Creative and Motivational Strategies Used by Expert Creative Practitioners

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Strategic Forgetting **Mode Switching** **Embodying Process** **Aestheticizing**
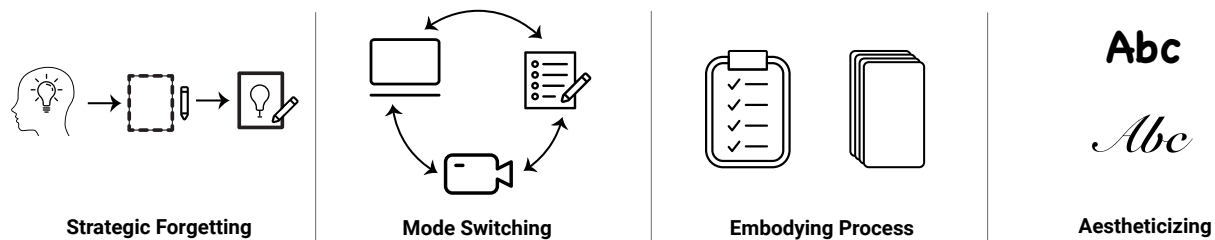
Figure 1: Through interviews with 12 expert creative practitioners in diverse domains, we identified four strategies for managing motivation and structuring process in creative work: *Strategic Forgetting,* specifically avoiding capture of creative output (Section 4.1); *Mode Switching,* consciously selecting a tool to shift into a particular creative mindset (Section 4.2); *Embodying Process,* the emotional benefits of tracking and visualizing an otherwise ephemeral process (Section 4.3); *Aestheticizing,* making deliberate aesthetic choices to manage intrinsic motivation (Section 4.4).

ABSTRACT

Creative practice often requires persevering through moments of ambiguity, where the outcome of a process is unclear. Creative practitioners intentionally manage this process, for example by developing strategies to break out of creative ruts, or stay motivated through uncertainty. Understanding the way experts engage with and manage these creativity-relevant processes represents a rich source of foundational knowledge for designers of Creativity Support Tools. These strategies represent an opportunity for CST research: to create CSTs that embody emotional and process-focused strategies and techniques. Through interviews with expert practitioners in diverse domains including performance, craft, engineering, and design, we identify four strategies for managing process: *Strategic Forgetting*, *Mode Switching*, *Embodying Process*, and *Aestheticizing*. Understanding tool- and domain-agnostic creative strategies used by experts to manage their own creative process can inform the design of future CSTs that amplify the benefits of successful strategies and scaffold new techniques.

CCS CONCEPTS

• **Human-centered computing** → *Empirical studies in HCI*; • **Applied computing** → Arts and humanities.

*Both authors contributed equally to this research.

KEYWORDS

Creativity Support Tools; Process; Qualitative Methods

1 INTRODUCTION

Creative practitioners deliberately structure their process, environment, and mentality to navigate the ambiguous and complex space of creative work. Techniques for structuring work are essential to "being creative," but from the outside can often seem unstructured, counterproductive, or unrelated to creative output. Practitioners use these *strategies* to manage and structure their creative experience, shaping creative output as well as motivation and emotional affect. Creative strategies can be tool- and domain-agnostic, allowing learning and sharing techniques across practices and between tools. Practitioners experiment with their individual creative processes, deepening their understanding of their own personal process by applying new strategies, or embracing different mindsets. Designers can support creative practitioners by incorporating understandings of such techniques and strategies into tools and systems to support these essential yet undersupported aspects of the creative process.

Creativity support tools can help expert creative practitioners maintain sustainable daily practice and scaffold newcomers into lifelong engagement by considering metacognition, emotional affect, task motivation, and working style. Such tools would go beyond skill- and task-oriented support, to address the overall experience of "being creative." We suggest that increased attention to the process-oriented aspects of sustained creative practice will improve the overall design of Creativity Support Tools (CSTs). In service of

this goal, this paper presents a selection of techniques that expert practitioners use to structure their personal creative experience as both a description of existing practices and a foundation for CST designers to draw from when considering process-oriented CSTs.

This work builds on studies which focus on supporting the personal experience and emotional well-being of the artist as they engage in the creative process. For example, Treadaway [80] articulated the importance of a tool supporting feelings of satisfaction, rather than focusing only on the tool's effect on creative output. Recent work has explored the benefits of supporting process by developing healthy relationships with failure [79], supporting productive procrastination [9], and enabling positive self-conception [25, 44] during creative work. Each of these contributions focuses on the subjective experience of doing creative work, an important yet undersupported aspect of the creative process.

Taking a process-oriented perspective, in this paper we identify techniques used by experts across diverse fields that embody intra-personal aspects of creativity such as metacognitive skills, emotional support needs, working style, and intrinsic motivation. Far from being immutable personality characteristics, these can be shaped and enhanced intentionally, often through the use of specific tools. Understanding how experts currently manage and perceive their own creative strategies can inform the design of future tools that amplify the benefits of successful strategies and scaffold new techniques. Our work addresses the question: *What characterizes creative strategies for creative professionals across domains?*

Because the study of creativity necessarily spans disciplines [30], it is crucial to work with experts across a wide range of domains, fields, and communities of practice as we seek to identify how experts manage meta-cognitive and emotional needs. Looking at a diversity of creative processes provides both a lens onto broader commonalities of practice, as well as insights into specific details of unique creative processes, both of which can enrich approaches across domains. Frich et al. observed that current HCI research only sparsely draws from skillful creative practitioners' tool-use and behaviours [29]; by drawing on experiences in diverse disciplines we expand existing bodies of knowledge about expert tool-use. Qualitative methods are uniquely appropriate for identifying and curating descriptions of creative strategies, which can provide a source of long-lasting and technology-agnostic knowledge. This type of knowledge complements that gained from novel CSTs, which instantiate new ideas but are often ephemeral and hard to maintain [28]. Strong foundational understanding of creative processes can develop our perspective on how creativity works, and help construct new design directions. For example, Terry and Mynatt described three creative strategies from a series of case studies of expert practitioners across diverse fields [76]; these rich descriptions remain relevant to the design of creativity support tools (CSTs) even many years later.

In this paper, we first situate our work within related literature in creativity theory and CST design. Then, we introduce our methodology and analysis. Through analysis of our interviews, we identified strategies and techniques for overcoming ambiguity, staying inspired, and managing the creative process used by expert practitioners across diverse domains of performance, craft, engineering, science, art, and design. Each theme is grounded in

descriptions of the behaviors of specific practitioners. We synthesize our observations into four strategies: *Strategic Forgetting*, *Mode Switching*, *Embodying Process*, and *Aestheticizing*. Some of these are different from or even contrary to common design recommendations, expanding our understanding of the range of creative process behaviors: for example, the strategy of Strategic Forgetting recommends *against* capturing output for future reference. Each strategy and technique is placed into our categorization of CSTs, to clarify relationships to prior work. We then ground these strategies in existing research about cognition, design practice, and creativity. Finally, we encourage a shift in CST research and design to focus on strategies that support creative process.
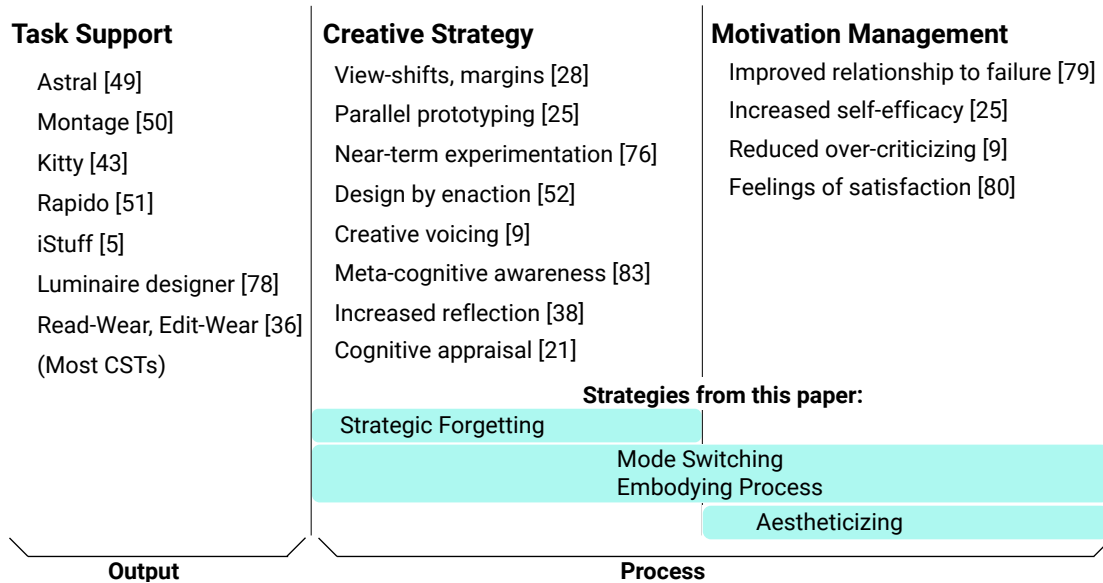
2 RELATED WORK

2.1 Creativity Research

This work is part of ongoing efforts to connect creativity research more deeply with HCI [20, 27], as well as to leverage practitioner expertise in our understanding of tool-use and creativity [28, 42]. We first establish a shared definition of creativity and a summary of current creativity research. The study of creativity spans disciplines, from neuroscience, cognitive science, psychology, and human computer interaction, to history, anthropology, and beyond, requiring a "synthesis of different disciplinary perspectives" [30]. As designers of CSTs, we draw on these myriad creativity theories to inform our approach. Rather than attempt a complete summary of all theories of creativity, here we discuss those most relevant to our work.

While the definition of 'creativity' has evolved over time, the widely accepted [2, 7, 28, 42, 62, 71] "standard definition" as articulated by Runco and Jaeger [65] requires both originality and effectiveness. Embracing this core definition, this paper additionally takes a social constructivist [81] perspective, which embraces a broad understanding of the ways in which people, environments, and tools combine to shape both process and outcome [18, 19, 37, 48, 62, 75, 81]. Plucker et al. [62] articulate such a vision of creativity research, focusing on the interaction between "aptitude, process, and environment", a definition that is particularly relevant to HCI researchers. Fundamentally, we understand creative work as being done in a particular social and environmental context.

An example of a particularly influential framing that takes into account both aptitude and process is Amabile's Componential Model of creativity. Amabile emphasizes three core aspects of creativity: domain-relevant skills, creativity-relevant processes, and task motivation (especially intrinsic motivation) [4]. Our paper focuses on the latter two components, creativity-relevant processes, which include cognitive style, working style, and knowledge of heuristics, and task motivation [2]. While some of these 'processes' may be immutable personality characteristics, many (e.g., "tolerance for ambiguity" and "suspending judgment") can be shaped by intentional tool use. Creativity researchers emphasize the value of focusing on dynamic, mutable aptitudes rather than on the study of static, immutable traits [2, 22, 32, 62]. Recent work has emphasized the importance of understanding the creative *experience* in addition to creative outputs [32]. This represents an opportunity for CST research: tools that take into account the overall creative experience can facilitate growth and sustainable practice by mediating mutable intrapersonal aspects of creativity. Understanding how experts

Creativity Support Tools Research

Task Support

Astral [49]

Montage [50]

Kitty [43]

Rapido [51]

iStuff [5]

Luminaire designer [78]

Read-Wear, Edit-Wear [36]

(Most CSTs)

Creative Strategy

View-shifts, margins [28]

Parallel prototyping [25]

Near-term experimentation [76]

Design by enaction [52]

Creative voicing [9]

Meta-cognitive awareness [83]

Increased reflection [38]

Cognitive appraisal [21]

Motivation Management

Improved relationship to failure [79]

Increased self-efficacy [25]

Reduced over-criticizing [9]

Feelings of satisfaction [80]

Strategies from this paper:

Strategic Forgetting

Mode Switching
Embodying Process

Aestheticizing

Output   **Process**

Figure 2: To contextualize the field of creativity support tools research, we consider three categories of research: Research that focuses on *task support* creates specialized systems and tools to enable specific types of *outputs* to be created. Research that identifies *creative strategy* provides insight into how creative practitioners work, such as how they generate ideas, gain new perspective, or reflect. *Motivation management* research focuses on how practitioners create and maintain motivation. The techniques described in this paper fall under *creative strategy* and *motivation management*, aspects of creative process.

engage with and manage creativity-relevant processes provides a particularly rich foundation of knowledge for the CST community.

Kaufman and Beghetto identify different levels of creative practice [42]: our interviews focus on professionals, the "Pro-c" level, with significant experience and established success in their fields. Professional practice is a rich source for understanding creative behaviour [28, 42]. We seek to contribute to deeper understandings of the way experts, operating at a high level of professional skill, manage and shape their own personal creative experiences, and how tools and systems could support that.

2.2   Process-Oriented Creativity Support Tools

HCI research related to creative strategies often focuses on designing tools whose primary purpose is to facilitate high quality output by supporting specific tasks [5, 9, 36, 43, 49–51, 78] (Figure 2). In contrast, our work focuses on identifying tool-agnostic creative strategies [9, 25, 28, 41, 52, 58, 76], that can inform the designs and uses of many types of tools. For example, Frich et al. [28] identified two strategies in creative practitioners' use of digital tools: 'margins', and 'view-shifts'. Both are tool-agnostic strategies used by expert practitioners as they iterate through a design process. We additionally focus on supporting mindsets that enable creativity. By supporting intrapersonal aspects of the creative process, we seek to improve and enrich day-to-day work and satisfaction (Figure 2).

The relationship between affect and creativity is complex, with some evidence showing the positive impact of positive moods on creativity [3, 40, 61] and other findings that add nuance to this

perspective [8, 11, 16]. Bartolic et al. found that brain activity associated with negative moods improves figural fluency compared with verbal fluency, while brain activity associated with positive moods had the opposite effect [8]. Sowden and Dawson similarly found that a negative mood helped participants assess the usefulness of a given evaluation, while a positive mood enhances performance on ideation tasks [70]. Bledow et al. described the impact of an *affective shift* on creativity, taking a dynamic view in which "the emergence of new ideas [and positive affect] is often preceded by and depends on a phase of negative affect" [11].

Creativity support tools can be designed to take emotional affect into account. For example, De Rooij et al. designed a system to enhance positive emotions which they argued would increase creativity [21]. Increasing positive emotions is not the only way to affect creativity, however: Torres et al. articulated strategies that expert practitioners use to manage experiences and feelings related to failure, including embracing failure, mitigation of the effects, and reframing failure entirely [79]. Belakova and Mackay reframed a 'negative' behaviour in their design of SonAmi: this tool addresses *over-criticizing* – a common barrier to creativity among writers – by providing creative distance from the authors' own writing by replaying written snippets with a computer-generated voice [9]. The computer-generated voice enhanced the authors' ability to both appreciate and constructively critique their own work. Kim et al. designed Mosaic to celebrate incremental process, a way of reframing the value of unfinished work. Mosaic displays works-in-progress as a way to both promote healthy communities

and positive self-conception [44]. Complementary to Kim et al.'s findings, in this work we focus on how practitioners manage their individual creative process, rather than community interactions. Dow et al.'s research on parallel prototyping [25] articulates not only a specific brainstorming strategy, but also the impact of such a strategy on a novice designer's sense of self-efficacy, which has been shown to influence a variety of outcomes [6], including one's ability to learn [26], find enjoyment in [17] and persist through [56] challenges, and engage in activities [6].

Directly influencing emotional affect is only one way to support creativity. Other researchers have discovered ways to support creativity by making the creative process itself more visible and legible. Increased awareness of one's own process can improve metacognitive understanding and learning outcomes [83]. Creating artifacts can be understood as a way to capture and view 'fleeting moments' of progress for visual artists [38], or a way to maintain focus [54]. While these strategies do ultimately improve the final creative output, the immediate benefit is to improve the emotional well-being of the creator by engendering a sense of progress. Our work similarly seeks to scaffold healthy mindsets by designing systems that take into account the emotional well-being of creative practitioners by reframing negative experiences, increasing positive affect, and supporting healthy awareness of process. Building on these earlier findings, we expand the conversation beyond students, designers, and engineers to include the rich practice across other domains, including performance, craft, science, and art.

3 METHODOLOGY

3.1 Interview Methods

To understand practice "in the wild" we carried out semi-structured interviews with 12 expert creative practitioners and 3 early career practitioners. Interview questions were guided by grounding themes of artifact use and personal creative practice, and shaped by the individuals' background and reflections. Each interview lasted 1-2.5 hours, during which we asked semi-structured interview questions, focusing on personal creative practice and background. Most interviews took place in participants' primary workspaces to understand their tool use in context [10, 74] [1]. To ground our discussion in concrete examples of daily work, we followed principles of contextual inquiry [10]: topics centered on how each practitioner engages in their creative practice, how they use artifacts in their process, the tools and materials they use, and the techniques and strategies of their creative process. Participants were asked to walk us through concrete examples of their work-flows as a starting point for surfacing details about their personal working style. Using a recent project of the participant as a grounding example, each participant was asked questions such as *How do you make progress when you feel stuck? How do you explore alternatives? How do you assess your growth as an artist over time?* and *What tools do you use during different stages of your process?*

Our interviews are interactional events [75], in which the questions evolve in response to participant background, shaped by earlier interviews. We examined the use and creation of artifacts – rather than their functional properties – embracing Suchman's idea that a tool can only be understood in relation to its social environment and use [39, 74]. Focusing on artifact use additionally allowed us to foreground custom-made tools, such as paper templates for weaving and violin making, or objects not typically understood as "creativity support tools," such as a pile of handwritten notes, or an old project hung up on the wall. These artefacts could be understood as elements of an 'Annotated Portfolio' [12, 31], generated as part of a creative practitioner's independent practice, helping to convey the decisions and the philosophy of each practitioner.

We followed a cognitive ethnography approach [37], focusing on how expert practitioners understand and reflect on their own practice. We are specifically interested in the reflective and metacognitive activities that creative individuals carry out, as well as their cognitive style [30]. Reflective self-report allowed us to investigate the ways that people interpret and manage their own behaviors in their creative process, and what meaning they ascribe to their own actions [37, 42]. As Glăveanu and Beghetto put it, "processes cannot be easily inferred from outcomes" [32], so we asked practitioners to engage in reflection about their own techniques and strategies.

3.2 Practitioners

Our informants represent domains that require novelty and open-ended problem solving, where practitioners must use creativity skills in daily work [42]. Many domains and practices are creative, even if they are not colloquially considered creative the way that art and performance are. We take a broad view of what domains are creative, as an area in which the practitioner utilizes creativity. For example, software development is creative, as it requires open-ended problem solving and the creation of contextually novel solutions [53]. Recruitment began by selecting sites and interviewees according to an *a priori* set of distinctions that seemed most likely to be relevant (e.g. collaborative vs independent work). We chose subsequent creative practices and experience levels to maximize the range and diversity of experiences as our understanding evolved, in concert with our research questions. Following Charmaz's Grounded Theory approach, we chose additional practices and experience levels within this frame that would support theory construction, rather than seeking population representativeness across "all" creative practices [15]. Each expert participant self-identified as an expert in their field, with a mean of 21 years of experience (range 10-47 years; Table 1). Participants were asked to walk through concrete examples of their workflows as a starting point for surfacing details about their personal working styles.

3.3 Analysis

Since the inception of Grounded Theory, it has split into three main branches: Strauss and Corbin; Glaser; and Charmaz [66]. We embrace Charmaz's constructionist research style that understands knowledge as co-constructed between interviewee and researcher [14, 15]. Our analysis is interpretivist, seeking to understand how our informants create meaning in their work [33], and

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[1]In the case of five participants, video conferencing was used to remotely connect to the subjects at their workspaces due to travel limitations, one because of the COVID-19 pandemic. One participant travels frequently, renting workspaces in different cities, so agreed to meet in a public space and share pictures from her rehearsal spaces.

Interview Participant (Main Creative Domain)	Years of Experience
Animal Behaviour Researcher	11
AR/VR Artist	19
Ceramicist	21
Director	47
Industrial Designer	23
Museum Curator	19
Physical Performer	22
Software Engineer 1	10
Software Engineer 2	12
Stylist	25
Tapestry Weaver	43
Violin Maker	18
Academic	9
Design Lead	6
Software Engineer 3	5

Table 1: We interviewed 12 expert creative practitioners and 3 early career practitioners across diverse creative domains.

is rooted in the social construction of knowledge and polysemic understandings of truth [46].

Our goals are to "provide a rich, contextualized understanding of human experience through the intensive study of particular cases" [63], and to perform analysis that identifies the transferability of findings [63]. We contrast quantitative understanding of generalizability, or statistical generalizability (generalizing from subjects drawn at random from a representative sample), with both analytical generalizability (generalizing to a construct or a theory), and transferability (a collaboration between readers and authors, where authors provide rich, thick description and readers do work to apply the findings to other fields) [13, 46, 63].

Following best practices for Charmaz's branch of Grounded Theory, we simultaneously engaged in analysis and data collection, iteratively constructing our analytic frame and updating our question prompts for future interviews as we identified and synthesized emerging themes [14]. For thematic analysis, we first transcribed each semi-structured interview, then performed open-coding [73] on the transcripts. We iteratively reviewed and analyzed all interview data and discussed all emerging themes [55]. Themes are presented below, addressing strategies practitioners use to structure their creative process to feed inspiration, break out of creative ruts, stay motivated, and tap into different aspects of the creative process when faced with ambiguity.

4 FINDINGS

Throughout the interviews, we identified themes relating to the creative process, creative cognition, motivation, and emotional affect (discussed below in this paper). We additionally uncovered tensions around version control systems, and identified values embedded in CSTs which are at odds with some aspects of the creative process. For a full discussion centering these additional topics, please see [72]. Because each interview evolved organically, following discussion topics relevant to the creator at hand and our evolving analytic frame, we did not address each topic with each practitioner in depth. As such, we focus the below discussion on the creative and motivational techniques emphasized by eight of our informants. We identified four themes across our interviews as dominant strategies used by creative practitioners: Strategic Forgetting, Mode Switching, Embodying Process, and Aestheticizing. We highlight each with a description and grounded observations.

4.1 Strategic Forgetting

Inverting the common practice of capturing ideas at the moment of creation, we observed several practitioners purposefully leverage the natural forgetfulness of their mind as part of their creative process. We observed this technique of *Strategic Forgetting* in the Performance Director and Physical Performer. The Performance Director has been performing professionally for 47 years, and teaching performance for 30 (Table 1). He has performed as an acrobat, juggler, and clown, and worked as a teaching artist, producer, director, and playwright for both theatre and circus shows. His primary domain is physical performance; recently he has expanded into writing and consulting. As a playwright, his process draws from his background as a performer, acting out scenes as he writes them.

When developing material for a show, the Performance Director relies on his imperfect human memory as a filtering mechanism that results in only "memorable" work getting saved. Even while engaged in a writing process, the Performance Director first generates many ideas through physical improvisation – a familiar and comfortable practice for him. The nature of these improvisational sessions is fleeting; yet rather than taking notes or recording the sessions, he purposefully prevents himself from capturing them:

> *Performance Director*: [My mentor] would say "Here's the scene, try it," and then I would do it... he would not let me write it down in rehearsal. [He would] say "write the scene up tonight," on the theory that whatever I remembered was worth keeping from the scene. Which I found incredibly frustrating. But it works!

In other words, the Performance Director relies on the inherently ephemeral nature of his craft to allow himself to forget ideas. After some time has passed, he will finally write down notes on the rehearsal from earlier, capturing the ideas "worth" remembering.

The Physical Performer engages in a similar process. The Physical Performer has been working in performance for 22 years. She designs, directs, and performs one-woman physical comedy shows, drawing on her years of training in mime, acrobatics, and physical comedy. Her primary creative domain is physical performance; recently she has expanded into music and spoken comedy. Her creative process involves improvisation, or "playing": trying out new ideas and cycling back to old ideas. This improvisation is inherently physical, acting out the details of a scene to feel it in her body. She often deliberately avoids referencing her notes while improvising, and does not write a script:

> *Physical Performer*: I'd spend the week journaling, [then] I would flip through whatever I had written that week... And then I'd get on stage, put the notebook down, and I would just improvise for 10-15 minutes... Things that were not important didn't get put in and things that were important got said.

Like the Director, the Physical Performer found this to be a very successful method. She trusts her subconscious processing to foreground the parts of the story that were important to tell. She

Figure 3: The Performance Director keeps and displays many artifacts from his career, including notebooks with extensive rehearsal content. He is dedicated to building a collection of artifacts to track and manage his creative process. Despite his dedication to capturing, his creative practice also involves Strategic Forgetting (described in Section 4.1). These images represent selected artifacts from his creative space, the tangible history of what has not been "strategically forgotten". From left to right: 1., 2. The Performance Director's working space, filled with props, costumes, set pieces, and memorabilia from his long career as a working artist. 3. A notebook containing notes on acrobatic tricks. 4. Hand-drawn stick figures showing acrobatic tricks, from the notebook. 5. A cut-out from a magazine, used to recall technique.

specifically structures her working style to enable her subconscious mind to play an active role in the creative process.

Through this process, the Physical Performer maintains freedom, flexibility, and liveness in her individual process and her collaborations by deliberately omitting certain information. For example, the Physical Performer would audio record instead of video record her performances, because she didn't want to constrain herself by repeating the gestures she had done in that earlier performance. This practice supports her own expectations and values of what a performance should be, and how it should feel from her perspective:

> *Physical Performer*: I need to keep something unscripted, otherwise I feel like it dies.

The two performers found value in purposefully embracing the ephemerality of their medium in the generative phases of their work. Strategic Forgetting supports liveness and curation of ideas.

4.2 Mode Switching

In Actor-Network Theory, Latour articulates what happens when a person (actor) works with a tool: a new actor entity comes into existence that represents the unique combination of them both [47, 48]. Creative practitioners similarly change which tool is in use in a conscious effort to bring a new, combined, person-tool entity into existence. We see Software Engineer 3 and the Physical Performer both leveraging this relationship with tools to enter and support particular *modes* of creative behavior by deliberately changing *tools*.

Software Engineer 3 has been working professionally as an engineer for 5 years. He works in the Research and Development arm of a wireless technology company. He has a habit of printing out new code he's learning, taping the pages together, and adding hand-written annotations to track his thinking. He keeps three different whiteboards in his office, one on his desk for quick notes, one on his wall for brainstorming, and one behind his computer for longer-term reference. The affordances of the different whiteboards initiate certain creative modes:

> *Software Engineer 3*: I like the size of [the wall whiteboard]: it's a nice big whiteboard, you can draw big things. It's also easier to reference – to look at [up on the wall]. Because sometimes

I'll sit here, [puts legs up on desk], and I'm just staring at my whiteboard, like "what am I going to do with this..." It's harder to do that with a small, 8x11 piece of paper.

The large whiteboard prompted a creative *mode* that supported engagement with "big ideas". Participants such as Software Engineer 3 are attuned to the ways in which different tools shape and define their creative process, and they consciously select a tool to shift into a particular creative mode. This behavior is distinct from choosing a tool in order to generate a specific output; instead, the tool is chosen to shape the practitioner's behavior or mindset, driven by changing creative, cognitive, and emotional needs.

The Performer also described consciously leveraging different tools to generate a particular mode of engagement with her work. For example, when she creates a new show, she sometimes improvises in front of a video-camera. The video-camera acts as a pseudo-audience, allowing her to access her performing mindset "without a lot of pressure, and with a lot of freedom and a lot of joy." Next, she re-watches these recordings, and writes down her favorite parts. Switching to writing is a deliberate choice; writing is a more difficult medium for her, which has "different vibes" from videotaping. Switching mediums allows her to switch mindsets, from "the improv, physical, playful channel" to the "gleaner of info channel". This switch is driven by her physical and emotional needs, rather than a need for a particular type of recording:

> *Physical Performer*: There's a time when it's right for me to get up and move and then there's a time when that window closes and it's a time to reflect and it doesn't feel right to get up and move – it would be forceful to do that. It's almost like a switch: different channels are open. There's a point where it's "off". The door on that [mode] is closed.

Writing in a journal was a relatively new introduction to the Physical Performer's creative process. Her previous techniques involved meditating on mental images, and sketching high-level 'texture maps' of her shows. She discovered journal writing in a class designed to help performers create a new show. The instructions from the course involved writing a script that would later be performed, but instead she found it more beneficial to integrate

Figure 4: The Physical Performer finds benefits in consciously leveraging different capabilities of tools in her practice to manage and respond to her evolving creative needs (*Mode Switching,* described in Section 4.2). Left: Components of a show, physically rearrangeable on notecards. Right: A rehearsal room the performer used while on tour.

this new journaling technique with her "home domain" of improvisation, and uses each medium at different parts of the process.

> *Physical Performer*: Many times I've videotaped 15-25 minutes [of improv] and that's like 3 minutes of something I like. So the writing would be grabbing the 3 minutes. And then the next video I would look at [the writing] and start with that, or I'd just put that to the side and [see] what wants to come through today. And then take the 2 minutes from that one, and then put the 2 minutes and 3 minutes together. And then do another video session that's 1 minute. ...It feels like a distilling process. One modality to the other modality would distill it.

Here, the Physical Performer is deliberately leveraging different forms of reflective conversations by using different tools and mediums through the strategy of mode switching.

4.3   Embodying Process

Completing a task and feeling that you've completed a task are sometimes two separate experiences. Especially for knowledge workers, whose output can seem ephemeral, having tangible, physical, visible, embodied proof of intermediate effort provides motivational benefits, both as concrete reminders of progress and completed work, and as tools to understand and reflect on personal process.

For example, the Animal Behavior Researcher takes care to design her tools around visible access to progress. The Animal Behavior Researcher has been working in the field of animal behavior for 11 years. She is as a post-doctoral researcher at a university in the United States and runs her own business helping clients with cat behavioral issues. As a scientist, she collects and generates many different forms of data, nearly all of which she has saved for the past several years, despite having no pragmatic need for the raw data. Instead, these notebooks, datasheets, annotated images, and other forms of information about her work support her emotional well-being: for example, the Animal Behavior Researcher has saved a notebook full of technical details from a complicated process she never plans to repeat. The process itself represents a particular scientific method that she associates with 'real science', so the notebook acts as a physical reminder of that experience and validation of her own competence:

> *Animal Behavior Researcher*:: [It is] proof that I actually did it.

She also keeps copies of datasheets, maps, and notes from a complicated and time-consuming research project as large stacks of paper in a cabinet in her house. Even though all the research with that data was already published, and there is no practical reason to keep physical records, the primary benefit for her is emotional: she finds emotional value in keeping the original physical pages as a reminder of her achievements.

The Animal Behavior Researcher also maintains a notebook for tracking various todo lists, meeting notes, and ideas. While pragmatically useful as a way to track her work, the act of writing down tasks prompts reflection, and provides her with useful visibility into her process:

> *Animal Behavior Researcher*: When I find myself writing the same task over and over it usually represents some kind of internal struggle.

The Animal Behavior Researcher deliberately constructs an environment that supports personal feelings of success, and provides visibility into her own process by capturing both process and progress in a physical lab notebook.

Foregrounding and physicalizing artifacts can also reframe failures and mistakes as essential stages of the creative process, which supports continued engagement with challenging tasks and a productive learning mindset. Keeping even unsuccessful artifacts available and visible can provide concrete benefit to future projects, and buffer against negative feelings of waste or lack of progress.

The Tapestry Weaver has been working on her craft for 43 years. Over her career as a weaver she has created everything from yardage for clothing to artistic pieces meant for display in exhibits. Her workspace (Figure 5) has boxes of old weavings, raw materials, notebooks, and works-in-progress tucked under every table and filling multiple bookshelves, and old artworks on the walls. The artworks she chooses to display are often ones she considers 'incomplete', or 'unsuccessful'. Instead of discarding or hiding a failure, she hangs it up so that she can continue thinking about how to re-appropriate or improve it. The purpose of a tapestry does not end when it is completed, but rather feeds back into the creative process:

> *Weaver*: And so I keep on thinking, well, this one wasn't so successful but I can play with it. And start reworking it.

The Weaver conceptualized even completed artwork as potential "grist" for her creative mill, especially if she was dissatisfied with the final output.

Compare the Animal Behavior Researcher's sense of accomplishment triggered by her old notebook, or feelings of potential created by the visibility of the Weaver's unsuccessful work, with Software Engineer 3's feelings of despair when his process of brainstorming on a whiteboard generates no artifacts:

> *Software Engineer 3*: What doesn't feel productive is indecision. Sometimes I'll spend the day like "should I make this design decision or should I make that design decision, I don't like this," and I always feel like I'm just going back and forth and not really making much progress. Just sitting there staring at my whiteboard like "should I do it this way or should I do it that way." I feel like I can waste a lot of time without any decision.
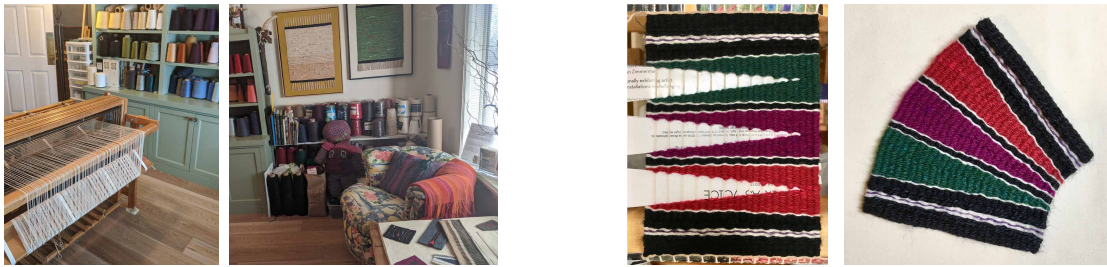
Figure 5: The weaver saves and displays 'unsuccessful' projects on her wall (second image) to reframe them as part of her process (*Embodying Process,* Section 4.3). Here we share additional images from the Weaver's practice. From left to right: 1. The weaver's in-home weaving studio, featuring a large loom, and materials in open cabinets. 2. Framed tapestries - her own work. More shelves and raw weaving materials. In the foreground, the table on the right displays woven studies of new techniques, laid out to encourage tactile exploration. 3. Tagboard holding space in a weaving to create a curved shape. 4. The completed weaving with the warp pulled taut after removing the tagboard.

The whiteboard used by Software Engineer 3 – easily erased, leaving no 'artifacts' of a brainstorming session whether successful or not – does not provide the benefit of embodied progress.

4.4 Aestheticizing

Brainstorming literature shows that encouraging quantity (over quality) produce both higher quantity *and* higher quality ideas in the end [23, 59, 60, 64]. In the context of brainstorming there is no trade-off between quality and quantity: by focusing on quantity, you get quality too. But for prototypes, which involve more time and effort to construct, this trade-off is an important concern. Design practitioners often sacrifice aesthetic refinement in favor of quickly generating many low-fidelity prototypes, which while individually less accurate or refined, lead to better end results [25, 57, 82]. However the aesthetics of an artifact do not only affect the output: deliberate choices around aesthetics are key factors in intrinsic motivation and overall creative experience. Motivation is an essential component of the process of creative work, with intrinsic motivation supporting creativity, and extrinsic motivation often suppressing it [2]. Among some of our participants, aesthetic refinement in their work was a source of intrinsic motivation.

Attention to beauty suffused all aspects of the AR/VR Artist's workflow, not just in his artistic outputs but also in even basic documentation. The AR/VR Artist is an expert in creating digital art in augmented and virtual reality. His creative process involves building reusable digital assets and creating documentation that he or others can use in the future to learn skills and process. The AR/VR Artist invests considerable time and effort into saving information, resources, and research if he feels that they might be useful for himself or others later. Yet even if a document will never be shared publicly, he takes time to make the visuals feel "finished". For example, as he collected examples for how to write campaign emails, he structured them into a beautiful slide deck because it satisfied his own sense of progress:

AR/VR Artist: I like to at some point take my ideas from a notepad document to…something that is a little bit more nice to look at. …It helps me visualize it as being more done, or presentable.

While he begins with less aesthetically refined collections of screenshots and notes, the act of creating a beautiful presentation helps him distill his thoughts. After creation, the aesthetic artifact is one he desires to return to and continue working with, which keeps his task motivation high. He emphasized how much this process benefited not only others, but upheld his own satisfaction with his work:

AR/VR Artist: It helps me feel like it's officially out there… it motivates me, more, than – if it were just in a notebook, I might feel like I were just scrawling out ideas.

The AR/VR Artist is highly intrinsically motivated by creating visually appealing content, and by designing for an audience, whether that audience is real or imagined (he described creating a 60-page document in InDesign that "no one asked for").

The Industrial Designer similarly described being motivated to make even quick sketching appealing to the eye. The Industrial Designer has been working in design for 23 years, on a wide variety of products, including toys, cars, medical devices and hand-held electronics, as well as experiences such as museums and restaurants. His process is highly physical and visual; a notebook or a piece of cardboard is always at hand, ready to be drawn on or reshaped. The impulse to externalize is almost reflexive at this point in his career; a conversation about ideas inevitably will become a sketching session, or example materials will come out to be handled, considered, and recombined. For him, the main purpose of sketching is to "inspire thinking", sketching itself is "exploration on the page". Yet he values making beautiful sketches, regardless of whether they are to be kept long term or used only briefly, shown to others or only himself. Creating sketches with a polished aesthetic both improves his ability to communicate ideas and gives him personal satisfaction in his work. He described wanting his drawings to be "happy to look at", and takes pains to ensure that even the quickest of sketches have this quality (see Figure 6 for examples of 'happy sketches').

While the AR/VR Artist and the Industrial Designer both increase intrinsic motivation through highly aesthetic artifacts, some participants felt an opposite effect. The Academic, early in his career, found freedom and motivation in "lowering the bar" of quality, both for aesthetics and content. The Academic is an advanced graduate
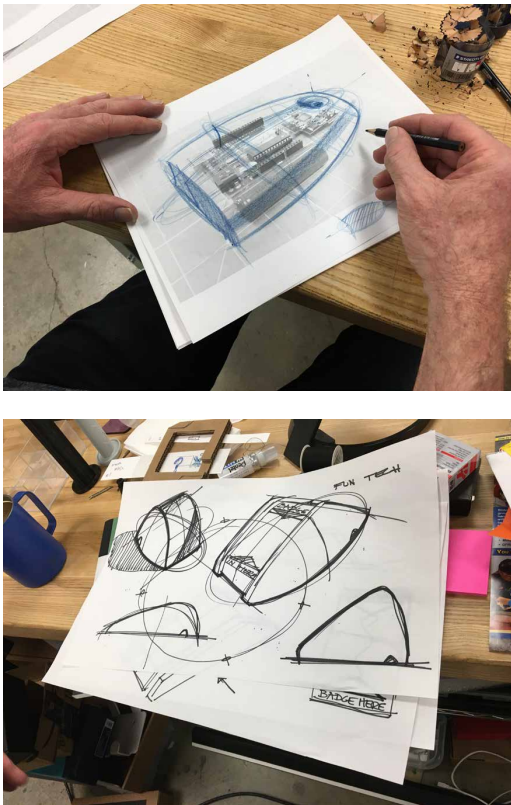
Figure 6: 'Happy sketches' created by the Industrial Designer. Sketches with a polished aesthetic improve his ability to communicate ideas with others and give him personal satisfaction in his work (*Aestheticizing,* Section 4.4).

student at a university in the United States. He specializes in studying how humans understand systems from an interdisciplinary lens and cares deeply about the craft of research. The Academic specifically described being "scared" by his "proper art notebook":

> *Academic*: Because I want every piece of art that goes in there to be beautiful …so whenever I go to draw in it, I'm like: "Once I draw in here, that page is in here forever, I can't remove it."

For him, the permanence and high quality of the art notebook was intimidating, stymieing creation. In this case, the art notebook placed external expectations of aesthetic refinement on his work, decreasing motivation. Instead, he prefers to hand-bind his own notebooks, using the cheapest possible printer paper.

> *Academic*: If I put a real clunker of a poem in [the handbound notebook], it's like, eh, who cares, I'm probably not even going to come back and read these, no one is going to read them, it's ok. It gives me more latitude to just try something.

By deliberately de-emphasizing aesthetics, the Academic increases his motivation. While their approaches to aesthetics differed, the AR/VR Artist, Industrial Designer, and Academic all found deliberate choices around aesthetics to be key factors in intrinsic motivation and overall creative process.

5 DISCUSSION

Here we situate our findings in current creativity support research, and identify future directions. While our findings primarily represent strategies used by expert creative practitioners, we speculate on ways in which these techniques may apply across domains, or be used to scaffold newcomers into sustainable creative practice.

5.1 The value of forgetting

Recent thinking in psychology has resulted in a major reframing of memory "failures", uncovering the ways in which errors can be beneficial to mental processes, including evidence that memory failures can facilitate novel thinking [24]. These recent findings have not yet been incorporated into the design of creativity support tools, but offer a structured way to consider how tools might leverage creative strategies like *Strategic Forgetting*. For example, memory errors that involve incomplete encoding, which the Director and Performer embrace, can be categorized as one of three types of 'omission' error [24], two of which are relevant here: *transience* and *absentmindedness*. Transient memories, or those that gradually fade over time, may help break creative "fixation" by letting irrelevant information fade, resulting in more focus on the problem at hand. Deliberately not capturing ideas may allow the subconscious mind to distill out the valuable content, only retaining the ideas that resonate. Absentmindedness describes the tendency of the mind to drift to new topics, which may result in creative combinations of seemingly unrelated information. Not writing down notes about an idea may increase the chances of encountering new ideas together with the topic at top of mind.

Because the mind automatically has a tendency to drift to new topics, Strategic Forgetting may increase opportunities for new and creative connections. This technique is related to, but distinct from, a well-known strategy of *incubation*, framed by early discussions of mathematical creativity: "incubation generally precedes illumination. In this period of incubation, no work of the mind is consciously perceived" [34]. Incubation continues to be important to conceptions of creativity; Shneiderman refers to those who embrace incubation and illumination as "Inspirationalists" [68, 69]. Strategic Forgetting is a more extreme strategy: rather than only taking time away from a project to allow the mind to incubate and free-associate, Strategic Forgetting prevents the capture of any information during the generative phase or prior to incubation. Identifying potential benefits of such a strategy is an area ripe for future exploration. CSTs could be designed to support hiding or obfuscation of data (e.g., by sub-sampling images, dithering, dropping frames, applying filters, etc).

While this strategy has recently begun to be explored within the field of creativity research, few designers[2] have attempted to incorporate this technique into a CST. Might a programmer think differently about the range of solution options if they prohibit themselves from writing down the details of an early solution draft? Would the architecture of an application simplify if an engineer had to remember it instead of writing it down? If we design digital tools that selectively blur notes and sketches to aid in "forgetting", should this forgetting be stochastic or predictable? Which details

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[2]One example is "another day", a tool that allows the capture of only 4 days' worth of writing at a time: https://github.com/thmsbfft/another-day

Theme	Recommendations
Strategic Forgetting	Design tools to flexibly support capture and omission, including no capture at all. A system that captures early brainstorming could also explicitly allow 'hiding' of early iterations to let the creative mind process.
Mode Switching	Support different creative modes through distinctive interfaces that take advantage of different mediums and modalities. Simplify transitions in and out of an application to help creators make a personalized 'pipeline' that works for their own process.
Embodying Process	Design progress-tracking systems to account for both practical and motivational needs.
	Provide visibility into process for personal reflection.
Aestheticizing	Provide tools that help creators become aware of and focus on the aesthetics of their creations.
	Highlight synergistic extrinsic and intrinsic motivations.

Table 2: Summary of our study findings and design recommendations for process-focused creativity support tools.

should be hidden, and when (if ever) should they reappear? At what point in a practitioner's development is it helpful to introduce these techniques - would a novice benefit from them as much as an established expert? Strategic forgetting may provide benefits through not creating artifacts at all. However, some practitioners must create artifacts in order to think-through-doing, such as a writer who develops their thoughts by drafting. To gain some of the benefits of strategic forgetting, a system could support the behavior of destroying that first draft. These represent themes that are currently underexplored in the world of software in particular, and creativity support tools in general.

5.2 Constructing creative modes via tool use

The Physical Performer's description of her relationship with her process, environment and tools closely parallels Dalsgaard's notion of *instruments of inquiry*, an understanding of the way the creative process "intertwines" and "co-evolves with" the environment and tools. This Deweyan pragmatist perspective, which underlies Dalsgaard's philosophy, elucidates the way the Performer leverages tools to augment her own cognition and creative process [18].

For example, we can frame her use of Mode Switching as 'knowing-through-action': combining her expertise as a professional performer with the tools of video-recording and writing together produces output – in this case, a scene – that is meaningful and that moves her design process forward. This 'knowing-through-action' arises as she leverages different tools throughout her process. She explicitly describes the different 'modes of work' she taps into by using the video-camera, or the journal, and how these tools then shape the mindset she has and the way she interacts with her own output. Distributed cognition [37] presents a similar lens for understanding this concept, which also embraces the larger context of her working environment as part of her cognition. In other words, her creative process is an emergent property of the interaction between her own skills and the camera or the journal.

A similar method, reported by Frich et al. [28], is the 'view-shift' strategy, described as: "deliberately shifting the perspective or view of the workspace in order to move between a view of the whole composition and a component that is part of it." View-shifting is primarily about switching between two perspectives to gain additional perspective on a particular sub-part of a project. In contrast, Mode Switching is about deliberately using different tools to manage creative, cognitive, and emotional needs across a project's lifetime. However, both represent emergent properties of the interaction between the practitioner and their tools.

Seen through the lens of *instruments of inquiry* [19] or distributed cognition [37], we can see the importance of understanding how closely enmeshed the creative behavior is with the tools at hand. In the example described above, switching modalities (from video-taping to writing) was nearly synonymous with switching creative modes (from generating to editing). It is difficult to separate the thinking and doing aspects of her working style, and difficult to separate the goal of the task from the tools used in that task. In what ways can tools support this process? Is the switch from paper-based to a video-based medium important? Our findings resonate with earlier work on tangible tools that tap into muscle memory and tacit, embodied forms of knowledge [45]. Finding ways to switch modes by switching tools can help practitioners transition across different stages of their creative process. Our work further motivates the design of tools that span modalities and mediums, or that have distinctive digital interfaces. More extreme switching of mediums may help more extreme switching of creative modes. Additionally, tools that make it easy to transition in and out of an application can help creators make a personalized 'pipeline' to support stages of a personal creative process.

5.3 Benefits of metacognitive awareness

To improve a process, it is important to first understand what the existing process is. Examining the steps involved in generating artifacts can bring awareness to the creative processes in place. Even during our interviews, our participants found that discussing, analyzing, and coming to a deeper understanding of their own processes was interesting, helpful, and at some points almost cathartic.

In addition to revealing process, artifacts can themselves provide metacognitive benefits. Some of our creative practitioners deliberately leveraged artifacts generated through their creative process as tangible reminders of a hard day's work. Supporting emotional well-being by embodying, foregrounding and visualizing progress is key to maintaining a long and sustainable creative practice. Hazzard et al. generated a 'taxonomy of failure' in the context of musical performance [35] highlighting another perspective on 'failure' in the context of artistic practice. Abtahi et al. recently explored ways in which people engage in manual self-tracking practices, finding similar benefits of creating personal, tangible traces [1]. Would a software engineer feel more positively about the productivity

of design sessions if that process generated a visible or tangible indication of activity? How can a system foreground these types of otherwise-ephemeral efforts in a way that supports creative work?

5.4 The role of aesthetics in task motivation

Some of our expert participants have found that embracing aesthetic refinement keeps them engaged in their creative practice. This engagement relates to the nature of motivation, intrinsic and extrinsic: the AR/VR Artist's and Industrial Designer's approaches are "synergistic extrinsic motivators", part of the task motivation component of Amabile's Componential Model of creativity [2]. Synergistic extrinsic motivators both 1) support a "sense of competence" and 2) enable a deeper involvement with the task, without undermining their sense of self-determination (a known problem with extrinsic motivators such as gamification). For these creative practitioners, aesthetics is such a synergistic motivator. Aesthetic satisfaction also has echoes of the values of craftsmanship: "an enduring, basic human impulse, the desire to do a job well for its own sake" [67]. Craftsmanship fosters a sense of pride and satisfaction in one's work, and ownership over process; for these creators, valuing aesthetics contributes to their sense of a job well done. Aesthetic enjoyment might also increase the length of time someone spends engaging with their creations, or make the creations themselves more memorable.

For some creators the pressure to create something beautiful can disrupt their creative process and cause writer's block. We note with interest that the early career Academic reported this, while the experts did not. For our expert informants, the joy they got from creating high quality artifacts kept them engaged in the process, and motivated them to continue creating. Our view is that nearly any behavior that keeps a creative practitioner joyfully engaged with their practice is valuable, as long as it does not become a fixation that prevents forward motion. Even if "best practices" recommend low fidelity creations, experts often find value in taking the time to enhance aesthetics when it works for them. Low-fidelity is often conflated with low-aesthetics, but even low-fi prototypes can maintain a level of craftsmanship and care. The Industrial Designer describes the extensive effort he put in to avoiding ragged edges when cutting foamcore, investing significant effort into creating clean cuts even during lo-fi prototyping. There is a certain level of craftsmanship that can be embraced even when other details are excluded. Because aesthetic taste is so personal, and tools cannot be designed to satisfy everyone, tools might instead help practitioners *identify* and *reflect on* their aesthetic preferences, and how these might be influencing their creative process.

6 LIMITATIONS AND FUTURE WORK

In this paper, we have engaged with a broad array of creative practices. We have identified tool- and domain-agnostic strategies that have great potential to provide insights that are relevant across domains, mediums, and approaches. Our primary interest is in what Kvale might describe as the "what could be" target of generalization [46]; seeking insight from the true experiences of individuals. We have found that learning about others' successful creative strategies is often beneficial; though creative process is highly personal,

heuristics and work styles can be learned, shared, and adapted between individuals [2]. Indeed, people often informally share their creative strategies in online settings as part of their creative process.

Foregrounding creative strategies may help individual practitioners experiment with their own process by applying new heuristics. Designers of creativity support tools can engage with process-focused aspects of creativity, incorporating support for heuristics to assist users in developing satisfying, lifelong practice. In the future, we hope to present these strategies and techniques to practitioners across disciplines. For instance, what would the AR/VR Artist or the Weaver think about the concept of 'strategic forgetting'? How might the Animal Behavior Researcher incorporate 'Aestheticizing' into her process? In addition to expanding our understanding of these practices, this could help identify the extent to which such techniques are actually 'practice-agnostic'.

Our methodology engages primarily with techniques that a practitioner is consciously aware of and can actively reflect on. Complementary methodologies may surface techniques that practitioners are not aware of or are hesitant to share with an interviewer. In future work, observations and formal contextual inquiry, paired with further interviews and microgenetic techniques are a particularly promising area for generating deeper understanding of unconscious behaviors [42, 77]. We also note that the two practitioners who shared feelings of dissatisfaction with their process (the Academic and the Software Engineer 3) are both early career practitioners. Further work may explore how creative satisfaction evolves over time. An additional area of interest is how and when to scaffold newcomers into behaviours that experts identify as supporting successful, sustainable careers. The strategies reported here are a selection of examples; many more creativity heuristics exist, and could be identified and shared through further research with other practitioners and domains.

7 CONCLUSION

In this paper we have described strategies and techniques that diverse creative practitioners leverage throughout their practice to manage their cognitive state, working style, motivation, and creative output. We identified four strategies from semi-structured interviews: Strategic Forgetting, Mode Switching, Embodying Process, and Aestheticizing. We then connected these to existing creativity research literature, and synthesized our findings into recommendations that we hope will inform the future design of Creativity Support Tools that increase generation of creative work in a way that also enhances creativity itself.

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[3]https://creativecommons.org/licenses/by/3.0/

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