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CHARACTERIZING ACTIVITIES THAT PROMOTE IDEATION – SURVEY CONSTRUCTION TARGETING REFLICTIVE PRACTICES

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Abstract: Idea generation in engineering design is most often studied within the context of specific tasks, such as brainstorming, mindmapping, TRIZ, etc. Additionally, researchers tend to constrain their search to time and activities within the workday and at the workplace, to understand and improve the process of creating ideas. This work examines creative ideation activities in engineering design from a broader perspective. We aim to 1) identify what accompanying activities designers are engaged in when they get ideas, 2) determine whether the activities occur within or outside of the direct context of 'work', and 3) discern which attributes of these activities makes them conducive to ideation. This paper presents the construction of on online pilot survey and discusses lessons learned before the project engages into the execution stage of a global survey.

Keywords: *ideation, design, creativity*

1. Introduction

Though academically overlooked, it is evident that ideas do not come only when at the office, or when engaged in brainstorming or other traditional design activities. We commonly hear of someone being struck by an idea while in the shower, or while driving to work. Prior research on ideation within this project has found that designers engage in a wide range of different types of activities when they generate or refine ideas, and that they often view off-line activities (outside of the workplace/work time) to be superior to those prescribed by traditional design processes. (Currano, R.M., Steinert, M., & Leifer, L., 2011; Currano, R., Steinert, M., & Leifer, L., 2012; Currano, Rebecca M., Steinert, M., & Leifer, L., 2011, 2012; Meinel & Leifer, 2012) Furthermore, many techniques for idea generation such as brainstorming or brainwriting, which are standard at the workplace, have been tested and found productive only to varying degrees, sometimes with a drop-off over time. (Chidambaram & Bostrom, 1993; Furnham, 2000; Meinel & Leifer, 2012; Sutton & Hargadon, 1996)

Rather than limiting our study to a specific work context, or looking for the 'best' methods for producing creative concepts, we aim to explore the attributes of idea-accompanying activities in general. After extensive multistage qualitative research, we have developed and tested a structured

online survey of 22 individuals with varying design experience. The first objective is to learn what activities they are engaging in, when they get ideas. Additionally, we have asked them to rate their five most and five least helpful activities along 13 bipolar attribute scales. In this paper we describe how we developed this survey. We also present the analysis procedure and discuss some descriptive data that came out of the pilot survey. Based on these results, we will create a second, shorter survey, which will be disseminated to a larger audience of engineering design researchers and practitioners. The aim is to generate a sufficiently large data set to run a factor analysis and to establish statistically significant findings, to support more innovative design practices.

1.1. Motivation

Based on prior research, we first hypothesize that some activities are more and some less helpful in the creation of ideas. Second, we propose that these activities are not necessarily constrained to the 'at work' context but increasingly take place outside of the work space or time. Last, we explore the possibility that a set of general attributes exists, which characterize the most and least helpful activities that enable or accompany creative ideation.

2. Pilot Survey Implementation

2.1. Setting up the Survey

To explore these questions quantitatively we developed and launched a structured online survey. The survey questions were derived from two prior studies. In the first prior study, we examined idealog data and found evidence of reflective practice in a variety of activities, such as mindmapping, sketching, and journaling. (Currano, R. M., Steinert, M., & Leifer, L. J., 2011) Within this same study we explored various dimensions for framing reflective practice. These included in-action vs. out-of-action, background vs. foreground, internal vs. external, and remembering vs. gathering.

The second study informing the survey was comprised of a series of in-depth interviews with design students (undergraduate and graduate), professors of design, and design professionals. Participants told us about their design processes, and the reflective practices that they use to get ideas, both within and external to their formal design practice. (Currano, Rebecca M., Steinert, M., & Leifer, L., 2011).

Both of these studies yielded unexpected data on the activities that designers engage in, and the way that they describe these activities. Instead of mentioning primarily work-related activities, participants more often referred to recreational, interim, or social activities like exercising, conversations with friends and family, biking across campus, taking naps, etc. When describing their reflective practices, several participants used words or phrases such as being 'mindless', 'not too mentally taxing', and of letting ideas 'creep into my mind'. These descriptions do not resonate with how we typically think of productive work tasks.

This discrepancy between the activities that designers report as being conducive to ideation and the activities that designers are taught in school and expected to perform in the workplace leads us to ask what the profile of an idea-conducive activity might be.

In this vein we designed a pilot survey, which we disseminated to colleagues in the Hasso Plattner Design Thinking Research program (HPDTRP) at Stanford University's Center for Design Research and at the Hasso Plattner Institute, in Postdam, Germany. Most of the survey respondents were colleagues, or acquaintances, who we knew to be engineers, designers or design researchers and who we could reasonably trust to be diligent in completing the survey.

2.2. Survey Design & Deployment

The pilot survey, designed through the Qualtrix survey tool at Stanford University (Stanford ITS, 2012), was launched in two stages by sending out invitations links via email: a quick first iteration, which three participants completed, and a second, distributed to 28 participants. The key questions remained the same through both iterations, but some open-ended questions, and additional demographic questions were added to the second release, to allow us to look at other variables, such as level of experience, and type of design background.

In step one of the survey, we asked participants to select, from a list of 41 activities, those that they have used in their ideation process for design projects. They could also add in up to three activities that were not on the list. In the second step, they chose up to five of these (selected) activities as most helpful to them for getting new ideas, and up to five as least helpful for getting new ideas. While we required that participants had experience using activities that they selected as most helpful, we recognized that some least helpful activities may never have been used in their design projects, precisely because they are deemed least helpful. In a third step, participants were asked to rate their most and least helpful activities according to 13 attribute pairs on a 5-point Likert scale (see figure 1).

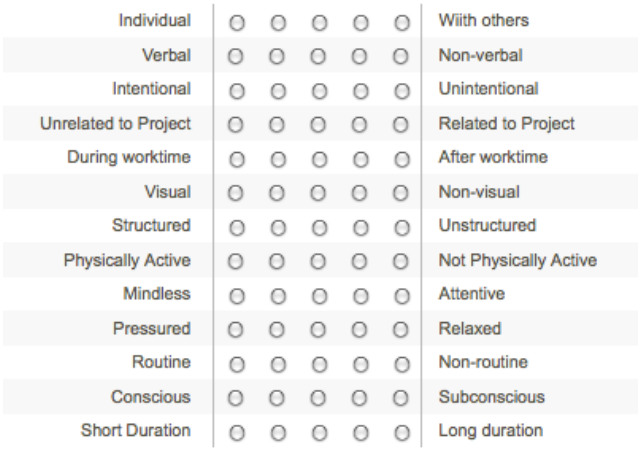

Figure 1. attributes and rating scale for the most and least helpful ideation activities

We also invited participants to expand on their most and least helpful activities in plain text and to comment on what makes these most or least helpful to them. We collected most of the data over a period of 2 weeks in September 2011. Before formally analyzing the data, we checked responses and discarded the datasets of 9 respondents due to incompleteness, straight-line answers, and insufficient completion time (anything below 7 minutes, which we deemed minimum time to thoughtfully complete the survey). In total, 22 participants successfully completed the survey and contributed to the pilot data set.

3 Descriptive Data Analysis

3.1. Activities that Accompany Ideation

3.1.1. All Activities Used

As shown in Figure 2, respondents use a wide variety of activities. In total, all 41 listed activities were identified as having been used for ideation. The number of activities used by each respondent ranged from 14-43, with a median of 24. In addition to this, the activities used were broadly distributed.

Every activity in the original list of 41 was selected by at least 5 respondents, with a range of 5-22 and a median of 14. The data fits a linear trend line with an R^2 value of 0.99, indicating that no single or few activities are used substantially more than others (as e.g., an exponential distribution might suggest).

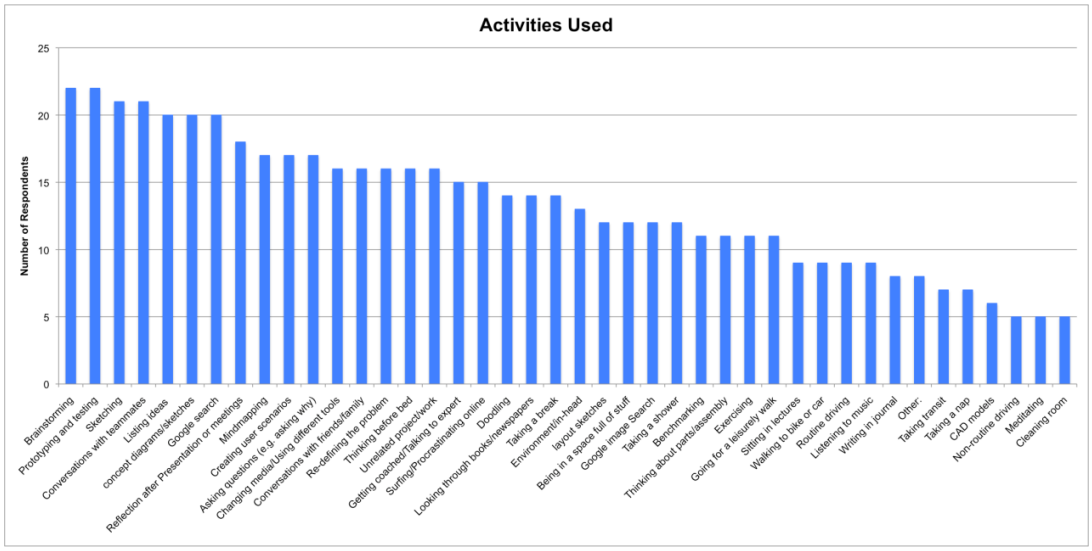

Figure 2. 41 activities and how many participants reported having used each activity in their ideation process for design projects

3.1.2. Most and Least Helpful Activities

Figure 3 shows the most and least helpful activities as reported by survey respondents. The frequency of selection of each category (most and least helpful) is more steeply varied than the frequency of selection of activities used (figure 2). In this case, the most helpful and least helpful selection frequencies do fit exponential trend lines, each with an R^2 value of 0.94, indicating that some are substantially preferred as most helpful and some as least helpful.

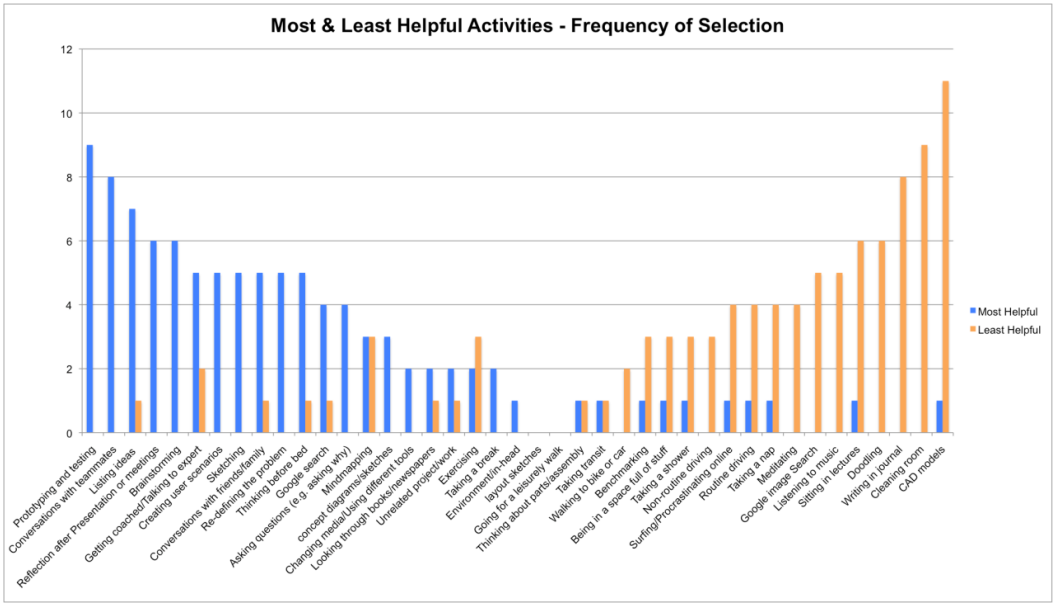

Figure 3. frequency of selection of all activities as either most or least helpful

Each most helpful activity was chosen by a range of 1-9 respondents, with a median of 2. Eleven activities were not chosen by any respondent as most helpful. Each least helpful activity was chosen by a range of 1-11 respondents, with a median of 3. Fourteen activities were not chosen by any respondent as least helpful.

While there is some overlap among the most helpful and least helpful selections, in most cases activities selected as most helpful were either not selected as least helpful, or selected by only one respondent as least helpful (and vice versa). Of the 19, which appear in both of these sets, in only three cases was the same activity selected more than once in both the most helpful and the least helpful sets. These are brainstorming, mindmapping, and exercising. It may be surprising to see that Brainstorming was not one of the top three most helpful activities, given how commonly it is both taught and used in design work. It is, however a method whose strength as an ideation technique has been criticized and debated (Furnham, 2000; Sutton & Hargadon, 1996). It is also interesting that mindmapping was selected equally as many times as most and least helpful, since it too is an established and broadly taught idea generation technique.

3.2. Characterising Attributes of Activities that Accompany Ideation

3.2.1. Attributes of Most Helpful vs. Least Helpful Activities

We call the group of average attribute rankings for each activity an *attribute profile* (two pairs of these are shown in figure 4). To first characterize, and then distinguish, the attributes of activities, we started by examining these profiles for the most helpful and the least helpful activities. Our thinking was that we should see similar rankings for many of the attributes of the most helpful activities, and also similar rankings for the attributes of the least helpful activities, but that these rankings should *differ* between most and least helpful activities. We therefore included the two most frequently selected most helpful activities: 'prototyping and testing' and 'conversations with teammates', and two of the three most frequently selected least helpful activities: 'making CAD models', and 'writing in a journal' (see figure 4).

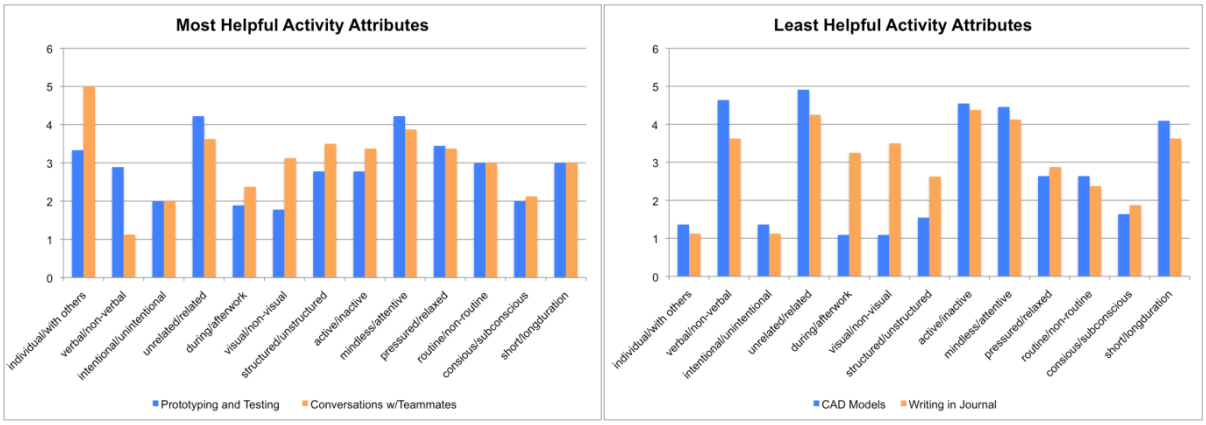

Figure 4. attribute profiles for top most helpful activities (left chart) and attribute profiles for top least helpful activities (right chart)

The chart on the left shows that several of the attribute values for the two most helpful activities are quite similar: specifically, 'mindless/attentive', 'pressured/relaxed', 'routine/non-routine', 'conscious/ sub-conscious', and 'short/long duration'. The chart on the right shows that even more attribute values for the least helpful activities are quite similar: all except 'during/after work', 'visual/non-visual', and 'structured/ unstructured'. For 'writing in journal', these three attributes have middling values, suggesting that

participants had no strong leaning; but for 'CAD models', the same three attributes have very low values, indicating that participants mostly work with CAD models during work, in a visual way, structured way.

3.2.2. Attributes of Ambiguous Activities:

We also examined the one activity (mindmapping), which was selected equally in both most *and* least helpful categories (each by 3 respondents). As such, this activity has two attribute profiles (most helpful and least helpful), which we would like to distinguish. From Figure 6, we can see that the values of some attributes (unrelated/related and active/inactive) vary substantially between these two profiles, while the values of others (visual/non-visual and mindless/attentive) are virtually the same.

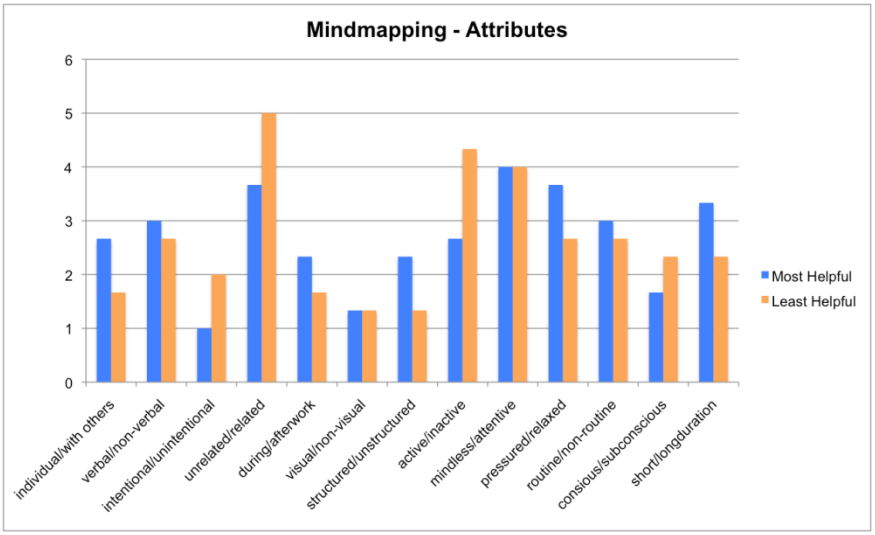

Figure 6. two distinct attribute profiles for mindmapping

3.2.3. Activity Attributes - Averages

Some attribute profiles are strongly contextual, influenced in part by the nature of the activity itself. For example sketching is by nature highly visual and generally non-verbal, while conversations with friends and family are by nature highly verbal, and non-visual. Yet both of these activities were frequently selected as most helpful. Since these attributes do not distinguish between helpfulness of activities, we will remove them from future surveys. Additionally, our sample size is small for any given activity, so we cannot draw very reliable conclusions from comparing attribute profiles of individual activities. For these reasons, we chose to also shift our attention to the profile averages across all most and all least helpful activities.

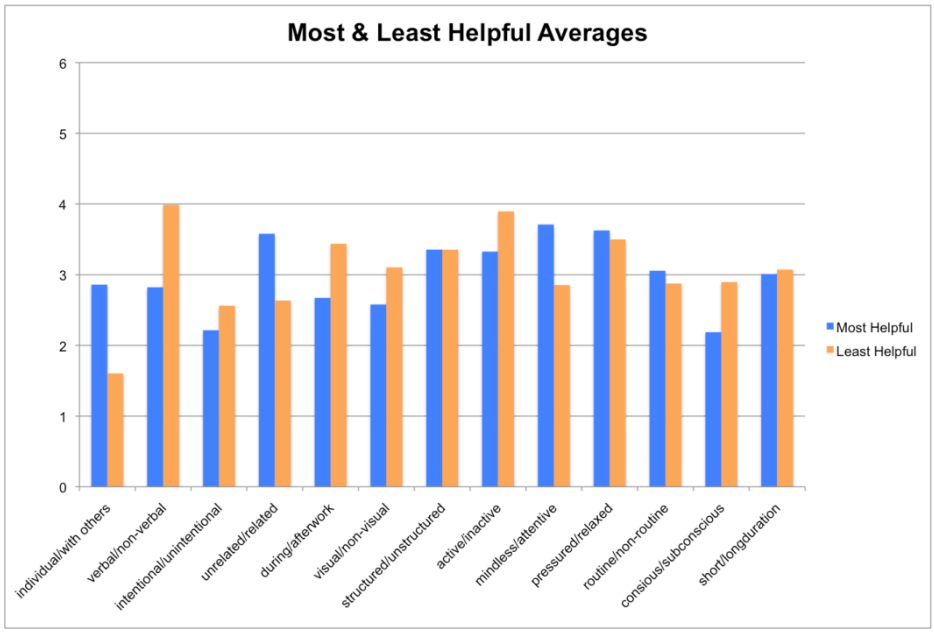

Figure 7. average attribute profiles for all most and least helpful activities

In comparing attribute rankings of least helpful activities to those of most helpful activities, two things stood out. First, that for some attributes, such as individual/with others, verbal/non-verbal, and unrelated/ related the means appear to be different between groups, while for others, such as structured/ unstructured, pressured/relaxed, routine/non-routine, and short/long duration the means appear very similar. The latter insight, that these attribute dimensions do not discriminate between most and least helpful activities, is further confirmed by viewing the data distributions for these attributes (see figure 8).

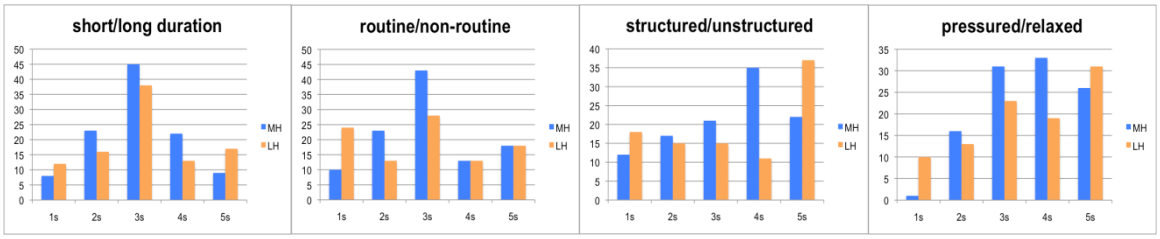

Figure 8. These charts show the data distributions, for particular attribute rankings across all most and least helpful activities. The x-axis indicates ranking options from the Likert scale (1 to 5) and the y-axis shows how many respondents chose each ranking option.

4. Discussion and Conclusions

4.1. Key Findings

From the many charts, graphs, and measures we extracted from our data analysis, a few key findings stood out. First, the survey data revealed a wide variety of activities used by designers to get ideas, which supports the idea of broadening our perspective beyond ideation techniques taught in school and encouraged in the workplace. Some activities as conversations with friends and family, and thinking before bed would not be considered by most people to be productive, work-related activities, yet they were often selected as most helpful for idea-generation by survey respondents. We believe

that such activities should be the subject of further study and should be encouraged in addition to more traditional, widely-taught techniques.

Second, we saw an unexpected discrepancy between some activities chosen as most or least helpful in the survey and those cited by interviewees in the prior study. For example, exercising or walking was emphasized by the majority of interviewees as a most helpful activity for getting ideas, while these were more often selected as least helpful by the survey respondents. Other activities, such as conversations with friends and family seemed to appear generally in the same categories in both studies, but more often in the interviews than in the survey data.

Third, we also noted a discrepancy between how participants ranked their most helpful activities in Likert-scale questions and how interviewees in the prior study describe them when answering more qualitative, open-ended questions. (Currano, Rebecca M., Steinert, M., & Leifer, L., 2012). For example, survey respondents ranked most helpful activities as 'attentive' and 'conscious', while interviewees stressed the value of 'mindless' activities or states of attention in activities that helped them get ideas.

We believe this may be due to differences in how question was posed to both groups (as a Likert-scale for the survey, and as a open-ended description in the interviews).

However, misalignment of the data from the preceding qualitative interview study and the current survey may also be influenced by the distinct background of participants, as all of the interviewees from the preceding studies come from the Stanford Design tradition, while the current survey respondents came from two distinct and potentially clustered subgroups, located in different countries, and with different academic backgrounds. The upcoming deployment of the survey will focus onto a global population of engineers and designers from various backgrounds, the common bond being member in an academic and trade association.

4.2 Revising the Survey for Global Distribution

Due to the discrepancy in how respondents' reply to Likert questions and open-ended interview questions, we will prompt respondents first to think about and rank *specific* activities that they have found helpful in generating *specific* ideas, rather than to make broader judgments about types of activities that they find more or less helpful 'in general'. This will increase our confidence in the rankings, by grounding their judgments in real experiences. This decision was influenced by the fact that interviewees described clear and compelling examples of ideas they had, and the context in which they got them, when describing their ideation activities.

As with all structured surveys, the format does not allow for a conversation with the respondent, or for a qualitative probing into the given reasons. We found that the conversations gave interviewees time to think and work out their thoughts aloud. We asked them to visualize and talk through their design process, and to think of their reflective activities in the context of real projects they've worked on. Therefore, we will add more open-ended questions, to encourage respondents to be more descriptive and thoughtful in their answers. These questions allow them to express their thoughts more fluidly and in their own style, which we find they do willingly and abundantly in interviews, despite the increased time involved.

At the same time we have decided to decrease the number of Likert questions, by removing those which relate strongly to the nature of a given activity but which don't distinguish between helpfulness of activities. We will revise other Likert questions, to make them more clear and relevant to the questions at hand, separate bipolar scale rankings into individual rankings, and reword or subsume confusing terms such as 'mindless' under more interpretable categories such as 'subconscious'. And instead of

asking respondents to rank five ‘most helpful’ and five ‘least helpful’ activities, we will ask them to rank and describe only two activities, recalling real experiences in which they generated specific ideas.

Lastly, we will distribute the survey over a much larger group to increase our data so that we can run statistical analyses from simple correlations and factor analyses in order to achieve greater validity, reliability and significance in our findings.

4.3 Conclusion

The field of ideation activities by engineers and designers is diverse and difficult to scientifically probe into. However, with this pilot, we have shown that it is possible to address questions such as how to identify 1) what accompanying activities designers are engaged in and when they get ideas, 2) whether the activities occur within or outside of the direct context of ‘work’, and 3) which attributes of these activities makes them conducive to ideation. We hope to roll out the main survey this spring quarter so that we will be able to show some preliminary results with an n>x00 at the conference.

Focusing on the creative potential of activities rather than on established practice can do more than just enhance the creativity of designers at work. It can break down paradigms of what activities and places are considered productive vs. not productive, and help designers to extend their creative potential greatly.

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