Brainsketching is an idea generation technique, based on brainwriting, that uses sketching as the primary means of recording ideas. During brainsketching, participants sketch their ideas individually on large sheets of paper pasted on the wall. After a few minutes, the participants explain their idea sketches, switch places and continue sketching. Usually, about five such rounds of idea sketching take place.

In an experimental set-up brainsketching was compared to brainstorming. Linkography was used as a method for analyzing the process characteristics of both techniques. Results show that during brainstorming, participants generated significantly more ideas, and that during brainsketching participants generated significantly more connections with earlier ideas. Also, during brainsketching participants made more incremental connections while maintaining a similar level of ‘wild leap’ connections. Conclusion of this study was that brainsketching does not necessarily provide a better idea generation process; rather, it provides a different process, which may serve different purposes.

Some steps towards further development of the brainsketching technique are indicated. Suggestions are provided for stimulating the group to reflect on their ideas. Finally, some suggestions are made for applying the brainsketching technique with groups of non-designers, mainly directed at removing the participants’ hesitation to draw in public.

Introduction

When designers need to generate ideas, they take paper and pencil, and start to produce idea sketches. Or, they may call an idea generation meeting. The available body of idea generation techniques is heavily based on writing as a working medium. Customarily the facilitator of the meeting writes down brief descriptions of ideas on a flipchart. However, many design researchers regard sketching to be instrumental to the creative process of designers. The research project reported here started with the notion that idea generation techniques for design could be enhanced if sketching could be included in such idea generation meetings.

Sketching consists of the production of quick and messy drawings of ideas. In design, the activity of sketching is regarded to not only provide a means for representing mental images of ideas. Instead, sketching is regarded to facilitate the actual generation of such mental images. In a review of the research on drawing and design, Purcell & Gero (1998) focus on research concerned with investigating the ways in which the activity of sketching stimulates creativity in design thinking. They point out underlying themes regarding the role of sketching in design. The principal theme deals with the positive role that sketching plays in re-interpretation. A second theme is that re-interpretation provides new knowledge and that this new knowledge leads towards further re-interpretation. Various researchers propose such cyclical models of re-interpretation, each with a slightly different connotation, ranging from a dialectic type of argumentation between seeing-as and seeing-that (Goldschmidt, 1991), interactive ‘conversations’ with the paper on which the designer draws (Schön & Wiggins, 1992), and movement from description to depiction (Fish & Scrivener, 1990).

In addition to the individual, cognitive functions of sketching, typical group functions can be identified. According to Scrivener & Clark (1994), sketching provides representations of design solutions that allow for a range of interpretations of elements. By sketching, temporal decisions are made which allow for evaluation and interpretation.
of a design solution, without excluding alternatives. For instance, the sketch in figure 1 was produced in an experimental design group meeting (Cross, Christiaans & Dorst, 1996). The objective was to design a bike rack for carrying a hiking backpack. This sketch of the rear of the bicycle was used to discuss various issues regarding the rack design. At a certain point, one of the designers comes up with the idea to use one over-sized hollow tube to support the rack, rather than a wire-frame. He adds a rough sketch of the tube to the drawing (see the arrow), without crossing-out, or excluding in any other kind of way, the already present sketch of the wire frame. This allowed the designer to explore the implications of his one over-sized tube idea, without dismissing the wire-frame idea.

Finally, by having more distinctive features, sketches are more easily recognized among other sketches, which means that sketches facilitate the designers’ access to earlier ideas. Easier access to earlier design ideas is likely to stimulate increased use of these earlier design ideas. According to McKim (1972) building and maintaining a – what he calls – ‘collective graphic memory’ fosters the group’s creative process by providing an immediately accessible database of ideas.

In order for these functions of sketching in design to apply also to idea generation meetings, the process of idea sketching needs to be compatible with the process of divergent thinking. The processes are not compatible if including sketching degrades the structure of the idea generation process. Whether or not this is the case can be examined by assessing the extent to which the structure of the idea generation process meets the four guidelines to divergent thinking (Osborn, 1953).

In a first exploratory study (Van der Lugt, 2000) three graphic variations to the brainstorming technique (in which sketching was used) were applied in experimental meetings. In a fourth meeting regular brainstorming was applied as a control condition. The graphic variations applied were:

- **Visual brainstorming.** Instead of the facilitator writing down ideas on the flip-chart, the participants make sketches of their ideas on jumbo-sized post-it notes.
- **Brainstorming with a graphic facilitator.** Instead of the facilitator writing down ideas on the flip chart, a ‘graphic facilitator’ (Lakin, 1988) records ideas by producing sketches of the ideas mentioned.
- **Brainstorming with added sketches.** This is a hybrid technique, in which the facilitator writes down ideas on a flip chart, but the participants are encouraged to add sketches on post-it notes.

The fully graphic variations (graphic facilitator and visual brainstorming) performed substantially less well on parameters that reflected the four guidelines of divergent thinking, compared to regular brainstorming. Not only did the graphic variations produce substantially fewer ideas, but there were also substantially fewer connections made between ideas, which meant that the idea generation process was less integrated. (We consider ‘integration’ to be a key indicator for the quality of the idea generation process). This led us to conclude that the processes of idea sketching and divergent thinking are not fully compatible. The functions of sketching in design activity cannot simply be added to the brainstorming process, as sketching appears to induce a structurally different process of idea generation.

In this paper, we will develop brainsketching, an idea generation technique that may be better suited for incorporating sketching in creative problem-solving. We will briefly report the results of an empirical study that compares this technique with a representative of idea generation techniques with written language as the primary working medium. Finally, we will propose directions for further improvement of brainsketching, intended to stimulate group reflection and we will provide some suggestions for using brainsketching in groups of non-designers.

**Brainsketching**

The basic brainsketching technique is a visual modification of the more widely known brainwriting technique (Geschka, Schauder &
Schlicksupp, 1973). Van Gundy (1988) mentions how this technique came into existence by students in his college class making a variation to an existing sentential technique. According to Van Gundy, they did so in order to satisfy their need for visual expression while generating ideas. A similar development occurred independently at the creative problem-solving course at the Delft School of Industrial Design Engineering.

During brainsketching, group members individually sketch their ideas on sheets of paper. After a few minutes, the group members pass on the sheets and continue to sketch ideas. After a couple of minutes the group members shift flipcharts and continue to sketch ideas. The idea sketches already present on the flipchart are used as a source of inspiration for new ideas. Usually about five such rounds of idea sketching take place. In between rounds, the facilitator may especially emphasize the 'building on other ideas' guideline. Either, the sheets of paper are passed around between rounds, or the group members change position. This is the case when sheets are posted on the wall, as in figure 2 and 3.

The predominant mode of expression used during brainsketching is, predictably, sketching. However, written annotations are used, for instance, for clarification or elaboration of a sketch (see figure 4).

Brainsketching allows the participants to be involved in a group idea generation process while at the same time it allows them to generate ideas individually, thus allowing them to engage in what Schön & Wiggins (1992) describe as a ‘reflective conversation’ with their drawings.

The version of brainsketching that has been reported in the literature is entirely non-verbal. Participants sketch ideas in silence and then pass on their sheets of ideas. Building on earlier ideas is stimulated by asking the participants to first browse through the earlier ideas on the sheet of paper, before generating new ideas.

We hypothesized that, by allowing the participants to briefly explain their ideas after each round of idea sketching, more of a group-oriented process could be achieved. Such a round of sharing ideas can increase the participants' understanding of each other's ideas, which may enhance the amount of building on each other's ideas taking place. To explore whether this adaptation to the brainsketching technique indeed provided a more group-oriented idea generation process, a small pilot study was executed (see Van der Lugt, 1999 for a detailed report of this pilot study). In line with expectations, compared to...
'traditional' brainsketching, when involved in the adaptation, group members made substantially more connections with each other's ideas. The revision of brainsketching indeed appeared to enhance the group process.

**Empirical study: Differences between the processes of brainstorming and brainsketching**

To achieve a more thorough understanding of the differences in structure of the idea generation processes which use either sketching or writing as the primary working medium, we compared our adaptation to brainsketching as a representative of idea generation techniques that use sketching, to brainstorming with post-its (Isaksen et al., 2000) as a representative of idea generation techniques that use writing as the primary working medium.

In each of four experimental meetings both the brainsketching and the brainstorming were applied which allowed us to perform a paired comparison analysis of the results for each participant (n = 20). Each meeting consisted of five advanced product design students who were involved in a course in facilitating creative problem solving meetings. Each meeting was moderated by an experienced professional creative problem solving facilitator.

The following design assignment was developed with these requirements in mind: ‘How to make travelling by car fun for children?’ The participants were asked to generate ideas for products to make traveling by car fun for children. The assignment involved generating ideas for a particular multi-functional family car, which was given the fictional name ‘Vista’.

**Method of analysis**

The main reason for organizing a group meeting is for the group members to interact in their problem solving efforts. This makes the ‘building on each other’s ideas’ guideline for divergent thinking (Osborn, 1953) especially relevant to this research project. Investigating the ways in which the participants build on each other’s ideas provides direct process clues regarding the functioning of the techniques applied.

Linkography (Goldschmidt, 1995; 1998) is a research approach that specifically addresses the ways in which designers build on each other’s input. We have adapted this method for application in our research of creative problem solving meetings. In this paper we cannot go into detail regarding either the empirical study or the linkography method. For a more elaborate description of both the empirical study and research method used we refer to earlier work (Van der Lugt, 2000; 2001). Here we will limit ourselves to a brief description of the method.

In linkography for each idea direct connections or ‘links’ with all earlier ideas are determined by gathering and evaluating evidence of such connections. This leads to a matrix display of a link system like in figure 5.

Once the link systems are finalized, link indices are calculated. The link indices provide insight into the general characteristics of the meeting process, regardless of the specific qualities of the separate meetings, like the number of participants or the number of ideas generated. The following indices were developed and used:

- **The link density** is an indicator of the integratedness of the process. A high link density indicates that ideas have many connections with earlier ideas.
- **The self-link index** is the ratio of links that the participants make with their own earlier ideas, in relation to the total number of links made. Together with the link density, the self-link index indicates to what extent the ‘building on each other’s ideas’ guideline is met.
- **The link-type indices (Supplementary, Modification, and Tangential)** indicate the nature of the connections that are made, based on a categorization of the nature of ideas provided by Gryskiewicz (1980). Tangential links indicate wild leaps into a different direction, modification links indicate direct variations and supplementary links indicate small alterations.

**Results**

What, then, were the differences found? During brainsketching, designers produce ideas that have significantly (p < 0.0005) more connections with the earlier ideas (Link density: Brainstorming $x = 0.84$, $SD = 0.23$; Brainsketching: $x = 1.27$, $SD = 0.35$). The designers produced a significantly (p < 0.0005) lower number of ideas when brainsketching, in comparison to brainstorming (Number of ideas generated per person: Brainsketching: $x = 9.60$, $SD = 2.30$; Brainstorming: $x = 13.05$, $SD = 4.32$). This means that brainstorming with post-its complies better with the ‘strive for quantity’ guideline for generating ideas, and brainsketching complies better with the ‘build on each other’s ideas’ guideline.
From the link type indices we learned that during brainsketching designers make significantly (p < 0.01) more supplementary connections, which are hardly present in the brainstorming segments (Link type index Supplementary: Brainsketching: $x = 0.25$, $SD = 0.15$; Brainstorming: $x = 0.11$, $SD = 0.11$). These incremental steps do not mean that there is a lower proportion of tangential connections made as no significant difference between the techniques was found (Link type index Tangential: Brainsketching: $x = 0.31$, $SD = 0.15$; Brainstorming: $x = 0.36$, $SD = 0.17$). In that sense, brainsketching appears to entail a more balanced problem solving process.

The differences in the idea generation processes become clearer when inspecting the variations in types of linking throughout the progress of the segments. Figure 6 presents the mean link type indicators for each ten percent of ideas generated for the brainstorming condition and figure 7 does the same for the brainsketching condition.

The brainstorming process quickly reaches a mature condition, in which the levels of tangential and modification links are more or less equal. The development of the link types in the brainstorming condition suggests a process of continuous inspection for, and exploration of, new search directions. In the brainstorming condition, throughout the meetings, few idea development steps take place, as signified by the low level of supplementary linking.

The brainsketching process develops from tangential linking in the first part of the meeting, to modification-type linking in the middle, with a focus on supplementary-type linking in the end.

This suggests that during brainsketching, designers make connections in accordance with the ways in which design processes are typically described (e.g. Goel, 1995): starting out with a broad search for new directions in the beginning, followed by the exploration of some of these directions, leading to specific
improvements of concepts in the later parts of the process.

The different characteristics of the brainsketching and brainstorming processes suggest that they may serve different purposes. Brainstorming-like techniques may better serve the traditional role of idea generation techniques, which is to generate a large number and variety of design ideas, of which some can be selected to further develop into design solutions. Brainsketching may be more suitable when, instead of a large number of ideas, a smaller but more refined collection of novel ideas are desired. For instance, graphic techniques may be applied in a design project start-up meeting to provide a quick simulation of the design process to come. Such a simulation allows the members of a team to gain a shared understanding of the design task by discussing possible pathways towards solutions that came up when generating ideas.

**Discussion: differences in structure between the brainsketching and the brainstorming process**

Now that we have found differences in the structure of the brainsketching and the brainstorming process, how can these differences be explained on a theoretical level? Here we will examine the theoretical differences in the basic activities that take place in the later parts of the process.
place in graphic and sentential idea generation meetings. A representation of the current view on the activities in the creative problem solving stage of idea-finding is provided in figure 8. The stage consists of a divergent phase that focuses on idea production and a convergent phase of idea evaluation and -selection.

An alternative view is provided by Finke, Ward, & Smith (1992), who propose, what they call, a ‘heuristic model of creativity’ called ‘Geneplore’ (see figure 9) in their efforts to develop a creative cognition approach to understanding creativity. ‘Geneplore’ is a combination of the verbs ‘generate’ and ‘explore’. Finke et al. argue that creative cognition involves a repeating cycle that contains a generative phase in which so-called pre-inventive structures are constructed, and an exploratory phase, in which the generated pre-inventive structures are interpreted. The results of these interpretations lead to insights that can be used to either focus on specific issues, or to expand conceptually, by modifying the pre-inventive structures. In the model, product constraints can be imposed at any time during the generative or exploratory phase.

The pre-inventive structures are central in Finke et al.’s theory. They observe:

These (pre-inventive) structures can be thought of as internal precursors to the final, externalized products of a creative act. They can be generated with a particular goal in mind or simply as a vehicle of open-ended discovery. They can be complex and conceptually focused or simple and relatively ambiguous, depending on the situation and the requirement of the task. (Ward, Smith, & Finke, 1999, p. 192)

According to Ward et al. (1999), both idea sketches and words – or, as they call them, ‘verbal combinations’ – can represent such pre-inventive structures. With the Geneplore model in mind, we can now start to infer differences in activities for the brainsketching and the brainstorming conditions. In figure 10 the two phases of the Geneplore model are included in the idea-finding stage.

The depictive characteristics of sketches provide a rich basis for analysis by allowing the designers to envision the consequences of the ideas. Fish & Scrivener (1990) consider that: ‘The necessity to sketch arises from the need to foresee the results of the synthesis or manipulations of objects without actually executing such operations’ (p. 117). Written language, which is descriptive in nature, refers to classes of objects rather than specific objects, which does not allow the designers to envision the consequences of the specific ideas. This stimulates the generation of ideas by allowing the designers to make free associations, but the inability to envision the consequences of the generated ideas, makes writing as a working medium less supportive of the interpret phase in the Geneplore cycle.

This corresponds with our findings from the empirical study, which show that during brainstorming, significantly more ideas are generated, and significantly fewer connections...
with earlier ideas were made. Conceivably, there is little place for interpreting ideas during brainstorming. Participants do build on each other’s ideas – this is supported by one of the guidelines – but the nature of such connections made can be regarded to be mostly concerned with brief inspections that spur further associations, rather than more detailed interpretation of the ideas. The guidelines for divergent thinking stimulate this, by dismissing any type of judgment from the divergent phase. According to the creative problem solving method, interpretation is regarded to be a kind of judgment, as interpretation involves assessing the consequences of the idea for the further generation of ideas.

The brainsketching process appears more closely connected to the generate-interpret cycle. In design research, various idea-sketching cycles have been proposed, which suggest that designers reflect on what they are sketching, while they are sketching it. For instance, Goldschmidt (1990) refers to design sketching activity as a ‘dialectic of sketching’, and in her research she showed how designers switch between making graphic propositions and language-like interpretations of these graphic propositions. Schön and Wiggins (1992) considered the designer to be involved in a ‘reflective conversation’ with the drawing surface, meaning that the designer interprets the consequences of a drawing act while he or she is making the mark. Reflecting on these previous theories, a basic model of idea generation through sketching can be considered to consist of two basic steps between which the designer shifts continuously. One step is related to producing (part of) a sketch of an idea on the paper and the other step consists of exploring and interpreting the sketch made in order to find directions for further idea sketching.

Stimulating group reflection in brainsketching

The ‘magical moment’ for brainsketching, in which group members share their ideas before going into the next round of idea generation, may have more potential than used so far. In the interactive brainsketching technique applied in this study, this moment was only used for the designers to briefly explain their ideas. During these moments, the designers listened as one at a time they shared their ideas. It may be possible to make more use of the step of sharing ideas as a group activity, by more actively engaging in a constructive group reflection on the ideas generated. Considering that brainsketching may involve a more deliberate and developmental idea generation process, such moments of creative interaction between designers – which in the present technique are not solicited during the step of idea sharing – can be used more deliberately as an essential element of the brainsketching technique. In the present brainsketching technique, designers are discouraged from going into discussion in the periods for sharing ideas. Sometimes, however, the designers could not be stopped.

A good example is found in meeting 1 of the empirical study. The relevant ideas for this example are provided in table 1. While C is explaining his ‘observation turret’ idea, designer E makes a verbal remark of adding a gun to the turret. Then designer D pretends to be playing with a gun turret. He does not appear to try to communicate through his gestures; the gestures appear to be some kind of simulation in support of his individual process. After C is done explaining his idea, designer D explains how the earlier idea 34, ‘virtually shooting other road users’, in combination with idea 44, can provide a gun turret game. The facilitator then asks D to add an annotation of that idea to designer C’s sketch of the observation turret. While D is doing this, designer A suggests developing this idea into a computer game, ‘car wars’. In this moment of sharing ideas, all of a sudden there is a lot of interaction taking place and energy in the room. There is laughter and quick verbal responses and four out of five designers pretend to be holding and shooting toy machine-guns. Instead of seeing such moments as an irregularity in the brainsketching process, such moments could be fostered as moments of creative group interaction.

In her research on the reflective practice of design teams, Valkenburg (2000) uses Schön’s (1983) ‘reflective practice’ theory of designing. She reports:

Schoén’s basic assumption is that the designer determines his position in the design situation. By interpreting the design situation in his own subjective way, the designer creates a context for further activities. By constantly considering his activities and their implications, the designer can adjust the activities, or adjust his interpretation of the situation (p. 229).

Valkenburg stresses the importance of framing and reflecting in team design activity. Reflection, in Schön’s opinion, relates to evaluating, for example, the appropriateness of the design activities that are taking place, rather than judging the quality of the ideas generated. Framing relates to (temporarily) following a certain guiding principle for focusing the design activities.
Frames can be detected throughout idea generation meetings, but they are not explicitly used as a device for structuring the idea generation activity. The absence of the explicit use of frames may be related to one of the main criticisms of Nijstad (2000) regarding brainstorming meetings. He describes the brainstorming process as a sequence of ‘trains of thoughts’. According to him, such a ‘train of thought’ is:

... a rapid accumulation of semantically related ideas. When such a train of thought no longer leads to new ideas, a new search of memory is undertaken, which may lead to the activation of a new image. This, in turn, may lead to a new train of thought. This process continues until the brainstorming session is ended. (p.139)

As a possible explanation of production loss in brainstorming groups, he proposes that such trains of thoughts are prematurely aborted when an idea cannot be expressed immediately, because the group member has to wait to take his turn. If we assume that a ‘frame’ shares much of the characteristics of such a ‘train of thought’, then during an idea generation meeting a ‘frame’ may be prematurely abandoned, just because another group member starts a new line of associations. Possibly, by dealing with frames more deliberately, a more directed and well-integrated search for ideas can be achieved.

For brainsketching, this could mean that rather than merely inspecting the group’s ideas for leads to further individual idea generation and interpretation, the designers could interpret and reflect on their ideas.

<table>
<thead>
<tr>
<th>Idea/Designer/Chart</th>
<th>Label</th>
<th>Time/protocol text</th>
<th>Sketch (translation of annotation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35/C/I</td>
<td>Virtually shooting other road users</td>
<td>C: I thought ... yes ... the youth of today is getting more aggressive anyway, so if you can make some kind of a virtual picture on the window, which you can shoot at ... and that it can kind of recognize the outline of the surroundings and that you get to hear through the headset that someone is hit or that the target is destroyed or something ... that you can interact with the surroundings by shooting at it. (+ headset, sound effects when you hit someone) (virtually shooting other road users)</td>
<td></td>
</tr>
<tr>
<td>44/C/II</td>
<td>Seat rises into observation turret</td>
<td>C: I thought that in the back ... if you make a chair that comes up automatically, into a glass- or see-through turret ... that you can see beyond the whole car. Then you can see the signs with city names better. And you can type those into a key-board immediately ... (observation post on top of car with chair that rises up) (keyboard to type in town names for information)</td>
<td></td>
</tr>
<tr>
<td>45/D/II</td>
<td>Gun turret</td>
<td>D: Yes! ... (unintelligible) ... that one (points at idea 35) in combination with that one (points at idea 44) ... let’s say ... a gun turret. (gun turret)</td>
<td></td>
</tr>
</tbody>
</table>

E: With some kind of gun on it

A: You can also sell a computer game ... Car Wars ... that you see all these Vistas with turrets fighting each other ... pappa, let’s go driving!

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together. After such a step of group reflection, the designers could return to their individual idea sketching accompanied by a shared understanding of the directions for further idea generation.

If the brainsketching technique included such an activity of group reflection, the ‘gun turret’ example discussed before (see table 1), could have been dealt with by the designers recognizing a ‘frame’ of ‘virtually shooting other road users’. Then, the designers could have determined whether this frame was sufficiently explored by proposing a gun turret and a ‘car wars’ video game, or whether in the next idea generation round efforts should be made to further explore the frame, and if so, which are interesting directions. Then, in the next round of generating ideas, the designers could have returned to their individual idea generation, but with directions that were generated in the group, for instance, to further explore video games in which the Vista car is the subject.

Some remarks on the applicability of brainsketching for participants without a design background

The studies performed involved advanced product design students, who have at least basic sketching skills due to their education. In the first two years of the program, Delft product design students receive about 120 hours of drawing instruction. The question remains whether non-designers are able to fully participate in techniques that involve sketching. In theory on design sketching, the designers’ ability to sketch is highly valued (e.g. McKim, 1972; Muller, 2001), and non-designers themselves tend to be eager to disqualify themselves; when asked to make a sketch of a certain topic, many people tend to respond with resolute remarks like, ‘Oh, but I can’t draw!’

One may expect that ideas from designers with good sketching ability are used more often for making connections than ideas from designers with poorer sketching ability. Better quality sketches look more attractive, which may draw attention to the idea, and the information conveyed through the sketch may be more easily accessible. But, contrary to expectations, the self-perceived sketching qualities of a subject and the average ratio of links made with their ideas did not correlate at all ($r = -0.16, p = 0.50$). Perhaps, in these early phases of generating ideas, the quality of the sketches are not very important, especially if the participants have the opportunity to explain their idea sketches.

In various creative problem solving meetings that we have facilitated in the past years, we have included techniques that involve sketching, among which the brainsketching technique. Usually these were meetings within the domains of engineering and marketing, with participants from a variety of backgrounds. Our experience is that non-designers can very well engage in sketching activity, provided that they are given the proper directions.

The main problem encountered, when applying brainsketching in groups with non-designers, is that these participants are inclined to immediately accept the first idea sketch on the paper as the basic direction for further idea generation. For instance, brainsketching was applied during a new business development meeting of a large consumer products company. The goal of this meeting was to explore opportunities regarding ‘health monitoring’. After an initial step of redefining the problem, the group members generated ideas by using an adaptation to brainsketching in which participants were asked to sketch ideas in pairs. Four rounds of generating ideas took place. In between rounds the participants were asked to briefly explain their ideas. Figure 11 shows one of the resulting flipcharts.

In this meeting, the participants tended to use the previous ideas as a frame for further idea generation. They tended to make amendments to earlier ideas, without challenging the frame set by the earlier idea. In the example, the initial idea sketched was to perform health monitoring.
monitoring through a ring on one’s finger. In the next rounds, various additions were provided. For instance, having medication in the ring, in order for the ring to not only function as a monitor, but also as a dispenser. Another idea was interaction with the health monitoring through a personal computer.

Two possible reasons for this early fixation taking place are: 1) It requires effort for the participants to set up an entirely new sketch. Using an existing idea as a basis for sketching, and making adjustments to that earlier sketch is much easier. 2) Because a sketch provides an idea with more detail than written notions, participants are not able to reflect on the idea in any other way than by judging it. Unlike the designers, the participants appear to be unable to regard the sketch as a mere snapshot of an idea generation process, and interpret it accordingly.

The following guidelines for using idea generation techniques that involve sketching with non-designers have helped overcome the difficulties of using brainsketching with non-designers:

1) Proper warming-up activity. To take away apprehension of using sketching as a means for expressing ideas, a warming-up activity is needed. Such an activity can show that non-designers can properly communicate through sketching, and that the quality of the sketch itself is not so important, because much of the information contained in a sketch is provided when the participant who drew the sketch explains it.

2) Emphasizing interpretation and exploration of ideas, rather than evaluation of ideas. As the participants may be inclined to assess the value of the idea sketches as finished product proposals, it is especially useful to ask the participants to stay away from value judgments regarding the idea. Ask the participants to freely imagine the consequences, or suggestions that the idea sketch provides for the generation of new ideas instead. Questions like, ‘what unique qualities are in this sketch that you would like to explore further?’ direct the participants towards constructive interpretation, rather than critical evaluation of the idea sketches produced.

3) Invite making new drawings, rather than drawing on the existing one. If participants are very focused on working within the same basic sketch, one can ask them to make new sketches, instead of adding features to the earlier sketch. This can even provide a steering mechanism: Drawing on the existing sketches emphasizes idea development and making new sketches emphasizes differentiation of ideas, as participants will not be inclined to produce replicas of the existing sketches.

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