

Understanding Physical Practices and the Role of Technology in Manual Self-Tracking

PARASTOO ABTAHI, Stanford University, USA
VICTORIA DING, Stanford University, USA
ANNA C. YANG, Stanford University, USA
TOMMY BRUZZESE, Stanford University, USA
ALYSSA B. ROMANOS, Stanford University, USA
ELIZABETH L. MURNANE, Dartmouth College, USA
SEAN FOLLMER, Stanford University, USA
JAMES A. LANDAY, Stanford University, USA



Fig. 1. Examples of our participants' mood and habit trackers, showing diverse styles, ranging from artistic to analytical.

Self-tracking practices enable users to record and analyze their personal data. In recent years, non-digital forms of manual self-tracking, such as bullet journaling, have gained popularity. We conduct a survey (N = 404) and follow-up interviews (N = 18) to better understand users' motivations for physical tracking, the challenges they face with their current practices, and their perceptions of both digital and physical tracking tools. We find that for some users, physical practices are a structured and constructive creative outlet and a form of artistic expression. While the resulting physical artifacts may not easily enable retrospective reflection over long-term data, they preserve personal traces in a unique and tangible form that is meaningful to users. Moreover, the reflective power of physical tracking stems from the interaction with the physical materiality, the slow pace of these practices, the creative exploration they facilitate, and the associated digital disconnect. We conclude with design implications for future technologies, including ways digital tools might extend current physical practices and support richly reflective self-tracking.

Authors' addresses: Parastoo Abtahi, Stanford University, Stanford, USA, parastoo@stanford.edu; Victoria Ding, Stanford University, Stanford, USA, vdng1@stanford.edu; Anna C. Yang, Stanford University, Stanford, USA, ayang7@stanford.edu; Tommy Bruzzese, Stanford University, Stanford, USA, tbru@stanford.edu; Alyssa B. Romanos, Stanford University, Stanford, USA, aromanos@stanford.edu; Elizabeth L. Murnane, Dartmouth College, Hanover, USA, emurnane@dartmouth.edu; Sean Follmer, Stanford University, Stanford, USA, sfollmer@stanford.edu; James A. Landay, Stanford University, Stanford, USA, landay@stanford.edu.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, or post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

© 2020 Copyright held by the owner/author(s). Publication rights licensed to ACM.

2474-9567/2020/12-ART115 \$15.00

<https://doi.org/10.1145/3432236>

CCS Concepts: • **Human-centered computing** → **Empirical studies in ubiquitous and mobile computing**.

Additional Key Words and Phrases: Self-tracking, quantified self, mood tracking, bullet journaling, self-reflection, mindfulness

ACM Reference Format:

Parastoo Abtahi, Victoria Ding, Anna C. Yang, Tommy Bruzzese, Alyssa B. Romanos, Elizabeth L. Murnane, Sean Follmer, and James A. Landay. 2020. Understanding Physical Practices and the Role of Technology in Manual Self-Tracking. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 4, 4, Article 115 (December 2020), 24 pages. <https://doi.org/10.1145/3432236>

1 INTRODUCTION

Self-tracking practices are important ways in which individuals record and draw patterns from personal data [69], often with a focus on health and wellness, for instance to manage mood, symptoms, exercise, or eating habits. In recent years, there has been a growing interest towards automatically tracking such information through sensing and digital technologies, for instance through wearable fitness devices (e.g., eyewear, rings, shoes, watches, wristbands) [47, 64], smartphone or ambient sensors to passively monitor health indicators [19, 46], or through semi-automated approaches that combine manual and automated tracking [11, 40] such as photo-based food journaling that lowers tracking burdens while maintaining active involvement in data collection [18]. Alongside these advances, there has also been an increase in the popularity of purely non-digital styles of manual self-tracking, such as journaling with pen and paper [60].

Bullet Journaling (BuJo) is a freeform, analog logging system for organizing tasks, events, and notes, designed to facilitate a productive and reflective lifestyle [9]. Mood tracking in particular has become popular as a "low-tech" bullet journaling practice [3]. For example, Year in Pixels is a technique where users color one square in a grid according to their mood, for every day in a year [8]. The practice is designed to help individuals reflect on their emotions, increase emotional self-awareness, and more effectively communicate emotions and needs to others. These positive outcomes may be attributed to the slow, deliberate nature of the activity [57]. At the same time, various mobile apps are now becoming available to support the simple and predefined structure of Year in Pixels, making it a well-suited case study to better understand users' practices and preferences in the modern landscape of analog and digital self-tracking tools.

In this paper, we explore people's idiosyncratic, non-digital tracking practices to highlight the value found in these activities, understand what challenges people face, and identify how digital tools might best support such needs while preserving the simple but rich benefits of low-tech tracking. In doing so, we build on recent research from Ayobi et al. [3], who analyzed a corpus of public Instagram posts related to paper bullet journaling as a way to examine the types of information people track and how they design their journals. They found that "*visualising data by hand can be an end in itself*," as the physicality of the process promotes engagement in self-reflection. Moreover, they emphasize how digital tools should focus on extending current practices, rather than replacing them, and support self-tracking in ways that maintain their reflective nature, instead of focusing on automation.

To more deeply understand and unpack people's attitudes regarding physical and digital tools, we extend prior work by taking a different methodological approach. Specifically, we conducted a large-scale survey (N = 404) and small-scale follow-up interviews (N = 18) with people who engage in self-tracking. Our primary contributions include 1) novel insights about people's current practices, motivations, frustrations, and broader perceptions of different tracking approaches, as well as 2) design implications for future technologies that can support and augment reflective self-tracking.

We find that for some users, the physical self-tracking practice serves as a structured and constructive form of artistic expression. For these individuals, writing by hand using a physical implement is imperative, and the creativity and aesthetics of trackers drive engagement. Moreover, we find that the tangible artifact is integral for preservation and personal legacy but that long-term retrospective reflection is challenging using physical tools. Accordingly, we propose recommendations for the thoughtful design of future generations of digital self-tracking

tools. These include opportunities for tools that augment physical practices through duplicate data collection and post-hoc data manipulation and visualization, as well as tools that support reflective self-tracking through creative freedom, slow and calming designs, and perceived digital disconnect.

2 RELATED WORK

2.1 Personal Data Practices and Digital Tools

With technology that can capture, store, and process personal information increasingly becoming part of our daily lives, a variety of cultural trends around collecting such data have emerged, such as lifelogging and the Quantified Self (QS) movement, together with the scientific study of these activities. We broadly refer to such personal data practices as "self-tracking".

Foundational work in personal informatics (PI)—a term originally introduced by Li et al. [44] to refer to the use of technologies for collecting and reflecting on personal information—conceptualized self-tracking as a five stage iterative process through which a person will prepare what data to collect and how, perform that collection, integrate and organize the data, reflect upon it, and eventually determine how to translate insights into a plan for action. Since then, researchers have continued to extend this model and develop further conceptualizations of personal data practices, including to identify additional styles of tracking (e.g., goal-driven and documentation-based activities [62]), stages of tracking (e.g., a maintenance phase and lapsed tracking [23]), and social aspects of tracking (e.g., the collaborative collection, sharing, and interpretation of personal data as well as the broader sociocultural backdrop in which self-tracking is embedded [51, 56]).

The literature finds that people use personal informatics tools to track various aspects of daily life, including finances, visited locations, and meals [23], though a majority of users are interested in capturing data about fitness, health, and well-being specifically [14, 69]. There are now over a quarter of a million health apps available to smartphone users, with downloads in the billions [29, 65]. Compared to self-trackers in general, the QS community has been identified as an example of "extreme users" [13] who aim to make the body a more knowable and hence "calculable and administrable object" through self-monitoring activities that represent a variety of bio-behavioral information via numerical, objective metrics [68, 69]. To capture such data at more accurate, continuous, and granular levels, technology-based measurement approaches are typically employed, for instance through on-body or even implantable sensors [50], video records [27], and biofeedback mechanisms [30].

Digital tools are associated with a few main benefits when it comes to self-tracking. First, the portability of personal mobile and wearable devices make them easy to access anytime and anywhere, especially compared to physical self-tracking artifacts that might be bulky or delicate to transport or that may be more easily forgotten. Digital tools' storage capabilities also enable the compact accumulation and indexing of large volumes of personal data, which can later be referenced. In addition, self-tracking interfaces are generally designed to be quick and lightweight to use, which can make for an efficient logging session. For example, several researchers have developed approaches that allow a user to tap icons or perform gestures on a smartphone lock screen in order to journal health information such as mood [76], sleep [12], or water intake [72], while other work has developed self-reporting prompts that enable users to record information directly from the notification panel [54]. Further, such notifications provide a means of proactively engaging users (e.g., by sending reminders to track). Finally, digital tools can help synthesize data, compute health statistics, and pull out patterns that a user can then examine to gain insights.

At the same time, whether performed purely "by hand" or through technology-mediated approaches, the manual capture of data is associated with several benefits. Non-automated self-tracking can empower users with a sense of agency [55], and directly engaging with data can foster self-awareness [13] and enhance mindfulness about behavior [41, 74]. A number of designers have suggested a hybrid approach, combining passive sensing with opportunities for users to manually contribute self-reported information. The UbiFit system [17] is an early

example of a system that inferred various physical activities automatically, while giving users control to edit or add data. More recently, researchers have formalized a spectrum from fully manual, to semi-automated, to fully automated tracking approaches, including the pros and cons of each with respect to different contexts, users, and types of data [11]. To instantiate such ideas, the OmniTrack system offers an architecture that enables users to define and customize semi-automated tracking setups to meet their needs [40].

2.2 Reflective Self-tracking and Slow Technology

On the other end of the spectrum from quantification-centric tracking that prioritizes accuracy and efficiency, other self-tracking efforts have emphasized more of a qualitative approach to data capture and sensemaking that focuses on mindfulness and reflection rather than an intent to change or optimize oneself. "Slow technology" was introduced as a design agenda in the early 2000s [28] to encourage the creation of systems aimed at promoting such contemplation and deliberate engagement. A key idea was that slow technologies were not intended to be immediately impressive, exciting, or computationally innovative but rather combine simplicity in material with complex, rich forms to create special experiences and opportunities for reflection. A broader modern movement around "slowness" similarly promotes a cultural refocus around balanced and deeply engaged living that emphasizes quality over quantity [57].

In the context of personal informatics, researchers are similarly exploring more reflection-oriented approaches. Ideas around "reflective informatics" provide a conceptual foundation and potential dimensions related to precipitating breakdowns, intentional inquiry, and transformed understanding along which technologies can be designed to support reflection [4]. "Documentary informatics" focuses on documenting and recalling memories rather than changing behavior, emphasizing self-tracking as a means of self-expression and remembering, rather than for data-driven monitoring and regulation [20]. Such work builds on "lived informatics" models that center the experiential aspects of tracking, rather than technological or goal-oriented perspectives [62].

Several recent projects have explored the complexities of lived experiences and relationships through data. In *Metadating*, researchers invited participants to create personal data profiles that were used as a vehicle to communicate during speed dating sessions, provoking questions about self-representation, identity, and how data can be a creative conduit for personal expression and socialization [21]. Similarly, the *Connected Shower* highlighted how "intimate" data is not necessarily intimate or sensitive in and of itself but in its role as a mechanism for fostering interpersonal interactions [42]. As documented in *Dear Data* [49], Lupi and Posavec sent each other hand-drawn postcards for a year, conceiving of the deliberately analog artifacts as "personal documentaries" to deeply learn about themselves and each other. Friske et al. also employed first-person methods, using yarn and sound as media to encode and exchange personal data narratives between the authors [25]. One common theme in such work has been the exploration of alternative formats, including physical artifacts, as part of collecting and representing data.

2.3 Physical Formats and Expressive Representations for Personal Data

In parallel with technical advances in data collection and analytics, recent years have also seen the careful critique of emerging data frontiers, including to promote more intentional technology design as well as consideration of scenarios where information technology may be inappropriate or even do more harm than good [5, 52, 53]. A push by self-trackers can similarly be observed towards deliberate practices that focus on non-digital approaches, especially through the use of physical artifacts like familiar paper-based formats [70]. Indeed, people have used paper to self-track personal information long before technologies existed to support the activity. Benjamin Rush's 1790 "Moral Thermometer" [63], which aimed to promote the temperance movement, was a paper chart that catalogued a variety of emotional states and associated behaviors and is considered one of the earliest self-tracking instruments in modern history. Today, people continue to use paper-based tools as a medium for recording and visualizing personal data, including mood tracking in particular [3].

Prior work has identified that preferences for non-digital forms of self-tracking can stem from familiarity with physical materials, which enhances self-reflection by relieving the need to learn and navigate new interface components [71]. Physical forms also activate perceptions beyond the visual and provide pleasurable multi-sensory experiences, such as the sound of pencil on paper and the tactility of a physical instrument's texture or weight [32]. Further, the process of crafting and caring for paper journals by hand imparts deeper meaning and intimacy between people, their information, and their artifact [70]. Such artifacts can also be tailor-made, whereas a commonly cited issue with existing digital tools is a lack of flexibility, for instance in supporting tracking goals that may not be well-defined or that may evolve over time [45] or in enabling customization of how data is recorded or represented [33, 34].

Regarding data representation specifically, most self-tracking tools use 2D visualizations that are rooted in scientific conventions that are heavily numerical and oriented around analytic tasks [48]. Recently, more "casual" visual depictions of data geared at non-expert users are being explored [61], for instance by using more artistic themes and personalized metaphors [39] that may even be co-designed with users to better convey the underlying lived experiences they represent [67]. The Trackly app allows users to define custom variables to monitor and select from a palette of pictorial trackers that can be colored by touching the screen [2]. To further give users creative control over personal data visualizations, authoring tools like DataInk [75] support expressive, free-form sketching combined with data-driven visualization. The term "casual creators" has been offered for such systems that aim to recreate the creative feeling associated with using physical artistic tools, by providing a freedom that encourages users to explore within a predefined space of creative artifacts [16].

Few digital tools exist, however, that combine both the data collection and visualization aspects of self-tracking in an expressive, meaningful, and personalized manner. One advantage of physical formats is that they enable precisely this blending, with the process of data logging actively producing an aesthetic archive. For example, it has been observed that bullet journalists develop rich textual and visual languages involving customized symbols and narrative techniques as they track idiosyncratic items of personal interest [3]. Recent work has begun to explore bridges between personal informatics and data physicalization, for instance by designing 3D-printed physical metaphors to represent a user's activity data in playful material formats [36, 37] or by guiding users through processes to creatively envision how to express information being tracked, prepare physical tokens (e.g., beads) to realize this vision, and ultimately construct the artifact [71]. Such efforts are often aimed at exploring forms and objects that invite alternative kinds of data engagement and reflection and that embrace the complexity and experiential nature of self-tracking [22, 35].

Motivated by the clear value in exploring more expressive, flexible self-tracking tools that combine the benefits of digital and physical modalities, our research aims to fill in the current gaps in understanding regarding why and how people engage in physical self-tracking, the benefits and barriers they face, and the design opportunities these insights can offer for the interactive and pervasive computing community.

3 SURVEY

To better understand people's tracking motivations and practices, including what information they track and how they do so, we designed a brief survey to be deployed at-scale. For those engaging in physical self-tracking, we were interested to learn more about their preferences and perceptions of digital tracking tools. We therefore asked open-ended questions about the limitations of their current practices, reasons why they prefer physical self-tracking, and whether they believe a digital tool could replace or improve their current practices.

3.1 Survey Questions

Our survey consisted of 9 main questions that asked about users' current self-tracking practices, including the tools they use (such as mobile apps, journaling, and wearables), what they like and dislike about their practice,

and their perception of digital and physical tracking methods. All survey questions can be found in the Appendix (section A). Participants were then asked to submit their name and email address if they were willing to take part in a follow-up interview about their self-tracking experiences. The survey was concluded by a set of optional demographics questions, asking participants' age, gender, location, highest level of education, and occupation.

3.2 Recruitment

The survey was online and publicly available for one month. The link to the survey was shared on our research group's website and advertised through social media. Considering our snowball sampling approach and the demographics of our networks, we anticipated most of these respondents would be students and researchers. Therefore, to reach a broader sample, including people who already engage in non-digital self-tracking practices, our group created an Instagram account where we included the link to the survey and regularly uploaded content related to BuJo and Year in Pixels. We then searched for public Instagram accounts using common tags identified by prior work [3], including #bulletjournaling, #moodtracker, and #habittracker. We also used the tag #yearinpixels, as we were specifically interested in reaching people who engage in the Year in Pixels practice (see Figure 2). We identified 700 public Instagram accounts, with *top viewed* or *recent* posts using those tags, and we shared the survey link with those accounts through direct messages. We acknowledge that our recruitment strategy has a bias towards individuals who choose to share their self-tracking artifacts publicly on Instagram.

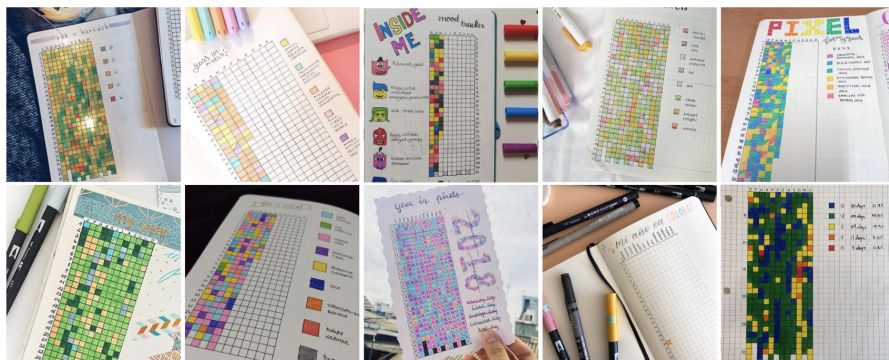


Fig. 2. Year in Pixels technique: each day is represented as a square and colored in according to that day's mood.

4 SURVEY RESULTS

420 people took the survey, with each session taking an average of 3 minutes. We removed 16 duplicate responses, based on the IP addresses and identical uploaded images. From the remaining 404 responses, 287 participants fully completed the survey, taking on average 10 minutes per session. All answers, including incomplete responses, were included in the analysis. In our reported findings, numbers in parentheses denote frequencies. On open-ended responses, we conducted an inductive qualitative analysis with 5 coders to extract and come to consensus on reported themes. 150 participants uploaded photos of their trackers. We did not analyze these images, given prior work has done so previously [3], but we present them throughout the paper as contextualizing examples.

4.1 Demographics

To complete the survey, participants had to be 18 years of age or older, which excluded younger users from our analysis. Of the 404 survey respondents, 249 reported their age (min = 18, max = 60, $\mu = 24.9$, $\sigma = 7.5$). 263 people reported their gender identity. Of those, the overwhelming majority identified as female (93%), followed

by male (6%) and non-binary (1%). Considering that around half of adult Instagram users are female (51%) and the majority between the ages of 25 and 34 [15], our survey demographics suggests that either physical self-tracking practices, such as Year in Pixels, are more popular among younger women, or that this population was more willing to complete our survey. 271 survey respondents reported their country of origin. We received responses from 44 countries, in North America (126), Europe (95), Asia (31), South America (12), Australia (6), and Africa (1). 40% of respondents were from the United States, which could perhaps be influenced by our recruitment strategy and the fact that survey questions were written in English. Of the 278 participants who reported their level of education, 38% had completed high school, 33% had a bachelor's degree, and 16% a master's degree or higher. 246 people reported their occupation; around half (47%) reported being students, followed by educators (7%).

4.2 Tracked Information

300 participants reported the type of information they track using digital and physical tools, with each person reporting around 4 different pieces of information (min = 1, max = 11, $\mu = 3.8$, $\sigma = 2.0$). The most commonly tracked information was moods and emotions (68%), as expected due our recruitment strategy's emphasis on such data, followed by fitness activities (58%). See Appendix (section B) for a more detailed breakdown.

4.3 Tracking Practices

300 participants reported what tools they use to track their data. Around half (53%) reported using physical formats, such as bullet journals (153), other journals (72), manual note taking (57), Year in Pixels (44), and planners (19). Note that these numbers do not reflect the overall popularity of physical practices among the full self-tracking community, as we had specifically recruited individuals who use non-digital tools. Regarding digital tracking, just over a quarter of survey respondents (26%) reported using mobile apps, including Apple Health (14), Fitbit (14), and Clue (13). Respondents also reported using a wearable device, such as Fitbit (29) and Apple Watch (20), as well as spreadsheet applications, such as Google Sheets (7) and Microsoft Excel (3).

4.4 Experienced Limitations of Physical Tracking

207 survey respondents described the perceived limitations of their physical self-tracking practices. 46 indicated that they do not experience any frustrations, while 161 reported facing various challenges, described next with representative quotes.

Forgetting and post-hoc recording. Participants reported sometimes struggling to remember to track their data on a daily basis (44). "There are days that I forget to use it, but I think that's part of the journaling experience." This was particularly an issue while users are travelling and cannot easily carry their materials with them (18). Respondents reported being frustrated with their incomplete journals (33) and having difficulty remembering their data when attempting to later complete their trackers retrospectively (12). "When I skip checking several days in a row, it is quite a big decision to continue and catch up."

Time and effort. Participants noted that physical tracking consumes a substantial amount of their time (15) and effort (4) and that they cannot always dedicate this time and effort to their practice. "Finding time to fill out the tracker can be hard, if I'm busy." Particularly, users reported that the initial set up is laborious and time consuming (21). "It's also a hassle to draw the whole lay-out, before being able to track anything."

Fixing errors and imperfections. Users reported frustrations with physical trackers being unalterable (11) and their inability to correct simple mistakes (9). "I cannot change anything if I make a mistake or no longer want a category." This issue was exacerbated by the pressure that some users feel to make their trackers artistic and visually appealing (16). The static nature of physical trackers also makes it more challenging to modify their

trackers as their needs and goals evolve over time. *"It's hard to update an existing representation of the state of something, so I have to redraw it."*

Data management and analysis. Survey respondents reported that they track too much information, written across many notebooks over the years (8). Users are unable to aggregate their data, search for information (2), or draw meaningful insights over time (5).

Self-criticism and negativity. Participants mentioned that their physical trackers could be a source of negativity (9), self-criticism (6), and a permanent representation of goals that were not reached (3): *"a physical record of my failure."* *"It was mostly frustrating how easily I could just not do a simple task like colouring a box."* These negative consequences are consistent with prior research on digital self-monitoring [24].

4.5 Perception of Digital Tools

251 participants who currently use physical tools answered whether or not they believe a digital tool could replace or improve their current practice. Around half (51%) responded with "No", while 32% said that digital tools could "Maybe" replace or improve their practice; however, some indicated that they would still prefer non-digital forms. When asked to elaborate, the main reason respondents chose "No" was that they believed no digital experience could replace the sensation of writing on paper (53) or support their practice in a way that would maintain its reflective and relaxing nature (20). Participants also believed that digital tools could not grant them the creative freedom they desire (24). Those who chose "Maybe" indicated that digital tools could only replace or improve their current practice if they were fully customizable (25).

17% of respondents chose "Yes", highlighting the benefits of digital tools, such as their efficiency (11) and ways they could improve one's current practices. People stated that it is both faster to initially set up and to record data on their electronic devices. Other reported benefits included portability of electronic devices (5), receiving notifications (4), and the sustainability benefits of using fewer physical materials (4).

4.6 Reasons for Choosing Non-digital Forms

247 participants rated how strongly they agree or disagree with various statements, describing their preference for physical tools over digital ones. These options were identified based on our initial findings and prior literature (see Figure 3). 173 participants further explained their reasoning, by responding to an open-ended question.

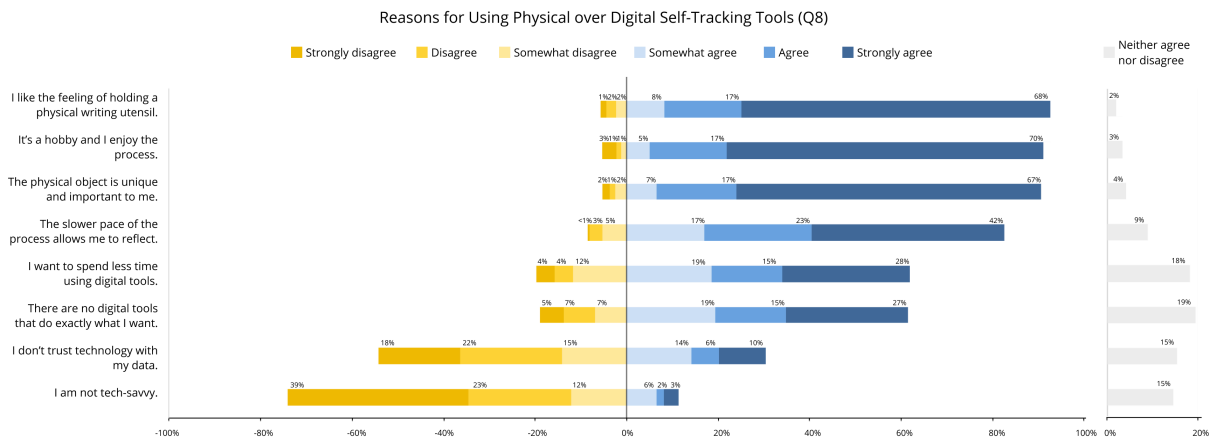


Fig. 3. Participants' ratings for each statement, according to reasons they choose physical over digital tools.

Art and creative expression. One of the highly rated reasons for choosing non-digital forms was *"It's a hobby and I enjoy the process"*, with 70% of respondents strongly agreeing and 92% indicating that they agree to some extent. This is perhaps correlated with users mentioning that they enjoy their physical practice as a **creative outlet** (36) and **an art form** (23). They also mentioned using this practice as a way of improving their skills, such as drawing (16) and calligraphy (2). One participant said *"because without my bujo I wouldn't paint so much."* Another reason mentioned by participants was the joy of using stationery supplies (10), including pens (10), stickers (6), and washi tape (3). The importance of visual appeal and the aesthetics (6) of the tracker was another reason some participants chose not to use existing digital tools.

Tangibility and the physical artifact. Another highly rated statement was *"I like the feeling of holding a physical writing utensil"*, with 93% of users agreeing to at least some extent with this statement. Moreover, participants felt that the physical medium, the bullet journal or planner, was a significant part of their tracking process, with 91% rating *"The physical object is unique and important to me"* as the reason they choose a physical practice. In the open-ended question, **tangibility** (15) was mentioned, including the importance of the sense of touch (5) and holding something (4). People explicitly mentioned *"it is more tangible"* (2) or *"feels more real"* (2). Survey participants also highlighted the importance of the produced artifact (7), saying that the final item that is created in the tracking process is novel and unique (5). Moreover, respondents reported engaging in physical practices in order to share (6) this artifact with their family and friends or through social media.

Slowness and reflection. 82% of respondents felt that the slower pace of their process allowed them to self-reflect. Participants described their physical practice as **relaxing** (15) and **reflective** (16). They also mentioned looking back after a period of time, and that the non-digital form makes it easier to **reminisce** (14), for example because the notebook can be placed on a shelf to be later picked up to flip through the pages.

Flexibility and customization. 61% agreed with *"There are no digital tools that do exactly what I want."* In the open-ended responses, this issue was frequently referenced as the **lack of flexibility** (35) in existing digital tools, and an inability to customize and personalize the digital practice to match personal needs. Respondents said they are better able to organize (7) their data using free-form, physical practices. People less frequently mentioned the lack of specific existing apps that do what they were looking for (3).

Overuse or mistrust of technology. 62% of respondents agreed that they choose physical forms because they want to spend less time using digital tools, though this seems secondary to the appeal of the physical instruments themselves, as described earlier. Wanting to **disconnect from technology** (17) was also frequently referenced in the open-ended question. People mentioned looking for an escape from their work and other forms of digital media consumption and that their physical self-tracking practice is a *"break from digital tools."*

30% of people agreed with the statement *"I don't trust technology with my data"*, as a reason for not using digital self-tracking tools. Only 11% of participants rated *"I am not tech-savvy"* as the reason for preferring physical tools. Those topics were also mentioned in open-ended responses, including privacy concerns (3), lack of familiarity with technology (1), and fear of dependence on digital tools (1). It seems that the preference for physical methods stems from the conscious decision not to use technology, rather than mistrust or unfamiliarity. This may however, be correlated with bias resulting from our recruiting method, which was done through social media.

We had hypothesized that one of the advantages of digital tools would be sending notifications to remind users to continue their tracking practice and the ability to store data in a more permanent way, in case the physical artifact is lost. However, these were reported as reasons for why some participants choose to use non-digital forms. Respondents said seeing the physical artifact, on their desk or shelf, helps them better remember to track (4) and motivates them to continue journaling; as one person said, *"I download an app and a few days later I forget"*

it exists." Participants also reported that storing their information in a physical medium, such as a notebook, feels more permanent and that they fear losing digital data (5) by accident or when they update or change their device.

Other reasons highlighted by survey respondents included unaffordable hardware (5) such as an iPad and Apple pencil, feeling of accomplishment resulting from their physical practice (4), not needing WiFi or power (2), better memory retention resulting from handwriting (2), and supporting small businesses such as stationery companies "*which have solid representation of women and minority ownership*" (1).

5 SURVEY DISCUSSION

Through our survey results, we found that some users approach non-digital self-tracking as a form of art and creative expression. These users consider their tracking practice an enjoyable hobby and a means to improve their skills, such as drawing or calligraphy. It seems that the utility of their practice with regards to personal informatics is an added benefit, and perhaps secondary. Many of these individuals cannot imagine a digital tool that grants them the creative freedom they seek. Moreover, they like holding a physical writing implement, the feel of writing on paper, and the use of other stationery. Participants also reported valuing the unique physical artifact that is created as part of their tracking process and stated that they cannot imagine replacing it with a digital tool, as it feels more "*tangible*", "*personal*", "*real*", and "*permanent*." Others stated that they choose a physical practice as it is relaxing and allows them to reflect. At the same time, many users acknowledged that their current practice has limitations, many of which could be overcome with the use of technology.

Following the survey, we were left with a few key questions: How do users approach their tracking as a form of art? Do they look back at their data later on? What features of physical tracking make it feel more permanent and real? What specific aspects of people's current physical practices contribute to reflection and relaxation? We were interested to dive deeper into these topics to better understand how digital tools could support or extend their practices. We therefore conducted follow-up interviews with a subset of our survey participants.

6 FOLLOW-UP INTERVIEWS

We followed up with survey participants who showed interest in being interviewed about their experiences with self-tracking. We set up 50 interview slots and scheduled 25 interviews, based on respondents' availability. We successfully conducted 18 virtual interviews with those who attended. We did not filter or select interviewees based on other metrics. Since all participants had previously completed the survey, the interviewer reviewed that person's responses prior to the session and asked relevant follow-up questions in a 15-minute semi-structured interview. In the following analysis, numbers in parentheses denote frequencies or participant ID in the form P#.

6.1 Demographics

We interviewed 18 people, aged 19 to 47 ($\mu = 26.8$, $\sigma = 7.4$). 13 people identified as female, 4 male, and 1 non-binary. Interviewees were from 5 countries: United States (12), Canada (3), Brazil (1), Mexico (1), and the United Kingdom (1). Half of the interviewees (9) reported being a student. With regards to the highest level of education, 7 had high school degrees, 5 bachelor's degrees, and 5 master's degrees or higher.

6.2 Background Information

Prior to conducting the interviews, we reviewed each interviewee's responses to our survey questions. All 18 interviewees engaged in self-tracking practices, each tracking around 4 pieces of information (min = 1, max = 7, $\mu = 3.9$, $\sigma = 1.4$), similar to the mean of our survey population. 13 out of 18 participants engaged in physical practices, with 6 participants specifically using the bullet journaling technique. 3 out of 13 participants used only physical tools, while others used both physical and mobile apps, with one person also using a wearable device. In

terms of their perception of digital tools, only one person believed that a digital tool could improve or replace their current physical practice, while 6 had chosen "Maybe" and 6 had chosen "No".

6.3 Setup and Method

All interviews were audio recorded and transcribed. We then took a collaborative Reflexive Thematic Analysis approach, with a combination of inductive and deductive coding [6, 7], using the NVivo 2020 software. Note that our analysis was influenced by related prior literature, summarized earlier in the paper, the questions we asked in our survey, the analysis of our survey responses, and the questions we asked during the interviews.

6.3.1 Assumptions. We had a few pre-existing assumptions that may have influenced our interview method and analysis. Our main assumption was that while many respondents reported engaging in physical tracking because it is an enjoyable process, we also saw that people faced frustrations and limitations that potentially, could be eliminated with the use of technology. We also assumed that many participants would not share this view and would think technology has no place in their current practice; we were interested to dig into such attitudes.

6.3.2 Interview Questions. We compiled a set of potential questions for the semi-structured interviews. The interviewer reviewed each person's survey responses in advance and chose the relevant follow-up questions accordingly. For example, some participants were prompted to describe how they started self-tracking, elaborate on frustrations they have with their current practices, and explain how they analyze or use their personal data. Interviewers also asked participants to elaborate on topics that came up during the interviews and asked additional follow-up questions that were not scripted. See Appendix (section C) for a list of interview questions.

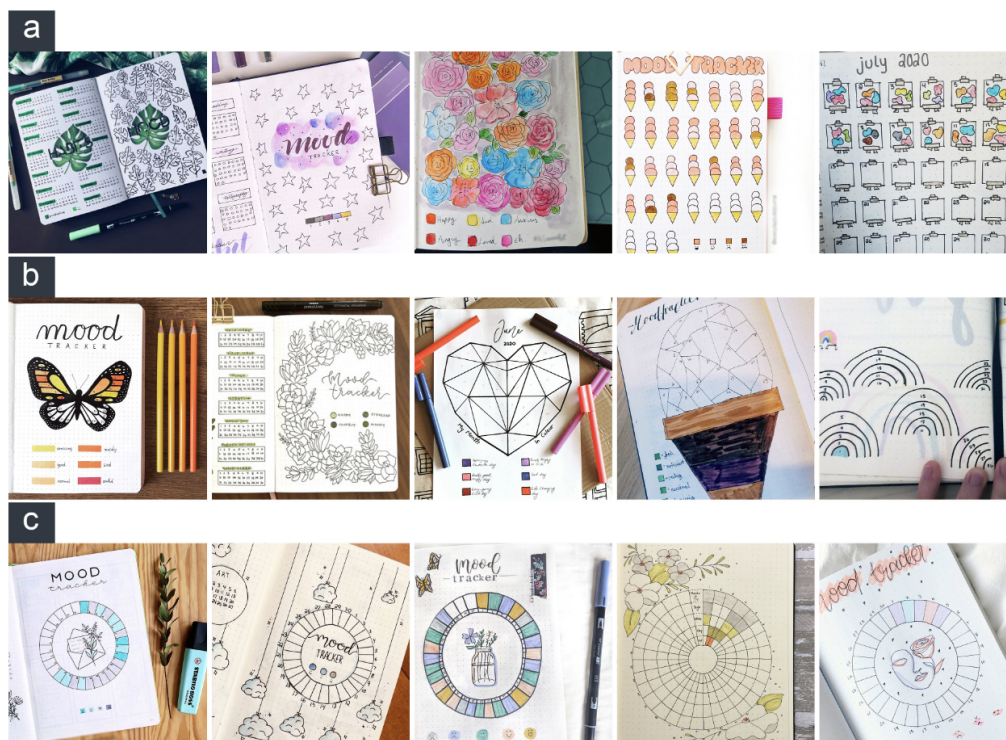


Fig. 4. Example mood tracking submissions, using (a) repetitive icons, (b) segmented graphics, and (c) decorated wheels.

7 INTERVIEW RESULTS

Here we present the findings of our qualitative analysis. Each section is organized around a high-level topic that provides context for sub-sections, denoting themes that were developed.

7.1 Art and Creative Expression

Similar to our survey responses, we found that many users engage in physical tracking as a creative outlet, a form of artistic self-expression, and an effective way to improve their artistic skills. From the 18 participants that we interviewed, 12 tracked their moods or emotions. From those who engaged in physical mood-tracking, 6 people used the Year in Pixels technique (see Figure 2), and others (6) mentioned that their practice is a way for them to be creative and express themselves artistically. We identified two artistic approaches: those who drew as part of visualizing their information, such as drawing a self-portrait to capture their mood (P1), and those who drew a template at the beginning of the month and later colored it in on a daily basis. The monthly templates seem to take on one of three forms. In the first form (see Figure 4a), people select a theme, such as ice cream (P11) or abstract art (P14), and draw repetitive patterns for each day of the month that they then color in daily, according to their mood. The second form (see Figure 4b) involves drawing a graphic, such as a heart (P1), and dividing that shape into segments for each day. In the final form of artistic mood-tracking (see Figure 4c), people draw simple trackers, such as wheels, and decorate them artistically, by "drawing things around them" (P5). As one person said, "for more simple trackers ... I usually like to dress them up a little just by drawing or decorating" (P9).

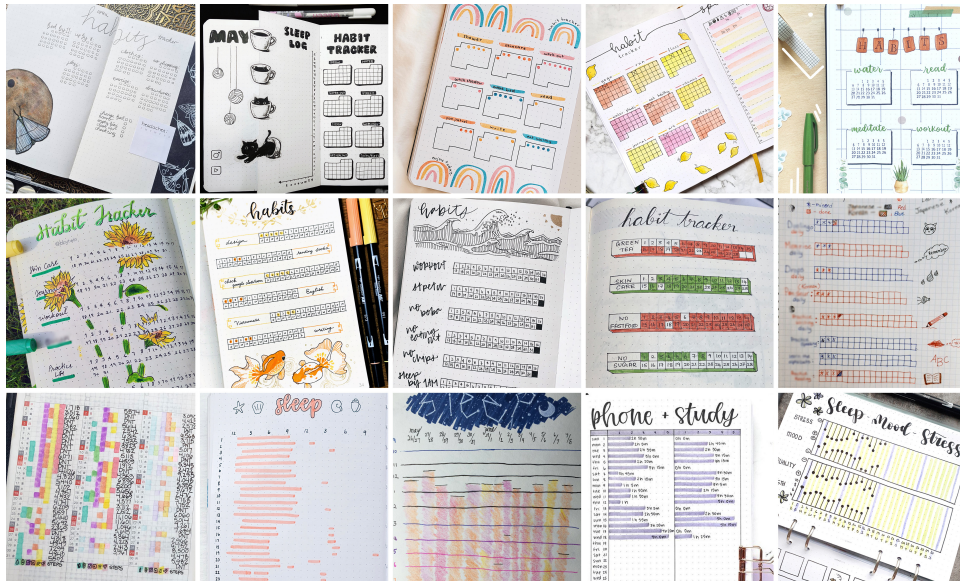


Fig. 5. Habit tracking examples, ranging from creative and artistic to minimalist and analytical approaches.

7.1.1 Self-tracking is a Structured and Productive Creative Outlet. From the survey analysis, we knew that participants used their physical tracking practices to improve their artistic skills. In interviews, we identified that tracking instruments, such as mood-trackers, give users more structure in their art practice and act as inspiration. "I also don't have any ideas for drawing most of the time, so I feel that decorating my bullet journal is drawing, so it's a good way for me to keep drawing" (P9). Specifically, the tracker itself and the creative context and cues it offers, acts as a prompt for the users' artwork. "Instead of just doing a plain July tracker, I tried to draw some of my

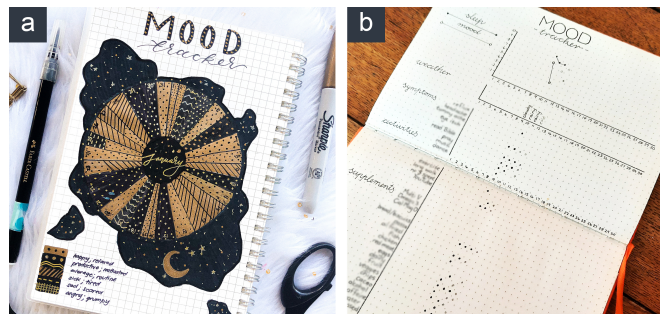


Fig. 6. Visual aesthetics in different styles of tracking, contrasting (a) artistic and (b) minimalist formats.

favorite things about summer around it" (P5). Moreover, this art form feels constructive to users, with the added benefit of personal tracking. *"What I enjoy about it is being able to be a little bit artsy, but also be able to track all of my information"* (P5). *"Bullet journal is kind of the way that I can still do art, but not waste too much time"* (P14).

7.1.2 Self-tracking Approaches Range from Artistic to Pragmatic. Physical self-tracking practices fall on a spectrum, ranging from creative and artistic to minimalist and pragmatic. As highlighted earlier, we found that users' mood-trackers ranged from those with creative themes and artistic drawings (see Figure 4) to simple techniques, such as the Year in Pixels (see Figure 2). We saw a similar pattern in participants' habit tracking practices (see Figure 5). Those on the artistic end of the spectrum use self-tracking as a prompt for their creative self-expression, while those taking a minimalist approach are concerned with efficiency and developing a sustainable practice. As one person mentioned *"I keep my track[er]s very simple"* by marking cells in a table (P4). For one person, the data collection and visualization were separate processes; we interviewed an artist who initially pragmatically performed data collection—simply writing on paper—but later visualized the data in artistic ways (P6).

7.1.3 The Visual Aesthetics of Self-trackers is Imperative. One theme that we identified is that the aesthetics of trackers is very important to users (9) — in some cases, even more so than the function they serve. *"It doesn't matter how effective it is, but if it looks nice, and I can look at it and be like that's really pleasing, that's really satisfying ..."* (P12). Participants specifically mentioned the importance of color (10) and the use of color schemes that match their style (7). We found that people with artistic tracking practices as well as those with a minimalist approach both valued visual appeal (see Figure 6). Those with simple tracking practices reported that neat and organized trackers are visually satisfying and pleasing to look at. One person mentioned enjoying the simple Year in Pixels mood-tracking technique because they found the juxtaposition of different colors visually beautiful (P4).

7.1.4 Artistic Expression and Visual Aesthetics Drive Engagement. The opportunity trackers provide to be creative and craft an artistic piece motivates participants to not abandon their tracking practice even if they believe they are *"not very good at drawing"*; *"it motivates me to actually sit down and do it, when I think about touching the papers, drawing, and making art"* (P2). Moreover, the visual appeal seems to be an important factor for engagement; *"I think it also looks good and motivates me to keep filling it out"* (P9). This encourages users to continue their practice, even when the benefits are not immediately apparent to them. *"The idea was that I could try to figure out what's making me sleep late, but that actually hasn't been helpful, so much as just cool to look at"* (P35).

7.2 Tangibility and the Physical Artifact

Interviewees mentioned the importance of physically holding a writing instrument (P30), holding their notebook (P12), and the texture of writing on paper (P21). People also highlighted that their notebooks are an invaluable possession — a tangible artifact that is the culmination of their self-tracking practice over a period of time (P6).



Fig. 7. Use of different stationery and materials, including (a) stickers, textured paper, stamps, (b) patterned adhesive tape, markers, highlighters, and (c) printed images and calligraphy quotes.

7.2.1 Writing is Preferred to Typing for Processing and Retention. Several people engaging in physical self-tracking believed that no digital tool could replace the experience of writing with pen on paper, as it helps them process and remember the information (6). *"The act of writing out my thoughts helps me process them ... almost makes it sink in more"* (P12). *"The motion of actually writing things down, it ... ingrains it more"* (P14). These observations are consistent with prior research studying memory retention when writing by hand, compared to typing [66].

7.2.2 Use of Stationery and Materials is an Integral Component of the Practice. Interviewees were skeptical that a digital tool could replace their practice because they enjoy incorporating stationery items, such as notebooks (P1), markers (P3), and stickers (P2) (see Figure 7). *"Using colors, using washi tape, different materials, helped me meditate"* (P3). One person mentioned that the materials are an integral part of their self-tracking practice and inform the creation of the final artifact, a phenomenon described by Ingold's model of creation [31]. *"I like knowing that I could just use my materials for whatever that may be, because I often don't have a complete idea of what I'm doing when I start"* (P12).

7.2.3 Tangible Artifacts Feel More Permanent. People perceive tangible artifacts as more permanent compared to digital forms of data storage (4), despite acknowledging that physical items *"can be lost in real life too"* (P6). *"There's something about having that object and knowing that it will persist and it's sort of archival in a way that a digital file isn't"* (P6); *"having it on my phone or on my computer is less real"* (P12). Moreover, similar to survey respondents, interviewees were concerned about losing their data if they were stored digitally (P6).

7.2.4 Tangible Artifacts Hold More Sentimental Value. The self-tracking artifact was important for some people to look back on, as a way of storytelling for their future self (P35), or to share with others. *"When you have an item in your hand, something that you touched or something that someone else touched, it connects you to that person. Maybe someday my ... grandchild will find this bullet journal and have something that their ancestor touched and they will feel connected to me, even if I am no longer there"* (P1).

7.3 Reflection and Relaxation

We knew from prior work [3] and our survey responses that users perceive their physical self-tracking as a mindful practice. We were interested in finding out more about what aspects of tracking facilitate self-reflection.

7.3.1 Physical Tracking Enables Reflection When Personal Data is Unquantifiable. Interviewees mentioned that digital tools are effective for quantifiable data (5), such as weight or sleep, as well as binary information, including whether or not they meditated, took their vitamins, or had a specific symptom that day. Participants highlighted

that their physical practice helps them reflect on data that is harder to quantify (5), such as their emotions, what they are grateful for, ideas, observations, energy level, how distracted they feel, pain level, and the state of their relationships. *"Tracking fitness ... is not like an emotional thing ... and it's a lot easier to track with an app"* (P9). *"Emotion is ... a deeper thing, and for me an emotion can't really be summed up with a bunch of ones and zero"* (P1).

7.3.2 The Slower Pace of Physical Tracking Facilitates Self-reflection. Interviewees referred to tracking as a mindful practice (12) and used it to tackle their mental health challenges (8). They attributed reflection to the slow pace of the process, such as the slowness of writing by hand (see section 7.2.1), drawing (see section 8.5), and creation using physical materials (see section 7.2.2). *"I do write slower than I type, and so you really have to stay with each thought a little bit longer, as you write things out"* (P12). *"It's really meditative for me to sit and draw"* (P2).

7.3.3 Calming Rituals Accompany Physical Tracking Practices. People mentioned that they approach their self-tracking practice as a form of self-care and a way to disconnect from work. *"It's a nice transition into the evening, so that I can leave work brain and focus on something for myself for a little bit"* (P5). People mentioned engaging in rituals that set the mood and *"make the environment more relaxing"* (P3). *"It's a time to turn on music and light some candles and just be alone with myself"* (P2). People considered disconnecting from technology an important component of their ritual. *"being ... on my phone ... stresses me out ... so I think that's part of what's so relaxing is it's time away from my phone and away from electronics and it's just me in the book"* (P5).

7.4 Making Sense of and Using Tracked Data

14 interviewees mentioned how long they have been self-tracking, ranging from 3 months to 24 years ($\mu = 4.4$, $\sigma = 6.6$ years). People had different motivations for self-tracking and used their data in various ways. Similar to prior work [3], we found that users draw insights primarily by comparing multiple pieces of data and looking for correlations (see Figure 8); *"I'm feeling tired ... oh I'm not getting enough sleep this week"* (P15).



Fig. 8. Users analyze their information to find patterns, by visualizing and comparing different pieces of self-tracking data.

7.4.1 People Consult Tracked Data from the Recent Past. While interviewees mentioned retrospectively reflecting on their long-term physical trackers (P2), they noted that often, they refer to their more recent data. For example, they look back a few days to find out how much time has passed since they last took their vitamins (P2) or to identify what habits may have led to a flare-up (P13).

7.4.2 Physical Trackers Are Not Commonly Used for Long-term Retrospective Reflection. Searching for insights and patterns was frequently mentioned by interviewees. Some noted that they look back through their digital data to view their progress, such as frequency of exercise (P20) or spending habits (P30), or to search for a specific event in the past (P17). However, only one participant referred to such form of retrospective reflection in the context of their physical tracker (P2). Rather than referencing the physical tracker to search for insights, interviewees highlighted the sentimental value that their notebook has (P9), mentioning that they sometimes casually flip through for fun (P21) or to reminisce (P11). While the utility of physical tracking appears to be reflection while

in the act of data collection, it is unclear whether or not people's lack of interest in retrospective reflection stems from limitations of the physical medium, in terms of its inability to synthesize and highlight insights. One user wished to *"be able to take that data and manipulate it, because that's something that I can't do in my book"* (P5). *"When it's analog it's a lot harder to find the patterns ... it's more useful in the moment and less useful later"* (P24).

7.4.3 Data is Duplicated and Transferred between Digital and Physical Mediums. Ayobi et al. found that users transition data between digital and physical forms by sharing digital representations of their practice online and printing digital content, such as quotes, and attaching them to their physical notebooks [3]. We found that users also transition between digital and physical forms by tracking the same information in both mediums; *"I'm always going to be one of those people that does both, even if ... I've written something down on my computer, I like to write it down on paper too - like a lot of duplication."* (P12). Users mentioned they might initially track their data in a digital form, because they receive notification reminders on their phone that help them remember to track their information more consistently (P4) and because they can do so on the move (P14). Memory retention (P13) and the unique, physical artifact appeared to be the main reasons users transfer their information to their notebooks afterwards (see section 7.2); *"I still write it down on paper afterwards ... there's something nice about having a physical artifact of the recording process"* (P6). Others reported tracking their information physically first, and transferring it to an app later to find patterns and correlations using their digital data (P15).

7.5 Sharing and Social Engagement

Similar to results from prior research [3], we found that users consider public, online sharing as an integral part of their practice (8). Participants mentioned having social media accounts specifically used for sharing their trackers, as well as consuming content from *"the bullet journaling community"* (P14) on social media platforms such as YouTube and Instagram. However, this may be a bias resulting from our recruiting strategy. In addition to online sharing, users mentioned sharing their practice in-person with friends (P30), family members (P3), and co-workers (P2). Users also mentioned gifting their self-tracking artifacts; *"I like to ... knit, crochet, or make miniatures out of clay and give that to other people"* (P12). We found that people had different motivations for sharing their practice, including sharing their artwork (P12), competing with friends (P30), or communicating with professionals; *"to my doctor, I don't even have to talk to him. I can just hand him the notebook"* (P13).

7.5.1 People Share Trackers to Publicize Their Practice. We found that one of the main reasons people share their trackers is to inspire others to engage in similar practices (P14). People mentioned that they have found self-tracking practices beneficial and would like to promote these practices so others can also benefit from them. *"I hope ... someday everyone makes this kind of stuff"* (P3). *"I think a lot of people can benefit from it"* (P1). *"I really recommend this kind of practice for everybody. I think ... it really helps a lot"* (P4).

7.5.2 Private Information is Filtered When Sharing. People mentioned filtering private information, when sharing their trackers, both on-line and in-person. One person mentioned that they choose not to share their emotion trackers and only share the data that is not personal; *"I feel like emotion is something ... pretty private"* (P20). *"I really put ... every part of my life there, so I don't share it ... [even] with my partner or with my family"* (P3).

7.6 Global Pandemic

The COVID-19 pandemic was brought up by 8 people as a phenomenon that has changed their self-tracking practice in different ways. The majority of those interviewees (7) indicated that they have been tracking more information and more often. 4 people highlighted that they use tracking as a coping mechanism and as a way of dealing with the mental health consequences of stress and isolation during this period. *"I've been bullet journaling ... to calm myself"* (P2). 3 people mentioned spending more time and effort on their physical tracking practice as a result of having more free time; *"I have more of the time to sit down and do it"* (P14). One person mentioned that

not using digital tracking tools is even more important now, as they work remotely and spend most of their day consuming digital content and feel the need to take a break from their devices more than ever before (P5). One person highlighted that they have stopped their practice because they are less motivated and not as active (P20).

8 DISCUSSION AND DESIGN IMPLICATIONS

We found that users who engage in physical self-tracking practices range from those who use it primarily as a form of artistic expression, to those who are searching for efficient approaches to track their data. It appears that for those on the artistic end of the spectrum, physical practices and tools are paramount. For these individuals, digital tools cannot act as a replacement but may improve and extend their current practices, through reminder notifications, complementary data input, back-up storage, and post-hoc analysis. For individuals on the other end of the spectrum with a focus on efficiency, digital tools can be an important tool if they are flexible, customizable, privacy-sensitive, and aesthetically pleasing. Most people we interviewed, however, fall somewhere in between; for them, physical self-tracking is a form of engaging with quantified-self data, but creative freedom and the physical artifact are also important (see section 7.1.2). Here we describe such design implications in more detail.

8.1 Augmenting Physical Practices

Participants described ways in which they use mobile apps to augment their physical tracking, noting that they have multiple copies of their data across digital and physical mediums (see section 7.4.3). There may be opportunities for designing tools to support preliminary data collection, by reminding users to track their data on the go and facilitating transfer from digital to physical mediums. Digital tools can also be used at a later stage in the physical self-tracking process as a secondary means of storage and a way for users to share their trackers online (see section 7.5). This could be done through smart-pens that transfer handwriting to digital devices, such as the Anoto Digital Pen [1], or via image capture, similar to the Bullet Journaling companion app [10].

8.2 Enabling Post-hoc Analysis

Participants who track their data using physical tools mentioned that they cannot easily find patterns or draw meaningful insights from their long-term data (see section 7.4.2). This suggests that there may be opportunities for digital tools to extend current physical practices by extracting data from existing physical artifacts, potentially through computer vision, and facilitating post-hoc analysis through visualization and manipulation of the data. Digital tools may also combine and correlate this data with existing digital data on the user's device, such as their images and videos, or with quantifiable data that can be automatically measured, such as their heart rate, to enable more comprehensive and rich analyses (see section 7.4).

8.3 Prioritizing Persistence and Privacy

While digital data is often associated with permanence and resistance to decay [26], both survey respondents and interview participants were concerned about the fragility of digital information and the possibility of losing their data over time (see sections 4.6 and 7.2.3). Digital tools not only need to ensure that data is reliably stored and is recoverable, but also need to explore strategies for preserving these highly personal data for future generations [73]. Users also mentioned tracking two types of information: data they consider very personal and would not even share with friends and family, and data they often choose to share with others on online public platforms (see section 7.5.2). Given this tension between the need to maintain privacy and the desire to share artifacts publicly, there may be opportunities for tools to mediate digital sharing of physical self-tracking data by enabling filtering or masking of the private aspects of information.

8.4 Valuing Visual Aesthetics

A common theme that we discovered through our study is that the visual appeal of trackers is very important to users, even for those with minimalist trackers (see section 7.1.3). Particularly, the color choices and the ability to customize the aesthetics of the platform is important to many people. Digital tools that wish to support or extend current physical self-tracking practices should carefully design the visual aesthetics of their platform.

8.5 Granting Creative Freedom

Prior work has highlighted the importance of flexibility and customizability in digital self-tracking tools, to enable non-standard visual encodings [67], support users' evolving tracking goals [45], and create a sense of control and agency [2]. We found that personalization is also important in the context of granting users a form of self-expression and creative freedom. Digital tools can draw from prior research on casual creators [16] to enable users to express themselves creatively and compose something they feel proud of. This sense of accomplishment and the resulting artifact will also motivate users to continue with their self-tracking practice, even when the benefits are not immediately apparent to them (see section 7.1.4).

8.6 Generating Physical Artifacts

We found that the unique physical artifact is an important component of people's self-tracking practices. Participants perceive these artifacts as a way of capturing their data in a more *"real"* way and consider them as part of their personal legacy (see sections 7.2.3 and 7.2.4). One potential design idea is that digital tools could benefit from periodically generating physical artifacts to maintain this archival value. Generating artifacts from personal tracking data, similar to prior work on activity tracking [38, 43], will enable users to store physical copies of their information and to share them with others, in a format that has a higher perceived durability [59]. However, such physical extensions should be carefully designed to inspire a similar sense of value and attachment. While the personal history of the data embedded in the artifact may create the symbolism needed to engender a strong attachment, users may not perceive the generated artifact as authentic or unique [26]. To imbue these values, it may be important to enable users to personalize their data representation and express themselves creatively through this encoding. Moreover, digital tools should consider ways in which a user can engage with the physical artifact, specifically considering the materiality of the object and the *"motor-tactile nature of using an object"* [59].

8.7 Facilitating Mindful Reflection

The slowness of physical practices such as writing, drawing, and crafting with materials leads to reflection-in-action. Designing for slowness, by consulting prior literature on slow technologies, may enable digital tools to facilitate similar forms of mindful reflection [58] and identity work [70]. Moreover, digital tools may encourage users to modify their space to create a calming atmosphere or set the mood through background music and lighting adjustments. Disconnecting from technology appears to be another important factor contributing to reflection and relaxation, especially in the midst of the digitally-saturated pandemic (see section 7.6). To help people "unplug", digital tools could perhaps disconnect the device from the internet or temporarily turn off notifications—or, the best design strategy may sometimes be to avoid foisting a technological experience onto tracking altogether, if that would ultimately not serve an individual's needs, practices, and preferences [5].

9 CONCLUSION

In this work, we conducted a large-scale survey and small-scale follow-up interviews to understand the role of technology in non-digital and manual self-tracking. We studied people's physical tracking practices to better understand their motivations for tracking, the challenges they face in their current practice, and more broadly, their attitudes towards both digital and physical tracking tools. We found that users' motivations for physical tracking

range from artistic self-expression to efficient recording and analysis of personal data. While we highlighted ways in which future digital tracking tools may support aspects of these practices, such as granting creative freedom and facilitating reflection through slow designs, we found that for some people, the richness of the experience is tied to the physicality of their self-tracking practice. For example, people find the feeling of holding a pen and writing on paper satisfying, and they value the regular time spent disconnected from technology during their practice. For these individuals, digital tools may be able to augment tracking by addressing other unmet needs, such as helping users draw insights from their physically-recorded data over time, through post-hoc visualizations or other sensemaking activities that complement and preserve the deep meaning inherent to physical tracking.

ACKNOWLEDGMENTS

We would like to thank our volunteers and the BuJo community more generally for participating in our study. We thank Lauren Zhu, Tristan Gosakti, Jean Costa, Jingyi Li, and members of Shape Lab for their feedback.

REFERENCES

- [1] Anoto Group AB. (accessed August 1, 2020). Anoto Digital Pen. <https://www.anoto.com/>
- [2] Amid Ayobi, Paul Marshall, and Anna L Cox. 2020. Trackly: A Customisable and Pictorial Self-Tracking App to Support Agency in Multiple Sclerosis Self-Care. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–15.
- [3] Amid Ayobi, Tobias Sonne, Paul Marshall, and Anna L Cox. 2018. Flexible and Mindful Self-Tracking: Design Implications from Paper Bullet Journals. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–14.
- [4] Eric PS Baumer. 2015. Reflective informatics: conceptual dimensions for designing technologies of reflection. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 585–594.
- [5] Eric PS Baumer and M Six Silberman. 2011. When the implication is not to design (technology). In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2271–2274.
- [6] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- [7] Virginia Braun and Victoria Clarke. 2019. Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health* 11, 4 (2019), 589–597. <https://doi.org/10.1080/2159676X.2019.1628806>
- [8] Passion Carnets. (accessed August 1, 2020). *Year in Pixel*. <https://bulletjournal.com/blogs/bulletjournalist/deep-dive-year-in-pixels>
- [9] Ryder Carrol. (accessed August 1, 2020). *Bullet Journal: The Analog Method for the Digital Age*. <https://bulletjournal.com/>
- [10] Ryder Carrol. (accessed August 1, 2020). *Bullet Journal: The Companion App*. <https://bulletjournal.com/pages/app>
- [11] Eun Kyoung Choe, Saeed Abdullah, Mashfiqui Rabbi, Edison Thomaz, Daniel A Epstein, Felicia Cordeiro, Matthew Kay, Gregory D Abowd, Tanzeem Choudhury, James Fogarty, et al. 2017. Semi-automated tracking: a balanced approach for self-monitoring applications. *IEEE Pervasive Computing* 16, 1 (2017), 74–84.
- [12] Eun Kyoung Choe, Bongshin Lee, Matthew Kay, Wanda Pratt, and Julie A Kientz. 2015. SleepTight: low-burden, self-monitoring technology for capturing and reflecting on sleep behaviors. In *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. 121–132.
- [13] Eun Kyoung Choe, Nicole B Lee, Bongshin Lee, Wanda Pratt, and Julie A Kientz. 2014. Understanding quantified-selfers' practices in collecting and exploring personal data. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1143–1152.
- [14] James Clawson, Jessica A Pater, Andrew D Miller, Elizabeth D Mynatt, and Lena Mamykina. 2015. No longer wearing: investigating the abandonment of personal health-tracking technologies on craigslist. In *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. 647–658.
- [15] J. Clement. 2020. Instagram: age and gender demographics. <https://www.statista.com/statistics/248769/age-distribution-of-worldwide-instagram-users/>
- [16] Kate Compton and Michael Mateas. 2015. Casual Creators. In *Proceedings of the Sixth International Conference on Computational Creativity*. 228–235.
- [17] Sunny Consolvo, David W McDonald, Tammy Toscos, Mike Y Chen, Jon Froehlich, Beverly Harrison, Predrag Klasnja, Anthony LaMarca, Louis LeGrand, Ryan Libby, et al. 2008. Activity sensing in the wild: a field trial of ubifit garden. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 1797–1806.
- [18] Felicia Cordeiro, Elizabeth Bales, Erin Cherry, and James Fogarty. 2015. Rethinking the mobile food journal: Exploring opportunities for lightweight photo-based capture. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 3207–3216.
- [19] Victor P Cornet and Richard J Holden. 2018. Systematic review of smartphone-based passive sensing for health and wellbeing. *Journal of biomedical informatics* 77 (2018), 120–132.

- [20] Chris Eldsen, Abigail C Durrant, David Chatting, and David S Kirk. 2017. Designing documentary informatics. In *Proceedings of the 2017 Conference on Designing Interactive Systems*. 649–661.
- [21] Chris Eldsen, Bettina Nissen, Andrew Garbett, David Chatting, David Kirk, and John Vines. 2016. Metadating: exploring the romance and future of personal data. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. 685–698.
- [22] Chris Eldsen, Mark Selby, Abigail Durrant, and David Kirk. 2016. Fitter, happier, more productive: what to ask of a data-driven life. *interactions* 23, 5 (2016), 45–45.
- [23] Daniel A Epstein, An Ping, James Fogarty, and Sean A Munson. 2015. A lived informatics model of personal informatics. In *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. 731–742.
- [24] Maria Faurholt-Jepsen, Mads Frost, Christian Ritz, Ellen Margrethe Christensen, AS Jacoby, Rie Lambæk Mikkelsen, U Knorr, JE Bardram, Maj Vinberg, and Lars Vedel Kessing. 2015. Daily electronic self-monitoring in bipolar disorder using smartphones—the MONARCA I trial: a randomized, placebo-controlled, single-blind, parallel group trial. *Psychological medicine* 45, 13 (2015), 2691–2704.
- [25] Mikhaila Friske, Jordan Wirfs-Brock, and Laura Devendorf. 2020. Entangling the Roles of Maker and Interpreter in Interpersonal Data Narratives: Explorations in Yarn and Sound. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference*. 297–310.
- [26] Rebecca Gulotta, William Odom, Jodi Forlizzi, and Haakon Faste. 2013. Digital artifacts as legacy: exploring the lifespan and value of digital data. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1813–1822.
- [27] Cathal Gurrin, Alan F Smeaton, and Aiden R Doherty. 2014. Lifelogging: Personal big data. *Foundations and trends in information retrieval* 8, 1 (2014), 1–125.
- [28] Lars Hallnäs and Johan Redström. 2001. Slow technology—designing for reflection. *Personal and ubiquitous computing* 5, 3 (2001), 201–212.
- [29] Philip Henson, Gary David, Karen Albright, and John Torous. 2019. Deriving a practical framework for the evaluation of health apps. *The Lancet Digital Health* 1, 2 (2019), e52–e54.
- [30] Noura Howell, Laura Devendorf, Tomás Alfonso Vega Gálvez, Rundong Tian, and Kimiko Ryokai. 2018. Tensions of data-driven reflection: A case study of real-time emotional biosensing. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–13.
- [31] Tim Ingold. 2010. The textility of making. *Cambridge Journal of Economics* 34, 1 (2010), 91–102.
- [32] Yvonne Jansen, Pierre Dragicevic, Petra Isenberg, Jason Alexander, Abhijit Karnik, Johan Kildal, Sriram Subramanian, and Kasper Hornbæk. 2015. Opportunities and challenges for data physicalization. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 3227–3236.
- [33] Ravi Karkar, Jessica Schroeder, Daniel A Epstein, Laura R Pina, Jeffrey Scofield, James Fogarty, Julie A Kientz, Sean A Munson, Roger Vilardaga, and Jasmine Zia. 2017. Tummytrials: a feasibility study of using self-experimentation to detect individualized food triggers. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. 6850–6863.
- [34] Ravi Karkar, Jasmine Zia, Roger Vilardaga, Sonali R Mishra, James Fogarty, Sean A Munson, and Julie A Kientz. 2016. A framework for self-experimentation in personalized health. *Journal of the American Medical Informatics Association* 23, 3 (2016), 440–448.
- [35] Maria Karyda, Merja Ryöppy, Jacob Buur, and Andrés Lucero. 2020. Imagining Data-Objects for Reflective Self-Tracking. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–12.
- [36] Rohit Ashok Khot, Deepti Aggarwal, Ryan Pennings, Larissa Hjorth, and Florian’Floyd’ Mueller. 2017. Edipulse: investigating a playful approach to self-monitoring through 3D printed chocolate treats. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. 6593–6607.
- [37] Rohit Ashok Khot, Larissa Hjorth, and Florian’Floyd’ Mueller. 2014. Understanding physical activity through 3D printed material artifacts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 3835–3844.
- [38] Rohit Ashok Khot, Larissa Hjorth, and Florian Mueller. 2020. Shelfie: A Framework for Designing Material Representations of Physical Activity Data. *ACM Transactions on Computer-Human Interaction (TOCHI)* 27, 3 (2020), 1–52.
- [39] Nam Wook Kim, Hyejin Im, Nathalie Henry Riche, Alicia Wang, Krzysztof Gajos, and Hanspeter Pfister. 2019. DataSelfie: Empowering People to Design Personalized Visuals to Represent Their Data. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. 1–12.
- [40] Young-Ho Kim, Jae Ho Jeon, Bongshin Lee, Eun Kyoung Choe, and Jinwook Seo. 2017. OmniTrack: A flexible self-tracking approach leveraging semi-automated tracking. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 1, 3 (2017), 1–28.
- [41] Judy Kopp. 1988. Self-monitoring: A literature review of research and practice. In *Social Work Research and Abstracts*, Vol. 24. Oxford University Press, 8–20.
- [42] Hyosun Kwon, Joel E Fischer, Martin Flintham, and James Colley. 2018. The connected shower: Studying intimate data in everyday life. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 2, 4 (2018), 1–22.
- [43] Moon-Hwan Lee, Seijin Cha, and Tek-Jin Nam. 2015. Patina engraver: Visualizing activity logs as patina in fashionable trackers. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 1173–1182.

- [44] Ian Li, Anind Dey, and Jodi Forlizzi. 2010. A stage-based model of personal informatics systems. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 557–566.
- [45] Ian Li, Anind K. Dey, and Jodi Forlizzi. 2011. Understanding my data, myself. *Proceedings of the 13th international conference on Ubiquitous computing - UbiComp 11* (2011). <https://doi.org/10.1145/2030112.2030166>
- [46] Lili Liu, Eleni Stroulia, Ioanis Nikolaidis, Antonio Miguel-Cruz, and Adriana Rios Rincon. 2016. Smart homes and home health monitoring technologies for older adults: A systematic review. *International journal of medical informatics* 91 (2016), 44–59.
- [47] Tatjana Loncar-Turukalo, Eftim Zdravevski, José Machado da Silva, Ioanna Chouvarda, and Vladimir Trajkovik. 2019. Literature on wearable technology for connected health: Scoping review of research trends, advances, and barriers. *Journal of medical Internet research* 21, 9 (2019), e14017.
- [48] Giorgia Lupi. 2017. Data humanism: the revolutionary future of data visualization. *Print Magazine* 30 (2017). <https://www.printmag.com/post/data-humanism-future-of-data-visualization>
- [49] Giorgia Lupi and Stefanie Posavec. 2016. *Dear data*. Chronicle books.
- [50] Deborah Lupton. 2013. Quantifying the body: monitoring and measuring health in the age of mHealth technologies. *Critical Public Health* 23, 4 (2013), 393–403.
- [51] Deborah Lupton. 2014. Self-tracking cultures: towards a sociology of personal informatics. In *Proceedings of the 26th Australian computer-human interaction conference on designing futures: The future of design*. 77–86.
- [52] Deborah Lupton. 2016. The diverse domains of quantified selves: self-tracking modes and dataveillance. *Economy and Society* 45, 1 (2016), 101–122.
- [53] Deborah Lupton. 2017. *Digital health: critical and cross-disciplinary perspectives*. Routledge.
- [54] Mark Matthews, Saeed Abdullah, Elizabeth Murnane, Stephen Volda, Tanzeem Choudhury, Geri Gay, and Ellen Frank. 2016. Development and evaluation of a smartphone-based measure of social rhythms for bipolar disorder. *Assessment* 23, 4 (2016), 472–483.
- [55] Elizabeth L Murnane, Dan Cosley, Pamara Chang, Shion Guha, Ellen Frank, Geri Gay, and Mark Matthews. 2016. Self-monitoring practices, attitudes, and needs of individuals with bipolar disorder: implications for the design of technologies to manage mental health. *Journal of the American Medical Informatics Association* 23, 3 (2016), 477–484.
- [56] Elizabeth L Murnane, Tara G Walker, Beck Tench, Stephen Volda, and Jaime Snyder. 2018. Personal informatics in interpersonal contexts: towards the design of technology that supports the social ecologies of long-term mental health management. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (2018), 1–27.
- [57] Janna V Nikolaeva. 2016. Slow Life. The New Philosophy of Slowness. *Observatory of Culture* 1, 1 (2016), 24–30.
- [58] William Odom, Richard Banks, Abigail Durrant, David Kirk, and James Pierce. 2012. Slow technology: critical reflection and future directions. In *Proceedings of the Designing Interactive Systems Conference*. 816–817.
- [59] William Odom, James Pierce, Erik Stolterman, and Eli Blevis. 2009. Understanding why we preserve some things and discard others in the context of interaction design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1053–1062.
- [60] Victoria Park. 2019. BulletJournal: Seven million beautiful ways to save money. *BBC News* (Aug 2019). <https://www.bbc.com/news/business-48840358>
- [61] Zachary Pousman, John Stasko, and Michael Mateas. 2007. Casual information visualization: Depictions of data in everyday life. *IEEE transactions on visualization and computer graphics* 13, 6 (2007), 1145–1152.
- [62] John Rooksby, Mattias Rost, Alistair Morrison, and Matthew Chalmers. 2014. Personal tracking as lived informatics. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 1163–1172.
- [63] Benjamin Rush, Isaiah Thomas, and Ebenezer Turrell Andrews. 1790. *An Inquiry Into the Effects of Spirituous Liquors on the Human Body: To which is Added, a Moral and Physical Thermometer*. By Benjamin Rush, MD Professor of the Theory and Practice of Medicine in the University of Philadelphia. by Thomas and Andrews. At Faust’s Statue, no. 45, Newbury Street.
- [64] Grace Shin, Mohammad Hossein Jarrahi, Yu Fei, Amir Karami, Nicci Gafinowitz, Ahjung Byun, and Xiaopeng Lu. 2019. Wearable activity trackers, accuracy, adoption, acceptance and health impact: A systematic literature review. *Journal of biomedical informatics* 93 (2019), 103153.
- [65] Karandeep Singh and Adam B Landman. 2017. Mobile health. In *Key Advances in Clinical Informatics*. Elsevier, 183–196.
- [66] Timothy J Smoker, Carrie E Murphy, and Alison K Rockwell. 2009. Comparing memory for handwriting versus typing. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, Vol. 53. SAGE Publications Sage CA: Los Angeles, CA, 1744–1747.
- [67] Jaime Snyder, Elizabeth Murnane, Caitie Lustig, and Stephen Volda. 2019. Visually Encoding the Lived Experience of Bipolar Disorder. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI 19* (2019). <https://doi.org/10.1145/3290605.3300363>
- [68] Melanie Swan. 2012. Sensor mania! the internet of things, wearable computing, objective metrics, and the quantified self 2.0. *Journal of Sensor and Actuator networks* 1, 3 (2012), 217–253.
- [69] Melanie Swan. 2013. The quantified self: Fundamental disruption in big data science and biological discovery. *Big data* 1, 2 (2013), 85–99.
- [70] Jakob Tholander and Maria Normark. 2020. Crafting Personal Information-Resistance, Imperfection, and Self-Creation in Bullet Journaling. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–13.

- [71] Alice Thudt, Uta Hinrichs, Samuel Huron, and Sheelagh Carpendale. 2018. Self-Reflection and Personal Physicalization Construction. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) (*CHI '18*). Association for Computing Machinery, New York, NY, USA, 1–13. <https://doi.org/10.1145/3173574.3173728>
- [72] Khai N Truong, Thariq Shihpar, and Daniel J Wigdor. 2014. Slide to X: unlocking the potential of smartphone unlocking. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 3635–3644.
- [73] Andrew Waugh, Ross Wilkinson, Brendan Hills, and Jon Dell’Oro. 2000. Preserving digital information forever. In *Proceedings of the fifth ACM conference on Digital libraries*. 175–184.
- [74] Mary H Wilde and Suzanne Garvin. 2007. A concept analysis of self-monitoring. *Journal of Advanced Nursing* 57, 3 (2007), 339–350.
- [75] Haijun Xia, Nathalie Henry Riche, Fanny Chevalier, Bruno De Araujo, and Daniel Wigdor. 2018. DataInk: Direct and creative data-oriented drawing. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–13.
- [76] Xiaoyi Zhang, Laura R Pina, and James Fogarty. 2016. Examining unlock journaling with diaries and reminders for in situ self-report in health and wellness. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. 5658–5664.

A SURVEY QUESTIONS

Q1. Do you currently use any self-tracking tools to regularly record an aspect of your life? This includes, but is not limited to, physical tools (such as bullet journaling or Year in Pixels) or digital tools (such as a Fitbit or a smartphone health app). Yes or no?

If self-tracking:

Q2. What aspects of your life do you track (such as emotion, exercise, or finances)?

Q3. What tools do you use to self-track? Select all that apply. Mobile applications, web applications, Wearable devices, Physical materials (such as journals, pen and paper, or knitting), Other. Please specify.

If using physical materials to track:

Q4. What physical self-tracking technique do you use? Select all that apply. Bullet journaling, Year in Pixels, Note taking, other. If other, please specify.

Q5. If you are willing, please upload a photo of a hand-drawn tracker or physical item you have made.

Q6. Are there any frustrations you experience or limitations you associate with your physical tracking? Please describe.

Q7. Do you think a digital tool could replace or improve your physical tracking activities? In each case, please elaborate.

- a. Yes because...
- b. maybe if...
- c. no because...

Q8. Rate the following statements according to how well they match your reasons for using physical, instead of digital, self-tracking tools, from strongly disagree to strongly agree on a 7-point scale.

- a. It's a hobby and I enjoy the process.
- b. The slower pace of the process allows me to reflect.
- c. The physical object is unique and important to me.
- d. I like the feeling of holding a physical writing utensil.
- e. There are no digital tools (such as mobile apps) that do exactly what I want.
- f. I want to spend less time using digital tools.
- g. I don't trust technology with my data.
- h. I am not tech-savvy.

Q9. Please elaborate or describe any other reasons you prefer physical self-tracking over digital self-tracking.

B TRACKED INFORMATION

We grouped responses based on categories identified by prior work: fitness activities, food and nutrition, bedtime routines, hygiene, social activities, hobbies, health, medication intake, mood, resolutions, and personal development [3]. Based on the responses we received, we added the following 6 categories: productivity, unspecified habits, finances, work and school, digital interactions, and external observations. We tallied the frequencies for each category (see Table 1) and marked the new categories with an asterisk. Note that the result, particularly the high frequency of the mood and emotion category, is affected by the bias in our recruitment strategy.

C INTERVIEW QUESTIONS

Each interview session began with the interviewers introducing themselves: *"My name is [insert name] and I'm a researcher at Stanford University and we are interested in learning about people's self-tracking practices."* The

Table 1. Frequency and examples for each category of reported tracked information, using both digital and physical tools.

Category	Frequency	Examples
Mood & Emotion	68%	mood, emotion, year in pixels
Fitness Activities	58%	steps, exercise, meditation, yoga
Finances*	35%	budgeting, spending, money, income, expenses
Health	26%	period, weight, mental health, heart rate, pain, stress
Unspecified Habits*	26%	habits, daily habits, habit tracking
Bedtime Routines	23%	hours of sleep, waking up at 7am, dreams
Food & Nutrition	23%	carb intake, eating healthy, calorie deficit, vegetarian diet, water intake
Productivity*	23%	daily tasks, planning, calendar, scheduling, chores, cleaning
Personal Development	19%	self-care, personal goals, prayer, memories, gratitude
Hobbies	16%	reading, learning language, drawing, TV, books, movies
Work and School*	11%	work, studying, schoolwork, homeschool, courses
Digital Interactions*	5%	screen time, app usage, social media posts
Hygiene	5%	flossing, skincare, shower
Medicine	4%	taking my meds, medication, supplements, vitamins
Social Activities	4%	phone calls, social contact with friends and family
External Observations*	3%	indoor air quality, carbon dioxide in air, weather, sunlight
Resolutions	2%	no sugar, no credit card usage, not smoking

following list of interview questions was based on participants' responses to the initial survey, with the number in parentheses denoting the frequency of usage:

- I can see from your survey responses that you track [*insert Q3 response*] and that you use [*insert Q4 response*]. Can you tell me more about that? (16)
- I saw that you mentioned [*insert specific quote from survey responses*]. Can you tell me more? (16)
- Can you imagine a digital tool that could have all the features you like about what you are doing? What would it look like? (8)
- I would love to hear more about when you started self-tracking? And why did you decide to start? (6)
- Do you ever look back at your data? If so, in what way? (6)
- Have you noticed any changes in your behavior as a result of your tracking practice? (5)
- Have you noticed any changes in your tracking practice over time? (5)
- Is there anything that you dislike or that is frustrating about your practice? (4)

Additional questions were asked as follow-ups to participants' responses during the interviews. Though these questions were not scripted, they were repeated due to commonalities in participants' responses across interviews:

- How do you manage using multiple tools? (7)
- How do you share your data with others? (4)
- What is different about writing compared to typing for you? (4)
- Can you tell me more about why you use different tools for tracking? (4)
- Anything else you would like to share? (4)
- When do you track information during your day? (3)
- How long does your tracking process take you? (3)
- Do you track the same information in these tools or are they mutually exclusive? (3)