007) of this physical interaction. Moreover, this interaction may depend on the type of communication between the product and the individual. In this regard, some works study the influence of the intensity of the interaction, depending on the senses involved (Artacho et al., 2008; Vergara et al., 2011). Then, after the objective sensorial part of the process has occurred, the subjective sphere comes into play. The information captured by the senses is analyzed, organized, and interpreted, thus enabling the association of meanings to the product, and the elicitation of emotions.

These meanings and emotions will give rise to an assessment of the product, product preferences or, as some authors call it (Crilly et al., 2004), a behavioral response. Thus, for an interested consumer, the behavioral response is called approach (purchase, use of the product, etc.), while for a disinterested one, the response is an avoidance of the product. But the preferences that are generated will also depend on the personal reference values. In the process of generating an assessment, a set of factors such as memory, previous experiences, culture, training, internal and learned rules, and also one's own emotional traits, can all play a part. In the literature all these personal values and criteria are denominated concerns (Desmet, 2002; Fenech and Borg, 2007), sociological values (Mantelet, 2006), or variables (Janhager, 2005). These personal reference criteria are part of the human diversity that should be understood in order

to add value in product design and use (Khalid, 2006). Accordingly, they should be considered as a possible influence on the relationship between meanings and emotions and product preferences.

These elements of human-product interaction (meanings, emotions, preferences, and reference values) and their relationships explained in previous paragraphs can be considered a framework with which to study the Subjective Impressions in Human–Product Interaction (SIHPI) (Agost and Vergara, 2010a; b). In this work a study to analyze these elements and relationships is described. Particularly, the analysis focuses on the relationship between product meanings and emotions, the relationship between both types of subjective impressions and product preferences, and the possible influence of personal reference values on the previous relationship. The products selected for the study were ceramic tile floorings, whose designs are highly influenced by fashion, and consequently by subjective impressions. They are, as defined by Selva et al. (2007), high-involvement products, that is, products that involve people in the purchasing process, are likely to elicit reactions, are usually expensive, and express the purchaser's personality.

2. Materials and Methods

To analyze the relationships between the main elements of the SIHPI framework, an experiment with ceramic tile floorings, based on questionnaires, was designed. A detailed description follows.

2.1. Selection of the subjects

Altogether 283 adults volunteered to participate in the study (158 male, 125 female). A website was implemented for the questionnaires, which were distributed to different types of customers or decision agents of ceramic design: actual or potential users of the product, architects, distributors, ceramic tile designers, etc. Several gifts were raffled among the participants who filled out the whole questionnaire to encourage participation.

2.2. Selection of the ceramic tile floorings

A total of 19 ceramic tile floorings were selected from recent catalogs. They were chosen to elicit very different subjective impressions and product preferences. 3D rendered images of a neutral room were used to show the different floorings. As pointed out by previous authors (Alcántara and Zamora, 2006a; 2006b), the floorings used in the main parts of the house (living rooms, dining rooms or bedrooms) contain a greater emotional component than the floorings for kitchens and bathrooms. Therefore, the elements of the room were chosen to be reminiscent of a neutral living room or bedroom. The images lacked any other decorative elements – except windows and doors – that could influence the subjective response. The format of the floorings was superimposed onto the rendered image and shown in the lower left corner of each image (Figure 1).

Figure 1. Image presented for one sample, with the lower left corner showing the format of the tile

2.3.   Description and selection of semantic, emotional, and reference value descriptors

The questionnaires included questions related to product meanings, product emotions, and reference values. To obtain the initial semantic and emotional universes, a comprehensive set of adjectives, nouns, and other words related to ceramic tile floorings was compiled from ceramics companies' websites, catalogs, articles, and advertising in specialized journals, as well as from previous works (Lindberg, 2004; Desmet, 2002; Mantelet, 2006). To achieve reduced semantic and emotional universes, the affinity diagrams technique was applied by the authors.

Some synonyms and antonyms were clustered using judgments like "It is cozy and comfortable, not at all cold". This was done to avoid different interpretations of each question and to reduce the number of questions. Antonyms were especially used in judgments related to product emotions, since these are characterized by a bipolar affective nature (Russell, 1979; Fernández-Abascal, 1995).

The 24 semantic descriptors and the 7 pairs of emotional descriptors that were finally used are shown in Tables 1 and 2, respectively. The descriptors used in the study were in Spanish.

Table 1.

Semantic descriptors

Translated words	Original words used (Spanish)
It is cozy and comfortable, not at all cold	Es acogedor y confortable, nada frío
It is resistant and durable, not at all fragile	Es resistente y duradero, nada frágil
It is hygienic, easy to clean	Es higiénico, de fácil limpieza
It is slippery, unsafe or unreliable	Es resbaladizo, poco seguro o fiable
It is multipurpose and versatile	Es polivalente y versátil
It is for a use other than the home, not very homey	Es para un uso distinto al doméstico, poco hogareño
It is practical and functional	Es práctico y funcional
It is decorative	Es decorativo
It provides a feeling of spaciousness	Da sensación de amplitud
It is seductive, attractive	Es seductor, atractivo
It is shiny, light, and makes the room brighter	Es brillante, luminoso, aporta claridad
It is youthful, fresh	Es juvenil, fresco
It is sober and simple, not at all flamboyant	Es sobrio y sencillo, nada recargado
It is expressive, suggestive, evocative	Es expresivo, sugerente, evocador
It is balanced, calm	Es equilibrado, sereno
It is innovative, original and creative	Es innovador, original y creativo
It is daring and ground-breaking	Es atrevido y transgresor
It is cheerful and lively	Es alegre y vital
It is sophisticated and elegant	Es sofisticado y elegante
It is a stylish, designer floor	Tiene estilo, de diseño
It looks expensive	Tiene aspecto de ser caro
It looks artificial, unnatural	Resulta artificial, poco natural
It never goes out of fashion, it is timeless	No pasa nunca de moda, atemporal
It is avant-garde, modern, not at all classical or traditional	Es vanguardista, actual, nada clásico ni tradicional

Table 2.

Emotional descriptors

Translated words	Original words used (Spanish)
It causes desire, I would like to use it (keep it at home/ apply it at work) ← → It causes rejection, I would prefer not to use it	Me provoca deseo, me gustaría utilizarlo (tenerlo en casa/ aplicarlo en mi trabajo) ← → Me provoca rechazo, preferiría no utilizarlo
It offers me a feeling of well-being and calm ← → It produces anxiety, makes me nervous	Me hace sentir bienestar y calma ← → Me produce ansiedad, me pone nervioso
I find it cheery, fun ← → It doesn't inspire me at all, it bores me, it puts me in a bad mood	Me hace sentir alegre, divertido ← → No me inspira en absoluto, me aburre, me pone de mal humor
I am positively surprised ← → I am negatively surprised	Me sorprende positivamente ← → Me sorprende negativamente
If I used it at home/work, I would feel like a modern, avant-garde person ← → I would feel old-fashioned	Si lo utilizara en mi casa/mi trabajo, me sentiría una persona moderna, vanguardista ← → Me sentiría pasado de moda
If I used it at home/work, I would feel like an elegant and distinguished person ← → I would feel vulgar	Si lo utilizara en mi casa/mi trabajo, me sentiría una persona elegante y distinguida ← →Me sentiría vulgar
If I used it at home/work, I would feel proud and satisfied; my neighbors and colleagues would be impressed, they would envy me ← → I would feel dissatisfied, ashamed.	Si lo utilizara en mi casa/mi trabajo, me sentiría orgulloso y satisfecho; mis vecinos/colegas de profesión estarían impresionados, me envidiarían ← → Me sentiría insatisfecho, avergonzado

For the personal reference values, sources related to sociological values and personality factors were consulted, in addition to catalogs and advertisements produced by the sector (Rokearch, 1973; Eysenck and Eysenck, 1975; Digman, 1990; Goldberg, 1993).

In addition, a descriptor related to the "search for new sensations" was added, since some articles point out the existence of differences between architects and non-architects when it comes to assessing buildings based specifically on that factor (Llinares, 2003). Finally, the sentence "I am interested in ceramic tile floorings. I am very fond of them" was added to the collection.

As in the previous cases, the universe was finally achieved through descriptive judgments (Table 3).

Table 3.

Reference values descriptors

Translated words	Original words used (Spanish)
I consider myself…:	Me considero una persona…:
… an ambitious person; I usually get what I pursue	… ambiciosa, suelo conseguir lo que me propongo
… a responsible, hardworking, disciplined person	…responsable, trabajadora, disciplinada
… an honest, loyal, sincere person	…honesta, leal, sincera
… a competent, skilled person	…competente, capacitada
… an open-minded, tolerant person	…de mentalidad abierta, tolerante
… an optimistic and cheerful person	…optimista y alegre
… an imaginative, creative person	…imaginativa, creativa
… a thoughtful, analytical person	…reflexiva, analítica
… a loving, family, friendly person	…afectuosa, familiar, amable
… a follower of trends, avant-garde person	…seguidora de tendencias, vanguardista
… an active person	…activa
… a demanding, perfectionist person; I am used to quality	…exigente, perfeccionista, acostumbrada a la calidad
… an elegant, sophisticated person	…elegante, sofisticada
… a practical person; I am more concerned about functional aspects than about aesthetics	…práctica, me preocupa más lo funcional que la estética
… a reserved, introverted person	…reservada, introvertida
… a moderate, restrained person	…moderada, comedida
… a clean, tidy person	…aseada, limpia
I am interested in ceramic tile floorings. I am very fond of them	Me interesan y me llaman la atención los pavimentos cerámicos
I like to know other views before making a decision	Me gusta conocer otras opiniones para tomar una decisión
I like security, I prefer to follow rules than to improvise or search for new sensations	Me gusta la seguridad, prefiero seguir normas a improvisar o a buscar sensaciones nuevas
I am concerned about ecology	Me preocupa la ecología
I like to stand out, to be the center of attention	Me gusta destacar, que se fijen en mí
To feel comfortable at home, I need a meticulous decoration	Para sentirme a gusto en mi casa necesito una decoración cuidada

2.4. Procedure

The chosen (web) interface facilitated distribution and allowed us to gather the data in a centralized way. Texts in Spanish limited the scope of the study. The questionnaires were based on rating scales.

First of all, some demographic characteristics and personal reference values were gathered from participants. Then, they were shown the 19 floorings. Each subject had to select two floorings: the first one that they would choose for home (or in their work, if they maintained a professional relationship with the product), and the first one that they would reject. These two images were shown afterwards together with a third flooring (Figure 2). The third one was the one with the lowest number of responses at that moment. It was chosen automatically by the website with the aim of homogenizing the number of responses about the floorings. The participants were asked to provide answers about the impressions elicited by each of the three floorings using a rating scale with values from +2 (completely agree) to -2 (quite the opposite) in a randomized sequence for each impression.

Finally, they were asked to give their product assessment rating (with a score of 0 to 10) of the three floorings (0 least valued, 10 most valued).

Figure 2. Questions about the meanings and emotions elicited by the three floorings

2.5. Analysis of results

All the statistical analyses were performed with the software application SPSS (PASW Statistics 18©). Four analyses were performed.

2.5.1. Analysis 1: Structure of meanings, emotions, and personal reference values

In order to reduce the data to a structure that was easy to handle and understandable, three Factor Analyses (FA) were conducted. Principal Component Analysis with Varimax Rotation was used for the extraction of components. The ratings of the 24 semantic descriptors, 14 emotional descriptors (grouped in 7 pairs of antonyms), and 23 judgments about reference values were taken as independent variables. For the first two analyses, 849 (283 x 3 images) cases were used, while for the last one 283 were used (1 per participant).

The factors that were selected were the ones with eigenvalues above 1, either for the rotated components or for the original components prior to rotation; that is to say, the factors chosen were the ones considered to provide the best and most comprehensive structure in each case.

The semantic and emotional structures were interpreted by taking into account the variables with significant loads, according to the sample size (Hair et al., 2000).

2.5.2. Analysis 2: Relationship between meanings and emotions

As only one factor was extracted for emotions, this relationship was performed by applying forward-step linear regression analysis. The emotional factor (EF) was considered as the dependent variable, and the semantic factors (SFs) were taken as the independent ones.

2.5.3. Analysis 3: Relationship of meanings and emotions with product assessment

Analysis of correlations was applied to check the relationship of the SFs and EF (subjective impressions) with the product preferences. Product Assessment (PA, the flooring rating from 0 to 10) was adopted as a representation of the product preferences.
Both Spearman's and Pearson's correlation coefficients of the subjective impressions with the PA were initially used. Not all the variables used in this case followed a normal distribution, so the non-parametric

correlation had to be used. However, as similar results were obtained, only Pearson's coefficients will be shown afterwards, as they are considered more powerful.

2.5.4. Analysis 4: Influence of the personal reference values on the relationship of meanings and emotions with product assessment

The next step was to analyze whether the relationship of meanings and emotions with product assessment could differ depending on the reference values of subjects.

First of all, the reference value factors were transformed into binary coded variables. For each factor, a cut-off value (corresponding to zero in the score of the original variables) was found, so as to be able to distinguish between the participants that are defined as positive or negative in terms of the factor. Thus, from each factor, a new qualitative variable was created: VFgroup = 0 (if the subject has been assessed below the cut-off value), and VFgroup = 1 (if he/she has been assessed above that value). This cut-off point was calculated as the value of the factor for a neutral (0) value of all the original variables. In this way, groups of people can be distinguished according to their personal reference values.

An analysis of variance (ANOVA) was performed to verify that there were no significant differences between the groups created by the new binary variables for the SFs, EF, and the PA, so that the groups were homogenous in terms of meanings, emotions, and global assessment. If this were not true, i.e., there were significant differences between groups for any of the variables, the differences observed in the relationship could be due to these differences and it would be a false result.

Then, in order to analyze the influence of the reference values on the relationship of meanings and emotions with product assessment, correlations of semantic and emotional factors with the overall product assessment were repeated, but this time distinguishing between population groups according to their personal reference values (VFgroup).

3. Results and Discussion

3.1. Structure of the meanings, emotions, and personal reference values (Analysis 1)

For meanings, nine semantic factors were extracted. As indicators of the goodness-of-fit of the analysis (Hair et al., 2000), the Kaiser-Meyer-Olkin (KMO) measure was used to indicate the sampling adequacy (0.9 > 0.6), Bartlett's test of sphericity was significant ($p < 0.001$), and the total variance explained by the model was over 80%. The results of the rotated components of each factor can be seen in Table 4, although only components with a value above 0.3 are shown.

Table 4.

Rotated components of the semantic factors

	Component								
	SF1	SF2	SF3	SF4	SF5	SF6	SF7	SF8	SF9
It is sober and simple, not at all flamboyant	0.851								
It never goes out of fashion, it is timeless	0.833								
It is balanced, calm	0.817								
It is multipurpose and versatile	0.780								
It is practical and functional	0.678					0.343			
It is sophisticated and elegant	0.633	0.420						0.331	
It is seductive, attractive	0.624	0.540							
It is cozy and comfortable, not at all cold	0.598						0.400		
It is innovative, original and creative		0.828							
It is avant-garde, modern, not at all classical or traditional		0.790							
It is daring and ground-breaking		0.760							
It is expressive, suggestive, evocative	0.309	0.725							
It is a stylish, designer floor	0.399	0.725							
It is decorative		0.653							
It is youthful, fresh	0.378	0.625	0.432						
It is shiny, light, and makes the room brighter			0.802						
It provides a feeling of spaciousness	0.464		0.743						
It is cheerful and lively		0.493	0.598						
It is resistant and durable, not at all fragile				0.911					
It is slippery, unsafe or unreliable					0.857				
It is hygienic, easy to clean						0.896			
It is for a use other than the home, not very homey	-0.409						-0.810		
It looks expensive		0.367						0.876	
It looks artificial, unnatural	-0.438								-0.788
ROTATED EIGENVALUES	5.78	4.83	2.23	1.10	1.09	1.09	1.08	1.05	1.04
% OF THE VARIANCE EXPLAINED	24.07	20.11	9.28	4.59	4.56	4.54	4.51	4.39	4.32
CUMULATED PERCENTAGE	24.07	44.17	53.45	58.04	62.61	67.15	71.65	76.04	80.36

The nine SFs could be interpreted and named as follows:

SF1 Simple, versatile. This explains more than 24% of the variance and consists of adjectives like *simple*, *timeless* and *balanced*, which could be seen as symbolic values. It is also associated to functional values, with adjectives like *versatile* and *functional*. Simplicity of the flooring is associated with versatility and timelessness. So the most important semantic factor shows that simple floorings will last for more time (people will not get tired of them). Moreover, simple floorings will be more versatile (changes in decoration will not come into conflict with the flooring).

SF2 Innovative, designer flooring. This also explains a high percentage of the variance (> 20%). It encompasses meanings again related to mainly symbolic names (in this case with innovation and avant-garde), and to aesthetic values, through adjectives such as *decorative* or *designer flooring*.

SF3 Light. This is related to an aesthetic value: brightness and spaciousness, which is grouped with a perception of cheerfulness. Hence, bright floorings (those with nice, light colors) provide a greater feeling of spaciousness.

SF4 Resistant; SF5 Slippery; SF6 Easy to clean. The percentages of variance explained are small (slightly more than 4% each one). These factors are related primarily to a single original variable, but these three factors are also clearly related to functionality and use.
SF7 Homely; SF8 Expensive-looking; SF9 Natural. Similar to the three factors above, these are related primarily to a single original variable with a similar percentage of variance explained, although in this case the factors relate to symbolic values.

This means that these six variables are perceived almost independently, regardless of the rest of the questions in the questionnaire.

In the Factorial Analysis of emotions, a single emotional factor was identified (rotated eigenvalue = 5.294) which can explain 75.63% of the variance (Table 5). The KMO value (0.934 > 0.6) and the significance level of the Bartlett's test (p < 0.001) confirm the adequacy of implementing factorial analysis.

Table 5.

Rotated components of the emotional factor

	Comp. 1
It causes desire, I would like to use it (keep it at home/ apply it at work) ← → It causes rejection, I would prefer not to use it.	0.921
I am positively surprised ← → I am negatively surprised.	0.899
If I used it at home/work, I would feel like an elegant and distinguished person ← → I would feel vulgar.	0.896
If I used it at home/work, I would feel proud and satisfied; my neighbors and colleagues would be impressed, they would envy me ← → I would feel dissatisfied, ashamed.	0.893
I find it cheerful, fun ← → It doesn't inspire me at all, I get bored, it puts me in a bad mood.	0.853
It offers me a feeling of well-being and calm ← → It produces anxiety, makes me nervous.	0.847
If I used it at home/work, I would feel like a modern avant-garde person ← → old-fashioned.	0.770
EIGENVALUE	5.294
% OF THE VARIANCE EXPLAINED	75.629

Eleven factors for personal reference values were identified (Table 6). The solution explains 76.16% of the variance. KMO (0.771 > 0.6) and Bartlett's test of sphericity (p < 0.001) show the goodness-of-fit of the analysis.

Table 6.

Rotated components of the factors of personal reference values. Only components above 0.35 are shown

	VF1	VF2	VF3	VF4	VF5	VF6	VF7	VF8	VF 9	VF10	VF11
I consider myself an elegant, sophisticated person	0.784										
I consider myself a follower of trends, avant-garde person	0.757										
I like to stand out, to be the center of attention	0.730										
To feel comfortable at home, I need a meticulous decoration	0.522							0.412	-0.445		
I consider myself a competent, skilled person		0.777									
I consider myself a responsible, hardworking, disciplined person		0.736									
I consider myself an honest, loyal, sincere person		0.658									
I consider myself a thoughtful, analytical person			0.817								
I like to know other views before making a decision			0.725								
I consider myself a reserved, introverted person				0.794							
I consider myself a moderate, restrained person				0.755							
I consider myself an open-minded, tolerant person					0.843						
I consider myself an optimistic and cheerful person					0.655						
I consider myself a clean, tidy person						0.725					
I consider myself a demanding, perfectionist person; I am used to quality			0 ,385			0.700					
I like security, I prefer to follow rules than to improvise or to search for new sensations							0.826				
I consider myself an imaginative, creative person							-0.598				
I am interested in ceramic tile floorings. I am very fond of them.								0.905			
I consider myself a practical person; I am more worried about functional aspects than about aesthetics									0.870		
I consider myself a loving, family friendly person										0.897	
I am concerned about ecology											0.912
ROTATED EIGENVALUES	2.310	1.822	1.554	1.503	1.476	1.359	1.269	1.243	1.234	1.150	1.075
% OF THE VARIANCE EXPLAINED	11.001	8.676	7.400	7.157	7.030	6.473	6.044	5.917	5.877	5.474	5.117
CUMULATED PERCENTAGE	11.001	19.677	27.077	34.234	41.264	47.737	53.782	59.698	65.576	71.050	76.166

These eleven factors can be interpreted and named as follows:

VF1 Sophistication and fashion. The factor with the highest percentage of explained variance (11%) is related to elegance and trends criteria. These are also adjectives that are characteristic of ceramic tile floorings.

VF2.Compliance and integrity. The next factor in proportion of variance explained (almost 8.68%) refers to personal skills such as responsibility, discipline, or honesty.

VF3 Reflexive. The third factor brings together descriptors relating primarily to decision-making.

VF4 Reserved. This refers to a reserved and restrained character.

VF5 Tolerant, optimistic. This represents a tolerant and optimistic mentality.

VF6 Neat, demanding. The biggest burdens correspond to the adjectives "Neat, clean" and "Demanding, perfectionist, used to quality". The burden of this second descriptor is divided with the factor FC3, although with lower weight.

VF7 Safety. This refers to the preference for safety, by grouping the descriptors "I like safety", "I prefer to follow rules than to improvise or to search for new sensations" and, with a negative coefficient, "Imaginative, creative".

VF8 Ceramic interest. This is related with people with a special interest in ceramic paving, although it also considers their taste for careful decoration.

VF9 Practice, VF10 Affectionate, VF11 Ecological. These three factors are related primarily to a single original variable.

3.2. Relationship between meanings and emotions (Analysis 2)

Since the SFs are independent of each other and just one factor has been extracted for emotions in the previous analysis, linear regression was applied to analyze this relationship. The SFs are considered as the independent variables and the EF as the dependent one. The intention is to check to what extent the EF can be explained by the SFs.

The results show that the nine SFs are included in the analysis, all of them contributing positively except for *SF5 Slippery*, which contributes negatively. The total variance explained by the model is 81.3%. Table 7 summarizes the information about the coefficients of the regression analysis for the final model obtained in the forward-step process.

Table 7.

Standardized coefficients of the linear regression analysis (SFs, independent variables – EF, dependent variable). Partial results: Last step

	Standardized coefficients		
	Beta	t	Sig.
SF1_ Simple, versatile	0.691	46.249	0.000
SF2_ Innovative, designer flooring	0.455	30.479	0.000
SF3_Light	0.223	14.939	0.000
SF8_Expensive-looking	0.177	11.872	0.000
SF9_Natural	0.162	10.854	0.000
SF7_Homely	0.113	7.549	0.000
SF4_Resistant	0.071	4.737	0.000
SF5_Slippery	-0.035	-2.349	0.019
SF6_Easy to clean	0.031	2.105	0.036

Three different groups of factors can be identified. The values of the coefficients show that SF1 (*Simple, versatile*) and SF2 (*Innovative, designer flooring*) have the greatest influence on the EF. Their meanings are mainly symbolic. The following four factors in terms of influence are *SF3 Light*, *SF8 Expensive-looking*, *SF9 Natural*, and *SF7 Homely*, whose functions of meaning are essentially aesthetic and symbolic. Finally, the factors with mainly functional meanings (*SF4 Resistant*, *SF5 Slippery*, and *SF6 Easy to clean*) barely influence the EF. In fact only one of them is significant with p < 0.01.

The results obtained show that there is a close relationship between the meanings given to the product and the emotions caused in the subject. However, emotions cannot be completely explained in terms of meanings: the nine factors included in the semantic analysis explain more than 80% of the variance of the EF. On the other hand, not all the meanings given to the product are related with the emotion in the same manner. In this experience, certain meanings, such as *SF1 Simple, versatile* or *SF2 Innovative, designer flooring*, present a greater relationship with the emotion generated by the product, while other meanings, such as *SF6 Easy to clean* or *SF5 Slippery*, do not show any relevant weight in the generation of

emotions. That is to say, the EF maintains a higher correlation with the SFs whose meanings are mainly symbolic or aesthetic, and is not (or is only very weakly) related with the factors whose functions of meaning are associated with more functional issues.

3.3.   Relationship of meanings and emotions with product assessment (Analysis 3)

Pearson's correlation coefficients are shown in Table 8 (left column). All the significant correlations are positive. Only the correlation of *SF5 Slippery* is negative, but it is not significant. The emotional factor presents the highest coefficient. With regard to the SFs, the most important influence on global assessment of the product is for the perception of simple and versatile (SF1), also with a high correlation. The factors *SF2 Innovative, designer flooring* and *SF3 Light* are on a second level of correlation, and *SF9 Natural, SF7 Homely* and *SF8 Expensive-looking* are on a third, still significant, level of correlation. Finally, the factors with functions of meaning that are essentially functional: *SF4 Resistant*, *SF6 Easy to clean*, and *SF5 Slippery*, are not significant (Sig = 0.01). In addition, the values of the coefficients are very small (< 0.1).

Due to the relationship that exists between the SFs and the EF, an analysis of partial correlations of each factor with the PA was performed, excluding the effect of the rest of the factors in the relationship (Table 8, second column). The only factor that has changed its position relative to the result obtained with total correlations is the EF, as expected. The rest of the factors (SFs) maintained the relative order established in the previous correlation. However, in this case, the values of the coefficients are higher and more significant for the last groups of semantic factors, i.e., the ones with a functional meaning.

Table 8.

Pearson and partial correlation coefficients between the PA and SFs, EF. Results ordered by absolute value of coefficients. In partial correlation, the effect of the rest of the factors has been removed in each case

Pearson correlation coefficient		Partial correlation coefficient	
0.868**	EF	SF1_ Simple, versatile	0.527**
0.722**	SF1_ Simple, versatile	SF2_ Innovative, designer flooring	0.351**
0.382**	SF2_ Innovative, designer flooring	SF3_ Light	0.340**
0.245**	SF3_ Light	EF	0.338**
0.168**	SF9_Natural	SF9_Natural	0.245**
0.147**	SF7_Homely	SF7_Homely	0.244**
0.132**	SF8_ Expensive-looking	SF8_ Expensive-looking	0.157**
0.078*	SF4_Resistant	SF4_Resistant	0.128**
0.062	SF6_ Easy to clean	SF6_ Easy to clean	0.122**
-0.047	SF5_ Slippery	SF5_ Slippery	-0.085*

It has been seen that both product meanings and emotions can directly influence preferences. Even after removing the effect of the meanings in the relationship between emotion and assessment, this relationship does not disappear completely, but continues to maintain a very relevant position (the EF continues to be located in the first group identified in relation to the PA, together with SF1, SF2, and SF3). This means that the relationship between emotion and product assessment cannot be explained only on the basis of meanings. Emotion, regardless of them, has an influence on product assessment.

In any case, not all meanings and emotions necessarily influence product assessment to the same extent. For the sample used in the study, the most influential semantic factors are linked primarily to symbolic and aesthetic meanings, while those related to functional meanings maintain low coefficients, as was already seen in their relationship with the emotional factor.

It should be noted that, in general, the relative importance of meanings on the product assessment does not vary, regardless of whether total or partial correlations are applied. This corroborates the assumption that the generation of meaning is prior to emotions (Desmet and Hekkert, 2007; Crilly et al., 2004), and that meanings are to a large extent responsible for the generation of emotions. Therefore, in the analysis of the relationship between meanings and product assessment, we could have used the simpler option: total correlations. In contrast, the relationship of emotion with product assessment should be analyzed with partial correlation or regression analysis because the relative influence of emotion with regard to the rest of the factors changes with the type of analysis.

3.4. Influence of the personal reference values on the relationship of meanings and emotions with product assessment (Analysis 4)

The groups of total cases created with the reference values for the binary variable VFgroup2-*Compliance and integrity* were 843 for positive and 6 for negative. This number was considered very small, and so in this analysis the variable was discarded. For the rest of the variables, the distribution of cases ranged from 465-384 in the most homogeneous split to 771-78 in the least homogeneous. In these cases, the sizes of the groups provided enough power to detect small and medium-sized differences for mean values with an ANOVA, in line with Cohen (1992) (with a power of 80% and significance level of 0.05). The exact power was calculated in accordance with Faul et al. (2007).

In all, 110 ANOVAs were performed (10 independent variables VFgroup x 11 dependent variables) to verify significant differences between the groups created by the new binary variables for the SFs, the EF, and the PA. Only in nine of them were the differences statistically significant, in spite of the high level of power to find them. Thus, it may be concluded that the groups for these 10 reference values can be considered homogenous in terms of meanings, emotions, and global assessment and, if any change is observed in their relationship, it will be a real effect of the reference values of the subjects. Moreover, these nine differences could be due to the way the floorings were chosen. It should be remembered that each participant selected two of the products to assess, and the third was assigned at random. So each group could have answered about different floorings. For instance, participants who define themselves as neat and demanding (VFgroup6 = 1) have chosen floorings number 1 and 5 (very bright ones) as their favorite more times than the rest of the subjects (Figure 3). Perhaps some differences would not have been detected if all participants had answered about the same floorings. However, as stated before, the 10 pairs of groups can be considered homogenous in terms of meanings, emotions, and global assessment, in spite of the possible differences in the chosen floorings.
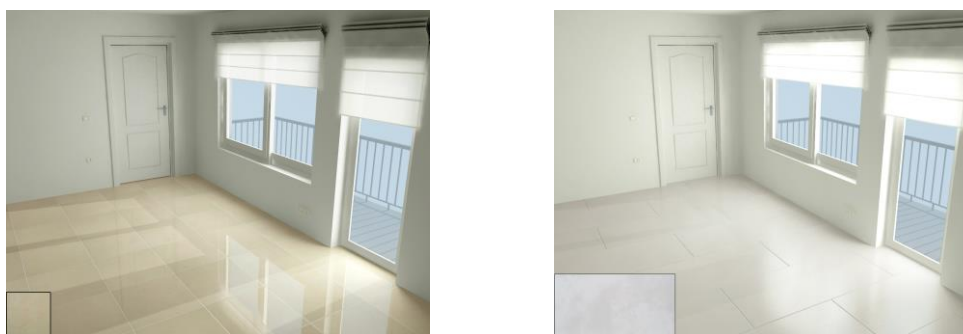

Figure 3. Bright floorings were chosen more frequently by people who define themselves as neat and demanding

Figure 4, below, shows the values of the correlation coefficients of SFs and EF with the global PA, and also with the PA when distinguishing groups of personal reference values (for VFgroup = 1 and VFgroup = 0).

Once confirmed that the groups were homogeneous, the correlations obtained showed that the relationship between the semantic factor *SF1 Simple, versatile* and the PA is not altered by the distinction of groups based on the reference values. And the relationship between the EF and the PA also remains without changes. It should be noted that SF1 and EF are the factors that are most strongly related to the PA. On the other hand, the relationship between SF6 *Easy to clean* and the PA changes when distinguishing the groups *VFgroup 5, VFgroup 6, VFgroup 7, VFgroup 8, VFgroup 9, VFgroup 10*, and *VFgroup 11*. Although general results show that SF6 do not maintain a significant relation with the PA, those who consider themselves neat and demanding, practical, or those who look for safety, do relate easy to clean with the PA.

Furthermore, the relationship between SF9 *Natural* and the PA changes when distinguishing the groups *VFgroup 1, VFgroup 3, VFgroup 4, VFgroup 5, VFgroup 9,* and *VFgroup 11*. For instance, individuals who consider themselves thoughtful, practical or ecological people do not relate naturalness with the PA significantly.

From the groups created from the new variables, other interesting results can also be seen. As an example:

In relation to *VFgroup1- Sophistication and fashion*, the individuals that are defined as interested in sophistication and fashion (VFgroup1 = 1) show a correlation coefficient between *SF2- Innovative, designer flooring* and the PA that is higher than the rest, which seems logical. Moreover, those who are defined as sophisticated do not relate *SF7 Homely* and *SF9 Natural* with the PA, while the ones who do not define themselves as sophisticated (VFgroup1 = 0) do maintain a significant correlation (Figure 4).

Those who do not consider themselves tolerant and optimistic people (VFgroup5 = 0) relate easy to clean (SF6) with the PA, whereas the rest of the individuals do not. On the other hand, individuals who do not show a preference for safety (VFgroup7 = 0) maintain a negative relation between the PA and SF5 *Slippery*, while the rest of the individuals do not maintain any significant relation between these variables. Although this can seem a strange relationship, we should remember that VF7 *Safety* was related to the preference for following rules, improvisation, or creativity, and not with physical attributes of the flooring. People with no interest in ecology (VFgroup11 = 0) also maintain a relationship between non-slippery and the PA.

Individuals who define themselves as neat and demanding (VFgroup6 = 1), and the ones who define themselves as practical (VFgroup9 = 1) relate *SF6 Easy to clean* positively with the PA. This relationship is not significant without distinguishing groups. On the other hand, those who do not consider themselves as affectionate or familiar (VFgroup10 = 0) do not correlate SF7 with the PA, while in the general case this relationship is significant, with a significance level of 0.01.

Therefore, it seems that some distinctions about the meanings that have the most influence on product preferences can sometimes be identified, depending on the predominant reference values in each individual.
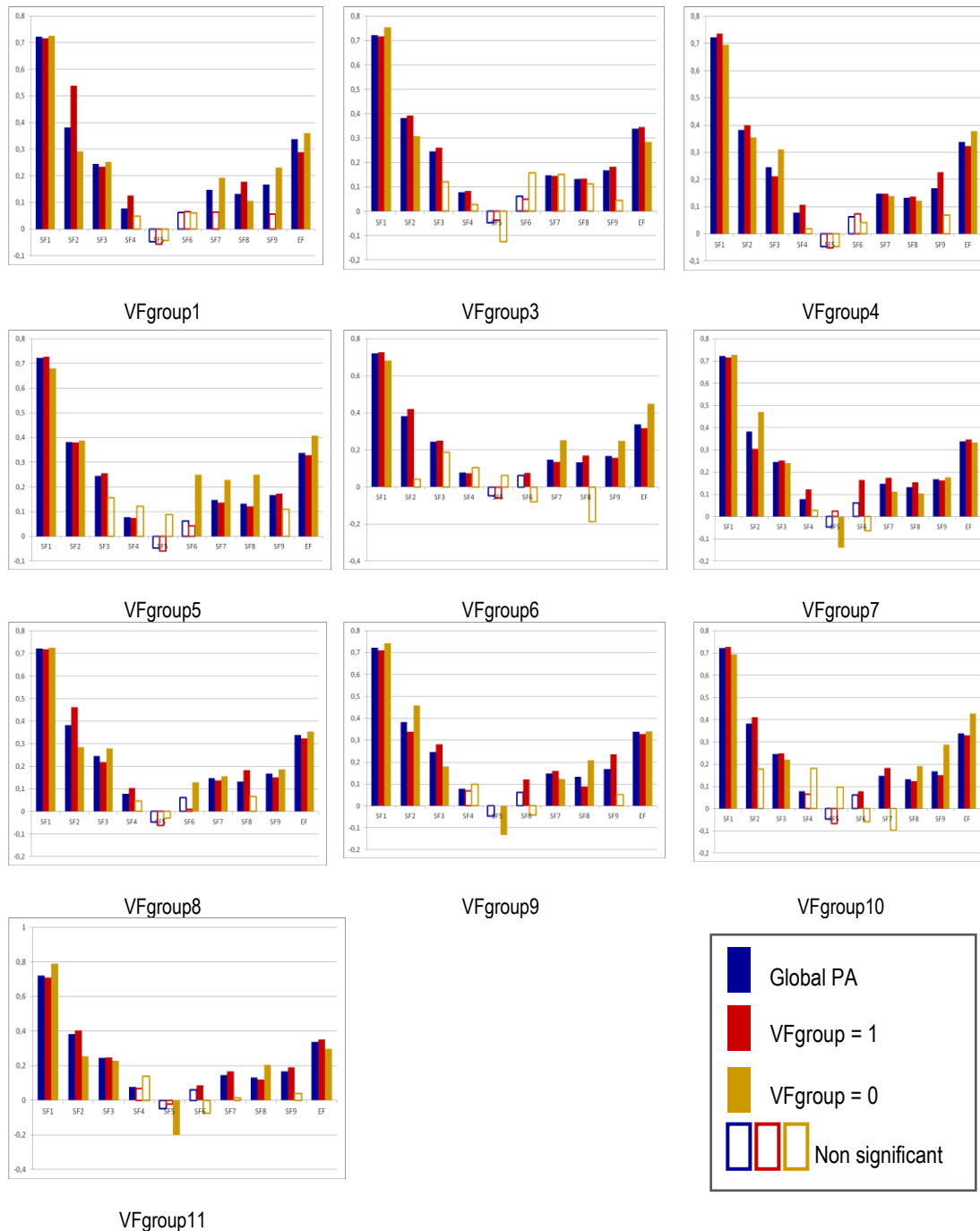
Figure 4. Values of the correlation coefficients of SFs and EF with PA, for all the cases (global) and when distinguishing groups of reference values. If the correlation is not significant (p = 0.05), the shading is omitted

3.5.   General discussion

The analyses have shown that meanings given to the product and emotions elicited are very close concepts; emotion can be explained on the basis of meanings to a large extent.

In this study, nine semantic factors belonging to the functional, aesthetic and symbolic fields were extracted, which corresponds to the types of meanings, product messages (Monö, 1997), roles (Creusen and Schoormans, 2005) or communicative functions (Bürdek, 1994) mentioned in the introduction. On the other hand, emotion has been identified as only one factor, which means that all emotions are almost the same, at least for this product and the emotions considered here. This fits the view of considering

emotions as affects, with a (high or low) intensity and a (positive or negative) valence (Fernández-Abascal, 1995). Our results show that the emotional factor is only characterized by the scores (intensity) and their sign (valence).

Not all the meanings are related to emotion with the same intensity. In our experience, functional SFs are not, or are only very weakly, related with EF. As we could expect, aesthetics and symbolic meanings are more related to the generation of product emotions.

It has also been noted that both meanings and emotions are related to the product assessment, taken as a representation of the product preferences. In particular, it has been found that preferences are related to a greater extent with semantic factors with symbolic or aesthetic functions. Future works could confirm whether, for kitchen or bathroom floorings, functional meanings are more related to preferences or not. The emotional factor is strongly related to product assessment, although in the analysis of partial correlations this relationship is weaker, because emotion can largely be explained from the meanings.

Furthermore, some distinctions in the meanings that most influence the product preferences are identified in some cases, depending on the predominant reference values in each individual. This could be an important result to characterize markets, not only with demographic and sociological data, but also with personal values. For instance, high-level markets can be composed mainly of people who are more influenced by sophistication and fashion, while middle markets may be a mixture of fashion and practical people, and this difference could affect and explain their different preferences.

4.   Conclusions

The theoretical models and tools for affective design proposed in the literature usually focus on the measurement of meanings given to the product or on the emotions generated. Both aspects have been considered jointly in this study. In addition, the reference values of the participants (personal criteria, rules, concerns, etc.) have been taken into account in the relationship of meanings and emotions with product preferences.

A questionnaire was designed and distributed to different types of customers of ceramic tile floorings via the web. Several factor analyses applied to the responses thus obtained showed: nine semantic factors perceived (Simple, versatile; Innovative, designer flooring; Light; Resistant; Slippery; Easy to clean; Homely; Expensive-looking; Natural), one emotional factor, and eleven factors of reference values (Sophistication and fashion; Compliance and integrity; Thoughtful; Reserved; Tolerant, optimistic; Neat, demanding; Safety; Ceramic interest; Practice; Affectionate; Ecological).

Results from the study suggest that both meanings and emotions elicited by a product must be taken into account in the generation of the product preference. The meanings given to the product can cause the generation of emotions, and both types of subjective impressions give rise to product preferences. The symbolic and aesthetic meanings are more influential in both relationships. However, the personal reference values can modify these relationships between subjective impressions and product preferences, and for some groups, functional meaning is also influential.

Acknowledgments

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