Qualitative Evaluations of New Scientific Concepts: Accurate, Fast, Easy and Inexpensive

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Abstract:

Evidence confirming the robustness of qualitative methodologies in marketing research is scarce. Instead, quantitative methodologies dominate publications in marketing journals, a stark contrast to other academic disciplines where qualitative research is the dominant approach. This research reports a case where the findings of an independent qualitative study were clearly supported by subsequent quantitative research. Applied in the context of a new technological science, the qualitative phase treated climate engineering techniques as brands with core concepts and a range of related memory associations. Attributes associated with climate engineering were elicited using Kelly's Repertory Grid or choosing from a pre-determined list of 30 attributes during 30 depth interviews. The qualitative results illustrated an overall negative reaction to the four concepts tested with solar reflection techniques viewed more negatively than carbon dioxide removal techniques. Large online surveys across two countries gave strikingly similar results, verifying the robustness of the qualitative study.

Key Words: Qualitative Methodologies, Attribute Elicitation, Network Memory Theory, Science Communication, Climate Engineering

Track: Marketing Research Methods

1.0 Background

Qualitative research methods are often the single main research methodology used in many academic disciplines, for example: management, communication, media studies, education and philosophy. Commercial marketing research often relies on qualitative findings for reporting to corporations who invest heavily in expensive marketing campaigns based on these qualitative outcomes. Yet, academic marketers do not seem to have the same trust in qualitative based research. Instead, many marketing academics tend to publish work that uses solely quantitative methodologies or a mixed qualitative/quantitative approach.

A review of 1,195 academic articles, in three major marketing journals, between 1993 and 2002, determined that 46.3 % of the sample used quantitative methods, 6.5% used qualitative methods and 8.8% used mixed qualitative/quantitative methods. The remainder of the articles examined were theoretical or opinion based (Hanson & Grimmer, 2007). Similarly, a content analysis of over two thousand articles in nine marketing journals, between 2003 and 2009, confirmed a skew towards the use of quantitative methodologies (Harrison & Reilly, 2011). This study reported that only 7% of the articles used qualitative methodologies. Marketing is not without qualitative journals. Qualitative Market Research: An International Journal" was launched in 1998. However, journals in marketing that report solely qualitative research are not common. Clearly, published support and evidence of the robustness of qualitative methodologies in marketing research is lacking.

The preference for quantitative based research may stem from its inductive-statistical orientation that enables defendable generalisations (Hanson & Grimmer, 2007). Quantitative methodologies are drawn from a school of thought known as logical positivism. Logical positivism embodies the idea that the extent of reality can be determined and described objectively, implying the observer and the subject being observed are independent (Amaratunga, Baldry, Sarshar & Newton, 2002).

In contrast, qualitative research is considered exploratory and insightful, rather than a specific measure of human behaviour. Qualitative research relies on words and images and concentrates on how something is said rather than focussing on how many consumers say it (de Ruyter &Scholl, 1998). The small samples typical of qualitative research are criticised for not being representative of larger populations however, careful target group selection and a classified sample can help ensure a wide variation of views and opinions are considered (De Ruyter & Scholl, 1998).

A third research approach in marketing is to use mixed qualitative and quantitative methodologies. A common justification for a mixed methods approach is that qualitative data has the ability to provide a better understanding of the phenomenon under investigation than purely quantitative studies (Hanson & Grimmer, 2002). The use of the mixed approaches provides validation, bias is reduced and confidence in the results is increased (Johnson, Onwuegbuzie & Turner, 2007).

While the reasons for using each of these three approaches is widely discussed in marketing literature, evidence where the qualitative outcomes clearly substantiate quantitative outcomes is rarely reported. Independent qualitative research shares a similar fate. More published evidence of robust qualitative research in marketing is required if confidence to use independent qualitative methodologies is to increase.

This research provides an example of a case where the robustness of the qualitative phase is validated by the strikingly similar outcomes of the ensuing quantitative phase. This

suggests the value of qualitative work is overlooked and the results support the usefulness of qualitative research depth interviews for clarifying public perceptions of new phenomenon.

The context for this research stems from calls for urgent inter-disciplinary research on ways to inform and engage the public with climate engineering, a relatively new environmental science proposed to mitigate the effects of global warming (Bellamy, Chilvers, Vaughan & Lenton, 2013; Caldeira, Bala, & Gao, 2013; Keith, 2000; Linnér & Wibeck, 2015; The Royal Society, 2009; Vaughan & Lenton, 2011: Wright, Teagle and Feetham, 2014). Climate engineering may help cool the planet through two broad approaches. One approach is to sequester carbon from the atmosphere through techniques such as air capture and enhanced weathering and the other is to reflect sunlight away from the earth through placing mirrors in space or brightening clouds. These and other propositions are untested in the field; their exact side effects and impact on global ecosystems is unclear, therefore they are likely to invoke much public debate and controversy.

2.0 Conceptual Foundations

Given the scientific context, science communication methodologies were considered for this research. However, an examination of the literature in this field revealed little consensus on which methodology best conveys an accurate representation of public opinion. Instead, this research utilises methodologies from marketing, as marketers have considerable experience in testing public reaction to new hypothetical product concepts and evaluation techniques.

The evaluative phase of the study draws on the Associative Network Theory of Memory (ANTM) developed by Anderson and Bower (1974). ANTM is considered useful for clarifying how human memories work, particularly encoding, storage and memory retrieval. In practice, presentation of a stimulus activates a cascading effect through a network of related memory nodes. The stimulus may be a specific brand, a new product concept or a scientific concept. The links between nodes indicate the memory structures associated with a concept. This network of information, stored in individual's memories, forms a mental picture of the concept (East, Wright, Vanhuele, 2013; Nenycz-Thiel, Sharp, Dawes & Romaniuk, 2010; Romaniuk, 2013). The attributes evoked to describe the concept are used to measure the evaluations of the brand or concepts in question. Therefore, it is an appropriate method to gauge likely reaction to climate engineering technologies.

3.0 Methodology

3.1 Qualitative Methodology

Brand and concept image measurement requires identification of relevant attributes. Attributes are elicited by various methods that prompt and identify related concepts from individual's knowledge structures (Steenkamp & Van Trijp, 1997). Previous research suggests that if instructions are held constant and focussed on choice then method effects are minimised regardless of which attribute elicitation method is used. Associated attributes are salient in participants' memories and easily evoked by all methods of attribute elicitation (Breivik & Supphellen, 2003).

Further research with a low involvement product compared five different attribute elicitation methods and found they were all considerably robust (Bech-Larsen & Nielsen, 1999). The choice of elicitation method however, is dependent on the purpose of the research. Since the purpose of this research is to determine public perceptions of relatively new

scientific concepts, two elicitation methods that identify perceptual attributes were selected. A pre-determined list of attributes from a climate engineering content analysis and Kelly's Repertory Grid were used to validate the most common attributes associated with the climate engineering techniques presented.

Pre-determined lists of attributes require the researcher to generate a list of attributes. While this lessens the chance of idiosyncratic wording it increases the risk that the attributes will reflect the language of the researcher rather than the respondent. The task is easy to administer and relatively easy for the respondent to complete (Bech-Larsen & Nielsen, 1999).

Kelly's Repertory Grid is built on personal construct theory. This theory advances the idea that individuals personalise objects or brands as a construct. The construct is evoked by asking the respondent to choose a pair from three brands or concepts and say why the pair is alike yet different from the third. The process is repeated with all the brands or concepts until no new attributes are generated (Bech-Larsen & Nielsen, 1999; Rogers & Ryals, 2007; Steenkamp & Van Trijp, 1997). Participants are generally more engaged with this method as they have to decide on which pairs to select.

Kelly's Repertory Grid was chosen to minimise the weaknesses of pre-determined lists by identifying gaps in the terminology not listed, and allowed final language choices to reflect the respondent's vocabulary. Previous research has shown most brand associations are at the sub-conscious level (Supphellen, 2000). Attribute associations may not emerge if they are at a respondent's subconscious level, however a second advantage of Kelly's Repertory Grid is that it allows underlying constructs to surface when brand or concept similarities and differences are examined.

Focus groups were considered as a method of attribute elicitation but rejected in this case due to the risk of biased results from irrelevant debate or dominant individuals. Climate engineering techniques are controversial with many associated risks and unknown side effects and likely to produce robust debate where dominant individuals may supress others' views. Individual structured interviews are adopted for data collection in this phase as they overcome the bias inherent in focus groups and allow for the depth of discussion required to identify cognitive associations.

3.2 Field work procedures

Convenience samples consisting of 30 participants with an even gender split and a range of age, education, occupations, and inclusive of minority ethnic groups, were recruited and split across the two methods. Participants in both methods were given a verbal introduction to climate warming and climate engineering, and then presented four examples of climate engineering techniques on laminated concept boards, typically used for assessment of new products (Lees & Wright, 2004). The carbon dioxide removal techniques (CDR) included *biochar* and *air capture* and the solar radiation management (SRM) techniques included *stratospheric aerosols* and *cloud brightening*. Each of the four concept boards displayed a colour image, a brief description of the concept inclusive of a list of known advantages and disadvantages. The word matched descriptions drew on the climate engineering techniques presented in the Experiment Earth deliberative workshops (The Royal Society, 2009) and later work in this area (Parkhill & Pidgeon, 2011; Vaughan and Lenton, 2011).

For the attribute elicitation task, one group chose as many attributes as they associated with each concept from a group of 30 pre-determined attributes previously peer reviewed by

climate engineering experts and pretested with four people known to the researcher. Each participant in the Kelly's Repertory Grid group viewed pre-tested and pre-planned combinations of three randomised and rotated concept boards at a time. They were asked to select a pair that was similar, discuss why they were similar and why the third concept board differed from the selected pair. After 10 completed interviews, no new attributes were generated thus the attribute list was exhaustive.

Both elicitation methods used in the depth interviews were fast to administer as all the interviews were completed within three weeks. Participants did not receive any incentives or rewards. If transcribing and analysis of the interviews are not carried out by the researcher then a cost is incurred. However, this type of interview usually involves only the cost of the researcher's time. In this case the qualitative work of arranging and carrying out the interviews, transcription and analysis took 70 hours.

3.3 Quantitative Methodology

The quantitative analysis used data collected from large on-line surveys conducted in Australia (n=1006) and New Zealand (n=1022). Participants were members of commercial panels and the samples' demographic compositions were similar to census data. Recruitment bias is unlikely due to the large size of the panels (n= 75,000 in NZ and n = 189,000 in Australia) and with both countries having more than 80% of their population with Internet access, coverage bias is minimised (Wright et al., 2014).

Two further climate engineering techniques, *enhanced weathering* and *mirrors in space* were added to the four concepts tested in the qualitative stage. To minimise respondent fatigue participants randomly evaluated four of the six climate engineering techniques shown as an on-screen image and descriptions matched by length as well as positive and negative content. Twelve attributes most commonly mentioned in the qualitative phase were used to evaluate each climate engineering technique. To ensure relevance the language evoked in the Kelly's Repertory Grid method was selected over similar terms used in the predetermined list of attributes. For example, *eyesore* replaced the term *visually cumbersome*. For, comparison twelve attributes used in the qualitative analysis are retained and reported here. However, later work removed the two attributes *unpredictable* and *beneficial* as Kendall Tau-b correlation tests showed overlapping memory structures.

On-line surveys using commercial panel providers are also fast to administer, responses were collected within a week. Data retrieval into statistical programmes is quick and convenient. For this research questionnaire design, survey administration and analysis took 100 hours. However, on-line surveys incur a large cost; a sample size of 1000 respondents (survey duration 10-15 minutes) cost more than 5,000 New Zealand dollars.

4.0 Results

4.1 Qualitative Results

For each elicitation method, the number of associations with each attribute is counted. For the pre-determined list of attributes the maximum number of possible associations is 60 (15 respondents x 4 techniques). No attribute had more than 22 associations which indicates a reasonable spread of perceptions across attributes. For the Kelly's Repertory Grid method no attribute had more than 32 associations and it also demonstrates a reasonable spread of

perceptions. Positive and negative attributes showed mixed popularity. Table 1 shows attribute association counts across both methods ranked in order of popularity.

Table 1: Attribute Associations Across Both Elicitation Methods

Predetermined List		**Kelly's Repertory**	
Attribute	**Associations**	**Attribute**	**Associations**
Good for the planet	22	Sustainability long-term	32
Risky	22	Natural	30
Ingenious	21	Risky	21
Beneficial	20	Artificial	21
Engineered	19	Proven	20
Artificial	18	Potential environmental impacts	18
Controversial	18	Least risk	17
Unpredictable	18	Environmentally friendly	12
Too expensive	17	Most beneficial	12
Feasible	17	Cost effectiveness	12
Understandable	16	Unknowns	11
Visually Cumbersome	15	Quick fix	10
Interfering	13	Eyesore	7
Reversible	12	Recyclable by-product	6
Constructive	12	Most likely to succeed	6
Effective	12	Local benefit	6
Quick fix	12	Treats source	6

To check if perceptions differ between climate engineering categories, association counts from the predetermined list of attributes is separated into the two broad classifications of climate engineering techniques in Table 2.

Table 2: Qualitative Comparison of Association Counts by Classification

Carbon Dioxide Removal		**Solar Radiation Management**	
Good for planet	18	Risky	19
Controllable	17	Unpredictable	17
Beneficial	16	Artificial	14
Feasible	15	Too expensive	11
Ingenious	14	Controversial	11
Understandable	12	Engineered	11
Effective	10	Unbalanced	10
Constructive	9	Dangerous	10
Harmless	9	Unrealistic	10
Visually cumbersome	9	Interfering	9
Necessary	8	Quick Fix	9
Engineered	8	Band-aid	8

Table key: blue highlight represents negative attributes

This separation shows a striking result – the most popular associations for CDR are predominantly positive, while the most popular associations for SRM are all negative. While

this preliminary finding indicates SRM techniques are likely to evoke more negative reaction than CDR technologies, proponents of quantitative research however, are likely to claim a weakness of this qualitative research is that the significance of the outcomes lacks statistical validation.

4.2 Quantitative Results

Table 3 shows the association counts of the twelve most common attributes mentioned across the two elicitation methods used in the qualitative stage from the Australian sample. The NZ data showed the same pattern and provides evidence of the robustness of the samples.

Table 3: Quantitative Comparison of Association Counts by Classification

Carbon Dioxide Removal		**Solar Radiation Management**	
Unknown effects	977	Unknown effects	1356
Unpredictable	649	Unpredictable	1102
Risky	592	Risky	959
Artificial	458	Artificial	701
Quick-fix	298	Quick-fix	503
Eyesore	489	Eyesore	285
Understandable	432	Understandable	294
Beneficial	483	Beneficial	237
Controllable	470	Controllable	241
Environmentally friendly	447	Environmentally friendly	240
Long-term sustainability	459	Long-term sustainability	168
Cost effective	297	Cost effective	191
Total Negative Associations	3463	Total Negative Associations	4906
Total Positive Associations	2588	Total Positive Associations	1371
Net Positive Associations	**-875**	**Net Positive Associations**	**-3535**

Table key: blue highlight represents negative attributes

The SRM techniques used in the quantitative evaluations show the same pattern apparent in the qualitative results. The total SRM associations are more negative than the total CDR associations. The CDR techniques show some variation in popularity of attributes compared to SRM techniques. Overall CDR techniques reflect less negative associations and almost twice as many positive associations than SRM indicating citizens are likely to react with less negativity towards CDR technologies.

5.0 Conclusion

Such similar results between the independent qualitative and quantitative methods were unexpected. Both the qualitative and quantitative results suggest public reaction to climate engineering is likely to be negative, although CDR techniques are perceived less negatively than SRM. This finding was clear in the much less expensive qualitative stage. By comparison the quantitative stage required a large monetary investment for data collection. This raises the question of why qualitative research, that is much cheaper to obtain, is not more widely used in marketing research. One could argue that qualitative research has small samples that do not allow a wide representation of public opinion and often lack statistical validation. However, the similarity of the results reported here suggests that exploratory

attribute elicitation techniques can deliver findings that are both insightful and robust. These techniques also have the advantages of lower cost, faster implementation, and greater flexibility in reaching and reacting with sub-groups. We hope that more prominence will be given to these qualitative techniques in marketing, as they offer the possibility of gaining rapid insights into important problems.

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