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Graphic elicitation: using research diagrams as interview stimuli

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Diagrams are effective instruments of thought and a valuable tool in conveying those thoughts to others. As such, they can be usefully employed as representations of a research domain and act as stimulus materials in interviews. This process of *graphic elicitation* may encourage contributions from interviewees that are difficult to obtain by other means. By representing concepts and relationships that other visual artefacts cannot depict, diagrams provide a complementary addition to conventional interview stimuli. This paper discusses the application of graphic elicitation within the broader context of the diagramming process. Consideration is given to the unique characteristics of diagrams and the ways in which they are interpreted. Thus, the specific benefits that diagrams offer as interview stimuli may be understood. Following this, an example study is described in which the graphic elicitation process was employed in interviews with industrial designers. Reporting on a study in which the interviewees possessed a well-developed graphic sensibility allows a broad range of graphic elicitation's potential benefits to be illustrated. In closing the paper, a discussion is held on the range of methodological issues that must be addressed when employing diagrams in a research study.

Keywords: *diagrams, interviewing, stimulus material, data collection, data analysis, grounded theory, theory building, member validation, respondent validation, industrial design*

Introduction

Visual elicitation stimuli are artefacts employed during interviews where the subject matter defies the use of a strictly verbal approach. Such stimuli might typically include physical specimens, maps, drawings, photographs and video-clips (Banks, 2001; Johnson and Weller, 2001: 510). This approach may yield contributions from interviewees that are difficult to achieve by verbal

transactions alone. For example, allowing interviewees to sort through word-, phrase- or picture-cards may elicit ideas that would otherwise remain unarticulated and promote general discussion (Gaskell, 2000: 50). This is because such stimuli bring factors external to the interview situation into view, prompting response to “not now” moments, “not here” events and “not present” actors’ (Törrönen, 2002: 348).

Despite the variety of possible stimulus materials the majority of literature on visual elicitation research has focused on the use of photography (Harper, 2002: 13). Photo elicitation involves introducing photographs into research interviews to invoke comments and discussion. Such images may be created by the researcher (see Collier, 1967), created by the interviewee (e.g. Clark, 1999; Samuels, 2004), or collected from existing sources (see Banks, 2001: 87, 99). Whatever the source of the images, Harper suggests that ‘photo elicitation mines deeper shafts into a different part of human consciousness than do words-alone interviews’ (Harper, 2002: 22).

In comparison with photographs, the use of diagrams in interview scenarios is less well established. There are however a small number of studies in which their use is reported. Interviewing with diagrams is considered to be particularly useful where cross-cultural language barriers or illiteracy limit the effectiveness of textual and verbal communication (Mayoux, 2003). Similarly, where the topics discussed are of a sensitive nature the use of *participatory diagramming* may be especially effective in providing rich and nuanced data on subjects’ experiences (Kesby, 2000). However, even without such challenges to communication, diagrams can be used to elicit knowledge from experts (Cheng, 1996), and it may be beneficial to focus discussion around the common framework that a diagram provides (Ford and Sterman, 1998).

Whereas researchers employing photo elicitation have used images originating from a variety of sources, the use of diagrammatic stimuli has, to date, focused on representations produced by the interviewee. This is despite some implicit suggestion in the literature that diagrams produced by researchers may provide useful stimuli. For example, Padilla recommends that issues identified in preliminary interviews might be codified as a sketch; presenting this in subsequent interviews may allow discussion to be focused around an artefact that captures the essential aspects of a domain (Padilla, 1993: 156). Furthermore, Törrönen has specifically described the use of ‘microcosm’ stimuli that imitate, illustrate or exemplify the subject of study. Interviewees are thus encouraged to ‘compare their own conceptions and experiences to the world constructed in the stimulus [...which may be...] a picture, map or metaphorical outline’ (Törrönen, 2002: 354).

Unlike other visual artefacts, diagrams may depict subject matter ranging from the conceptual to the physical by adopting various degrees of graphic abstraction. This affords an overview of the topic that is unavailable by other

means and elicits unique contributions accordingly. Thus, employing diagrammatic representations of a domain in interviews offers a useful addition to the established array of elicitation stimuli. In this paper, the use of such a technique is referred to as *graphic elicitation*. Diagrams may represent a broad range of topics and may originate from a variety of sources. However, this paper focuses on the use of representations of the research domain that have been produced by the researcher. This is because an account of how these representations are produced and employed necessarily includes much of relevance to interviewing with diagrams in general.

There are a number of sources to which researchers may turn for advice on the application of photo elicitation techniques (e.g. Collier, 1967; Banks, 2001; Harper, 2002). These texts offer guidance on the preparation of images, their insertion into the interview process and the benefits that might thus be gained. Although such material provides a useful indication of how non-photographic visual stimuli might be employed in interviews, they are of only limited relevance when considering the application of researcher-generated diagrams as an elicitation technique. This is because diagrams differ from photographs not only in what they can depict but also in how they are created and how they are interpreted.

Consequently, there is a lack of supportive structure for the use of graphic elicitation in research interviews. In particular, the following questions have not been adequately addressed. Firstly, what are the *unique characteristics* of diagrams in relation to other elicitation stimuli? Secondly, what *specific benefits* might be realised by employing diagrammatic stimuli in interviews? Thirdly, what are the *practical and methodological issues* that must be addressed when considering the preparation of diagrams and their insertion into the interview process? This paper seeks to address these questions by considering graphic elicitation in both theoretical context and practical application.

In the first part of the paper, graphic elicitation is discussed within the theoretical context of research diagrams by drawing on literature from the fields of 'Notation and Visual Representation', 'Diagrammatic Reasoning' 'Member Validation' and 'Theory Building'. The application of diagrams as an instrument of thought and as a tool for communication is described, as it is upon these processes that graphic elicitation depends. The process of graphic elicitation is then discussed in detail with reference to how this compares with the more conventional process of obtaining the interviewees' assessment of research reports. The specific types of contribution that are obtained through graphic elicitation are described and the ways in which these contributions may be used in subsequent research activities is illustrated. In closing this part of the paper, attention is given to the potential for diagramming in general, and graphic elicitation in particular, to assist in the activities of theory building from interview data.

So as to provide an illustrative example of graphic elicitation in practice, the second part of the paper presents a study in which the technique was extensively employed. The focus of this study was the activity of *industrial design* and a series of interviews with practising designers is described. Design is one industrial context in which visual representations enjoy a privileged status and designers are especially adept at visual thinking and visual presentation. This was an important contributory factor to the successful use of diagrammatic stimuli in the study and allows a number of graphic elicitation's potential benefits to be illustrated. Following a description of how diagrams were employed in the study attention is turned to the importance of assessing the interviewees' visual literacy when considering a graphic elicitation approach.

Having considered graphic elicitation in theoretical context and practical application, a discussion is then held on a range of methodological issues that must be addressed when employing diagrammatic stimuli in a research study. The three research questions outlined above are addressed in both parts of the paper and in the accompanying discussion. In concluding the paper, material from the preceding sections are summarised thus offering specific answers to each question in turn. Suggestions are then made for how future work in graphic elicitation might address the issues raised in this paper when the technique is applied in a range of different interview contexts.

Part 1: graphic elicitation in context

A diagram is a visual representation that shares the properties of written text and representational images, but cannot be reduced to either (Blackwell, 2001: 1). Familiar examples include public transport 'maps' such as the London Underground diagram, economic graphs and charts, or the assembly drawings and flowcharts included in instruction manuals. Diagrams are unlike text in that we cannot 'speak' them, but are also unlike images because that they do not correspond to our sense perceptions of any physical objects (Ittelson, 1996). Thus, rather than imitating the appearance of things, 'diagrams are most suitable for visualisations of conceptual knowledge [...] modelling reality *as we understand it*' (Kazmierczak, 2001: 177).

In representing the technical world of diagram use, McKim divides visual thinking into two distinct activities: *graphic ideation* and *graphic communication*. Graphic ideation typically involves quick freehand sketches to assist in the process of 'visually talking to oneself'. In contrast, graphic communication often involves representations with increased clarity that assist in the process of 'visually talking to others' (McKim, 1980: 12, 123). MacEachren draws a similar distinction between the private early stages of visualisation, which involve the exploration of unknowns, and the later public stages of communicating what is already understood (MacEachren, 1994: 2).

Further to graphic ideation and graphic communication, graphic elicitation involves presenting interviewees with a diagrammatic representation of the domain with which they are involved. This may provoke comment on the details of the diagram and the conceptualisation inferred from it, in addition to prompting further discussion of the domain in general. Graphic elicitation draws upon and extends the graphic ideation and graphic communication processes. Therefore, these processes are reviewed here before graphic elicitation is discussed in detail.

GRAPHIC IDEATION

Graphic ideation offers the opportunity to thoroughly examine a problem from a number of perspectives using visual representations to both record and stimulate thought. In particular, complex, intangible and non-linear concepts may often be thought about more rigorously through the application of diagramming (McKim, 1980). Graphic ideation involves both exploratory and developmental phases. The exploratory phase is formative and requires the imagery of a new idea to be visualised and recorded. The subsequent developmental phase requires the evolution of these 'promising, though initially embryonic, concept[s] into mature form' (McKim, 1980: 122).

Graphic ideation is described by both Enrick (1972: 4) and McKim (1980: 124) as an iterative process in which ideas are visually expressed, tested, and then fed back to the expressive stage (see *Graphic ideation* in Figure 1). The output of this initially cyclic activity is the eventual convergence on a graphic solution that is considered appropriate. Thus, diagramming is seldom the mere formality of setting down in graphic form what is already understood. On the contrary, the iterative process of structuring ideas and developing representations for those ideas may trigger previously unconsidered notions (Albarn and Smith, 1977: 7). The ambiguity of these initial representations may be valued as an opportunity for creative leaps in interpretation (Hewson, 1991). As a result, drawing diagrams may lead to an improved understanding of the subject and conceptualisations that would not otherwise have been entertained.

One possible consequence of the new-found clarity that diagrams provide is that the originator of the diagram is 'tempted to treat [these] simplified constructs as though they were reality itself' (Arnheim, 1969: 307). However, diagrams are necessarily a radical simplification of a domain from a single perspective and this leads to an emphasis of some aspects at the expense of de-emphasising others (Green et al., 1991). Thus, visual thinking can be enhanced if the graphic ideation process involves actively moving between different graphic languages (Cox and Brna, 1995). This includes exploring the different modes of presentation available and experimenting with various degrees of abstraction. The ongoing process of searching for different visual solutions helps in the refinement of conceptualisations as 'every time visual thinkers change graphic languages, they submit an idea to a new set of built-in mental operations'

(McKim, 1980: 132). For valuable guidance in exploring the available modes of presentation Bertin (1967), Lockwood (1969), Harris (1999) and Engelhardt (2002) provide visual summaries of the varieties of diagrammatic possibility.

The opportunities presented by graphic ideation for continually re-examining a problem lead to expansion and refinement of the entire thought process surrounding that problem. Thus, the inconsistencies and imprecision of early ideas are revealed because 'your initial inability to prepare a meaningful [diagram] is the result of gaps in your original thought processes' (Enrick, 1972: 7). With a diagram available that accurately reflects the current conceptualisation of the domain, the process of communicating on that domain may be greatly improved.

GRAPHIC COMMUNICATION

Effective graphic representations are capable of providing concise visual summaries of data, concepts and relationships (Enrick, 1972: 1). Consequently, communications on many subjects are clarified by presenting diagrams of the subject matter involved (Dondis, 1973; Lowe, 1993). Diagrams are not inherently intuitive however, and if the reader of the diagram does not understand the visual language of the representation then they will have difficulty accessing, interpreting and decoding its meaning (Bennett, 2002: 62). Thus, when developing diagrams for communication, consideration must be given to how the representation will be 'read' and what it will mean to its intended audience (see *Graphic communication* in Figure 1).

By combining the syntactic properties of linguistic symbols and pictorial representations, diagrams can carry meaning in a variety of ways (Goodman, 1969). Firstly, the separate *graphical objects* of which a diagram is composed (e.g. icons and pictograms) can hold significance almost independent of context. Secondly, the *attributes* of those objects (e.g. shape, size, and colour) can convey information about the represented entities. Thirdly, the *relative arrangement* of the graphical objects (e.g. proximity, inclusion, and adjacency) can be used to communicate the relationships between these represented entities. Finally, the space on which the graphical objects *are arranged* (e.g. political maps or building plans) can also hold associations that are meaningful. In each of these cases, correspondence from the visual representation to its interpretation can be literal, metaphorical, or based on arbitrary conventions (Blackwell and Engelhardt, 2002; Engelhardt, 2002).

It is important to be aware that, to some people, diagrams may not be perceived as neutral with regard to mechanisms of hierarchy and power. Indeed, diagrams can be regarded as closely implicated in processes of discipline and control. They fall within the class of phenomena that Foucault describes as technologies of representation: sign systems that impose power structures upon knowledge

and experience by encoding relations (Sheridan, 1980). This can be especially salient to corporate contexts, where the organisation chart might be equated with architectures of discipline that Foucault calls the 'Panopticon' (from Bentham's design for prisons constructed around an observation tower). By reducing individual workers or managers to symbols, and then subjecting the whole visible assemblage of relations within the diagram to an 'incarcerating' administrative gaze, the organization chart becomes an emblem of corporate power (McKinlay and Starkey, 1998).

Beyond considering the conventions of culture and media, attention should also be given to the preferences of the target audience. Craig distinguishes between those who have a tendency to view and produce diagrams and those who exhibit a preference for linear, textual presentations of information (Craig, 2000: 3-4). To accommodate this variation in preference, diagrams are typically supported by textual or verbal explanations of what is being depicted, what the graphic language implies, and how the visual material should be interpreted. This is because 'even well-designed diagrams can be ineffective if the [reader] is given insufficient support in how to use them' (Lowe, 1993: 11).

GRAPHIC ELICITATION

As discussed, the process of graphic ideation results in diagrammatic structures that are felt to represent the current conceptualisation of a domain. The subsequent process of graphic communication involves the development of representations that are meaningfully presented to others. In graphic elicitation this presentation is performed so as to encourage contributions from interviewees during the interview process. Where these diagrams represent the researchers' interpretation of the research domain, the interviewees' response may offer some form of 'member validation' (Seale, 1999: 61). Taking Schutz's 'postulate of adequacy' (Schutz, 1970: 279) as a philosophical basis, such idea-sharing activities have conventionally involved presenting the subjects of a study with the researchers' report and seeking their appraisal (Schatzman and Strauss, 1973; Douglas, 1976).

Whilst this approach offers valuable insight into how the researchers' findings are interpreted, as a method of validation it is problematic. As Emerson (1988) and Bloor (1978; 1997) acknowledge, member validation is not free from the interpersonal and political ambiguities that characterise all qualitative investigation. Consequently, feedback from members may be viewed as just another valuable source of data rather than as validation or refutation of the researchers' inferences (Fielding and Fielding, 1986: 43). One particular problem associated with member validation is that members of the studied group do not necessarily possess the skills or motivation required to analyse and comment on the documents that they are provided with (Emerson and Pollner, 1988; Bloor, 1997). Such issues prompted Bloor to ask, 'how does one frame and present one's analysis in such a form and in such a setting that one can be confident that

one's respondents will fully understand it [...] ?' (Bloor, 1978: 550). This is one instance in which the diagram's capacity to convey conceptual entities allows researchers to present their ideas, hypotheses or theories in a simple and coherent manner. This in turn allows interviewees to compare the representation constructed in the stimulus to their own experiences or ideas. As such, diagrammatic representations may circumvent many of the problems associated with verbal or textual reports.

Graphic elicitation evokes a variety of responses that can be categorised according to how they relate to the diagram. Firstly, presenting diagrams to interviewees may provoke comments on the details of the presentation and offer insights into how the diagram is interpreted. Unanticipated assumptions and misunderstandings noted at this stage might be accommodated in future communications. This may involve modifying the representation and offering guidance in the supporting material. Secondly, interviewees may be encouraged to comment on what the diagram reveals about the researchers' conceptualisation of the domain. These comments may provide feedback on the underlying structure of the representation, rather than the details of its execution. Consequently, the researcher may gain new perspectives on the implications of their assumptions and the limitations of the graphic language used. Thirdly, and in a broader sense, interviewees may be encouraged to discuss the subject in general based on their interpretation of the diagram. If the diagram provides a visual overview of the domain this may allow connections to be made and scenarios to be envisaged that might otherwise be overlooked. The researchers' interpretation of these three forms of response offers new insights that may be used in the ongoing processes of graphic ideation and graphic communication (see Figure 1).

Employing diagrammatic stimuli may also assist with other aspects of the interview process. For example, by presenting a diagram that provides a common frame of reference to both parties, complex lines of questioning may be formulated more clearly. Similarly, involved answers or statements from interviewees can often be more easily expressed with reference to the representations. These transactions might typically involve both parties interacting with the diagram, 'animating' it with gestures to convey flows, relationships or dependencies. Presenting interviewees with a diagram of the research domain may also prove useful in communicating the limits of interest. Especially in research where the boundaries are set widely, verbal or textual descriptions of the topic may be confusing. Outlining the domain graphically may reassure interviewees that their contributions are relevant to the researchers' interests. Alternatively, a clear view of the existing boundaries set by researchers may provoke the interviewees to challenge the validity or relevance of such constraints.

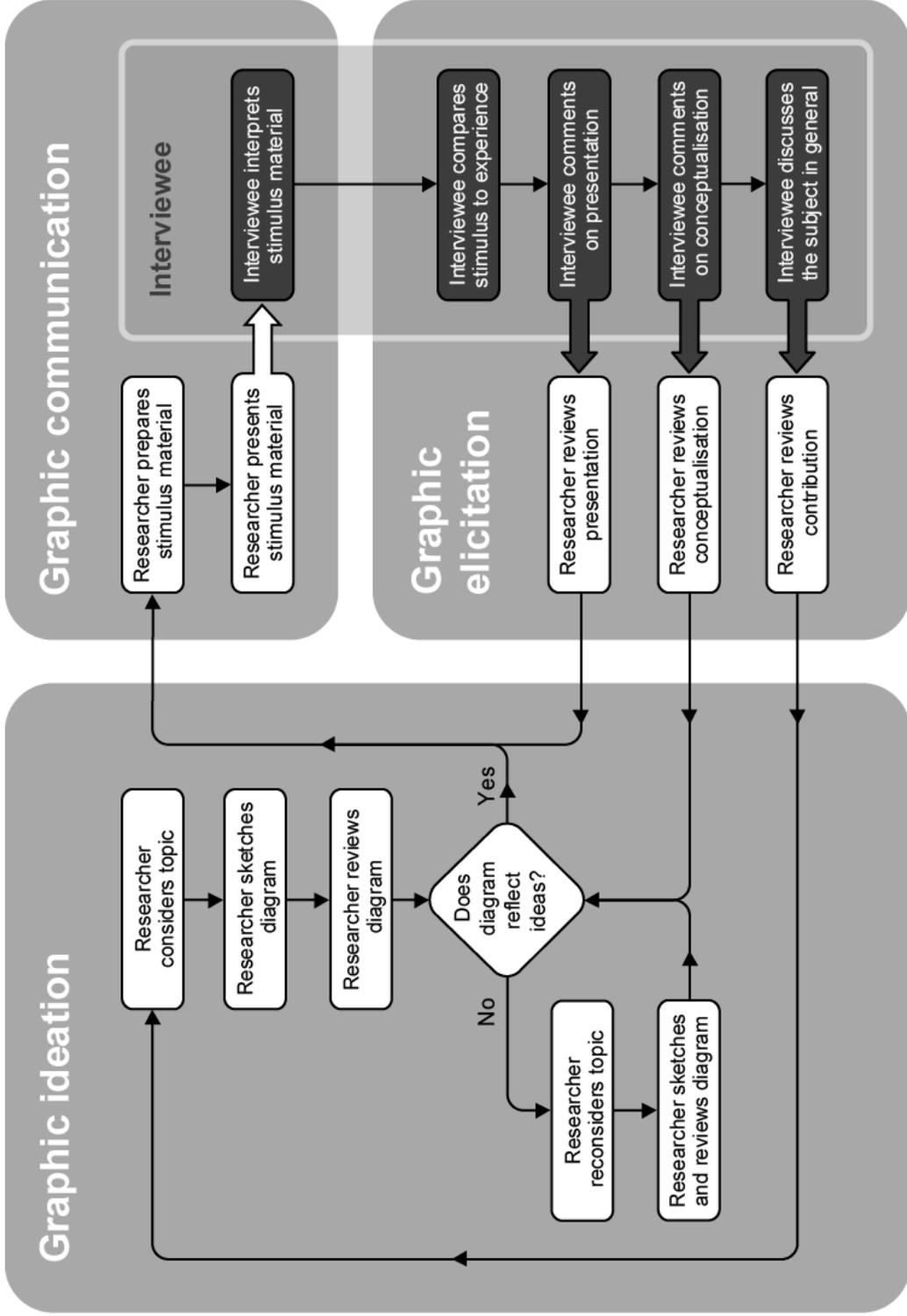


FIGURE 1 Flow chart depicting a simplified and abstracted view of how the graphic elicitation process may integrate with the graphic ideation and graphic communication processes. The graphic ideation and graphic communication components are adapted from Enrick (1972: 5).

The potential for diagrams to offer a holistic overview of the subject must be placed in the context of other available visual stimuli. In particular, stimulus materials are often selected to be evocative, probing beyond the bounds of verbal discourse. For example, Harper describes the use of aerial photographs as offering a new and interesting perspective that can 'break the frame' of the subject's normal view (Harper, 2002: 20). By offering a gestalt perspective on the domain, diagrams may achieve a similar effect but are freed from the constraints of figurative representation. Through employing a range of graphic conventions, diagrams may represent conceptual matters (such as patterns of behaviour or organisational structures) in addition to the physical world. As such, diagrams are interpreted in a different manner to other stimuli and researchers should consider this when preparing and implementing diagrammatic stimuli.

INTERPRETATION IN GRAPHIC ELICITATION

The arrangement of diagrammatic elements can adopt the conventions of cartography (MacEachren, 1995), newspaper infographics (Wurman, 1997), or even typographic devices such as bullet points, tables and poster layouts (Kress and van Leeuwen, 1996). In addition to conveying information, these visual references to conventional systems provide an implicit social context. Like many sign systems, diagrams may be interpreted as carrying not only their primary meanings but also secondary meanings that are attached to the mode in which the primary meanings are conveyed (Hervey, 1982: 136). For example, maps are often associated with political boundaries and this association may extend to maps, charts and plans that are without political content (Monmonier, 1991). Thus, researchers must consider not only what the diagram *denotes* but also what it might *connote*, as this too will influence the interviewees' response (Krampen et al., 1987: 217).

Verbal descriptions establish structure by defining linguistic labels for components of the situation and then making references to those labels in order to describe relational aspects of the situation. The structured nature of diagrams allows viewers to 'read' content both through such semiotic associations *and* through direct perceptual structures (Blackwell, 2002). Thus, when expressed in diagrammatic form, relationships between graphical elements can be suggested by direct visual conventions (such as topological connection or adjacency) without the attentional costs of labelling either the represented elements or the relation itself (Larkin and Simon, 1987). This offers the benefit that diagrams permit the representation of relationships that are only vaguely understood. Diagrams may thus allow researchers to bring concepts into the interview situation that they would be unable to verbalise clearly. The interviewees' response to such ambiguous depictions may clarify vaguely understood concepts and hint at previously unconsidered ones.

Whilst researchers may employ this graphic ambiguity to their advantage, in other functions diagrams may be more explicit than linguistic constructs. Where spoken language or texts can be underspecified, a visual representation often presents a concrete view of a situation. To consider a simple example, we are able to say 'A sat down beside B' without specifying whether it was to the left or the right. In contrast, a visual representation cannot avoid making a claim one way or the other, even when the original information was uncertain (Shimojima, 1996). The advantage of such concrete presentations is that interpretation becomes simpler as the number of alternative readings decreases (Stenning and Oberlander, 1995).

Such simplification may facilitate contributions from interviewees by reducing a complex topic to a clear graphic abstraction around which discussion is based. Alternatively, the interviewee might object to the simplification as being unrepresentative. Inappropriate assumptions that the researcher has made are thus highlighted, and unarticulated factors that the interviewee considers important are brought to the fore. Thus, even diagrams known to be inadequate may still be of use in interview scenarios as interviewees strive to articulate the shortcomings of the representation through example or speculation. These contributions may expand, modify or refute the researchers' conceptualisation of the domain. As such, graphic elicitation offers a useful tool for data analysis and theory building.

GRAPHIC ELICITATION IN DATA ANALYSIS AND THEORY BUILDING

Many qualitative research texts advocate the use of visual representations in the data analysis process (see Dey, 1993; Miles and Huberman, 1994; Ryan and Bernard, 2003). In this capacity, diagrams are often regarded as a useful tool for generating, exploring and recording ideas. Despite this, there is rarely (if ever) any explicit description of how using these diagrams in data collection scenarios might enhance researchers' analysis and theorising activities. Even within a methodology such as (Straussian) grounded theory, which advocates both the production of diagrams and the discussion of theories with interviewees (Strauss and Corbin, 1998: 45, 217), there is no suggestion that these two activities might be connected. On the contrary, diagrams are considered to be one of the private analytic tools of the researcher and 'are rarely seen by anyone but the analyst' (Strauss and Corbin, 1998: 218). Whilst this approach acknowledges that diagrams are effective instruments of thought, it fails to exploit their potential for eliciting responses that can improve the accuracy, comprehensiveness and parsimony of the diagram used in theory building activities.

The objective of theory building is to 'find order in the booming, bustling confusion that is the realm of experience' (Dubin, 1978: 5). To achieve this there

are four essential questions that Dubin suggests a theory must answer: *What* is the domain of interest and what factors should be considered? *How* are these factors related? *Why* have these factors been selected and what justification is there for the proposed relationships? Finally, to *whom*, *where* and *when* are the propositions limited (what are the boundaries of the theory)? Generating analytic diagrams and employing these diagrams in graphic elicitation studies can aid researchers in establishing answers to these four questions.

Eisenhardt describes theory building from case studies, as a process of constantly juxtaposing the emergent theories with the case data (Eisenhardt, 1989: 546). Diagramming facilitates this process by providing a visual summary of the concepts and relationships under consideration. Comparing the evidence of each case to visual representations encourages an ongoing appraisal of the accuracy of the concepts and relationships depicted. Thus, in relation to the 'what' and 'how' elements of a theory, Whetten suggests that 'visual representation often clarifies the author's thinking and increases the reader's comprehension' (Whetten, 1989: 491).

By presenting diagrams that clearly depict the factors of interest and the relationships between them, researchers illustrate their conception of the domain. This may elicit comments from interviewees on the importance of not only that which has been represented, but also that which has been omitted. This serves to strengthen the researchers' justification for the factors and relationships that have been selected and clarifies the 'why' element of a theory. Finally, in attempting to generate diagrams that reflect observation, researchers must strive to reveal a general structure that is applicable to a variety of specific cases. When interviewees respond to these generic representations they may offer clues to the possible limits of generality and help determine the 'who, where and when' elements of a theory.

SUMMARY OF GRAPHIC ELICITATION IN CONTEXT

This first part of the paper has described the processes that researchers must engage in when generating diagrammatic representations of a domain and converting these to meaningful stimuli to use with interviewees. The application of such stimuli in the interview process has been described along with an indication of what information may be obtained. Finally, the ways in which interviewees' contributions integrate with the ongoing diagramming process have been presented and the role of graphic elicitation in data analysis and theory building activities has been outlined. So as to offer an illustrative example of graphic elicitation in practice and to examine the insertion of diagrams into the interview process, an example study is now reported in which the technique was extensively employed. This is followed by further discussion of the methodological issues that must be addressed when considering the application of diagrammatic stimuli in a research study.

Part 2: graphic elicitation in practice

The objectives of this study were to assess the range of factors that influence product appearance from the perspective of industrial designers and to understand the relationships between those factors. The profession of industrial design is variously defined, but for this paper it might be described as the activity that 'determines the form of a manufactured product, shaping it to fit the people who use it and the industrial processes that produce it' (IDSA, 2004). A grounded theory approach was adopted for the study as described by Strauss and Corbin (1998). Whilst a number of research techniques were employed in the study, only those aspects relevant to graphic elicitation are discussed here.

Although the study was conducted in a continuous and iterative manner, for the purpose of description it can be divided into three phases with each phase involving a series of interviews with professional designers. In *Phase I*, seven exploratory interviews were conducted so as to provide an overview of the domain and establish the best interview technique to proceed with. For example, the efficacy of various types of interview stimuli was assessed and the benefits of focusing each interview on a single product were established. From the data gained in this phase of the study a preliminary graphical framework was developed and an interview guide was produced for use in the subsequent phases. In *Phase II*, six case-based interviews were conducted with each interview focussing on a single product. During each interview the graphical framework was presented to the interviewees so as to elicit further contributions. Based on the designers' responses to the framework a modified representation was produced for use in the next phase. *Phase III* of the study involved a further six case-based interviews conducted in a similar manner to those in phase II. However, now both the original and modified versions of the framework were used as stimulus materials (see Figure 2). Analysis of the interviews from all three phases allowed the generation of an updated framework that could be used in further graphic elicitation studies.

PHASE I

In the first phase of the study, seven exploratory interviews (see Oppenheim, 2000) were conducted on a one-to-one basis in the designers' work environments. In discussing the activities of industrial design, clarity was improved by reference to a range of visual material provided by the interviewees. This included sketches, photographs, computer-based presentations, physical prototypes and finished products. With the interviewees' permission, audio recordings were made and later transcribed to produce accurate records of the conversations (see Fielding and Thomas, 2001). Where permitted, photographs were taken of the visual material provided by the designers. The average interview length was 80 minutes with discussions

based around several themes that existing literature suggested would be of relevance (see Crilly et al., 2004).

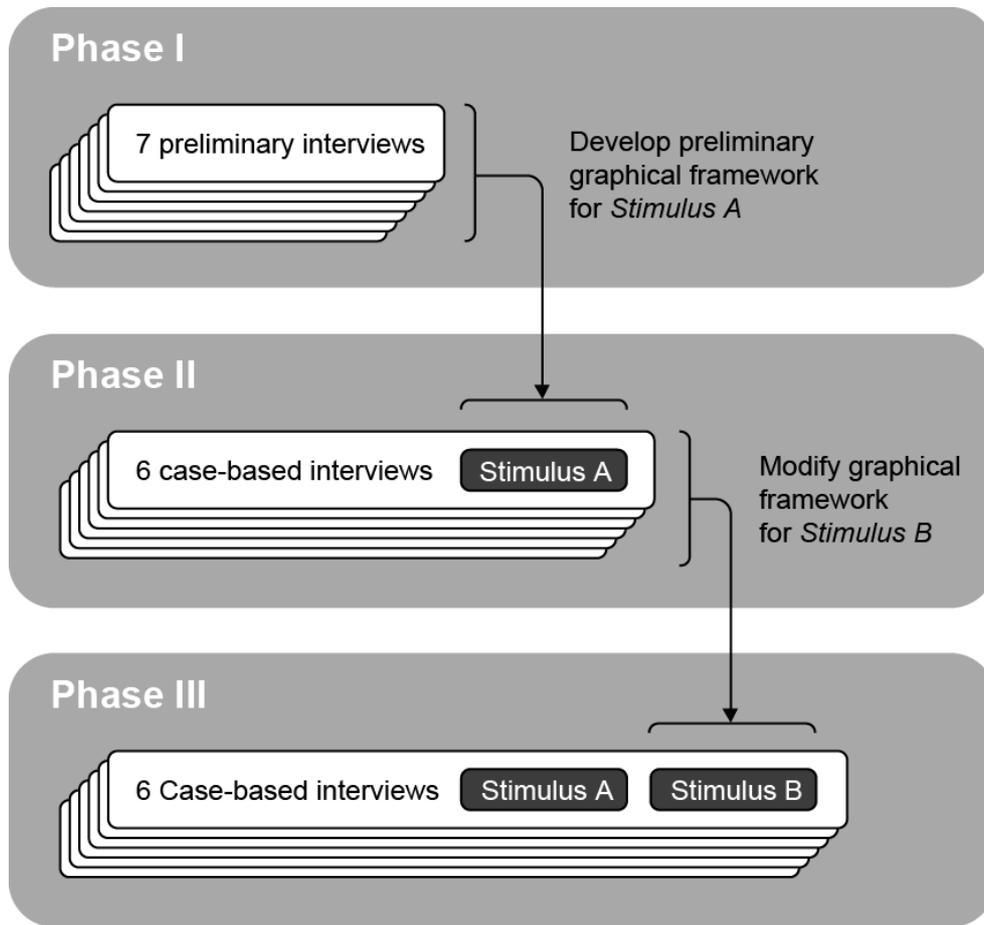


FIGURE 2 Representation of how the data collected in each phase of the study was used to produce stimuli for use in the subsequent phases.

Following the interviews, the transcripts were reviewed and coded to establish themes, connections and contrasts within the data (see Glaser and Strauss, 1967; Strauss and Corbin, 1998). From this information sketches were made in an attempt to capture the essence of the subject in diagrammatic form. Iterating through the graphic ideation process permitted the development of a preliminary graphical framework that was felt to adequately depict the factors involved. This representation was refined and a presentation was generated suitable for communication with the next round of interviewees. An interview guide for the second phase of the study was produced based on transcript analysis and the diagramming process.

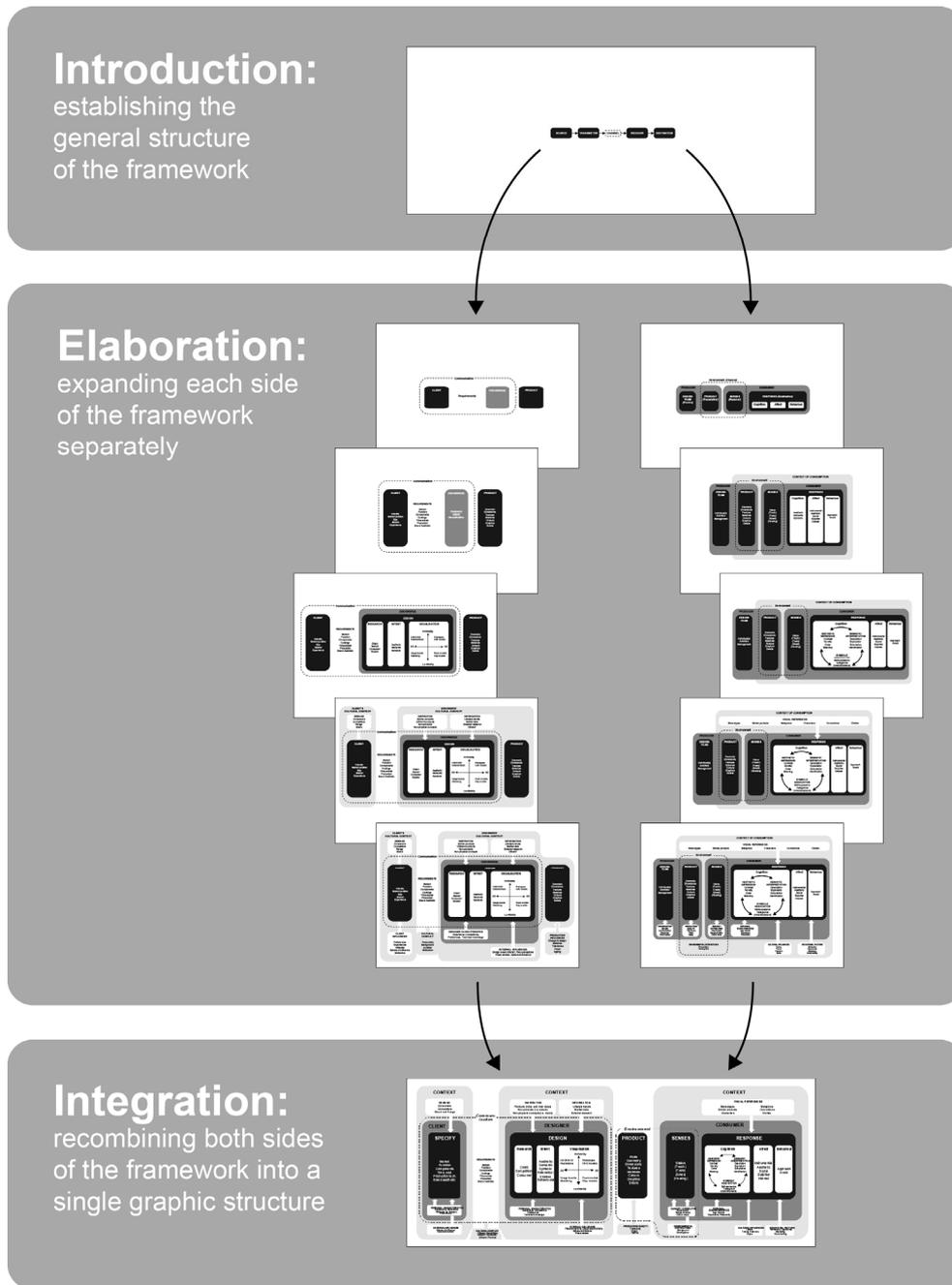


FIGURE 3 Illustration showing the general form of the preliminary graphical framework and the way in which the graphical layers were sequentially revealed. Although available elsewhere (Crilly et al., 2004), the stimuli used in this study are too involved to reproduce in detail here. Instead, Figure 4 shows simplified representations of the stimuli's basic structure, with Stimulus A corresponding to the linear arrangement shown above.

PHASE II

In the second phase of the study six case-based interviews were conducted under similar conditions to those already described. Each interview was divided into two parts. Firstly, a general discussion was conducted on the factors

influencing product appearance from the designer's perspectives. Using the interview script as a guide each interview focused on a particular product to explore the factors that were influential in determining its form. Secondly, the preliminary graphical framework was presented to the designers in a series of slides that cumulatively built up the layers of the representation (See Figure 3). The different aspects of the diagram were sequentially revealed so as to constrain the interviewees' attention to the area under discussion and so that their comprehension of each layer could be assessed before presenting the next.

Through a series of interjections, or at the end of the presentation, the designers commented on the diagram and offered further opinions on the subject in general. This included comments on the details of the representation, such as whether references to individuals (i.e. 'Designer') should instead be made to groups (i.e. 'Design Team'), and on the relative importance of items presented in list form. A number of interviewees in phase II also expressed concern over the linear structure used in the diagram (see *Stimulus A* in Figure 4). They felt that the iterative, fluid and complex process of design was not conveyed by a representation that encouraged left-to-right reading. Furthermore, the linear arrangement of the parties involved in the process (client, designer and consumer) resulted in graphical separation that was not felt to reflect their true relationships. For example, one designer commented, '...you kept the client a long way from the consumer... in fact, probably [in] most cases, the client is constantly interacting with the consumer'.

Consideration of comments such as this in conjunction with preliminary analysis of the interviews resulted in the creation of a non-linear (circular) representation. This new graphic structure encouraged the depiction of interactions between the parties that had not previously been shown (and not fully considered) due to the limitations imposed by the linear form of the original diagram. A new slide was mocked up for this mode of representation using a combination of the existing computer graphics and new elements sketched by hand (see *Stimulus B* in Figure 4).

PHASE III

In the third phase of the study, six case-based interviews were conducted in a similar manner to those in phase II. Following the initial product-focussed discussion the original presentation slides were shown and the designers made comments and contributions as before. However, now when interviewees expressed concern over the misrepresentative implications of the diagram's linear structure the new slide was presented to address these issues. For those interviewees who made no comment on the diagram's linear structure the new circular sketch was simply presented as an alternative representation of the domain.

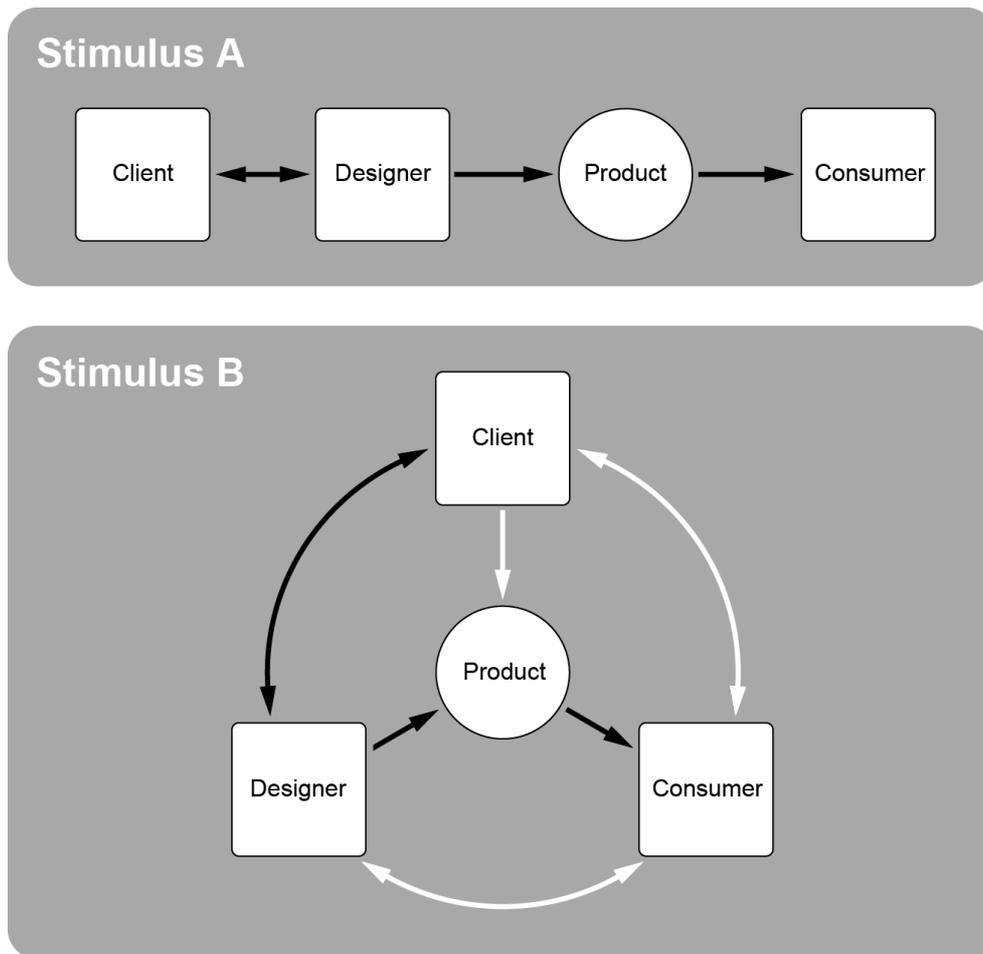


FIGURE 4 *Simplified representations of Stimulus A, the preliminary graphical framework (top) and Stimulus B, the modified graphical framework (bottom). In Stimulus B, the new (hand sketched) relationships are depicted with white arrows.*

The circular structure of the final slide was generally agreed to offer a more accurate representation of the factors and relationships involved. This new diagram provided a common conceptual framework upon which to base further discussion, and expansive contributions were more forthcoming now that the initial objection to linearity had been addressed. In addition, the sketched (circular) representation was more readily accepted as being work-in-progress than the slides produced using software. Consequently, the interviewees were less inclined to appease the researcher by simply agreeing with the diagram. One possible explanation is that the sketched representation was considered by the interviewees to be a preliminary depiction that could be improved upon immediately. For example, one designer's response to Stimulus B was, '...that's already starting to sound much more interesting... [begins sketching]... I think I'm just going to draw what you've drawn here actually... [continues sketching his own alternative representation]'.

Stimulus B depicted interactions that were not shown on the original graphical framework. Thus, the researcher was able to visually hint at the existence of relationships, the nature of which were not yet well understood. In response to the depiction of these relationships (indicated by the white arrows in Figure 4), the interviewees commented on the clients' role in influencing the design process and the consumer research activities conducted by both the designer and the client. Furthermore, the overview of the topic afforded by the diagram encouraged the interviewees to comment on relationships and provide anecdotes that had not previously been mentioned. For example, interviewees discussed aspects of promotion, manufacturing, branding and packaging, either because of their place on the diagram or their conspicuous absence from it.

By providing the designers with a representation of the topic in graphic form, the researcher elicited information that had been difficult to gain by verbal transactions alone or through reference to the other visual materials. Consequently, a more comprehensive and accurate conceptualisation of the domain was possible than if the interviewing and diagramming processes had remained separate. It is this conceptualisation, and its graphic expression, which formed the basis of subsequent data analysis and theory building activities.

DATA ANALYSIS AND THEORY BUILDING

In analysing the transcripts and attempting to reveal the underlying 'meaning' of the interviews a coding system was applied to the data. Computer assisted qualitative data analysis software, *QSR NVivo 2.0* (QSR, 2002), was used to assign a hierarchy of themes and interpretations to segments of the transcribed text. Also linked and coded in the software was visual material such as product photographs and sketches produced by the interviewees. The codes assigned to the interview material were partly suggested by the structure of the diagrams used in the interviews and partly based on post-interview analysis.

Using a visual modelling environment provided by the software it was possible to construct diagrammatic representations of the domain from the hierarchical codes assigned to the transcripts (see Weitzman, 2003: 321; Bringer et al., 2004: 259). The coded elements of the model were linked to the appropriate segments of text. Thus, alternating between views of the model (emergent theory) and the transcripts (interview data) was a simple procedure. This facility for constant comparison of the diagram against the case-based evidence allowed continual appraisal of the diagram's validity as a representation of the domain.

Analysis of the interviews and the initial theory building activities were dependent on the diagrammatic representations used in the interviews. Furthermore, the output of the analysis and theorising processes was an updated and refined diagram that drew more rigorously on the collected material. The emerging diagram was thus produced in collaboration with the

interviewees and was both an instrument and product of the research. Consequently, the designers' ability to interpret and respond to graphic artefacts was highly influential in determining the effectiveness of diagrammatic stimuli.

THE VISUAL LITERACY OF INTERVIEWEES

Drawing is a central activity in design that facilitates the exploration of possible solutions to a problem by providing a medium for visual and spatial thinking (Dorst, 2003: 118). Whether or not the designer is creating graphical products, the process of design often involves constructing and sharing visual representations in the form of sketches (Eckert et al., 2004). For example a designer may make marks on paper in order to develop partly-formed visual concepts and then observe and reflect on the appearance of these marks in order to develop the design (Fish and Scrivener, 1990). Thus, designers are considered to be engaged in 'conversation' with the drawing (Schön, 1991: 78), and their sketching process may be considered as one form of graphic ideation. Consequently, there are a number of reasons why designers are a group well suited to the use of diagrams in interviews. Firstly, they are familiar and comfortable with interpreting information presented visually. Secondly, they are predisposed to viewing graphic artefacts as 'designed products' that may be revised and improved upon. Thirdly, they often have a well-developed graphic sensibility and are capable of commenting on their own response to diagrammatic stimuli.

These characteristics are certainly not the exclusive preserve of designers, as individuals from a range of backgrounds are confident in producing and interpreting diagrammatic representations. However, some groups are less likely than others to exhibit strong visual literacy and there may be limited benefit in using diagrammatic stimuli with all interviewees. For example, in the researchers' previous experience, many groups associate diagrams with the work of technology, in particular with professional practices where social interventions are achieved by technical means. This has the effect that diagrams may be both alienating for those who feel disempowered by technological change, and affirming for those who are engaged in the processes of change (McKinlay and Starkey, 1998). Thus, when considering graphic elicitation as a possible approach, the researcher must remain mindful of the interviewees' preferences and capabilities with regard to diagram use.

Further to the example study reported here, the evolving diagram has been employed in graphic elicitation studies with the professional researchers who investigate user behaviour to inform industrial design. In future work, the representation might be adapted for studies with other stakeholders in the industrial design process such as manufacturers, brand managers, marketers, retailers, and consumers. In each of these studies the visual literacy of the

respective groups would need to be assessed when considering the preparation and implementation of diagrammatic stimuli.

SUMMARY OF GRAPHIC ELICITATION IN PRACTICE

This second part of the paper has illustrated how graphic elicitation may be incorporated within a qualitative research study. The integration of diagramming with the interview process has been discussed, and the role of diagrams in subsequent analysis and theorising activities has been outlined. Examples of the ways in which interviewees interpreted the stimuli and their subsequent contributions were also reviewed. In addition, an exploration of the designers' relationship with visual artefacts was offered as an indication of how the interviewees' familiarity with visual representations should be considered when employing the graphic elicitation technique. Examination of these issues within one particular study suggests some of the broader methodological considerations relevant to the preparation and application of diagrams in the research process. Having now considered graphic elicitation within its theoretical context and through in practical application, these methodological considerations are now discussed before conclusions are drawn.

Discussion: methodological considerations

Despite the potential benefits that diagrams offer researchers, care must be taken to ensure that they are used appropriately. There is the danger that graphical representations of a domain may be sufficiently persuasive so as to define rather than reflect thinking. In particular, researchers may inadvertently strive to fit observations to the diagram, rather than modifying the diagram to reflect observations. Similarly, it is possible for concepts or relationships suggested by the data to not even be observed because the researcher's conceptualisation of the domain is constrained by an inadequate representation. These problems stem from considering diagrams to be true reflections of the domain rather than a temporary model that should be subject to evaluation and revision. Constantly comparing case data against the representation and regularly experimenting with different graphic languages are effective ways to combat these potential problems.

Just as the graphic ideation process may become too strongly aligned with a particular representation, there is the danger that presenting interviewees with a single graphic summary of the domain will constrain their thinking. Consequently, interviewees may be inclined to suggest only modifications to the diagram rather than offering new conceptualisations. Furthermore, well-finished diagrams may appear particularly convincing and interviewees may not perceive substantial failings due to this 'graphic seduction'. Such problems can be alleviated (although probably not eliminated) by presenting the diagrams

as works-in-progress that depict *possible* representations of the domain. This might be achieved by verbal guidance or, perhaps more persuasively, by presenting ambiguous sketches and alternative stimuli.

A further issue for consideration is that of *when* the stimuli should be introduced into the interviews. Presenting the diagram at the outset may facilitate a concise description of the researchers' interests and provide an immediately available basis for discussion. However, such an approach may also prejudice the interviewees' responses and strongly bias the material collected. A less imposing approach may involve employing graphic elicitation after a substantial period of discussion, or only in repeat interviews. Thus, interviewees' perspectives might be revealed through verbal discourse (possibly with reference to non-diagrammatic stimuli) before the researchers' interpretations are disclosed.

If the interviewees' response to the diagram modifies the researchers' evolving conceptualisation of the subject new representations may be generated. Whether these are employed in future interviews will ultimately be determined by the research objectives and the methodological framework adopted. However, there may be benefits to maintaining some consistency in the stimuli used in a study. For example, continually updating the diagram based on each interviewee's comments may prevent the assessment of any consensus or variation in response.

In graphic elicitation studies, interviewees may indicate elements of the diagram by gesture as they talk. Consequently, an audio recording (and any subsequent transcript) offers only an incomplete record of the interviewees' contribution. For example, when responding to a representation, interviewees may make comments such as, 'this [indicating an element of the diagram] is sometimes also over here [indicating an area on the page], next to this one [indicating another element of the diagram]'. Although listening to the recording, or reading the transcript, may allow the researcher to recollect the meaning of such a vague statement, errors in interpretation are clearly possible.

One approach for overcoming this problem is for researchers to adopt a confirmation strategy, verbally reiterating the interviewees' (partially visual) messages. Thus, the recorded interactions include questions or comments from researchers that clarify the interviewees' responses. Video recording may offer a more complete record of the interviewees' interactions with the diagram by documenting the subtleties of gesture and expression. However, whilst this approach may aid analysis, it also presents attendant problems relating to access, behaviour and technique. As an alternative approach, the interviewees' comments might be sketched out either on the original diagram or elsewhere. Thus, the essential details of the interviewees' visual ideas may be recorded for later elaboration and analysis.

Conclusions

Graphic elicitation encourages contributions from interviewees that are relatively inaccessible by other means. This is possible because diagrams provide a common conceptual foundation upon which discussion can take place. Reference to (and interaction with) diagrammatic stimuli may improve communication between researchers and interviewees. This can lead researchers to improved conceptualisations of a domain and provide a strong foundation upon which to base future theorising activities. As such, graphic elicitation comprises a valuable component in a wider qualitative research methodology. This paper has considered the graphic elicitation process within the broader context of diagramming and through examination of an example study. This has afforded a comprehensive discussion of the technique and in particular, three specific research questions have been addressed.

Firstly, it was asked, *'What are the unique characteristics of diagrams in relation to other elicitation stimuli?'* We have seen that diagrams differ from other elicitation stimuli both in what they can represent and how they are interpreted. By adopting various degrees of graphic abstraction, diagrams allow the depiction of subject matter ranging from the conceptual to the physical. They therefore permit representation of the salient features of a domain in a single graphic overview. By adopting literal, metaphorical and arbitrary conventions, diagrams can convey meaning in a variety of ways. The graphical objects of which a diagram is composed, the properties of those objects, the relationships between them and the space on which they are arranged can all guide interpretation. Furthermore, diagrams differ from other stimuli in terms of their ambiguity. In some instances diagrams permit very vague depictions yet still remain coherent, whilst in other instances they demand the concrete representation of an uncertain situation. These characteristics of diagrams facilitate both the development and presentation of the researcher's emerging interpretations or theories.

Secondly, it was asked, *'What specific benefits might be realised by employing diagrammatic stimuli in interviews?'* We have seen that employing diagrams as interview stimuli elicits a range of contributions that can be classed according to the extent to which they refer to the diagram. By referring to the details of the diagram, interviewees may comment on the specific presentation and the researcher may thus gain insights into how the diagram was interpreted. By referring to the structure of the diagram, interviewees may comment on the conceptualisation which it implies including the accuracy of what is depicted and the relevance of what has been omitted. In addition, and without necessarily referring to the diagram, interviewees may offer their perspectives on the subject in general, as the stimuli prompts reflection on topics not previously discussed. These three forms of contribution may support those

gained by other methods and expand, modify or refute the researcher's emerging conceptualisation.

Thirdly, it was asked, *'What are the practical and methodological issues that must be addressed when considering the preparation of research diagrams and their insertion into the interview process?'* We have seen that during the process of graphic ideation, researchers should employ an iterative approach to sketching and evaluation and develop representations that correspond well with their ideas. Actively changing between different graphic languages will stimulate thought and submit the representations to increased scrutiny. The subsequent process of graphic communication requires consideration of the interviewees' visual literacy and anticipation of how the diagram might be interpreted. These processes inform the activity of converting the researcher's initial sketches into a form suitable for use in graphic elicitation. Following this preparation of the stimuli, the issues of when and how they are to be used in the interview must be addressed. Whilst the details of such considerations are likely to vary between studies, the requirement to address the potential introduction of bias is ever present. Finally, when recording the interviewees' response to the stimuli, researchers should strive to preserve the full richness of the (often physical) interaction irrespective of the recording method chosen.

Through the presentation of an example study, integration of graphic elicitation into the diagramming and interviewing processes has been demonstrated as particularly applicable to a professional context in which visual representations are culturally privileged. Exploration of graphic elicitation in this specific domain has shown that it is both a feasible and effective research technique. A greater understanding of the potential for graphic elicitation and the practicalities of its implementation will require further studies across a range of populations, domains and interview scenarios. Such work may reveal the ways in which graphic elicitation can be adapted to a variety of applications and offer guidance as to how the issues raised in this paper might be addressed in different contexts.

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