CHARACTERIZING REFLECTIVE PRACTICE IN DESIGN – WHAT ABOUT THOSE IDEAS YOU GET IN THE SHOWER?

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ABSTRACT

Innovation is in part driven by creative ideation, particularly in the fuzzy front-end of the design process, which has been described and studied as a process of reflection-in-action [1]. We introduce and explore the notion of 'reflection-out-of-action', documenting it as a practice utilized by designers in coming up with new ideas, and contrasting it to Schön's concept of reflection-in-action. We explore reflective design activities that occur on the level of the individual designer. Based on examining artifacts, surveying experts, conducting inductive and deductive conceptual framing rounds, we were able to: 1) show preliminary evidence of various types of reflection in idealog artifacts; 2) identify and characterize reflective practices in use by designers; and 3) develop a framework for mapping reflective practices with respect to whether they take place in-action or out-of-action and whether they are driven by remembering or gathering.

Keywords: Reflection, Reflective Practice, Design

1   INTRODUCTION

As innovation is the basis for economic growth [2] it is of interest to understand how it occurs, to lay a foundation for systematically increasing the innovative potential of designers, teams, and corporations. New concept creation forms the integral foundation for innovation, particularly during the "fuzzy front-end of innovation" [3], which, though poorly understood, presents significant opportunities for improving the innovative process [4] [5]. Design Thinking has been shown to be a successful method to encourage the generation of new concepts during the front-end of innovation [6] [7] [8]. At the same time, there is still little understanding of how Design Thinking works in action and how it is best managed. It is the goal of this research to close this gap. Our over-arching motivating question, therefore, is:

> *What role does reflection play in Design Thinking, and how can designers and managers use reflection to systematically maximize the potential for the generation of novel concepts?*

Prior research has resulted in the hypothesis that Design Thinking leads to new concepts through insights, which are gained through experimentation rather than by deliberation. The same research also suggests that managers and other reviewers can have a detrimental effect on the ability of researchers to gain insights by requiring that experiments be pre-validated. These findings are depicted in Figure 1 [9].

Design practices, as verified through research, integrated into higher education, and employed in real-world projects, have enabled students and practitioners to continuously develop and refine new products, services and systems at a high level. A plethora of models and generalized processes describe and support the design activities. Though early approaches were linear, today most design processes either incorporate feedback loops or present themselves as circular in nature [10].

Skogstad provides a useful perspective on the design process through his unified innovation process model (Figure 1), which emphasizes the iterative nature of design based on various types of feedback, and highlights the inherent conflict between censorship and learning. It combines the iterative and fast prototype nature of the process as well as the learning loops and possible instances of censorship and approval. While we have seen and described the existence of this loop on a team and project basis extensively [11] [12] [13] [14], we realized that this loop might actually be of a fractal nature. It can

easily be extended into the macro level of technologies, programs and companies, even industries, but can it also be extended into the micro level, the individual designer?

The unified innovation process model, however, does not explicitly recognize the role that reflection plays in gaining insights, nor the limitations that censoring (including self-censoring) can place on the reflective practice. These are what we hope to illustrate through this paper.
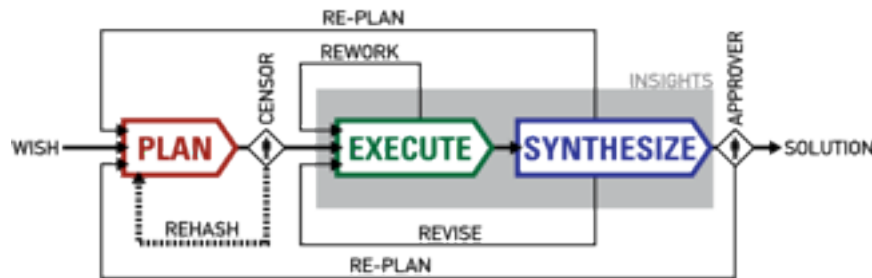

*Figure 1: "Unified Innovation Process Model for Engineering Designers and Managers"
depicting the kernel of the design process. It shows where designers gain the insights to
advance a design and where reviewers intercept the design process at the censor and
approver gates [9].*

To better understand the recursive iterative activities that happen on an individual designer level, we have tried to systematically identify existing reflective loops and their impact on the design outcome. As the measurement of design outcome or design performance remains the holy grail of design research ([15], we have opted for an iterative research design, modeled on Glaser and Strauss's grounded theory approach [16] [17]. Thus we commenced without having in mind a set hypothesis to be tested. Instead we identified several research questions that we have tacked in succession. Each round of qualitative and experimental probing led to new and refined insights into the existence and workings of the reflective inner design loop. For our research approach we relied on all three established methods, inductive, deductive and abductive. As such, our methods include observations, surveys, experiments and expert workshops.

2 DESIGN AS A REFLECTIVE PRACTICE

Researchers describe and study the design process from one of two primary perspectives: design as rational problem solving, and design as a reflective practice. These perspectives are exemplified by Simon and Schön respectively. While Simon's positivist perspective on design remains the prevailing one in design methodology research, the constructivist approach of Schön informs our understanding of design and forms the foundation of our current research [18].

In his description of the reflective practice of design, Schön focuses principally on "reflection-in-action" (RIA), or a designer's explicit reflection in the close context of the design task. It is directed at awareness of and limitations of "knowing-in-action", which Schön describes as knowing that is "ordinarily tacit, implicit in our patterns of action and in our feel for the stuff with which we are dealing." Reflection-in-action may occur in response to surprise that occurs when unexpected events incite the designer to think back on his actions and the knowledge contained therein, as well as on the materials and situation at hand [1].

Valkenburg extended Schön's concept of design as a reflective practice, clarifying and developing it theoretically, and applying it to team design work. Her work maintains Schön's focus on reflection-in-action, which she characterizes as a recurrent compound process of naming, framing, moving and reflecting [19].

2.1 Theoretical discussion of ROA in context of reflective practice in design.

This paper introduces and explores the notion of reflection-out-of-action (ROA) as another category of reflective practice in design. Reflection-out-of-action is distinguished from reflection-in-action contextually. RIA happens in the context of design work, it is intentional, and it occurs as an explicit foreground activity. ROA, on the other hand, while it may deal with the same content as RIA, happens

out of the context (physical and/or mental) of design work and may be a semi-conscious background thought process accompanying non-work-related physical or social activities. For example, getting insights into a design problem while showering, coaxing the mind to wander reflectively through doodling (even at work), or mulling over an unsolved problem while jogging in the park would all fall under the category of reflection-out-of-action. In these cases there is a clear separation between the reflection and the design work, noted by the location (in the shower, in the park) and/or the background activity (showering, doodling, jogging).

2.2 Empirical Approach to studying ROA

The current research is a broad qualitative exploration of reflective design activities on the level of the individual designer. We begin with an empirical approach, examining student design idealogs to discern evidence of reflection, and categorizing the many different types of reflection that we found. Following this, we surveyed design experts to uncover a broader range of reflective practices and to determine dimensions that could be used to characterize reflection in design. Finally, we explored a theoretical framework for mapping different reflective practices.

3   EXPLORING REFLECTION IN DESIGN

To launch our current analysis, we asked ourselves the following guiding question: *Does reflection help designers?* And more specifically: *How can designers use reflection to support creative ideation?* Based on literature analysis and the elaboration of a working definition of reflection in the context of design, we have opted to break our guiding question into three concrete research questions, which we will consider individually:

1.   *Can we see evidence of reflection in design practices such as idealogging?*
2.   *What other reflective practices do designers use?*
3.   *With what dimensions can we frame reflective practice?*

Current concepts of reflection do not help us to understand the characteristics of reflection as it happens in design activity. We have chosen an explorative approach to find evidence of reflection and to characterize our findings, taking each of these questions as a starting point.

3.1 Can we see evidence of reflection in design practices such as idealogging?

The activities around our first research question aim to present evidence for the existence of reflective practices in design. As an exemplary source, we have opted to screen and analyze idealogs. Idealogging is a common design practice, particularly within the inner design loop, and is most utilized during the fuzzy front end of design projects. We chose idealogging as a proxy for design practice, since it is a typical output of design projects and it is easily recordable. We examined idealog data to discover evidence of idealogging as a reflective activity. The data included sketches and notes, mindmaps, doodles, and weekly reflection entries, all of which are present in the idealogs.
Our data was comprised of scans from 22 undergraduate students who had taken a senior design elective, Ambidextrous Thinking, at the University of Maryland. The review process was iterative, and was initially focused on finding indications of reflection within the idealog artifacts.
First we selected four students' idealogs demonstrating varying styles/techniques. We printed out and displayed digital scans one at a time, on the wall or a table, so that each student's entire idealog could be seen at once (see figure 2 for examples). Then three researchers went through them simultaneously, marking them according to our individual interpretations of their idealog material, noting anything that implied evidence of reflection. We discussed each idealog individually and in conjunction with the others, describing what we had marked and justifying why we had identified it as evidence of reflection.
In doing so, we were able to identify different forms of reflection evidence. This led us to distinguish and name a variety of reflection modalities. We compiled them in a comprehensive list of reflection practices observable through the idealogs.
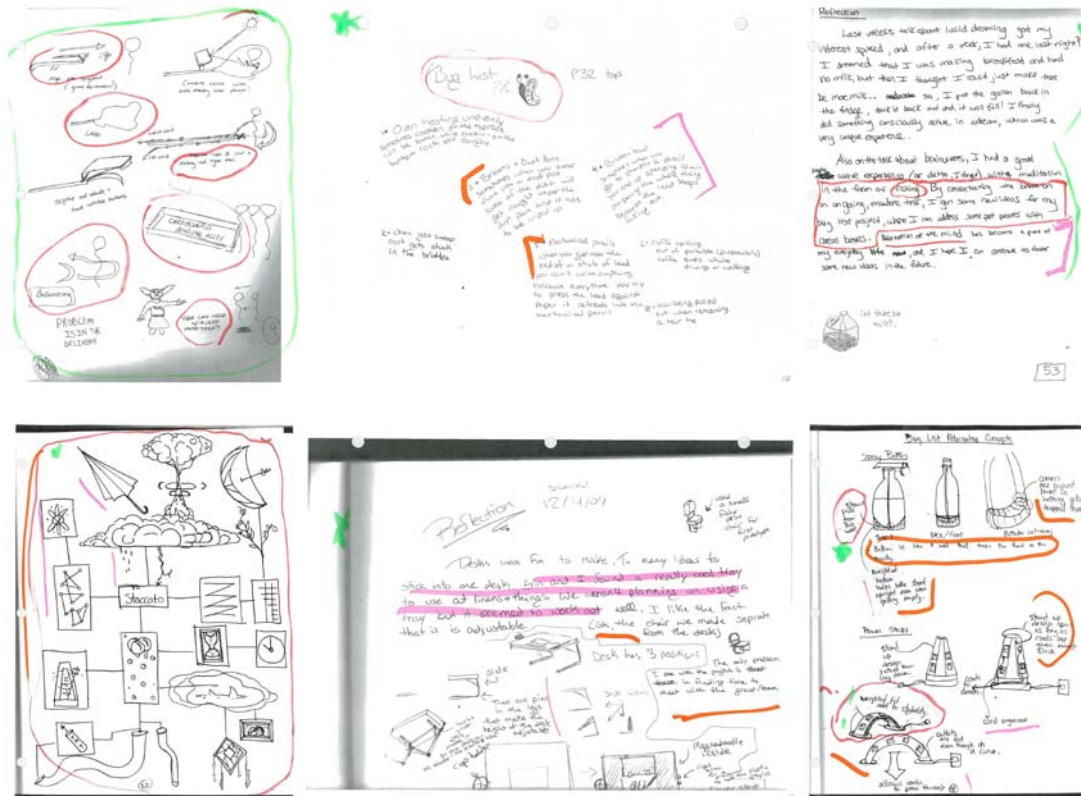
Figure 2: Example pictures from the students' idealogs, coded by the researchers. From the top left it shows: project design ideas, weekly reflection task, bug list, weekly reflection, mind map and final project ideas.

Each idealog we reviewed led us to refine and solidify our understanding of what forms reflection in idealogging could take. We expanded on or refined the list with each idealog. By the fourth idealog we found that our list was not growing significantly, so we moved away from the data for a while and started looking more closely at the reflective practices we had identified.

This list formed the basis for a discussion on the types of reflection and how they might be grouped. This step enabled us to characterize different kinds of reflective practices in early stage design. We chose a subset of activities to explore in-depth. We recompiled the full list, and reorganized it into a) most b) moderately, and c) least interesting sub-lists, based on common agreement between the researchers. This gave us a way to narrow down the set to the following distinctions:

- Imaginative reflection
- Skill-building reflection
- **Metaphorizing**
- Doodle-flexion
- Surprising reflection
- Reflection ghost

- Background reflection
- **Metathinking**
- **Reflection-out-of-action**
- "What I didn't do"
- Broader meta-categories of verbal vs. pictorial

At this point we recognized that the previously identified reflection 'types' were not described consistently with respect to language or level. To better understand these reflections we narrowed our scope and focus on the three particular reflection types defined by each researcher's favorite (shown in bold font in the above list).

The three types we selected were "metaphorizing" (reflecting using metaphors), "metathinking" (reflecting on how one thinks), and "reflection-out-of-action" (reflecting outside of the work setting). We divided the remaining 18 students' idealogs between us and informally coded them for instances of those three kinds of reflective practice. Two distinct categories emerged from the cluster of different reflection types: those based on external observations and those based on internal memories.

At this point, we redesigned our approach to include this variation for systematically characterizing reflection in the idealogs, which we termed: i) gathering and ii) remembering. These distinctions originated from a framing exercise we had conducted prior to the idealog analyses. Taking these expressions, we again classified the reflection types from lists a), b) and c) according to whether they were primarily related to 'looking back at memories' or from 'gathering from the environment'. These different meanings resonated with both the idealog data and our understanding based on personal experience, which pointed to 'gathering' and 'remembering' as the two primary sub-modes of reflection (see figure 3).
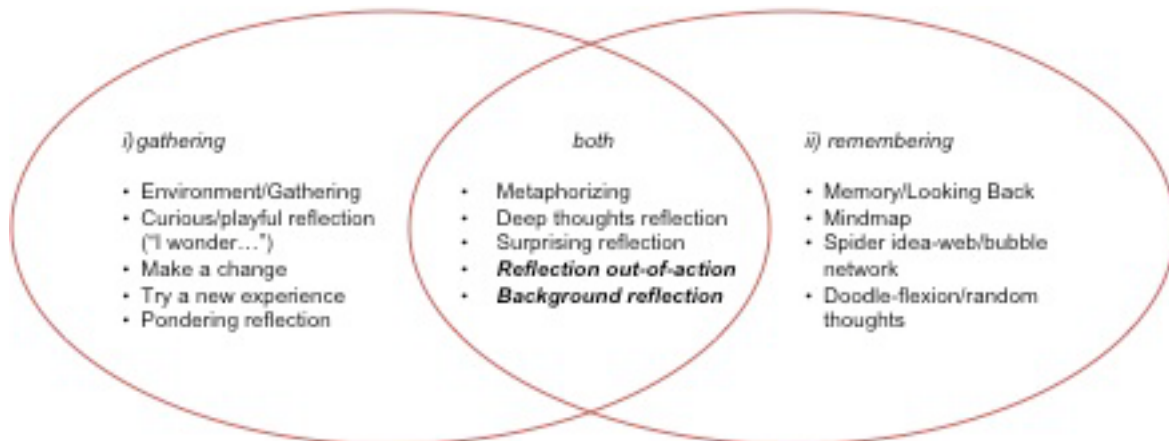

Figure 3: Reflective practices based on i) gathering and ii) remembering. It emerged that some practices stem from both sources. Reflection-out-of-action and background reflection proved to be especially interesting.

Some of our identified reflection types exemplified both expressions, rather than just one or the other. "metaphorizing", "reflection-out-of-action", and "background reflection" are three reflection types from our most interesting sub-list, which represent broader reflective activity. Many of the other identified types, outside of gathering or remembering, can be viewed as concrete reflection tools stemming from these broader reflection types.

Reflection-out-of-action and background reflection, in particular, caught our attention, as descriptive of many productive, yet underappreciated reflective activities, such as showering or talking a walk. They include any activity that removes you from the work setting (mentally and/or physically) and from conscious effort, and enables sub-conscious ideation. By sub-conscious, we mean ideation that is happening in the mind of the designer, but as a relaxed thought process, and not explicitly focused. Background reflection, more specifically, refers to reflection that happens when the mind is otherwise disengaged from what the person is doing physically. We use the term background for two reasons: 1) because the reflection happens as an incidental, background, rather than a deliberate, foreground thought process; and 2) because it is accompanied by a routine background physical activity that doesn't require mindfulness, but frees up the mind for reflection.

As these reflective practices are among those farther removed from the traditional workplace and work pace, they are largely unrecognized and underappreciated as potential sources of productivity. One can imagine that time spent doing them would not be allowed as billable work-time, and that designers employed by many firms and companies would be discouraged from spending part of their work day engaged in these types of reflective practice. Therefore we decided it to be useful to distinguish reflection-in-action (or -during-action) from reflection-out-of-action.[1]

The first research probe provided evidence from the idealogs of two different dimensions for characterizing reflection:

- remembering vs. gathering
- reflection-in-action vs. reflection-out-of-action

We now move on to describe our second research probe into the distinction regarding reflection-in-action and reflection-out-of-action, and into background reflection as a sub-category of reflection-out-of-action.

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[1] This conceptual separation must be differentiated from Schön's reflection-in-action and reflection-on-action [1].

3.2 What reflective practices do designers use?

The idealog probe indicated that the dual characteristics of remembering and gathering are a frame that can be used to characterize reflective design practice. It also pointed to the existence of many different ways in which reflection permeates the idealogging practice. It was necessary, however, to step back a bit and look at reflection in design from a broader perspective. We wanted to understand more generally how reflection contributes to ideation and what reflective practices designers employ to produce ideas, so we surveyed design experts from the Stanford Center for Design Research community and the Hasso Plattner Institute – Stanford Design Thinking Research Program. This survey yielded evidence of subtler, and more relevant, distinctions among categories of reflection than current design thinking practice recognizes.

At this point we started to believe that there is a relationship between background activity and ideation. We sensed that context and mental focus play a part in the reflective processes that underlie creative ideation. We asked twenty survey participants in a Stanford design research seminar to complete a survey. We asked them to think of a creative idea that they had recently experienced, to recall where they were, what they were doing, and whether or not they were trying to come up with the idea at the time. While not every participant responded to every question, we compiled the responses that we did receive, and coded them according to place, background activity, and intent. Figure 4 presents and describes the reported reflective practice trends observed:

	Idea	Where were you?	What were you doing?	Were you trying?
	HowYouGetIdeas ME397 Ideation Survey			
1	watermelon peeler for juicing	home - kitchen	making food	yes
2	unnamed	out - cafe	drinking coffee, chatting with friends	
3		home	walking	no
4	skateboard with novel controls	out - hospital	getting stitches	yes
5	audiobook for friend	work	not working	no
6	unnamed	home - shower	[showering]	no
7	unnamed	work - outside (quad hallways)	walking	yes
8	unnamed	out - outside	jogging	yes
9	Use role preference in videogames to find preferences in design/working teams	class	writing	no
10	unnamed	out - metro	sitting or standing	yes
11	baby bottle maker	home - room	ideating	yes
12	idea for gearbox	home - shower	showering	no
13	unnamed	work	sitting	yes
14	unnamed		I was trying the morphological method	yes
15	unnamed	home - living room	talking	no
16	unnamed	out - between Stanford and home	biking	
17	unnamed	out - car	driving, listening to music	
18	measurement device for blind people to see the level of fill	out - museum	viewing exhibition	yes
19	idea/discovery that my laws map to the hunter-gather mode	work - CDR for HPI workshop	communicating, drawing	no
20	playground cover and bar-baby stool and room separation		brainstorming	yes
	Lightly shaded = not sure	Green Font = reflection-out-of-Action		
	Shaded = not at work, not doing work activities, not trying to come up with ideas.	Blue Font = background reflection		

Figure 4. Reflective practices demonstrated by designers in our survey group. Note the activities that take place in the workplace vs. those that take place elsewhere (equivalent to our previously described out-of-action) and note the activities out-of-action and the background reflection activities. Reflection-out-of-action, in this context, does not always happen physically outside of the workplace, but it does happen while the subject is not specifically engaged in work tasks.

Eighteen participants answered the first question (Where were they at the ideation instance?). Of these, only three reported being at work when they thought of their idea. Of the rest, six were at home, and the remaining eight researchers were engaged in various transportation or recreational activities. One participant was at the hospital, having an injury cared for.

Likewise, for question two (What were they doing?) fourteen of the participants reported being engaged in non-work-related activities at the time their ideas came to them. Of those who were at work, one reported not working at the time, and one reported being engaged in a communication-related activity rather than an ideation-related task. Two were engaged in work-related tasks while not at work.

Ten of the seventeen participants who responded to question three (Were they trying to come up with an idea?) reported that they did try to come up with an idea at the time, while seven reported that they did not intentionally engage in reflection for ideation. We did not ask participants to describe the specific idea they had, though some offered related information.

In most cases, ideation took place outside of the traditional work situation, with respect to location and background activity. Subjects were almost as likely to get ideas when they were not looking for them as when they were looking. One respondent said that he finds various types of physical activity particularly helpful for different kinds of ideation. For example, he finds jogging to be good for situations to see structure, and walking helpful when he's dealing with mathematical problems.

These survey results support of the notion that reflective practices can be meaningfully categorized as "reflection-out-of-action", and "background reflection", in addition to more commonly recognized reflection categories like Schön's "reflection-in-action". These survey results support "reflection-out-of-action" and "background reflection" as meaningful distinctions, which incorporate a greater range of reflective practice than are captured by Schön's concept of "reflection-in-action".

Reflection-out-of-action happens out of the workplace and the context of work activities. Examples are when participants said they got their ideas at home while making food, or while chatting with friends over coffee. Background reflection happens during routine physical activities. Examples are when participants noted that their ideas came while jogging, or while in the shower, which enabled them to think mindfully about other things.

Having given evidence of reflective practices based on design artifacts and having obtained a survey-based list of reflective practices actually in use, we decided to take another step back, with the aim to make further distinctions regarding reflective practices and the impact of context.

3.3 With what dimensions can we frame reflective practice?

From research question one, the idealog probe, we came up with a preliminary list of reflection types as seen in common design practice. The survey probe offered support for two of these types, reflection-out-of-action and background reflection, as commonly practiced and applied in productive ideation. The third probe was designed to further our understanding of how the various types of reflective practice differ, and where they fit within a general framework of reflective practice.

Direct reflective practices, such as sketching design ideas, seem to support 'gathering' more exclusively, while indirect practices, such as taking a walk, seem to support both 'gathering' and 'remembering' with less discrimination. We propose that this is because:

Direct practices are more tightly centered on the immediate design problem at hand, and less readily tempt the mind to wander off into more contextually distant associations or more temporally distant memories.

Indirect practices are more loosely centered on the immediate design task, and more explicitly allow the mind to wander both contextually and temporally, since they expose the senses to stimuli which are more mundane and therefore associated with a broader set of past experiences.

To illustrate this, taking a walk (an indirect reflective practice) encourages the designer to become aware of the surrounding environment, the landscape, people walking by, conversations happening around them, the air, the light, trees, grass, and cityscape. These, or similar environmental aspects, are a common part of past experiences, but are oftentimes not consciously noted. Perceiving them during reflection incites the mind to draw associations between features of the surroundings and the design task at hand, in a gathering reflection mode. Additionally, it may open up pathways to dormant memories, thus serving as links between past experiences and the current task, exemplifying the remembering reflection mode.

Design sketching (a more direct reflective practice), on the other hand, provides a steady inflow of visual stimuli, inciting the cycle of seeing new things, and making changes or moves based on the surprises experienced [1] [20]. Design sketching also keeps the mind focused on the task at hand, and does not readily open pathways to more distant memories. Thus, it favors gathering over remembering.

Defining reflection was the starting point for framing the reflective loop. Our definitions included: contemplation, looking back and observing mindfully, mirror image, indirect expression, manifestation, similitude, and echo. These various ways of characterizing reflection capture both transitive and intransitive meanings, actions and entities, memory-based and observation-based perspectives, and physical and conceptual references. Figure 5 presents a thesaurus map depicted as a mind map used for capturing a definition of reflection. Its components are devised from several rounds of the researchers' work sessions:
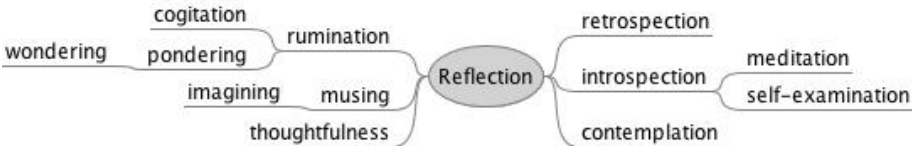

Figure 5: This mind map represents a thesaurus map of reflection. We compiled this map from related words, as a second route toward developing a working definition of reflection.

Several iterations on this exercise of defining reflection led us to the realization that reflection in design is perhaps best studied not as a disembodied concept, but in the context of reflective practices. Since we cannot get inside the designer's head (making this a black-box problem), a more practical way of learning about the reflective loop is through the activities in which reflection takes place, which we call reflective practices. We approach the study of reflective practices by observing and analyzing the behavior of designers and the artifacts that they produce.

A reflective practice is any activity, which leads the designer to reflect, not necessarily on the activity itself, but on the design task, process, or goals through the activity.

The first step in framing our understanding of reflective practice in design was to represent it metaphorically, starting with inputs to reflection: environmental stimuli and recollected memories. These factors aligned with the remembering and gathering factors, which emerged from our idealog study, and resonated with our recollections of our personal experiences with reflection.

To reflect in this context is to engage the mind with the goals of the design task, which typically includes creative ideation, by recalling and considering memories of past experiences, and/or observing and considering things in the present environment. As indicated through the survey (in section 2.2), reflective practice can be either intentionally or unintentionally motivated.

We generated a series of diagrams to describe our Remembering-Gathering model of Reflection (see figure 6):
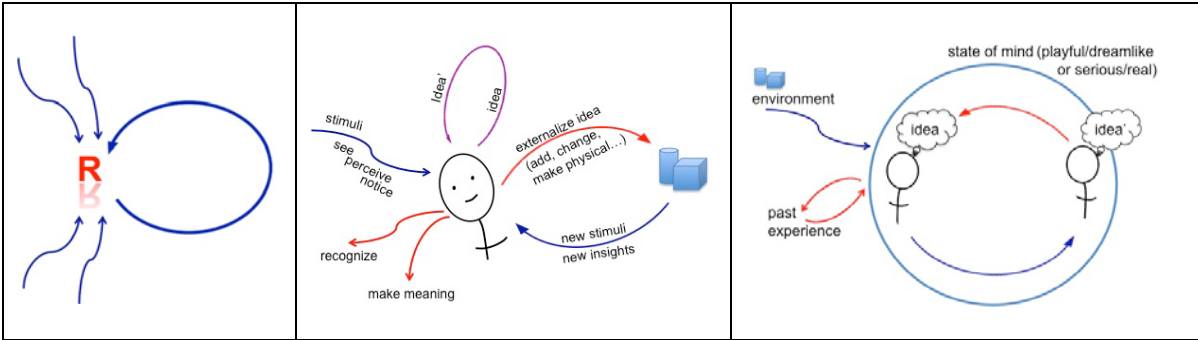

Figure 6: Remembering-Gathering Models of reflection. This figure shows the interchange between remembering and gathering in the action of reflection. a) shows the elements of gathering from the environment and the remembering. b) expands on this, highlighting the sub-activities such as perceiving, recognizing, externalizing, etc. c) places the Remembering-Gathering Model in the context of the individual's state of mind.

The end result of any reflective activity, for example, as depicted in the Remembering-Gathering Model, is the creation of a new design-specific idea.

To provide a space to map different kinds of reflective practice, we constructed a framework of some key elements of reflective practice (shown in figure 7). This framework drew on the personal experiences of the researchers involved and the models of the process of reflection we had prototyped. It is based on three dimensions: in-action vs. out-of-action on the y-axis, internal vs. external on the x-axis, and background vs. foreground on the z-axis. The x and y dimensions map well to the 'serious/real vs. playful/dreamlike' states of mind from figure 6c, and to the 'remembering, gathering' perspectives discerned through our prior research probes.
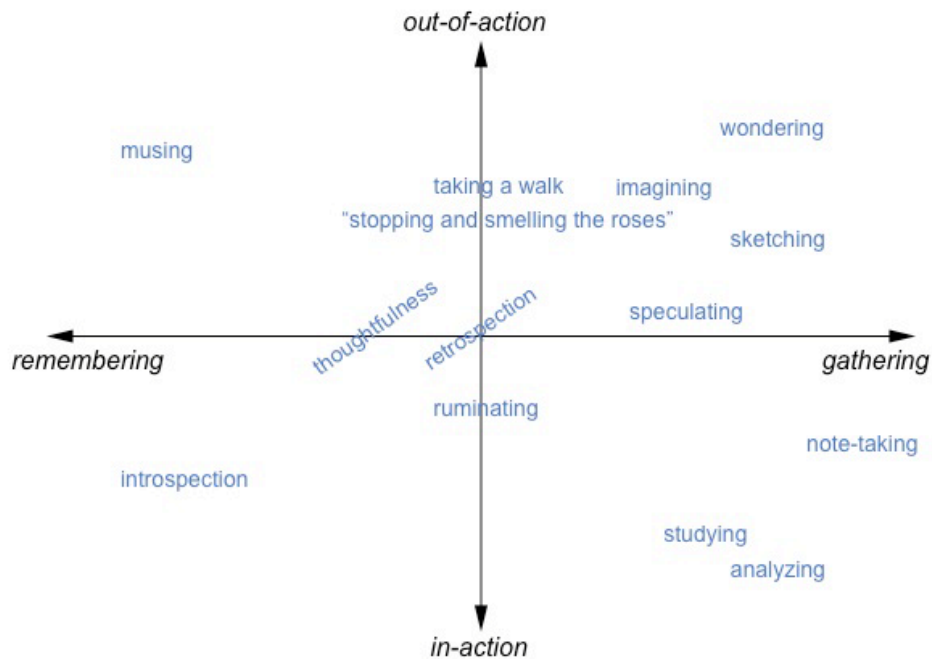

Figure 7: The resulting general conceptual framework for reflective loops, showing two
dimensions for characterizing reflective practice: 1) x-axis: remembering vs. gathering; and
2) y-axis: in-action vs. out-of-action

This conceptual model allows us to cluster reflective practices according to the dominant features of each practice. After having elaborated a theory-driven framework of reflective practices, we are ready to explore the same experimentally.

4   SUMMARY AND FUTURE WORK

Driven by the desire to understand the individual, reflective design loop, we have identified and shown evidence of reflection in the design practice of idealogging. Using various perspectives and techniques, comparably to a grounded theory approach we have identified and framed the space where these reflective activities show some very unexpected and rich properties and take place in a very interesting and so far under researched space:

Reflection may occur in the foreground, consciously or in the background, sub-consciously, so to speak. Also designers may actually focus onto the design task at hand, in action, or approach it in a playful, out-of-action manner. Additionally, we may draw from internal inspiration by drawing on memory, or gather inspiration from external sources.

This framework allows us now to systematically identify and place reflective design activities. The results should allow us to identify and better understand different reflective practices and their position relative to the creative product development and design process. Our ultimate aim is to use and integrate reflective practices, even sub-conscious ones such as ideation when showering, in a conscious way to improve ideation.

Next steps in our research will include observing and analyzing reflective practice of designers at work in the laboratory, and collecting additional survey and interview data from a larger sample of designers in multiple sub-groups (such as design students, industry practitioners, and professors of

design). We have artifactual evidence of reflective practice, and survey support for the use of certain types of reflection in ideation. We hope, through observing reflection as it happens in design ideation tasks in the laboratory and listening to designers' more detailed accounts of their reflective practices, to further enhance our understanding of the role of reflection in creative ideation.

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