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Measuring Preferences: from Conjoint Analysis to Integrated Conjoint Experiments

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ABSTRACT

When there are many attributes, experiments with Conjoint Analysis include problems of information overload that affect the validity of such experiments. The impact of these problems can be avoided or reduced by using Hierarchical Information Integration (HII).

The present work aims to demonstrate how the integrated experiments can resolve the limitations arising in Conjoint Analysis and HII, and to further establish ways to proceed in these types of situations. A variation of Louviere's (1984) original HII model, proposed by Oppewal *et al.* (1994), is applied in this work for the selection of mobile phones.

Keywords: Conjoint Analysis; Hierarchical Information Integration; preferences.
JEL classification: C35; C99; L63.
MSC2010: 62K15; 62H99.

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Medición de preferencias: desde el Análisis Conjunto a los Experimentos Conjuntos Integrados

RESUMEN

Los experimentos de Análisis Conjunto con muchos atributos incluyen problemas de sobrecarga de información que afectan a la validez de dichos experimentos. El impacto de esos problemas puede ser evitado o reducido utilizando la Integración de Información Jerárquica (HII).

El objetivo de este trabajo es mostrar cómo los experimentos integrados pueden resolver las limitaciones planteadas en el Análisis Conjunto y en el HII, estableciendo una forma de actuar para este tipo de situaciones. Una variante del modelo original de HII de Louviere (1984), propuesta por Oppewal *et al.* (1994), se aplica en este trabajo a la elección de teléfonos móviles.

Palabras clave: Análisis Conjunto; Integración de Información Jerárquica; preferencias.
Clasificación JEL: C35; C99; L63.
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1. INTRODUCTION

Conjoint analysis (CA) is the most popular approach for measuring customer preferences in marketing research (Wittink *et al*., 1994; Green *et al*., 2001; Gustaffsson *et al*., 2003). It is a methodology of decompositional character in which respondents only value different alternatives or profiles, from which their preferences are obtained. In CA, respondents indicate their preference for a series of hypothetical multi-attribute alternatives, which are typically displayed as stimuli or profiles of attributes (Oppewal and Vriens, 2000). Each attribute is formed by a series of levels that constitute the practical definition of said attributes.

The data collection method most commonly used in conjoint analysis experiments is the full profile method. It consists of separately describing each stimulus or profile by means of a card that includes level combinations of each attribute. The interviewed person must organise or evaluate all the profiles resulting from the attribute-level combinations. The descriptions carried out with the full profile method are much more relevant for the objectives pursued with the conjoint analysis since a complete description of the product or service is given to the interviewed person (Green and Krieger, 1993). The main advantage of this method is that it enables a more realistic vision of the analysed problem since it simultaneously deals with the attribute features of the product or service. Notwithstanding, there is a major drawback. As the number of attributes and/or level number increases, the possibility of an information overload is also greater. In this case, the interviewed person may be tempted to simplify the evaluation process by focusing on only a few attributes, when this methodology requires the simultaneous consideration of all the attributes.

The impact of this and other problems can be avoided or reduced by using Hierarchical Information Integration (HII). The procedure consists of classifying the high number of attributes into a small group of constructs. An experimental design is then created for each construct. Finally, a bridge design is made to calculate the partial utilities. Oppewal *et al*. (1994) identify a series of limitations in the HII original methodology. An alternative in order to overcome these limitations is the use of integrated sub-experiments. As in traditional HII applications, the profiles of the integrated sub-experiments include attributes to determine a decision. However, in addition to these attributes, a series of decision constructs are included in each profile.

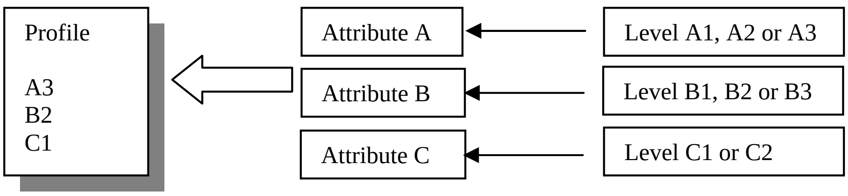
The present work aims to demonstrate how the integrated experiments can resolve the limitations arising in conjoint analysis and HII and to further establish ways to proceed in these types of situations. A variation of Louviere’s (1984) original HII model proposed by Oppewal *et al.* (1994) is applied in this work for the selection of mobile phones. To achieve this goal, the following section briefly describes conjoint analysis. Subsequently, the HII methodology and the integrated experiments are explained. The application is then carried out to draw the most important conclusions.

2. NUMBER OF PROFILES TO EVALUATE IN CONJOINT ANALYSIS

Conjoint analysis is a methodology in which a decision maker has to choose from a number of options that vary simultaneously from between two or more attributes (Green *et al*., 2001). Researchers describe products or services by sets of attribute values or levels and then measure respondents' purchase interest (McCullough, 2002). This description presents respondents or judges with several hypothetical products or services, each consisting of a combination or stimuli of specified features or characteristics (Myers and Mullet, 2003). Such stimuli are therefore described by several attributes. The conjoint results go beyond attribute importance and provide quantitative measures of the relative appeal of specific attribute levels (Wyner, 1992). Therefore, to explain and predict preferences that result in an assessment of achievements is the principal goal of conjoint analysis (Schweikl, 1985).

In applications of conjoint analysis, products or services (profiles) are described through a set of attributes with the idea of measuring the preferences of the respondents, as shown in Figure 1.

Figure 1. Relationship between profiles, attributes and levels.



In the case of having *N* attributes with *k* levels each, the number of profiles or stimuli that must be evaluated is:

$$\underbrace{k \cdot k \cdots k}_{N\ times} = k^N$$

For example, if we have 6 attributes with 3 levels each, the number of profiles to be evaluated are $3^6 = 729$. If there are two more attributes with the same number of levels, in other words, 8 attributes with 3 levels each, the number of stimuli will increase significantly, since the number of profiles to be evaluated becomes 6,561. If the number of levels varies between the attributes, for example *N* attributes with *k* levels and *M* attributes with *l* levels, then the number of stimuli to be evaluated is:

$$\underbrace{k \cdot k \cdots k}_{N\ times} \cdot \underbrace{l \cdot l \cdots l}_{M\ times} = k^N \cdot l^M$$

For example, if we have 2 attributes with 3 levels and 3 attributes with 2 levels, the total number of profiles to be evaluated will be $3^2 \cdot 2^3 = 72$. If we have 2 attributes with 4 levels and 3 attributes with 2 levels, the total number of stimuli to be evaluated will be $4^2 \cdot 2^3 = 128$.

Table 1 shows the number of profiles to be evaluated in relation to the number of attributes and levels. It reflects how fast the number of stimuli rises when the total number of attributes and levels are increased.

Table 1. Number of profiles for evaluating

	Number of levels			
Number of attributes	**2**	**3**	**4**	**5**
4	16	81	256	625
5	32	243	1.024	3.125
6	64	729	4.096	15.625
7	128	2.187	16.384	78.125
8	256	6.561	65.536	390.625

The number of profiles established in Table 1 is determined by a full factorial design. This design uses all the possible combinations of attribute levels or factors. These factors are studied because they are believed to have a conjoint effect over a variable answer. The factor effect is defined as the variation experienced by the variable answer when a change is produced in the factor level. Frequently, this is known as the main effect because it refers to the fundamental interest factors of the experiment (Louviere, 1988).

A full factorial design allows estimates to be obtained of the parameters corresponding to the main effects and to all the interaction effects. Evidently, this provides excessive information; therefore the person interviewed is unable to make a proper evaluation. The person would lose interest and their evaluation would negatively influence the quality of the answers obtained (Vázquez, 1990). The fractional factorial designs have been created in order to solve this problem.

The fractional factorial design is the most commonly used design in Conjoint Analysis (Martín, 1987). Usually, most studies estimate the main effects by assuming the inexistence or unimportance of the interaction effects. Therefore, the interaction effects can be disregarded and a fractional factorial design used instead. The latter allows us to calculate the main effect with a smaller number of combinations than thoser used by a full factorial design, which calculates all the effects (main and interaction).

As in the full factorial design, the fractional factorial design must be optimum in order to ensure the correct calculation of the main effects (Hair *et al.*, 1999). In other words, it must be an orthogonal design[1] (there is no correlation between attributes) and balanced (each level appears the same number of times in each attribute) (Varela, 2003).

Therefore, the fractional factorial design reduces the information load to be evaluated by the interviewed person by means of partially or fully disregarding the interactions of the model. Although fractional factorial designs greatly reduce the difficulties present in a full

[1] A more detailed explanation of orthogonal designs can be found in Varela (1983).

factorial design, when the number of attributes and levels is elevated, the fractional factorial design is also configured by a high number of profiles and consequently there is still some information overload which impede the required quality of the answers. Therefore, when there are many attributes, experiments with conjoint analysis include problems of information overload that affect the validity of such experiments. These problems can be 1avoided or reduced by using integrated conjoint experiments.

3. HIERARCHICAL INFORMATION INTEGRATION AND INTEGRATED CONJOINT EXPERIMENTS

HII is an extension of information integration theory (Anderson, 1981; 1982). The original approach of HII was proposed by Louviere (1984). HII is based on the idea that consumers process information in a hierarchical fashion if the decision situation is complex and the alternatives involve many attributes. This basic idea is based on a set of assumptions (see Louviere and Timmermans, 1990a, 1990b). The application of this methodology assumes a two-step decision-making process (Johnson, 1988). In the first step, attributes are classified into a limited number of perceptual dimensions, called decision constructs (Oppewal and Vriens, 2000). Step two involves the integration of the perceived scores of the constructs into an overall judgement for the alternative. A more detailed description of the steps of HII can be seen in Oppewal *et al.* (1994) and Molin and Timmermans (2009).

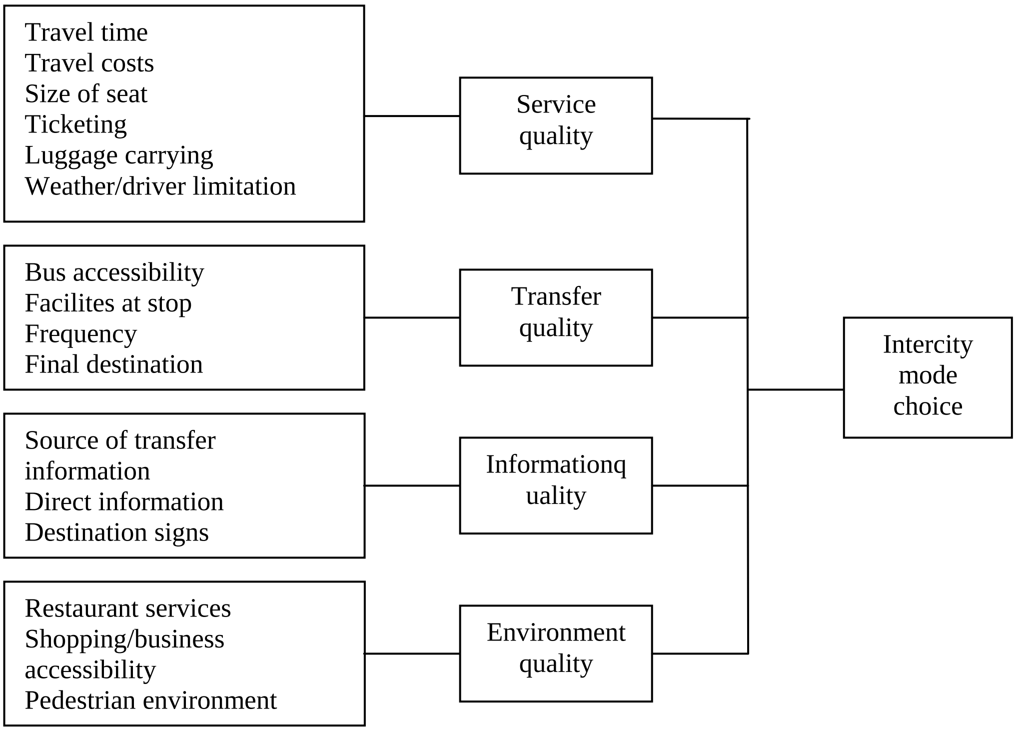
Since each sub-experiment has fewer attributes than the complete design, the information overload is reduced. Moreover, since each sub-experiment is addressed to different interviewee groups, the information overload is also reduced, assuming of course that the different groups are sufficiently homogenous (Molin and Timmermans, 2009).

An example of the structure of the conventional HII experiments is shown in Figure 2 (Chiang *et al*., 2003). First, attributes are clustered into sets based on logic, theory or empirical evidence. Second, separate experimental designs are constructed for each of the sets identified in the first step. Third, the response data obtained in the second step are analysed separately for each set. The data obtained can be used to analyse the data.

Oppewal *et al.* (1994) and Van de Vijvere *et al.* (1998) identified a series of potential limitations for the original HII approach. Firstly, these authors considered that the original HII methodology requires the calculation of separate models for each sub-experiment and for each bridge experiment. Therefore, this methodology produces various models rather than a single model, and hence it is not possible to directly calculate a global model.

Secondly, the remaining constructs are not specified in each sub-experiment because they, supposedly, do not have a systematic effect on the evaluations of a particular construct. Therefore, the attribute effects are limited to a group of constructs and there is no control over the inferences of the results in the other constructs.

Figure 2. The structure of the conventional HII experiments applied to model intercity mode choice (Chiang *et al*., 2003).



Thirdly, the evaluation scale in the bridge experiments is unclear which may cause problems in its validity (Molin and Timmermans, 2009).

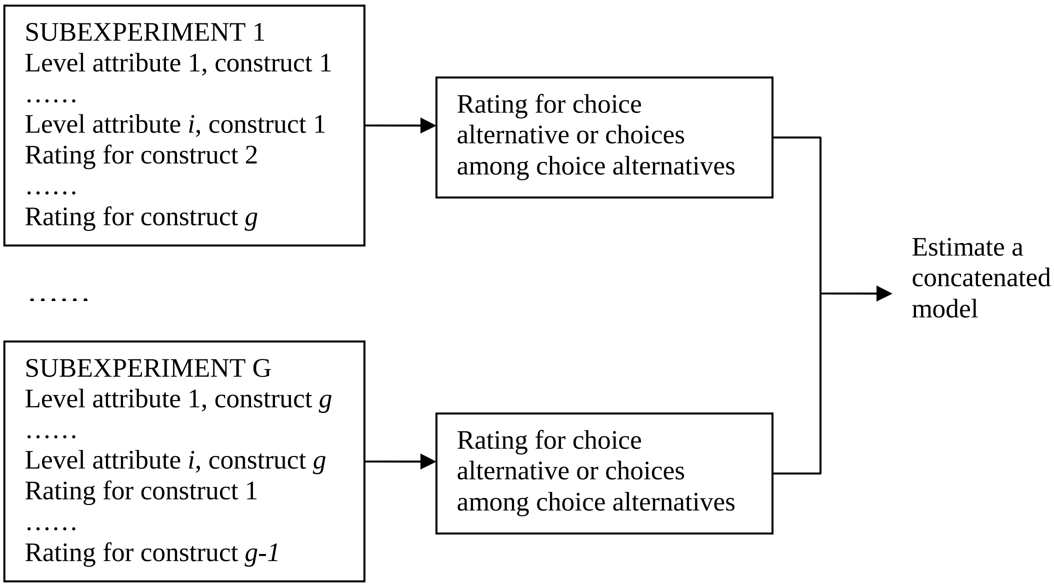
Fourthly, the HII original methodology contrasts the decision hierarchic structure. Therefore, it must be assumed that the hierarchic structure is the most suitable for relating the sub-experiments.

Fifthly, although the bridge experiment can be designed as a choice experiment, the traditional HII sub-experiments cannot be configured as choice experiments. The reason is that the evaluations of the attributes which define the construct must be measured as a scaled ratio.

Finally, the interactions between variables that define different constructs cannot be estimated (Molin and Timmermans, 2009).

As an alternative to the HII original methodology, Oppewal *et al.* (1994) proposed an approach based on integrated sub-experiments. As in the traditional HII methodology, the sub-experiment profiles are formed of attributes which define a specific decision construct. However, in this alternative methodology, the evaluations of the other decision constructs are also included in each profile. These evaluations are commonly expressed on a ratio scale. The basic idea of integrated choice experiments is depicted in Figure 3.

Figure 3. Scheme of experiments underlying HII with integrated subexperiments (Molin and Timmermans, 2009).



The HII approach with integrated sub-experiments overcomes most of the limitations of the original HII approach (Molin and Timmermans, 2009). First, the profile evaluations can be regarded as overall evaluations, and therefore at the level of the complete decision alternative, because all the decision constructs are described in the profiles, either as combinations of attribute levels or as summarizing ratings of constructs. Consequently, all separate sub-experiments can be concatenated to estimate a single model. Secondly, the interviewees do not have to make deductions regarding the omitted construct levels since all the constructs are specified in each profile. Thirdly, there is no need to carry out a bridge experiment because the profiles already fully describe the choice alternatives. Fourthly, the validity of this methodology[2] can be measured (Oppewal *et al.*, 1994; Van de Vijvere *et al.*, 1998). Fifthly, the experiments can be designed as choice experiments. Finally, the interaction between attributes and decision constructs can be calculated. However, it is not possible to estimate the interactions between the variables which define different constructs.

4. AN APPLICATION FOR THE SELECTION OF MOBILE PHONES

In order to illustrate how HII reduces the interviewees' evaluation task, a study of the purchase preferences of mobile phone users is presented. The example is for illustration purposes only and therefore its conclusions are not binding. The data has been obtained through a questionnaire addressed to university students. According to the study "*Segundo Estudio sobre Internet y otras tecnologías en España*" (Second Study on Internet and other technologies in Spain) carried out by the BBVA Foundation, the use of mobile phones in Spain has been

[2] A detailed description on how to measure this methodology validity can be found in the work by Molin and Timmermans (2009).

generalised and there are hardly any differences between the different age groups. The range of services and applications used in mobile phones increases in direct proportion to age. The youngest use the services and applications that transcend conventional telephone communication more extensively and intensively. To cover this demand, new communication modalities are created (text messages, file exchange...) as well as other entertainment-related activities (photographing, video recording, listening to music, games...). On the other hand, adults basically use their mobile phones to make and receive calls.

The first step in the application of the methodology is the definition of the attributes and levels that characterize the product. For this purpose, the decisive attributes have been identified. An attribute is considered decisive if it greatly contributes towards establishing the consumers´ preferences. Those attributes considered to be basic have not been taken into account. In other words, the attributes similarly offered by all products (Múgica, 1986). For example, the battery is an attribute that has not been considered since it has been classified as a basic attribute due to the fact the most mobile phones have a standard Li-ion battery. In order to identify the attributes of our study, several Internet mobile phone portals have been examined. In regard to the levels, a balanced number has been sought for each attribute since there are studies which indicate that the level rank and number of an attribute affect its relative importance (Verlegh *et al*., 2002; Wittink *et al*., 1982; Wittink *et al*., 1990). On the other hand, levels similar to those present in reality have been defined thus increasing the preference validity (Ramirez, 2007). Table 2 shows the different attributes with their corresponding levels.

Table 2. Identification of attributes and establishment of levels

ATTRIBUTES	LEVELS
Size and weight	Small / Medium / Big
Type of screen	Without lid / With lid / Touch screen
Price	Less than 30 € / Between 30 and100 € / More than 100 €
Stand-by autonomy	Less than 300 hours / 300 or more hours
Call autonomy	Less than 3 hours / 3 or more hours
Call vibration	Yes / No
Voice recording	Yes / No
Voice dialling	Yes / No
Digital photo camera	Yes / No
Video recorder/ player	Yes / No
Games	Yes / No
Radio FM	Yes / No
mp3 player	Yes / No
Infrared	Yes / No
Bluetooth	Yes / No
Internet Access	Yes / No

After the different attributes and their corresponding levels have been identified, we classified them into different sub-groups or decision constructs. HII assumes that when the interviewees have to evaluate alternatives with many attributes, they first classify the attributes into general groups, denominated constructs (Molin and Timmermans, 2009). In our case, the different attributes were classified into five constructs, denominated tangible aspects and price, battery duration, call management, entertainment and connectivity. The number of attributes in each construct may vary.

Table 3. Constructs defined by attributes and levels

I. Tangible aspects and price	II. Battery duration	III. Call management	IV. Entertainment	V. Connectivity
1. **Size and weight** 1.1. Small 1.2. Medium 1.3. Big 2. **Type of screen** 2.1. Without lid 2.2. With lid 2.3. Touch screen 3. **Price** 3.1. Less than 30€ 3.2. Between 30 and 100€ 3.3. More than 100€	4. **Stand-by autonomy** 4.1. Less 300 horas 4.2. 300 or more hours 5. **Call autonomy** 5.1. Less than 3 horas 5.2. 3 or more hours	6. **Call vibration** 6.1. Yes 6.2. No 7. **Voice recording** 7.1. Yes 7.2. No 8. **Voice dialling** 8.1. Yes 8.2. No	9. **Digital photo camera** 9.1. Yes 9.2. No 10. **Video recorder / player** 11.1. Yes 11.2. No 11. **Radio FM** 11.1. Yes 11.2. No 12. **Games** 12.1. Yes 12.2. No 13. **mp3 player** 13.1. Yes 13.2. No	14. **Infrared** 14.1. Yes 14.2. No 15. **Bluetooth** 15.1. Yes 15.2. No 16. **Internet access** 16.1. Yes 16.2. No

The next step was obtaining a factorial design for each sub-experiment. If the traditional conjoint analysis had been applied, the number of profiles to evaluate would have been too high and therefore would have resulted ininterviewee fatigue. In the case of HII, each group interviewed is randomly assigned to a sub-experiment. A conjoint analysis is applied for each sub-experiment. Table 4 shows a summary of each sub-experiment. Evidently, as can be observed, the number of profiles to be evaluated by each interviewed person by means of the HII methodology is significantly lower than that obtained when applying the traditional conjoint analysis.

Table 4. Designs used in the five subexperiments

Subexperiment	**Full factorial**	**Fractional factorial (number of profiles[a])**
Subexperiment 1	$3^3 \cdot 3^4$	20
Subexperiment 2	$2^2 \cdot 3^4$	18
Subexperiment 3	$2^3 \cdot 3^4$	18
Subexperiment 4	$2^5 \cdot 3^4$	29
Subexperiment 5	$2^3 \cdot 3^4$	18

[a]Two holdouts were include in each subexperiment.

A questionnaire was then created for each sub-experiment. Each interviewee had to make two valuations for each profile. First, each interviewee valued the levels of a specific attribute, and on completion of this task was asked to evaluate a type of mobile phone on a scale of 0 to 10. Although the first valuation is not strictly necessary, it is convenient to familiarise the interviewee with the levels and attributes (Molin and Timmermans, 2009). The remaining constructs are added as attributes in each sub-experiment. There are three levels for each added attribute: 2 (not very suitable), 5 (suitable) and 8 (very suitable), which were selected to cover a feasible range on a scale of 0 to 10 points. Figure 4 shows an example of a profile evaluated by the interviewees.

Figure 4. Profile example from subexperiment 4.

ENTERTAINMENT: 1. Digital photo camera: **yes** 2. Video recorder/player: **no** 3. Games: **yes** 4. Radio FM: **no** 5. mp3 player: **yes**
The mobile phone's entertainment is : ………. *(0 – Extremely low;……..; 10 – Excellent)*
TANGIBLE ASPECTS AND PRICE: 2 (not very suitable) **BATTERY DURATION: 5 (suitable)** **CALL MANAGEMENT: 5 (suitable)** **CONNECTIVITY: 5 (suitable)**
The preference for this mobile phone is: ……….. *(0 – no preference ;……; 10 – high preference)*

The obtained questionnaire was handed out to a sample group of 110 university students. Nowadays, practically every university student has a mobile phone, and were chosen as the sample group due to their knowledge regarding the analysed product. The 110 interviewees were randomly distributed to participate in each sub-experiment, whereby the percentages for each sub-experiment were 23%, 15%, 22%, 17% and 23%, respectively.

5. RESULTS

Once the data is analysed with SPSS 18.0, the results obtained indicate the importance of the attributes and the partial utility of the levels. Tables 5 and 6 show these values for each of the aspects defined for each sub-experiment. The validity of the calculations obtained for each sub-experiment was very high, with Pearson (*r*) and Kendall Tau coefficients greater than 0.7.

Table 5 provides information regarding the validity of the hierarchic structure assumed in our application. If the hierarchic structure is assumed as correct, then the effects of each aspect should be the same in the different experiments. We can observe how Aspect 1 (call management) presents effects that are more equivalent throughout the sub-experiments. On the other hand, Aspect 3 (connectivity) shows noticeable differences throughout the sub-experiment. Therefore, this is a way to test the hierarchic structure of our application. Table 6 shows the relative importance and the partial utility of each of the attributes and levels, which are detached depending on each sub-experiment. In order to see if certain transitions allow the increase or reduction in the preference for mobile phones, we can investigate the structure of the partial utilities of each attribute. Therefore, we observed that mobile phones with touch screens are preferred to those with a lid. This enables the interpretation of all the partial utilities appearing in Table 6.

Table 5. Partworth utilities and importances of dimensions in the five experiments[b]

I. Tangible aspects and price		II. Battery duration		III. Call management		IV. Entertainment		V. Connectivity	
I. Tangible aspects and price	(67.68%)	*I. Tangible aspects and price*	24.15%	*I. Tangible aspects and price*	16.88%	*I. Tangible aspects and price*	16.09%	*I. Tangible aspects and price*	18.65%
Not very suitable (2)		Not very suitable (2)	0.892	Not very suitable (2)	0.723	Not very suitable (2)	0.728	Not very suitable (2)	0.762
Suitable (5)		Suitable (5)	1.783	Suitable (5)	1.445	Suitable (5)	1.456	Suitable (5)	1.524
Very suitable (8)		Very suitable (8)	2.675	Very suitable (8)	2.168	Very suitable (8)	2.184	Very suitable (8)	2.285
II. Battery duration	7.60%	*II. Battery duration*	(10.17%)	*II. Battery duration*	31.70%	*II. Battery duration*	22.67%	*II. Battery duration*	15.66%
Not very suitable (2)	0.027	Not very suitable (2)		Not very suitable (2)	1.321	Not very suitable (2)	1.064	Not very suitable (2)	0.649
Suitable (5)	0.053	Suitable (5)		Suitable (5)	2.642	Suitable (5)	2.129	Suitable (5)	1.298
Very suitable (8)	0.080	Very suitable (8)		Very suitable (8)	3.963	Very suitable (8)	3.193	Very suitable (8)	1.947
III. Call management	7.65%	*III. Call management*	18.94%	*III. Call management*	(25.62%)	*III. Call management*	15.21%	*III. Call management*	17.21%
Not very suitable (2)	0.163	Not very suitable (2)	0.737	Not very suitable (2)		Not very suitable (2)	0.681	Not very suitable (2)	0.496
Suitable (5)	0.327	Suitable (5)	1.473	Suitable (5)		Suitable (5)	1.363	Suitable (5)	0.993
Very suitable (8)	0.490	Very suitable (8)	2.210	Very suitable (8)		Very suitable (8)	2.044	Very suitable (8)	1.489
IV. Entertainment	8.40%	*IV. Entertainment*	19.70%	*IV. Entertainment*	11.10%	*IV. Entertainment*	(33.55%)	*IV. Entertainment*	11.46%
Not very suitable (2)	-0.077	Not very suitable (2)	0.549	Not very suitable (2)	0.404	Not very suitable (2)		Not very suitable (2)	0.376
Suitable (5)	-0.153	Suitable (5)	1.099	Suitable (5)	0.809	Suitable (5)		Suitable (5)	0.753
Very suitable (8)	-0.230	Very suitable (8)	1.648	Very suitable (8)	1.213	Very suitable (8)		Very suitable (8)	1.129
V. Connectivity	8.67%	*V. Connectivity*	27.04%	*V. Connectivity*	14.70%	*V. Connectivity*	12.48%	*V. Connectivity*	(37.06%)
Not very suitable (2)	0.127	Not very suitable (2)	0.940	Not very suitable (2)	0.605	Not very suitable (2)	0.547	Not very suitable (2)	
Suitable (5)	0.253	Suitable (5)	1.880	Suitable (5)	1.210	Suitable (5)	1.094	Suitable (5)	
Very suitable (8)	0.380	Very suitable (8)	2.820	Very suitable (8)	1.815	Very suitable (8)	1.640	Very suitable (8)	

[b]In each experiment, the importance of the omitted construct is shown as is calculated as the sum of the attribute importances.

Table 6. Partworth utilities and importances of attributes in the five subexperiments

I. Tangible aspects and price		II. Battery duration		III. Call management		IV. Entertainment		V. Connectivity	
Size and weight	23.67%	**Stand-by autonomy**	4.46%	**Call vibration**	10.65%	**Digital photo camera**	8.30%	**Infrared**	8.45%
Small	-0.913	Less than 300 hours	-0.018	Yes	0.404	Yes	0.335	Yes	0.060
Medium	-1.827	300 or more hours	0.018	No	-0.404	No	-0.335	No	-0.060
Big	-2.740	**Call autonomy**	5.71%	**Voice recording**	7.06%	**Video recorder/player**	8.15%	**Bluetooth**	12.95%
Type of screen	24.64%	Less than 3 hours	0.011	Yes	0.164	Yes	0.278	Yes	0.435
Without lid	0.900	3 or more hours	-0.011	No	-0.164	No	-0.278	No	-0.435
With lid	1.800			**Voice dialling**	7.92%	**Radio FM**	5.34%	**Internet access**	15.66%
Touch screen	2.700			Yes	0.206	Yes	0.186	Yes	0.640
Price	19.37%			No	-0.206	No	-0.186	No	-0.640
Less than 30€	-0.543					**Games**	6.37%		
Between 30 and 100€	-1.087					Yes	0.225		
More than 100€	-1.630					No	-0.225		
						mp3 player	5.39%		
						Yes	0.243		
						No	-0.243		

As shown in Oppewal and Vriens (2000), since all experiments involved orthogonal designs, the estimates obtained from the integrated analysis are largely similar to the results from the separate experiments in Tables 5 and 6. In Table 7 we present the derived overall importance ranking of dimensions and attributes.

Table 7. Derived overall importance ranking of dimensions and attributes

Ranking of dimensions		**Ranking of attributes**	
Tangible aspects and price	28.69%	Size and weight	16.42%
Connectivity	19.99%	Type of screen	16.18%
Battery duration	17.56%	Internet access	11.51%
Call management	16.93%	Price	9.77%
Entertainment	16.80%	Bluetooth	7.82%
		Call vibration	7.26%
		Digital photo camera	6.02%
		Video recorder/player	5.00%
		mp3 player	4.37%
		Games	4.05%
		Voice dialling	3.70%
		Radio FM	3.34%
		Voice recording	2.95%
		Infrared	1.08%
		Stand-by autonomy	0.32%
		Call autonomy	0.20%

The relative importance for the aspects has been calculated by means of an arithmetic average of the relative importance throughout each sub-experiment. We can observe that the interviewees mostly value the tangible aspects such as the telephone price and connectivity. On the other hand, the lowest-valued aspects are those related with entertainment.

In order to define the importance ranking of the attributes (standardized across experiments), the typical formula used in a traditional conjoint analysis is applied, in other words, dividing the rank of an attribute between the rank sums of all the attributes. The results are reflected in Table 7. The attribute most valued by the interviewees is with regards to the phone size and weight, followed by the type of screen and Internet access. The least-valued attributes are the possibilities of having infrared light and call and stand-by autonomy.

6. CONCLUSIONS

The work herein has illustrated the use of integrated conjoint experiments as an alternative method to the traditional conjoint analysis in cases where the number of attributes is very high. These types of experiments can be applied in order to avoid tiring the interviewees during the survey process. The integrated experiments are derived from the integrated hierarchic information theory (HII), although they overcome most of HII limitations. The present work aims to show how the integrated experiments can resolve the limitations arising in conjoint analysis and HII, and to further establish ways to proceed in these types of situations. When there are many attributes, experiments with conjoint analysis include problems of information overload that affect the validity of such experiments. The impact of these problems can be avoided or reduced using Hierarchical Information Integration (HII). The procedure consists of the classification of the high number of attributes into a small group of constructs. An experimental design is then created for each construct. Finally, a bridge design is drawn up to calculate the partial utilities.

Based on an illustrative example of mobile phone preferences, we have observed the advantages of applying this methodology. The most important advantage in this sense is that a greater number of attributes can be applied in comparison to the traditional conjoint analysis. Since the sub-experiments are separately constructed, the interviewees receive less information upon which to express their opinions.

The main limitation of this methodology is the need topreviously define a hierarchic structure. Notwithstanding, this methodology is a significant alternative to conjoint analysis when the number of attributes is very high, and can be further employed in a wide range of applications.

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APPENDIX. SPSS syntax for executing the sub-experiment number five.

```
CONJOINT PLAN = "D:\OLAVIDE\INVESTIGACION\HIERARCHICAL INFORMATION
INTEGRATION\METODOLOGÍA\EXPERIMENTO5.SAV"
        / SCORE = P1 TO P18
        / SUBJECT = ID
        / FACTORS = tangible (LINEAR MORE) battery (LINEAR MORE) calls (LINEAR MORE)
entertainment (DISCRETE) infrared (DISCRETE) bluetooth (DISCRETE) internet (DISCRETE)
         / PRINT = SUMMARY
        / PLOT = SUMMARY
        / UTILITY = "util.sys".
```