

Choice Experiments for Quality and Sustainability in Seafood Products: Empirical Findings from United Kingdom

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Abstract. There has been a growing interest in recent years in the potential use of product differentiation (through eco-type labelling) as a means of promoting and rewarding the sustainable management and exploitation of fish stocks. This interest is marked by the growing literature on the topic, exploring both the concept and the key issues associated with it. It reflects a frustration among certain groups with the supply-side measures currently employed in fisheries management, which on their own have often proven insufficient to counter the negative incentive structures characterising open-access fisheries. The potential encapsulated by product differentiation has, however, yet to be tested in the market place. One of the debates that continues to accompany the concept is the nature and extent of the response of consumers to the introduction of labelled seafood products. Though differentiated seafood products are starting to come onto the market, we are still essentially dealing with a hypothetical market situation in terms of analysing consumer behaviour. Moving the debate from theoretical extrapolation to one of empirical evidence, this paper presents the empirical results of a study undertaken in the UK. The study aimed, amongst other things, to evaluate whether UK consumers are prepared to pay a premium for seafood products that are differentiated on the grounds that the fish is either of (a) high quality or (b) comes from a sustainably managed fishery. The results are presented in this paper.

Keywords: Consumer demand, seafood, fisheries management, certification, sustainability, quality, stated choice methods

1. INTRODUCTION

Traditionally, the focus of fisheries management has lain with supply-side measures and attempts to use these measures to promote responsible and sustainable fisheries management. Over the last few years, however, there has been a growing recognition that traditional techniques aimed at controlling either inputs or catches may not be sufficient on their own to adequately address many of the management challenges facing fisheries management, particularly over-exploitation (Hanna 1992, Homans and Wilen 1992, Wessells and Anderson 1992, Johnston 1995). This recognition has spurred interest in the potential of product labelling, as a means of generating market-driven incentives in support of fisheries management objectives. Traditionally there has been little differentiation in seafood products, such that consumers have been largely unable to exercise choice as to the location and state of the fishery their seafood came from and how it was caught. By introducing 'eco' -type labelling the intention is to facilitate this consumer choice and by employing an environmental vector in the consumers demand function provide an incentive and reward structure for fisheries adopting 'sustainable', 'responsible' or 'ecologically' sound management practices.

The concept builds on a growing understanding of the workings of the market place and the inter-relationships between the market and fisheries management. Over the last 10 to 15 years there have been a number of studies exploring the characteristics of the market for seafood products. These studies have addressed, among other aspects, price integration (Squires et al 1989), price transmission within the industry (Nyankori 1991), how the market reacts to uncertainty (Lent 1984), product substitution and patterns of demand, demographic aspects of demand (Cheng and Capps 1988), the effect of advertising on retail demand (Brooks and Anderson 1991, Capps and Lambregts 1991, Kinnucan and Venkateswaran 1990) and price flexibility in response to changes in supply (Cooper and Whitmarsh 1994, Jaffry et al 1997). Of particular relevance is the work by such as Wang and Kellogg (1988) and Botsford et al (1986). which have assessed the relationship

between product attributes and price (in these instances, size) and studies which have used variations of self-explicated utility approaches (notably conjoint analysis) to characterise seafood markets, for salmon in the USA (Anderson and Brooks 1986, Anderson 1988) and Japan (Anderson and Kusakabe 1989) and striped bass (Wirth et al 1991). In the last five years, this body of literature and research has enveloped the particular issue of the eco labelling of fish products (Asche, pers. comm. 1999, Wessells et al 1999, Young et al 1999). Amongst other things, this research has addressed the consumers' willingness-to-pay for seafood safety assurances, establishing that consumers are able to demonstrate clear preferences and values for alternative assurances of safety (Wessells and Anderson, 1995), which obviously has potential knock-on implications for quality. It has also encompassed the potential effectiveness of ecotype labelling of seafood products in altering consumer demand for seafood in the USA and Norway (Wessells and Holland 1998, Wessells 1998).

The concept has also received practical manifestation in a number of schemes initiated around the world, one of the most prominent being that initiated by the Marine Stewardship Council. Other schemes include the Swanlabel for labelling ecological food products in Sweden and the "blue" label for fish and fish products in Denmark, aimed at supporting "ecologically" sound fisheries (Legal Act of Parliament nr. 233 16 April 1997). The first fish products covered by these schemes are now starting to enter the market place, as with the Thames herring, the Alaskan salmon, New Zealand Hoki and the Western Australia rock lobster fisheries certified by the Marine Stewardship Council. However, it is still early days and their presence is limited, as is consumer awareness. As a consequence, the potential of the concept to generate an appropriate incentive structure to complement supply-side management measures has yet to be clearly determined.

This paper presents some of the findings of a survey in the United Kingdom, which attempts to elicit the influence of sustainability certification and labelling on consumer choice for seafood products: the first stage in determining the potential of the concept to generate an appropriate incentive structure. 'Seafood' in this context is defined as including finfish, shellfish and crustaceans in fresh, frozen and processed product forms. The survey and analysis explored in the paper employs expressed preference techniques, notably choice experiments, with the aim of identifying any price increment that consumers' may be willing to pay for. It should be noted that for comparison a second form of product differentiation is explored alongside sustainability certification: that of 'quality' differentiation. The findings have interesting connotations for the management of seafood quality throughout the production chain.

2. CHOICE EXPERIMENTS

Choice experiments are the product of two inter-related, heritages: one associated with the conjoint analysis paradigm and one with Lancasterian consumer theory and the random utility theory.

The conjoint analysis paradigm has its basis in marketing research and the elicitation of the relative importance of different attributes (characteristics or features) of a good or a service. It assumes that any good or service can be defined as a combination of levels of a given set of attributes. The total satisfaction or utility that an individual derives from that good or service is determined by the utility to the individual of each of the attributes. The aim of the technique is to estimate (a) the relative importance of the individual attributes; (b) the trade-offs or marginal rates of substitution that individuals are willing to make between these attributes; and (c) the total satisfaction or utility scores for different combinations of attributes (Ryan, 1996).

It is a paradigm that has received wide acceptability within the field of market research for the analysis of marketed private goods, which makes it particularly relevant to the subject matter of this paper. However, it is viewed by many economists as lacking a behavioural theoretical foundation consistent with economics (Adamowicz et al 1998, Carson 1999, pers. comm.). This criticism derives from the traditional elicitation methods employed within the paradigm notably ranking and rating, and the underlying assumptions necessary for the inference of consumer preferences from them. With the ranking format, respondents are asked to rank a group of commodities, each with different attributes and levels, from "most-preferred" to "least-preferred". In the rating format respondents are asked to indicate their preferences for several commodities based on a pseudo-cardinal preference scale, which could result in two or more commodities receiving the same score.

In both of these formats, the drawing of inferences as to consumer preferences requires a number of assumptions to be made that are potentially logically inconsistent and a number of mathematical axioms to be met. The analysis of ranking data, for example, requires a number of ordinal conditions to be met and assumes, *inter alia*, an additive utility specification, perfect information and that individuals are perfectly transitive and consistent and do not exhibit indifference or ambivalence

(Mackenzie 1992, 1993). In terms of rating, while the method of elicitation potentially provides more information about preferences for attributes than ordinal rankings (Mackenzie 1992), to forecast choices from conjoint ratings data one must assume that either (a) the highest predicted rating equals first choice, or (b) the predicted ratings values satisfy Multinomial Logit (MNL) or other choice model scale properties. These assumptions do not necessarily hold. A further limitation involves the comparability of ratings across respondents, particularly where no particular rating level is specified to represent respondent indifference or ambivalence. The cardinal significance of any ratings is also not readily clear (Mandasky 1980, Morev 1984).

Over the last few years, this criticism has led to developments in the range of elicitation methods available, including the development and adoption of choice experiments. Choice experiments draw notably on Lancasterian consumer theory and the random utility theory, although psychological theories on information processing in judgement and decision-making have also played a fundamental role. Lancasterian consumer theory proposes that utilities for goods can be decomposed into separate utilities for their component characteristics or attributes (Lancaster 1966). Random utility theory explicitly models the choice among substitute alternatives on a given occasion, given constraints (e.g. income, time) with the choice being modelled as a function of the characteristics of the substitute alternatives. The random component reflects, *inter alia*, that the analyst may omit variables or commit measurement errors or that the consumer may be inattentive during the choice process (Adamowicz et al 1998). This economic foundation has made the elicitation method popular among economists. However, it should be noted, that due to this foundation, the choice experiment method is regarded among certain sectors of the economic and marketing community as being distinct from conjoint analysis, rather than being a development within the paradigm (e.g. Adamowicz et al 1998, Carson 1999, pers. comm). It is an issue that comes down to the definition of and the drawing of boundaries around 'conjoint analysis'.

The rationale behind the use of choice experiments to elicit the influence of sustainability certification and labelling on consumer choice for seafood products outlined below partly explains this popularity among economists. Being based on random utility theory, from an economics point of view, choice experiments have distinct advantages over the alternatives (Carson 1999, pers. comm.). Further:

- The method does not require any assumptions to be made about order or cardinality of measurement (Louviere and Woodworth 1983)
- Choice models can be estimated directly from choice data, thus avoiding potentially unrealistic ad hoc assumptions about choice behaviour that would be implied under the alternative formats
- The method can also avoid problems like the unstable statistical properties of estimated parameters in ranking data and cardinal measurement assumptions in the rating method
- In particular, it permits the design of choice or allocation experiments, which mimic real choice environments closely.

There are, however, challenges associated with the format, notably the construction of both the choice alternatives (products) and the choice sets. Choice experiments are challenging in their design because they require two separate designs to be combined: one to create the choice alternatives and a second to place choice alternatives into choice sets. Both designs must satisfy certain statistical properties to enable one to estimate parameters and conduct statistical tests efficiently (see Louviere & Woodworth 1983). However, it is not an insurmountable challenge, and one assisted by a variety of factorial and fractional factorial designs (for detail, see Louviere 1988b; Louviere and Woodworth 1983; Adamowicz et al. 1994).

Within the choice experiment format, the respondent makes a discrete choice from a set of presented alternatives or choices, combined within choice sets. Each alternative is represented with a utility function that contains a deterministic component (V_i) and a stochastic component (e_i). The overall utility of alternative i is represented as:

$$U_i = V_i + e_i$$

An individual will choose alternative i if $U_i > U_j$ for all $j \neq i$. However, since the utilities include a stochastic component, one can only describe the probability of choosing alternative i as:

$$prob\{i \text{ chosen}\} = prob\{V_i + e_i > V_j + e_j \text{ for all } j \in C, j \neq i\}$$

Where C is the set of all possible alternatives. The V_i contains attributes of the products and there are four alternatives (A, B, C and D). Assuming a type I extreme value distribution for the error terms (we could also experiment with the mixed

lognormal, gamma and Weibull distributions of preferences) and independence between choice scenarios and individuals. the probability of choosing alternative i becomes

$$P_i = \frac{e^{-\frac{1}{s} V_i}}{\sum_{j=1}^J e^{-\frac{1}{s} V_j}}$$

where s is the scale parameter.

In any single sample the scale parameter cannot be identified and thus is assumed to be 1.

By selecting an appropriate functional form for the cumulative distribution. the systematic portion of the expected utility function can be estimated as specified.

There are several probability models, which can be used to analyse choice experiments. These consist of multinomial logit, conditional logit model and nested logit models. The choice of model mainly depends upon the type, characteristic and assumptive distribution of data and theory. Multinomial logit models are particularly appropriate in this context in that they serve as an error mechanism to diagnose or test various specifications for the utility function if the choice experiment is designed in such a way as to accommodate the required tests. Models that satisfy IIA can be fully specified by estimating the

marginal choice probabilities for each alternative. The general form of the model is:

$$V_i = \alpha_i + \beta(Z_i) + \gamma(Y_i)$$

Where α_i is an alternative specific constant, Z_i is a vector representing all attributes, Y_i is vector of demographic variables and β and γ are parameters.

3. PRACTICAL APPLICATION

The rest of this paper looks to the practical application of choice experiments to the context in question.

Louviere (1988a) describes several steps and considerations to be applied to its practical application:

- Understanding the decision problem and environment: one must develop a perceived model of how respondents make decisions in a particular situation through various methods such as exploratory research and pre-test;
- Identify determinant attributes: once a list of attributes is determined, two other considerations arise - whether the decision attributes are actionable and the language and terms or the way in which an attribute's variation is to be communicated to respondents;
- Developing product positioning measures, like ranges of levels that satisfy research objectives and are meaningful to subjects;
- The experiment must be designed to elicit how the target individuals integrate the decision attribute. That is, how they evaluate multi-attribute alternatives or brand;
- Measurable and actionable market segments must be identified;
- A choice simulation system must be created to forecast how the target individuals are likely to choose among different brands or multi-attribute alternatives offered in the marketplace.

These tasks are undertaken in parallel with consideration for the practicalities of design, implementation and analysis:

- The administration of the survey tasks;
- Developing practical approaches to approximating the overall utility function;
- Simplifying models by assuming responses to be approximately linear;

- Incorporating non-linearity and non-additives in the design;
- Developing approximations to non-linear and non-additive models;
- Combining individual-level and aggregate response information.

Choice experiments also offer excellent informational efficiency via a question format that respondents find plausible and easy to understand. Compared with open ended contingent valuation methods, choice experiments minimise protest responses and increase familiarity with the elicitation method by subsuming price within vignettes (Mackenzie 1990). In the context of food and fish product purchasing in northern Europe, consumers are rarely price setters, with prices pre-determined for them. In treating price as simply another attribute, the analysis minimises many of the biases that can arise in open-ended contingent valuation studies when respondents are presented with the unfamiliar, and often unrealistic, task of being price setters. It is also a powerful extension of the closed-ended contingent valuation methods, over which a greater insight to consumer behaviour can be obtained (Mackenzie 1992) Strategic bias, ordering, embedding and scope effects may also be somewhat less of a problem with choice experiments than contingent valuation, while scenario mis-specification bias and implied value cues may be encountered in both of them.

4. SURVEY DESIGN

Because of the substantial amount of among-person variation in consumer preferences, the analysis is usually carried out at the individual level. The form of the preference model is generally assumed to be the same for all individuals, but the parameters of the model are permitted to vary across the sample of individuals from the relevant target population. Likewise, after selecting the preference model there are several considerations for survey design such as sampling plan, data collection method, stimulus set construction, and stimulus presentation.

Sampling theory provides a framework within which one can make a decision on sample size and distribution. The considerations involve an assessment of the desired limits of error and the intended purpose of the analysis, matched against the resources available.

On the basis of this theory and the practical considerations of the budget, 600 in-home interviews were carried out in each of the two case study countries (United Kingdom and Denmark), aimed at returning a margin of error of less than 5% for each country. The target population was the number of households in the United Kingdom and Denmark, 24.08 million and 2.37 million, respectively (1996 figures). The sample represents 0.002% and 0.02% of catch population, respectively. Both fish and non-fish consumers were included to elicit any switching behaviour into fish products in response to the introduction of Labelling. The sample was then stratified in accordance with the regional distribution of households within the country, and then by age of respondent, existence or otherwise of dependent children, and social class within each region. The number of stratification criteria was guided by resource constraints.

Table 1: Factors of orthogonal design Attributes Levels

Attributes	Levels
Product form:	Fresh and chilled cod fillets Fresh and chilled salmon steaks Tinned tuna Frozen fish fingers Smoked haddock fillets Frozen prawns
Certification:	Certified for sustainability Certified for quality Uncertified
Certifier:	Non-governmental Governmental
Origin:	UK Foreign Un-stated
Production method:	Wild Farmed
Price:	Low

	Medium
	High
	Very high
Brand:	Shop's brand
	Manufacturer's brand

The attribute combinations that make up the products on each card were constructed using orthogonal main-effects design. This design resulted in thirty-two choices. This was considered to be too large a choice task for each respondent. Therefore, the design was blocked providing eight cards of four choices. The number of alternatives or choices presented to each respondent theoretically depends on the number of the coefficients to be estimated.

However, there is evidence that certain numbers of choices can make respondents confused and distract their interests. According to Malhotra (1982), the use of 15 to 20 (or to 25) alternatives does not significantly affect the standard error of the parameters, however, other authors cite the optimal number to be presented at one time to be much lower (Carson 1999, pers. comm.). The block design was, therefore, adopted to minimise this effect as well as to minimise the 'none' responses (zeros), while providing, in combination with a random number chart, for each choice to be presented an equal number of times throughout the survey and the respondent to be presented with a choice set that mimics the purchase environment.

The format for the presentation of the questionnaire and stimuli was a combination of verbal description with cue cards, paragraph descriptions, and pictorial representation. The verbal description method offers simplicity and efficiency. The written description method provides the advantage of a more complete description of the stimuli, reinforcing the message through the use of multiple senses. Written information is then combined with pictorial representation facilitating as far as possible the reduction of information overload; homogeneity of perceptions across respondents; and the retainment of the respondent's interest.

5. CURRENT STATUS OF THE STUDY AND RESULTS

The questionnaires were pre-tested using focus groups and trial interviews with a cross-section of respondents and subsequently modified to accommodate language and cultural differences between the United Kingdom and Denmark. A full pilot was undertaken during December 1999 and January 2000, with the questionnaire format subsequently refined to incorporate the findings. The full survey was undertaken during May and June 2000 by market research companies in both the United Kingdom and Denmark and the analysis is now underway.

Table 2 below demonstrates the marginal utilities derived from the survey results. It can be seen from table 2 that all the variables listed are significant in influencing consumer choice, apart from store brand. Price has the expected negative sign, implying that a higher price reduces the likelihood of a fish or fish product being chosen. In contrast the product forms have a positive influence. Reference to table 3 provides an indication of the size of their respective influences. It is also evident from table 2 that certification, either in terms of "sustainability" or "quality", has a positive and significant influence on product choice: a result reassuring for groups promoting product labelling as a management tool. Another form of labelling that may also have potential in this regard is the distinction of wild caught fish versus farmed fish, which is shown here to exert a positive and significant influence on consumer choice.

Some of these findings accord well with expectations, which can also be said in respect of the negative and significant influence of labelling conveying that the fish was produced or caught abroad rather than produced or caught in the United Kingdom. Not all the results, however, do so. With increased concern over governmental management of 'food scares' in recent years [such as salmonella in eggs; bovine spongiform encephalopathy (BSE) contaminated beef products; and the recent foot and mouth epidemic] one result which may not accord with expectations is the negative attitude towards non-governmental certifiers, over governmental certifiers. However, scepticism of the incentive structure behind and the agendas of non-governmental certifiers may be a factor here, along with the non-specification in the survey instrument of the identity of the non-governmental certifier.

Table 2: Marginal utilities

Variables	Coefficient	Standard	t-statistic	P[Z >z]
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		Error			
Price	-0.048	0.021	-2.354	0.019	
Fresh cod fillets	0.951	0.140	6.784	0.000	
Fresh salmon steaks	<i>0.560</i>	0.172	3.264	0.001	
Frozen fish fingers	0.791	0.131	6.039	0.000	
Smoked haddock fillets	0.388	0.177	2.197	0.028	
Tinned tuna	1.088	0.113	9.596	0.000	
Frozen prawns	0.539	0.225	2.398	0.017	
Quality certified v. uncertified	0.349	0.072	4.871	0.000	
Sustainability certified v. uncertified	<i>0.505</i>	0.069	7.323	0.000	
Private certification v. governmental	-0.232	0.077	-3.014	0.003	
Foreign origin v. domestic	-0.482	0.089	-5.411	0.000	
Wild caught v. farmed	0.168	0.062	2.712	0.007	
Store brand v. manufacturer brand	0.002	0.054	0.040	0.968	

Table 3: Marginal effects

	Quality v uncertified	Sustainability v uncertified	Non- governmental v governmental	Foreign v domestic origin	Wild v farmed	Store brand v manufacturer brand
Cod fillets	4.57	6.61	-3.03	-6.31	2.20	0.03
Salmon steaks	3.58	5.17	-2.38	-4.94	1.72	0.02
Fish fingers	3.09	4.36	-2.00	-4.17	1.45	0.02
Haddock	2.40	3.46	-2.90	-3.31	1.15	0.02
Tinned tuna	4.37	6.32	<i>-1.59</i>	-6.04	2.10	0.03
Frozen prawns	2.98	4.31	-1.98	-4.12	1.43	0.02

Table 3 expands the analysis to the marginal effects¹ of labelling for different product forms. From this table it can be seen that brand has very little influence on the probability of choice of any of the product forms. Although the vast majority of fish and fish product sales are made in packaged and branded form, the generic distinction between a product having a store brand versus a manufacturer's brand is not a major influence. Particular brands (such as Bird's Eye) within these categories could, however, have a different influence to that demonstrated here.

The effect of a label indicating that the fish was caught in the wild also has a limited effect on the probability of choice, albeit greater than that demonstrated by the brand. It is interesting to note that this survey was conducted prior to the raised media profile of the accumulation of toxins in the flesh of farmed salmon, such that the response of consumers today may differ from that of last year. The nature of the certifier also has a relatively small effect on the probability of a product being chosen, although there is a gradient of effect noticed for the different product forms, with cod fillets and tuna being at the extremes.

¹ The effect of a change in attribute "m" of alternative "j" on the probability that the individual would choose alternative "k".

The more significant effects on the probability of choice derive from the inclusion of quality and sustainability labelling and from labelling the origin of the fish. A label conveying that the fish was either produced or caught abroad is shown to reduce the probability of a product being chosen by between 3.31 and 6.31, the largest effect being experienced for cod fillets and tinned tuna.

Of the two forms of labelling particularly targeted by this study (quality and sustainability certification), sustainability would appear to have the greatest positive influence on the probability of choice. The presence of a label conveying that the fish comes from a sustainably managed fishery, for cod fillets, increases the probability of that product being chosen by 6.61%. Although this is the largest effect experienced for the product forms presented in the survey, the probability of a tin of tuna or a salmon steak being chosen is also increased by over 5% through the presence of the 'sustainability' label. The size of the marginal effects for these products corresponds well with the media profile afforded to the sustainability of the fisheries from which these fish are sourced. The state of cod stocks, the environmental implications of fish farming (particularly salmon farming) and the by-catch of dolphins associated with certain tuna fisheries, are all issues that have received media coverage, and as such have a raised public profile.

Cod fillets and tins of tuna also experience the greatest effect from the presence of a quality label: the probability of cod fillets being chosen increasing by 4.57% and tinned tuna by 4.37%. For salmon steaks, however, the presence of a 'quality' label would only increase the probability of choice by 3.58%. As with the results for the presence of a 'sustainability' label, the size of the effect from the presence of a 'quality' label on the probability of fish fingers, smoked haddock or frozen prawns being chosen is less than that for cod fillets, salmon steaks and tinned tuna. The effect, however, is greater than that derived from labelling conveying that the fish was sourced from the wild or the brand. The differences in the effect between product forms could be attributed to several reasons. For cod fillets sold in a fresh or chilled form, the observed inability of many consumers to interpret quality from intrinsic cues may be a factor, consumers preferring extrinsic cues for reassurance (Anderson and Wessells 1994). However, such an argument could also stand for fresh and chilled salmon steaks. For tinned tuna, the rationale could lie with the amount of tinned tuna purchased by consumers. Tinned tuna has the highest level of market penetration of any fish products in the UK retail market. In addition, the form of packaging removes all potential intrinsic cues for the assessment of quality. The consumer has to rely on proxies (such as brand), which do not necessarily have scientific foundation.

6. DISCUSSION

From these findings, it would appear that there may be potential encapsulated within the development of quality and sustainability labels for fish products. Although the results presented in this paper only explore part of the analysis and do not identify the size of any price premium, the marginal effects reported would appear to vindicate moves underway to implement certification schemes in support of fisheries management.

These findings also reveal some of the benefits of utilising choice experiments for the analysis of consumer choice notably the ability to disaggregate the effect on choice of the component attributes of a product and their various levels. By including the targeted attributes within an overall product description, the consumers also face a more realistic purchase scenario and with price being an attribute rather than a measure of preference (as in most forms of contingent valuation), they are more familiar with the preference elicitation format. This advantage is compounded by the use of a choice-based elicitation method, which further mimics the purchase scenario.

The choice experiment used has a number of distinct advantages over other 'conjoint' elicitation methods (e.g. ranking and rating), not least in being based on the random utility model, which gives it a strong economic and theoretical basis. The avoidance of order or cardinality of measurement issues and the avoidance of potentially unrealistic assumptions about choice behaviour, being estimated directly from choice data, are further fundamental advantages. The practical application of the method does, however, throw up some challenges, notably: in the identification of the key product attributes that satisfy the research objectives, facilitate cross country comparisons and are meaningful to the survey respondents: the construction of the choices and choice sets in accordance with rigours of the analysis, while minimising nonsense combinations; and the design of stimuli presentation to avoid information overload, to ensure comprehension and valid responses.

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