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Inside out: Addressing the "how" of data collection in experience design research applying introspective methods

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A B S T R A C T

Introspective (or first-person) methods are carving out their niche in experience design research. Relevant epistemological conversations in recent years have led experience design researchers to appreciate the value of "researcher as subject" in understanding nuanced, rich, felt human experiences mediated by designs. However, there is still a clear need for more detailed guidance on how to employ introspective methods for experience design research. This existing gap in practical application often leads to inconsistent or inconsiderate use, especially among design researchers new to these methods. To address this, this paper explores various ways design researchers can collect introspective data. We conducted a systematic review of 118 articles, each employing or developing introspective methods in some form, published by reputable design research venues from 2012 to 2022. Our analysis offers a comprehensive and organized overview of six categories of introspective data collection techniques and the supportive tools for each. Additionally, we reflect on the current use of introspective methods in experience design research and propose five recommendations for future methodological development. We aspire for this paper to serve as a timely, go-to guide for introspective design researchers, and to promote a more refined and thoughtful application of introspective methods in our field.

1. Introduction

A family of research methods, commonly referred to as "introspective" [1] or "first-person" [2], has been steadily evolving in experience design research. The defining characteristic of these methods is the stance of "researcher as subject" [3]. It means that their primary mechanism for data collection is the researcher's internal self-observation of the experience being studied. Introspective methods, as an alternative approach, stand in stark contrast to the mainstream experience design research methods. To maintain a "trouble-free" status, mainstream methods typically strive for a good appearance of objectivity by solely relying on data generated by (non-researcher) participants. Introspective methods, on the other hand, encourage the researcher to personally immerse in the experience, exploit a privileged and peculiar access to experiential data from within which are not directly accessible through other approaches, so that they can insightfully capture those deeper, more dynamic, and subtle experiential aspects of human-design interaction [1].

While celebrating the acceptance of introspective methods in our field, some crucial "how" questions about introspective methods are still underexplored. This may be due to the challenge of embracing "researcher as subject" for academic research within the implicitly entrenched positivist institutions. Consequently, to date, much of the relevant methodological literature in our field has focused on the "why" questions or metaphysical debates, particularly those related to ontology and epistemology. Although convincing the design research community to accept the stance of introspective methods is crucial and fundamental, it alone is insufficient for the systematic development and proper use of these methods. The ignorance of the "how" questions may lead to a worrying misconception - "It is as simple as looking at my own experience" - among the quickly growing number of introspective researchers in experience design. Therefore, in this paper, we examine one of the most important yet underexplored practical aspects of introspective methods - data collection. Specifically, we address the question: *How have design researchers collected data when applying introspective methods*? To achieve this, we conducted a systematic review of 118 articles, each employing or developing introspective methods in some form, published by reputable design research venues from 2012 to 2022.

The contributions of this paper, to the use and development of introspective methods in our field, are threefold. First, we identify six categories of data collection techniques that design researchers have used for introspective inquiry (i.e., text-based, photograph-based, video-

based, audio-based, drawing-based, designerly artifact-based). The value of this result lies in its comprehensiveness. It provides introspective design researchers with an inclusive and structured overview of accepted introspective data collection techniques in our field.

Second, we surface two underlying dimensions of introspective data collection: "metacognitive/analytic" versus "narrative/evocative" and "data of introspection" versus "data for introspection". This deeper appreciation can help a researcher-introspector better navigate in the landscape of diverse introspective data collection techniques and make informed decisions regarding the most suitable techniques and reporting styles for their specific research objectives.

Third, based on our reflection on the current use of introspective methods, we propose five recommendations for their future development in our field. These recommendations include 1) dedicated self-cultivation for introspective research, 2) need for a more nuanced understanding of introspective methods, 3) discussion of rigor, 4) exploring new technologies as data collection tools, and 5) ethical issues in introspective methods.

Overall, we envision this paper will serve as a valuable guide for experience design researchers aiming to systematically use introspective methods. We hope that our recommendations will also inspire further discussion and development of introspective methods in our field.

2. Background

2.1. Defining introspective methods

When discussing "introspection" as a research approach, the term may indicate two conceptual scopes, depending on who the introspector is during the research process, and the researcher-participant relationship [4]. In its narrower definition, introspective methods rely on *the researcher's* first-person perspective and self-observation, documentation, and report of subjective experiences. Of course, introspective researchers may not always depend exclusively on their own introspection, as they may engage others in interactive introspection (i.e., both the researcher and the participants introspect, and share, debate on and co-create introspective insights into the experience under study) [1]. For example, heuristic inquiry, a form of introspective method developed in humanistic psychology, requires the introspective researcher to begin "with immersion, self-dialogue, and self-exploration, and then moves to explore the nature of others' experiences" [5:43]. In this case, participants are typically recruited and treated as highly motivated knowledge-seeking partners (i.e., co-researchers), rather than passive participants simply answering the researcher's questions. Thus, the narrower scope of introspective methods are "characterized by the researcher's, either sole or partial, reliance on systematic and transparent self-introspection" for investigating subjective experience [1:38].

When adopting a broader scope, "introspective methods", can also include those methods featuring the participants introspecting for data generation *under the guidance of the researcher*, such as in-depth interview, experience questionnaire, diary, UX curves. Methods of this kind have long been accepted in experience design research, and often *mistakenly* considered as objective, due to the researcher's detached stance (i.e., collecting, analyzing, and drawing findings only from data generated by the participants). Nevertheless, someone must introspect in these methods, even though it is not the researcher. Therefore, these methods are also called "introspective", especially when evaluated against positivistic standards, and categorized as *guided introspection* [1,6].

True objective methods are those only collect, analyze, and draw conclusions from *publicly observable* data, such as behaviors, brain images, or heart rates. They are involuntarily produced by human participants and automatically collected by non-human instruments, eliminating the necessity for introspection by either the researcher or the participants. For example, eye-tracking data are commonly used to approximate the trajectory of one's conscious attention, overlooking the potential presence of mind wandering.

In this paper, we use "introspective methods" to refer to the narrower scope of the concept. Conventional experience design research methods that fall into the category of guided introspection, as well as objective methods are not the concern of this paper.

2.2. Early acceptance and development of introspective methods outside design research

As experience-focused design research matures and HCI research progresses into its third wave, a critical reflection has emerged, which challenges the deeply entrenched "gold standard" of scientific research - the researcher should remain an external observer, solely responsible for collecting and analyzing data about participants' experiences [7]. This standard has limited what aspects of human experience can be studied and how they can be studied.

It is not surprising. Looking back in history, similar reflections also happened in several other disciplines, when their research on the experiential aspects matured. For example, in 1991, about a decade after experiential consumption was established by the seminal work of Holbrook and Hirschman [8,9], consumer researcher Gould reflected that "much of consumer research has failed to describe many experiential aspects of my own consumer behavior" [10:194]. In the same year, Ellis reflected, from a sociologist's perspective, "most methods available to sociologists focus on the rational order in the world. Surveys, questionnaires, and laboratory observations of emotional feelings tell us about the surface public self … we are forced to talk of spiritless, empty husks of people who have programmed, patterned emotions, and whose feelings resemble the decision-making models of rational choice theorists" [11:45].

What directly followed these critical reflections was a systematic development of introspective methods for investigating subjective experience in these fields. For example, Holbrook developed his version of introspective method, *Subjective Personal Introspection* [12,13], and has argued that "I believe that—because I am human—when I write about myself, I inevitably describe some aspect of the human condition" [14:45]. Gould developed *Researcher Introspection* [15,16] which later evolved to become *Consumer Introspection Theory* (CIT) [17]. For sociological and communication research, Ellis developed *Sociological Introspection* [11] based on her argument that "Introspection will allow us to study emotions as they are experienced without using models that have rationality built into them"[11:45] and this method later became famous *Autoethnography* [3,18,19].

Despite different names and origins, introspective methods share one commonality - the researcher uses themselves as a primary source of data to study subjective experiences from within for a richer, deeper, and more vivid understanding. While using introspective methods, the researcher has a dual role that represents the ultimate unity in the researcher-participant relationship [3,15,20]. As Hirschman and Holbrook point out that "In sharp contrast with the objective, distanced stance common to logical empiricism, the introspective researcher intentionally becomes personally, emotionally involved with the topics under investigation" [21:237]. In this sense, introspective researcher's subjectivity is not unquestioningly treated as a source of unwanted bias, but rather a faculty to be well cultivated to serve as the basis for exploring nuanced *intersubjective* knowledge of human experience.

2.3. Introspective methods for experience design research

History repeats itself. Although it occurred decades later than in the fields mentioned above, the acceptance and development of introspective methods are now taking place in experience design research. For example, through applying introspective methods, Xue and colleagues have identified and described 20 nuanced mood states that users may bring into and leave with an interaction with designed systems [22]. Lucero conducted a nine-year long autoethnographic inquiry on his personal experiences of living without a mobile phone to offer unique

design insights [23]. Similarly, Höök and colleagues argue for and have demonstrated the significance of introspective methods in soma-based design research, highlighting their unique advantage in gaining insight into the felt dimension of experiences [24].

To promote introspective methods for experience design research, Xue and Desmet [1] have pointed out six special strengths of them, in comparison with conventional methods.

- **Data accessibility**: Introspective methods can allow a privileged and peculiar access to experiential data that are lived and felt, which are not directly accessible through other approaches.
- **Data readiness and richness**: Introspective methods can offer a round-the-clock access to vivid, detailed, and rich phenomenological data about the stream of experiences under investigation.
- **Duration of research**: Introspective methods can enable the researcher to continually monitor and analyze lived experiences over extended periods (e.g., months or years).
- **Depth of analysis and reflexivity**: Introspective methods can foster increased reflexivity and deeper insights into the emotions, experiences, and motivations inherent in the studied phenomena through mental reliving, hypothesizing, theorizing, and retesting.
- **Research presentation**: Data and findings of introspective studies can be presented as highly captivating, engaging narratives or experiential accounts. In this way, introspective methods can bring "a human dimension to research by focusing on life in its full complexity" [1:8], better resonate with their experiences, and allow the results to be empathetically validated.
- **Research ethics**: Introspective methods pose fewer ethical concerns related to privacy and consent of participants, as data are generated by the researchers themselves. However, it is not to say that introspective methods do not have ethical issues, rather, they introduce unique ethical challenges. We will discuss this point in subsection 7.5.

In addition, it is important to be aware that introspective methods are not suitable for all design research nor for all scholarly design researchers. Thus, a clear understanding of under what pre-conditions introspective methods are appropriate is crucial. Regarding this, Xue and Desmet [1] have specified that a design researcher should self-evaluate at least following four aspects, and may consider applying introspective methods when the four conditions are *all present simultaneously*.

- The experiential aspects (e.g. hedonic qualities, felt dimension, sociocultural or symbolic meanings, emotions, and moods) are the focus of the study, rather than the instrumental and utilitarian aspects (e.g. usefulness, usability, efficiency).
- The social, cultural, and experiential gap between the researcher and the target group is small or the researcher is a complete member of the group (i.e., Complete Member Researcher, CMR [25]).
- The researcher is emotionally engaged in and highly passionate about the topic in personal life.
- The researcher is adequately trained for introspection.

2.4. Data collection in introspective methods

With introspective methods being accepted in experience design research in recent years, questions regarding data collection and the types of data that can be gathered for introspective inquiry naturally arise. Focusing on the best known introspective method (i.e., autoethnography), Anderson and Glass-Coffin argued that "autoethnographic inquiry is guided less by specific techniques of data collection than it is by a set of ethical, aesthetic, and relational sensitivities that can be - and are being - incorporated into a wide variety of autoethnographic modes of inquiry" [26:65]. Nevertheless, they also thought necessary to bring a better methodological clarity to autoethnography, thus reviewed autoethnographers' data collection techniques, and detailed three most

used: field notes, personal documents, (self-)interview [26].

This inherent characteristic of introspective methods, "researcher as subject", introduces considerable methodological ambiguity, a concern frequently raised by their critics. As specified by Wallendorf and Brucks [6:347], when using introspective methods, the researcher often has "a series of undocumented recollections employed while writing a manuscript rather than a systematic recording of experiences that was separately analyzed". Because of this, at least partially, the researcher in the data analysis process is likely to miss a form of detachment or distance from the perspective of the subject or the researched, which typically serves an important analytic counterpoint [6:347].

As advocates of introspective methods, we believe both *spontaneous* (i.e., intertwining manuscript writing, introspective data collection, and analysis within a singular evocative personal narrative writing process) and *structured* (i.e., better supporting constant comparison and analytical agenda) data collection approaches could be valuable. However, we also view the methodological ambiguity as a double-edged sword that demands expertise and skill to wield effectively. While it offers seasoned and confident introspective researchers great flexibility, leaves novices perplexed due to the absence of a practical guiding framework. Hence, we aim to offer a comprehensive and structured overview of possible ways to collect introspective data for experience design research and surface the underlying dimensions of introspective data collection. This will pave the way for more systematically planned and executed introspective studies in our field.

3. Differentiating method, technique, and tool

In this study, we distinguish between "method", "technique" and "tool", though they often overlap. *Methods* represent systematic procedures or sets of investigative steps that the researcher can follow to collect and analyze data to answer appropriate research questions and to generate new knowledge. For a research method to work in practice, apart from the general procedural knowledge, the researcher also must be familiar with a variety of techniques and tools that support the execution of the method. *Techniques* also manifest as systematic procedures, and therefore techniques and methods are often considered as synonyms. Nevertheless, a clear distinction between techniques for data collection and those for data analysis can be easily drawn in most cases. To better serve our current research purpose - to survey how design researchers have collected data while using introspective methods (i.e., focusing on the techniques for data collection, rather than those for data analysis), it is necessary to conceptually differentiate techniques and methods. *Tools* are devices used while performing techniques. To illustrate their relationships, consider this: when a researcher using autoethnography (a method) in a study, journaling, photo taking, drawing or collage (techniques) may be performed to collect and document introspective data; to enable the practice of these techniques the researcher may use pens and notebooks or smartphones, tablets, and relevant apps (tools).

4. Methods

To ensure the quality of this review study, we followed a search strategy that is in line with the PRISMA (preferred reporting items for systematic review and meta-analyses) [27]. The process of literature search and selection is demonstrated in the PRISMA-ScR flow diagram (Fig. 1).

4.1. Literature search

We intended to include only peer-reviewed articles published by renowned design research journals (e.g., Design Studies, International Journal of Design) and conferences (e.g., CHI, DIS) that are indexed in Scopus, Web of Science and ACM Digital Library, between 01/2012-10/2022. To ensure the design relevance, we limited our search in Scopus
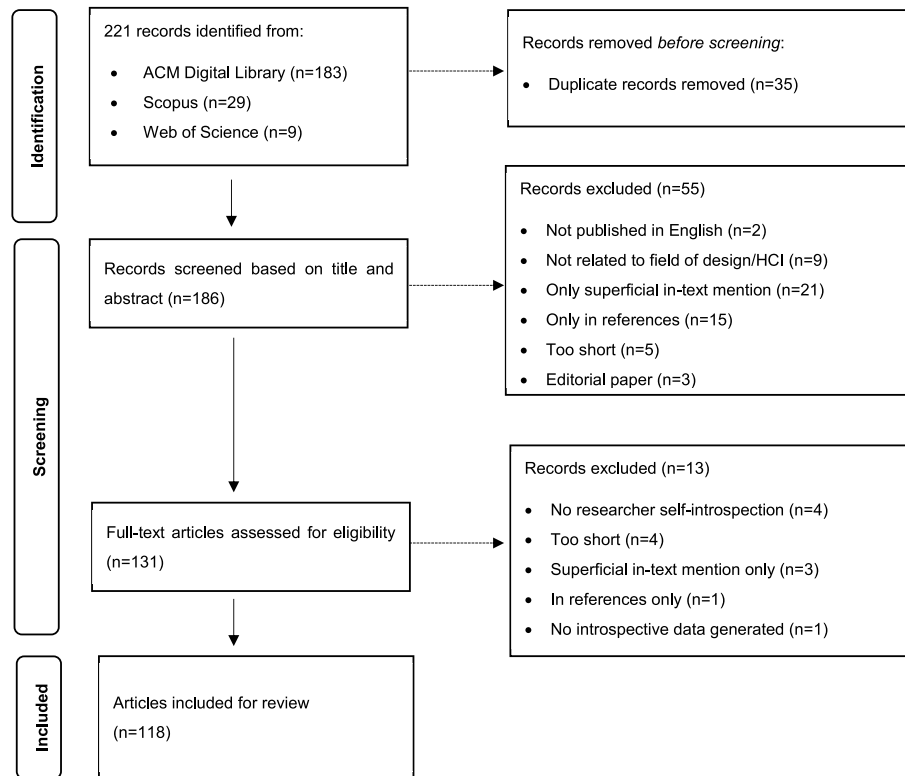
Fig. 1. The process of literature search and selection.

and Web of Science within a list of 20 high quality design research journals, which was largely guided by the study on peer-perceived design research journal quality by Gemser and colleagues [28].

Excluding book chapters from the review study was a strategic decision aimed at maintaining the rigor and focus of the research. Often, book chapters do not undergo as stringent a peer-review process as journal articles, which could compromise the reliability and credibility of the study. Furthermore, they tend to provide broader, more generalized views, and their varied structures and lengths can introduce inconsistency in data extraction and aggregation, making them less suitable for focused and cohesive synthesis. Lastly, the limited accessibility of book chapters could constrain the availability and reproducibility of the research.

The following terms were used as search keywords: "autoethnography" or "first person method" or "first-person methods" or "first-person methodology" or "researcher introspection". These terms were noticeable names of introspective methods that have appeared in design research. This step resulted in 221 items, including 186 unique entries. Each source was last visited on Oct 5, 2022.

4.2. Literature selection

In the design field, research methods evidently serve dual purposes: informing design processes and facilitating scholarly research. Moreover, the lines distinguishing design practice from scholarly design research frequently blur, given the prominent roles of Research through Design (RtD) and practice-led research in our field. The employment of introspective methods epitomizes this trend. Some studies may explicitly employ introspective methods to derive insights and inspire design projects. Others may utilize these methods to investigate into experiential phenomena with the goal of producing knowledge that holds broader design implications. Meanwhile, many may also occupy a middle ground between these two approaches. Thus, our study encompasses all these scenarios.

To select eligible papers, both authors first individually conducted abstract-based screening, giving a value to each paper as "included" or "excluded" or "maybe", according to following inclusion and exclusion criteria.

Inclusion criteria: The paper 1) methodologically develops (an) introspective method(s); or 2) reports a study that utilized (an) introspective method(s).

Exclusion criteria: The paper 1) is not in English; or 2) not related to the field of design; 3) or superficially mentions (an) introspective method(s) in-text (e.g., once) or only in the references; 4) too short (e.g., workshop call, abstract); 5) or an editorial paper.

The conflicting choices (n = 26) and maybes (n = 7) were then discussed and resolved. This step excluded 55 articles. In the following step, we retrieved and reviewed the full text of the remaining 131 articles. 13 articles were excluded in this step, according to the same inclusion and exclusion criteria.

The final dataset consisted of 118 articles, out of which, 10 were published between 2012 and 2015. By contrast, 39 were published between 2016 and 2019, and 69 between 2020 and October 2022. We identified 12 methodological papers that contribute to the development of introspective methods; these papers either advocate for the unique value of these methods or introduce novel data collection techniques and tools (i.e., [1,29–39]). The methodological articles were used to provide an understanding of the status of methodological development of introspective methods in our field. Additionally, there were 5 articles (i.e., [40–44]) in our dataset employed introspective methods without specifying how and what introspective data were collected. In these cases, "autoethnography" was mentioned as an attitude for reflexivity, or as an additional or alternative method combined with other conventional methods. Due to lack of useable information about introspective data collection, we excluded them from our analysis, but kept them for making a general observation. We used the remaining articles (n = 101), all of which employed introspective methods, for our analysis to understand the data collection techniques and tools used by design researchers

when adopting a "research as subject" stance.

4.3. Data extraction and analysis

The final selection of articles was imported into ATLAS.ti for analysis. To address our research question, we extracted data focusing on the following two aspects: 1) the data collection techniques used in the study; 2) the tools used in the study to support the data collection techniques. Meanwhile, we also stayed open to valuable data that would allow us to observe the current use of introspective methods in our field and make recommendations for the future development, even if they were not directly linked to our primary research question.

Following the six-phase procedure introduced by Braun and Clarke [45], the analysis process was a collaborative effort between the first author (FA) and the second author (SA). The steps of familiarization, generating initial codes, and searching for themes were mainly conducted by the SA, with the guidance and input from the FA. The collaboration between the authors was underpinned by four 1-h meetings spread over two months that were dedicated to the iterative revision of the codes and themes. These sessions ensured that both authors contributed to and agreed upon the interpretation of the data. With the refined codes and themes, the authors had another intensive 3-h meeting to review, define, and name the final themes. Finally, the FA took the lead in the reporting phase, with the assistance of SA.

5. Presenting the six categories of introspective data collection techniques

This section presents a detailed overview of introspective data collection techniques and tools utilized in our field. Our analysis reveals that introspective design researchers have employed a rich variety of data collection techniques that are recognized in reputable design forums. We categorize them into six general types: 1) text-based, 2) photograph-based, 3) video-based, 4) audio-based, 5) drawing-based, and 6) designerly artifact-based. Table 1 presents the six categories, their relevant papers, specific data collection techniques, and an example reference for each technique. Notably, techniques from different categories are often combined to serve the introspective data collection purpose of one study, and thus some articles appear multiple times in different categories in the table. For example, photos and videos are often combined with written personal narratives to become a visual diary (e.g.,

Table 1

Six categories of introspective data collection techniques that are used in design research.

Category	References	Specific Techniques [example]
Text-based	[22,23,33,46–128]	Diary [52], Journaling [122], Field notes [75], Self-interview [74], Poetry [92], Vignettes [54], Personal narratives [55], Chat logs [108], Social media-post [101,123]
Photograph-based	[44,46,49,52,56,63,65,68, 70,71,81,82,85,87,97, 100–102,108,109,111,112, 117,124,127–129]	Photographing [46], Screen shotting [112]
Video-based	[46,48,50,63,65,67,70,76, 82,86,97,101,105,113,114, 130–138]	Video recording [130], Screen recording [70], Collaborative live video [86], Video making [50]
Audio-based	[46,50,63,64,70,71,82,86, 90,97,133,139]	Voice recording [139], Sound recording [97]
Drawing-based	[22,49,59,82,85,90,92,101, 106,113,118,132,135, 140–142]	Body map [141], Soma trajectory [142], Dialogical Sketching [140], Comics [106]
Designerly Artifact-based	[36,49,50,64,73,81,92,101, 113,129,135,138,143,144]	Collage [92], Typographic composition [81], Annotated workbook [36], Design Memo [143], Prototypes [113], Design Memoirs [144]

Ref. [46]). In the following subsections, we provide a detailed explanation of each category and the tools used to support them.

5.1. Text-based

Unsurprisingly, in our dataset, text-based techniques represent the most widely used way to collect data for introspective inquiry (85.1%, 86/101). This preference for text-based techniques may be attributed to two main reasons. Firstly, written text has been the primary mode of qualitative data for a long time [145]. Secondly, autoethnography, the most used form of introspective method in our field, typically produces textual data.

Text-based category includes nine specific techniques, with diary, journaling, fieldnotes, and self-interview (transcript) being the most widely known and systematically developed. Some text-based techniques have an *artistic orientation* and aim to produce highly evocative data, such as poetry, vignettes, or other highly engaging personal narratives. Researchers have also experimented with novel text-based techniques made possible by the development of information and communication technologies, such as social media posts and chat logs. These techniques can facilitate quick self-logging, interactive or collaborative introspection, and instantaneous sharing and documentation among multiple researchers.

Both analog and digital tools have been widely used to support text-based techniques. These can be in many formats, such as, paper notebook and writing utensils [72], shared Google Docs [109], diary apps [53], online blog [50], digital notebook software [74] and WeChat app [87]. While traditional text-based techniques do not need any digital tools to work, some recently adopted text-based techniques are made possible because of new digital tools or platforms. For example, digital chat logs require a chatting medium like Facebook Watch Party [48] or a chat window embedded in an online game [108]. Of course, the use of digital applications also implies the use of the digital devices, such as a smartphone, tablet, or computer.

5.2. Photograph-based

Photograph-based techniques are another common approach to collecting introspective data in our dataset (26.7%, 27/101). Photographing is particularly useful for quickly documenting changes in the external context or environment, in which the experience under study occurs. In some cases, documenting the external environment could be as important as capturing the inner experience, because introspective researchers often face a dilemma between immersion and self-examination, or between "their own first order participation in the events and second order reflections on a more abstract, analytical level" [117:36]. Photographing has been used to deal with this dilemma, because photographs are very effectual in assisting the researcher to relive of the experience later in the analysis stage, so that the researcher can first fully live through the event with a deeper immersion.

Notably, photographing is practically always combined with other techniques. A popular combination is that of photos and diary writing, creating a so-called visual diary [52,100,111]. In addition, given many of our daily experiences happen nowadays in or mediated by virtual environments, the documentation of virtual context is also frequently seen, through a special "photographing" - screenshotting, for example in games or apps. They can be useful data that supplement diary or journal writings [70,108]. Photograph-based techniques are almost always performed by digital tools, especially by smartphones [46,100].

5.3. Video-based

Different video-based techniques are also found serving different introspective data collection purposes (23.8%, 24/101). First, the *first-person point of view* video recording may be used to capture both detailed external context and content of the researcher's inner experience

simultaneously [135]. The researcher's self-narration can integrate an immediate introspective analysis, which makes the video a "reflective essay" that allows a concurrent introspection. Second, the *fly on the wall* video recording [30,37] can document the details of the researcher's everyday activities in a given space (e.g., kitchen, office). Such videos are typically used to support *retrospective introspection* on the experience occurred during the time of recording [130]. Furthermore, screen recording [120] and collaborative video chat recording [86] are also included in this category. The latter is especially useful for researchers who conduct introspective data collection and analysis interactively and collaboratively – for instance, when performing collaborative autoethnography.

In addition to faithfully documenting the external environment, video-based techniques can be artful and evocative too. An remarkable example of this kind is a study by Biggs and colleagues [50], in which the first author conducted several video making experiments with found video and audio materials (rather than self-recorded video), that resulted in creative videos and soundscape explorations that relate to the author's personal experiences of bird watching. All the authors used these videos as "objects to think with" and created subtitles to present their introspections and reflections in the videos. Like tools supporting photograph-based techniques, video-based techniques are also fully supported by digital video cameras or digital video editing applications online nowadays.

5.4. Audio-based

Audio-based techniques (11.9%, 12/101) include sound recording and voice recording. *Sound recording* primarily focuses on capturing the environmental sound. For example, in Ref. [97]:519, "sound recordings were collected to expand the scope of investigations beyond the spoken and written word".

Voice recording, on the other hand, is a convenient means for quickly collecting real-time think-aloud accounts of the researcher. An example in our dataset is [139], in which voice recording enabled the author to document her introspective insights during a walkthrough of the research site where their prototype was installed, including what she saw, felt and became aware of internally. For audio-based techniques, smartphones again seem to be an ideal tool [46,50]. However, majority studies employed audio-based techniques did not clearly mention the tool used for audio recording.

5.5. Drawing-based

Drawing-based techniques (15.8%, 16/101) can encompass both *freehand* and *template*-supported approaches. A noteworthy and inspirational example of a freehand drawing-based technique identified in this review study is *comics* [106]. In this study, the authors employed comics to humorously capture and present their self-reflections on the experiences of staying connected with their relatives remotely during the Covid-19 pandemic. Another freehand drawing technique, *Dialogical Sketching*, was introduced by Koulidou and colleagues [140]. This data collection technique employs sketching between multiple researchers as a visual dialogue for documenting introspective accounts and facilitating communication, collaboration, and knowledge co-creation. Among the template-supported techniques, the *body map* [82,90,141] (or *body sheet* [135]) is frequently used to document bodily sensations through colors, shapes, and simple text, providing a way to "capture complex and non-explicit emotions and sensations" [146]:463. Additionally, the *Soma Trajectory* technique was introduced as a template-supported approach to documenting the temporality and dynamics of somatic experiences, which static body maps cannot capture [142].

While freehand drawing requires an adequate artistic skill or at least confidence of the researcher, template-based drawing is much easier to start and engage. In addition, freehand drawing may be more ambiguous and open for alternative interpretations. By contrast, template-supported drawing techniques can better facilitate cross-sample comparison. Tools that support drawing-based techniques are typically papers, sketchbooks, and colorful pens or other drawing utensils. Some researchers also used digital drawing tools, such as Procreate [106].

5.6. Designerly artifact-based

Many researchers in our field can make a variety of artifacts to document and represent their introspective data (13.9%, 14/101). Compared to other fields where introspective methods are also used, tangible artifact-based techniques are much easier to encounter in our field, due to the researchers' higher artifact-making capability and confidence. Specifically, collage and typographic composition, annotated workbook (or design memo), designerly prototype (e.g., Design Memoir) have been used as designerly ways to collect introspective data.

A *collage* is a collection of various visual materials curated to form an artifact that captures the impression of an experience as it appears to the researcher. According to Ref. [92], the visual juxtapositions of the collage can form new connections between ideas. Collage can also make use of material that more literally refers to certain experiences, such as in Ref. [135], where a collage was made with materials from the forest to document the experience of a walk in the forest. Besides curating materials collected from sources (e.g., magazines, printed digital images collected from the Internet, or even tangible material samples with diverse haptic qualities), it can also include self-made visual materials resulting from those data documentation techniques elaborated above, such as photographing, drawing and writing [81].

For design professionals, *annotated workbook* is also a familiar technique for collecting introspective data and insights [36,135]. Some design researchers may call their annotated workbooks design memos [143]. Researchers consider these memos as an equivalent of autoethnographic field notes, which enable their introspective analysis and insight generation. In our current review, studies that employed this technique all used it to document and reflect on the design process, or in other words, the designer's experience of designing. This technique can assist the researcher to continuously collect introspective data over a longer period. In addition, multiple types of data can be documented and curated in one physical annotated workbook, including "physical samples, pictures of explorations and prototypes and documentation of the methods use" [36]:3 and also sketches, fragments of code, co-written documents, and screenshots from an app. These features introduce strengths and challenges. For researchers going through a design or design research process, it can be practical, useful, inspirational, and enjoyable to keep track of the process and their subjective experience with sensorially rich data in the same place. On the other hand, it may be sometimes overly curated for aesthetic purposes, which designers tend to do naturally, at the cost of faithfulness. The richness of data variety may be also overwhelming, and connections between them overly unclear, so that the involvement of other researchers in the data analysis may become difficult. Therefore, a balance should be carefully maintained, according to the research purpose of the study at hand.

Finally, the most designerly introspective data collection techniques are those based on creating novel artifacts or designerly prototypes which represent felt experiences and values. This practice is inspired and encouraged by the data physicalization research in HCI [64,147]. An impressive example is making *Design Memoirs* that are "subjective and corporeal in nature, and provide a direct and observable way to reckon with felt experiences through, and for, design" [144]:1. This technique translates emotional and meaningful experiences into designerly physical prototypes – "things that give form or curate access to that which is difficult to speak about" [144]:3.

From all categories, designerly artifact-based techniques are open to the most diverse tool use. Tools might range from "paper, photography, water color, sketch, Adobe Creative Suite, Procreate, Processing" [81]:554. Furthermore, open source hardware has been used to create or support tangible artifacts, such as using Arduino to make a

shape-changing artifact [113].

6. Two dimensions underlying introspective data collection techniques

This section presents two dimensions or continuums underlying introspective data collection techniques. Uncovering these dimensions can assist introspective researchers in selecting and customizing data collection techniques and reporting styles, to align with their research purposes.

6.1. Metacognitive/analytic vs. narrative/evocative

Introspective inquiry, facilitated by various data collection techniques, can manifest along a dimension ranging from *metacognitive/analytic* to *narrative/evocative*. Although this dimension naturally emerged from our analysis, it is a not brand-new concept. We therefore first introduce it based on a brief review of relevant discussions from other fields, and then connect it with our current review.

Over past decades, autoethnographers have engaged in a long debate on the evocative and analytic qualities of autoethnography. Autoethnography, as a research method, was originally developed to embrace an *epistemology of feeling* in social science. Ellis and Bochner have argued that autoethnography generates new knowledge that *can be felt*; it "fractures the boundaries that normally separate social science from literature" [3:744]. Detailed, private, evocative stories, therefore, are the most typical form of introspective data in autoethnographic studies. They have even taken a rather extreme stance, and made it clear that these evocative introspective data "long to be used rather than analyzed; to be told and retold rather than theorized and settled; to offer lessons for further conversation rather than undebatable conclusions; and to substitute the companionship of intimate detail for the loneliness of abstracted facts" [3:744].

Although such a harsh rejection of the traditional social science standards unequivocally acknowledged the value of the researcher's first-person accounts and clearly positioned autoethnography in the landscape of research methods, it also kept autoethnography away from the mainstream social science [25]. Thus, Anderson has advocated another form of autoethnography – an analytic one that features systematic guidelines and the researcher's commitment to analytic agenda and theoretical development [25]. Nevertheless, it is more appropriate to see this analytic-evocative differentiation as a continuum with many possibilities in between possessing both qualities. As Anderson has reflected in a later work – "I do so today with a greater sense of blurred boundaries as opposed to clear distinctions … the modes and key features of autoethnographic inquiry are similar no matter where along the spectrum from 'evocative' to 'analytic' one stands"[26]:64].

Like autoethnographers, introspective consumer researchers have also long noticed a similar *metacognitive-narrative* continuum underlies introspective methods [148]. Perhaps due to the dominant popularity of autoethnography among introspective methods, the qualities of being narrative, retrospective, and evocative are often unquestioningly taken as the defining features of all introspective data. However, Gould has clarified that "there is no necessity for that being the case" [148]:194]. He has argued that introspective data and their collection techniques can also have salient metacognitive characteristics, especially when focusing on supporting the researcher's simultaneous introspection on their "own real-time thoughts and feelings" [[149]:408–409].

Techniques that support metacognitive data collection are typically employed for *concurrent* (rather than retrospective) introspection. Due to the ongoing status, the experience under study is not yet a complete episode which can be meaningfully recorded as a narrative. Therefore, these techniques typically generate "micro" and "mini" metacognitive descriptions of particular aspects or facets of the ongoing experience (e.g., descriptors or the ongoing thoughts or bodily feelings), rather than autobiographies as data [1]. The introspective researcher's intention of

taking a stance more towards the metacognitive end of the continuum is often because of a higher commitment to analytic agenda and theory building in the study.

In our dataset, some data collection techniques can clearly better support a more metacognitive/analytic mode of introspective inquiry. For example, the authors of [22] employed an event-contingent *self-experience* sampling technique (i.e., a structured online diary) to concurrently collect mood experience samples of their own, whenever a mood change was noticed. These data facilitated a structured cross-sample comparative analysis at a later stage, which effectually enabled a structure of experience to emerge from. By contrast, many writing-based (e.g., Refs. [54,55]) and most drawing-based (e.g., Refs. [106,140]) and designerly artifact-based techniques (e.g., Refs. [36,81, 92,113,143,144]) are more towards the narrative/evocative end of the spectrum. Meanwhile, some techniques may be well found in the middle having both qualities. For example, body map is one of such techniques, data collected through which can be evocative as well as serve analytic purposes (e.g., when the researcher collects many body maps of themselves under different states).

6.2. Data of introspection vs. Data for introspection

Data collected during an introspective research process may include two forms. On one hand, *data of introspection* are externalized by the researcher as the results of their internal self-observation of their own feelings, sensations, thoughts, meaningfulness, values, or conflicts woven into the subjective experience. In other words, data of introspection directly represent and communicate the internal experiential content that the introspective researcher has noticed. *Data for introspection*, on the other hand, typically document the changing external environment in which the researcher lived through the experience, and sometimes also the researcher's changing behaviors and physiological states (e.g., heart rate). Data for introspection do not directly represent the researcher's introspection, but they can be highly valuable for introspective studies, because they can support the researcher to better introspect on the experience retrospectively.

Data of introspection and data for introspection are not always mutually exclusive. Therefore, they represent the two ends of another continuum underlies introspective data collection techniques. For example, written personal narratives and videos with self-narration often record simultaneously both what is out there (data for introspection that support retrospective introspection) and the stream of inner thoughts and feelings (data of introspection as the result of concurrent introspection).

Another point worth mentioning is that, while data of introspection are qualitative and descriptive in nature, data for introspection are not necessarily qualitative. For example, quantified-self data generated by the researcher may be effactually used to support the researcher's introspective inquiry, despite being quantitative. Those sudden changes in heart rate recorded during an event may indicate intensive emotions occurred somewhere, sometime. With this information, the researcher can better direct their attention when introspecting retrospectively. Nevertheless, simply collecting such quantified-self data would capture little about the felt dimension. In this case, they are generated by the researcher themselves, and have a *potential* to be data for introspection, but this potential will not be actualized if the researcher does not use them to support introspection.

6.3. Practical implications of the two dimensions

Nuances exist across the use of introspective methods, despite their shared characteristic of "researcher as subject". Understanding the two dimensions underlying introspective data collection can effectively assist introspective researchers in planning their studies appropriately.

Introspective methods may be used to explore new theoretical possibilities and generate frameworks. In these cases, data collection techniques with salient metacognitive and analytic features can conveniently

facilitate structured analysis, and therefore offer the necessary systematic and in-depth dissection of the key experiential elements. Such techniques often require a careful development of templates for introspective data collection before the study, whether they are text-based (e.g., a template with predefined prompt questions) or drawing-based (e.g., a template with body outlines). Accordingly, introspective inquiry that features metacognitive/analytic qualities is typically reported in a more structured manner and evaluated based on rational reasoning.

In contrast, when the primary research purpose is to capture the nuanced felt qualities and richness of human experience, and allow the researcher's subjective insights to be felt (rather than reasoned) by the readers, techniques that generate narrative, poetic and emotionally contagious introspective data are more appropriate. Of course, many text-based techniques can achieve this goal, but photographs, videos, audios, drawings and designerly artifacts can tell vivid stories too, and enhance the evocativeness of introspective data beyond what words can provide. An unique advantage in our field is that many design researchers are open to and competent at scholarship beyond words. Ellis praises these data collection techniques for experimenting "with alternative ways to transform what is in our consciousness into a public form that others can take in and understand" [150]:215. They are likely to capture and better communicate the felt impression, wholeness, and meaningfulness of the experience, rather than detailed facts and explication. They strive less for certainty, clarity, and conclusiveness, but are more comfortable with ambiguity and allow for open and alternative interpretations. They empower introspective researchers to achieve insights that complement what a reductionist analytical approach can offer [151]. Quality of such introspective inquiry should be appreciated based on their ability to emotionally resonate with readers, rather than conventional standards that only focus on rationality [25,152].

Becoming aware of the differences between data of introspection and data for introspection is also important for introspective researcher to make informed decisions on the selection of data collection techniques. During our search and selection process, we noticed one "introspective" study [153] that looks unusually "objective". Although it is a very insightful work, it seemed that the researchers misused the "researcher as subject" approach, due to a lack of necessary conceptual distinction between data of introspection and data for introspection. They claimed that autoethnography was used to generate data in one case study. However, the data they collected were through a variety of sensors, about the environment and one researcher's bodily states. "All numeric data collected, including lux, sound, temperature and heart rate measurements, were analyzed in SPSS"[153]:65. Then, connections between these potential data for introspection were made directly to draw conclusions, without using them to support any transparent researcher introspection (or generating data of introspection) at all. At least it is not visible in the paper. In this case, the advantage of "researcher as subject" (i.e., a privileged and peculiar access to lived and felt experiences from within) is not taken. With no one introspecting on the experience, the same research results can be, or perhaps should be achieved by engaging research participants other than the researchers themselves. Developing a conceptual difference between data of introspection and data for introspection can hopefully support a better understanding of the unique value of introspective methods, a more precise and meaningful use of them, and a clearer report of introspective studies in our field.

7. Recommendations for the future development of introspective methods in design research

Introspective methods have brought new challenges as well as opportunities to our field. Based on our own reflections and those offered by experienced introspective researchers from other fields, we outline five recommendations for design researchers who aspire to further develop and/or systematically use this family of methods.

7.1. Dedicated self-cultivation for fruitful introspection

Introspective methods cannot be simply developed, learned, and applied as a set of prescribed steps that are independent from the researcher, despite being introduced as a "method". In using these methods, the researcher must positively exploit *the self* as the central site of experience and the most important research instrument for data collection. Although introspection sounds simple, researchers studying consciousness have noticed that introspecting for research purposes is far beyond mere observation or "just-take-a-look" [154]:2, and that "most people are poor introspectors of their own ongoing conscious experience" [155]:247. This highlights the need to cultivate introspection capabilities. For example, Gould shared his long-term self-training exercises rooted in Eastern meditation, which allowed him to become highly capable of using introspective methods for consumer experience research [148]. Other exercises developed in literary art (e.g., estrangement [156]), Chinese poetics (e.g., savoring for emotion refinement [157]), cognitive therapy (e.g., detached mindfulness [158]), and somatics (e.g., The Feldenkrais Method [159]) can also help introspective researchers improve their sensibility to and meta-awareness of experience, or slow down the internal experience process for more fruitful first-person observation. These exercises offer limited effects if practiced only right before or during a project as quick fixes. We therefore encourage a long-term self-cultivation attitude towards these exercises. In other words, introspective researchers should habitually practice them to examine experiences that naturally occur in daily life. Although this may sound time-consuming and inefficient by decoupling the exercises from specific projects, we argue that such long-term, self-motivated, and self-directed engagement would better prepare the introspective researcher before an introspective research or design project officially takes place.

7.2. Need for a more nuanced and precise understanding of introspective methods

While collecting data from the research participants', design researchers often gain valuable experiential data and insights through observing their own experiences. Under conventional standards for scientific research, such researcher's personal subjective insights are often judged as biased. Therefore, by mentioning a well-known method that allows researchers to incorporate their first-person accounts, the researcher can avoid repeating a long epistemological discussion. It not only legitimizes the researcher's first-person perspective but also establishes a solid methodological foundation for justifying the use of self in research. As the most known introspective method, autoethnography (or its name) has been widely used (or mentioned) for this reason, and almost become synonymous with all introspective methods in our field. Such loose understanding and rough use of "autoethnography" can lead to some problems.

Using autoethnography as a research method implies that the study somewhat focuses on the sociocultural meanings of experiences, and the researcher's retrospective autobiographical narratives are collected as data and presented in the paper [1]. However, in our review process, we noticed some authors conveniently dropped "autoethnography" in the method section without specifying what they did exactly in relation to "autoethnography" (e.g., Ref. [43]). "Autoethnography" is also sometimes used to name a pre-study sensitizing process for designers to become more aware of their own experiences (e.g., Ref. [47]). This could cause confusion among readers, especially for those who know autoethnography well from other fields – "Why does a paper reporting an autoethnographic study not present any personal narrative of the researcher?". Autoethnography is not the only introspective method, despite it is the best developed and most broadly used. We suggest that researchers in our field should develop a more nuanced understanding of

the diversity of introspective methods, and be more precise about what specific form of introspective method is used for their particular research purposes.

7.3. Rigor in introspective methods

Our field is currently in a stage of *antithesis* (i.e., a negation of the *thesis* that only well-established yet confining methods are valid) and celebrating a new level of methodological liberation. Many papers in our dataset were exceptionally creative, and reading them was an exciting, emotionally touching, and inspiring experience that conventional research papers rarely offer. However, as advocates of introspective methods, we argue that rigor is important for all scholarly research, even when applying a research approach as free as introspection. Therefore, we encourage a *synthesis* stage to emerge in our field - the systematic use of introspective methods with appropriate criteria for rigor.

To achieve this goal, we can learn from other fields where the debate on rigor in introspective methods has been ongoing for much longer. For example, in consumer research, Woodside has contributed to the synthesis, by critically reflecting on and transforming Holbrook's original *Subjective Personal Introspection* into *Confirmatory Personal Introspection* [20]. Similarly, outside the field of design research, autoethnographers have made significant efforts to establish rigor in autoethnography [160]. Humanistic psychologists have also been working on their introspective method, *Heuristic Inquiry*, for decades and have developed a set of criteria to guide its use and ensure rigor [161]. Discussion about rigor of introspective methods is still yet to be developed in our field, with those unique challenges in our own field carefully considered (e.g., the salient role of technology, faster project pace, and a focus on usefulness for designing rather than merely understanding experience itself).

7.4. Explore new technologies as data collection tools

Of the reviewed papers, digital tools (n = 71) were used twice as often as analog tools (n = 30). This suggests that design researchers have a relatively high level of tech-savviness, which is not surprising. Furthermore, with the quick development of AI and AI-based applications, we envision researchers in our field may become one of the first groups to experiment with introspecting collaboratively with non-human agents. Additionally, we see great value in developing new technologies that facilitate introspection for research purposes, as well as for self-knowledge in daily life. This is inspired by a recent study that explored how AI can help human users appreciate alternative perspectives on their lives [162].

7.5. Ethical issues in introspective methods

Experience design researchers choose to use introspective methods often because their research endeavor would pose too large risks to participants, and having the researchers themselves as the participants could resolve the ethical dilemma [51,75,105]. For instance, to explore, design and test interactive technologies aimed at mediating romantic long-distance relationships, the authors of [56] chose to use autoethnography as the method, because "messing with other peoples' relationships is sensitive, no matter how 'designerly' it is done" [56:278].

While acknowledging this advantage related to research ethics, we hope to stress that "researcher as subject" should not be naively seen as having no potential ethical issues. For example, when writing an autoethnographical work, the researcher's self-narratives often inevitably involve others, which may easily reveal their private information [163]. In addition, the researcher's emotional vulnerability, safety and privacy are also hidden yet important ethical issues related to introspective methods [164–166].

Discussions on ethical issues of introspective methods are still rare in design research community, and thus we suggest that researchers in our field, at least for those who would like to use introspective methods, develop a good understanding and sensibility towards possible risks. A first step could be to engage in a systematic review of how ethical issues in introspective methods have been tackled in other fields that accepted, developed, and used these methods decades earlier than our filed. For example, Ellis has developed *relational ethics* to guide researchers to approach to ethical issues in autoethnography [167]. Emerald and Carpenter have reflected on the emotional risks and vulnerability that introspective researchers face, and encouraged to develop a culture and practice of introspective researcher's self-care [168].

8. Conclusion

Through a systematic review of 118 design research publications, we have examined how design researchers have collect data about their own experiences for introspective inquiry. Our analysis revealed six categories of data collection techniques, including text-based, photograph-based, video-based, audio-based, drawing-based, and designerly artifact-based approaches. We have also identified two underlying continuums: "metacognitive/analytic" vs. "narrative/evocative" and "data of introspection" vs. "data for introspection". Additionally, to further the development of introspective methods in our field, we have recommended that introspective researchers should engage in a long-term dedicated self-cultivation (rather than taking introspective exercises as quick-fixes or pre-project sensitizing practice only), acquire a more nuanced and precise understanding of introspective methods, debate on rigor, explore new technologies as novel data collection tools for future introspective inquiry, and take ethical issues under consideration despite the unity of researcher-participant.

One limitation of this systematic literature review is that we only searched for papers in ACM Digital Library, in combination with highly reputable design research journals that are available from Scopus and Web of Science. As a result, relevant papers published elsewhere may have been missed. Additionally, our search terms were limited to a few expressions of introspective methods, which may have excluded papers that used different terminologies to describe the use of introspection. To further build on our findings, future research could explore related concepts and use a more comprehensive search strategy.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT as a proof-reading tool to evaluate and improve the language and readability of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

The author is an Editorial Board Member/Editor-in-Chief/Associate Editor/Guest Editor for [Advanced Design Research] and was not involved in the editorial review or the decision to publish this article.

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Appendix A. Articles Included for Review

Source Type	Author(s)	Year	Title	Source
Journal Article	L. Loke; T. Robertson	2013	Moving and Making Strange: An Embodied Approach to Movement-based Interaction Design	ACM Trans. Comput.-Hum. Interact.
Journal Article	P. Cash; B. Hicks; S. Culley; T. Adlam	2015	A Foundational Observation Method for Studying Design Situations	Journal of Engineering Design
Journal Article	K. Williams	2015	An Anxious Alliance	Aarhus Series on Human Centered Computing
Journal Article	S. Bakker; K. Niemantsverdriet	2016	The Interaction-Attention Continuum: Considering Various Levels of Human Attention in Interaction Design	International Journal of Design
Journal Article	F. F. Mueller; S. J. Pell	2016	Adventure and Technology: An Earthquake-Interrupted Expedition to Mt. Everest	Interactions
Journal Article	A. Mackey; R. Wakkary; S. Wensveen; O. Tomico	2017	"Can I Wear This?" Blending Clothing and Digital Expression by Wearing Dynamic Fabric	International Journal of Design
Journal Article	S. Nemorin	2017	The Frustrations of Digital Fabrication: An Auto/Ethnographic Exploration of '3D Making' in School	International Journal of Technology and Design Education
Journal Article	N. Sadowska; L. Dallas-Conte	2017	Infusing Management Education with Design to Foster Resilience, Adaptability and Flexibility	The Design Journal
Journal Article	K. Kennedy	2018	Designing for Human-Machine Collaboration: Smart Hearing Aids as Wearable Technologies	Communication Design Quarterly Review
Journal Article	L. Loke; T. Schiphorst	2018	The Somatic Turn in Human-Computer Interaction	Interactions
Journal Article	M. Mainsbridge	2018	Gestural Systems for The Voice: Performance Approaches and Repertoire	Digital Creativity
Journal Article	B. Aryana; E. Naderi; G. Balis	2019	Strategies for Empowering Collective Design	The Design Journal
Journal Article	D. A. Chen; J. A. Mejia; S. Breslin	2019	Navigating Equity Work in Engineering: Contradicting Messages Encountered by Minority Faculty	Digital Creativity
Journal Article	D. Clarke; D. Kirkpatrick; T. Cunningham	2019	Running with Scissors in Business Management Education: A Collaborative Autoethnography on Designing Pedagogical Interventions with an Art-Maker and an Academic Skills Tutor	The Design Journal
Journal Article	P. Garcia; M. Cifor	2019	Expanding Our Reflexive Toolbox: Collaborative Possibilities for Examining Socio-Technical Systems Using Duoethnography	Proc. ACM Hum.-Comput. Interact.
Journal Article	H. Xue; P. M. A. Desmet	2019	Researcher Introspection for Experience-driven Design Research	Design Studies
Journal Article	W.-C. Chien; M. Hassenzahl	2020	Technology-Mediated Relationship Maintenance in Romantic Long-Distance Relationships: An Autoethnographical Research through Design	Human-Computer Interaction
Journal Article	M. Cifor; P. Garcia	2020	Gendered by Design: A Duoethnographic Study of Personal Fitness Tracking Systems	Trans. Soc. Comput.
Journal Article	M. Kleinsmann; M. Ten Bhömer	2020	The (New) Roles of Prototypes during the Co-Development of Digital Product Service Systems	International Journal of Design
Journal Article	E. Priego; P. Wilkins	2020	Comics as Covid-19 Response: Visualizing the Experience of Videoconferencing with Aging Relatives	Interactions
Journal Article	H. Xue; P. M. A. Desmet; S. F. Fokkinga	2020	Mood Granularity for Design: Introducing a Holistic Typology of 20 Mood States	International Journal of Design
Journal Article	A. A. Ahmed; B. Kok; C. Howard; K. Still	2021	Online Community-Based Design of Free and Open Source Software for Transgender Voice Training	Proc. ACM Hum.-Comput. Interact.
Journal Article	S. Erete; Y. A. Rankin; J. O. Thomas	2021	I Can't Breathe: Reflections from Black Women in CSCW and HCI	Proc. ACM Hum.-Comput. Interact.
Journal Article	N. Howell; A. Desjardins; S. Fox	2021	Cracks in the Success Narrative: Rethinking Failure in Design Research through a Retrospective Trioethnography	ACM Trans. Comput.-Hum. Interact.
Journal Article	T. Joshi; J. Bardzell; S. Bardzell	2021	The Flaky Accretions of Infrastructure: Sociotechnical Systems, Citizenship, and the Water Supply	Proc. ACM Hum.-Comput. Interact.
Journal Article	A. Rapp	2021	In Search for Design Elements: A New Perspective for Employing Ethnography in Human-Computer Interaction Design Research	International Journal of Human–Computer Interaction
Journal Article	A. Ståhl; V. Tsaknaki; M. Balaam	2021	Validity and Rigour in Soma Design-Sketching with the Soma	ACM Trans. Comput.-Hum. Interact.
Journal Article	P. Karpashevich; P. Sanches; R. Garrett; Y. Luft; K. Cotton; V. Tsaknaki; K. Höök	2022	Touching Our Breathing through Shape-Change: Monster, Organic Other, or Twisted Mirror	ACM Trans. Comput.-Hum. Interact.
Journal Article	R. van Oorschot; D. Snelders; M. Kleinsmann; J. Buur	2022	Participation in Design Research	Design Studies
Journal Article	D. Zhou; R. Gomez; J. Davis; M. Rittenbruch	2022	Engaging Solution-based Design Process for Integrated STEM Program Development: An Exploratory Study through Autoethnographic Design Practice	International Journal of Technology and Design Education
Conference Paper	F. Hamidi; M. Baljko	2012	Using Social Networks for Multicultural Creative Collaboration	4th International Conference on Intercultural Collaboration
Conference Paper	B. Kolko; A. Hope; B. Sattler; K. MacCorkle; B. Sirjani	2012	Hackademia: Building Functional Rather than Accredited Engineers	12th Participatory Design Conference - vol 1 (PDC'12)
Conference Paper	S. Pijnappel; F. Mueller	2013	4 Design Themes for Skateboarding	2013 CHI Conference on Human Factors in Computing Systems (CHI '13)
	E. Witkowski	2013	Running from Zombies	

(*continued*)

Source Type	Author(s)	Year	Title	Source
Conference Paper				9th Australasian Conference on Interactive Entertainment: Matters of Life and Death (IE'13)
Conference Paper	A. A. O'Kane; Y. Rogers; A. E. Blandford	2014	Gaining Empathy for Non-Routine Mobile Device Use through Autoethnography	2014 CHI Conference on Human Factors in Computing Systems (CHI '14)
Conference Paper	M. Patel; A. A. O'Kane	2015	Contextual Influences on the Use and Non-Use of Digital Technology While Exercising at the Gym	2015 CHI Conference on Human Factors in Computing Systems (CHI '15)
Conference Paper	J. Pearson; S. Robinson; M. Jones	2015	It's About Time: Smartwatches as Public Displays	33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)
Conference Paper	P. Fernando; M. Pandelakis; S. Kuznetsov	2016	Practicing DIYBiology In an HCI Setting	2016 CHI Conference on Human Factors in Computing Systems (CHI EA '16)
Conference Paper	C. Gatehouse	2016	Feral Screens: Queering Urban Networked Publics	2016 ACM Designing Interactive Systems Conference (DIS '16 Companion)
Conference Paper	F. F. Mueller; S. J. Pell	2016	Technology Meets Adventure: Learnings from an Earthquake-Interrupted Mt. Everest Expedition	2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '16)
Conference Paper	N. D. Ngidi; C. Mtshixa; K. Diga; N. Mbarathi; J. May	2016	'Asijiki' and the Capacity to Aspire through Social Media: The #feesmustfall Movement as an Anti-Poverty Activism in South Africa	8th International Conference on Information and Communication Technologies and Development (ICTD '16)
Conference Paper	J. Rajko; M. Krzyzaniak; J. Wernimont; E. Standley; S. Rajko	2016	Touching Data through Personal Devices: Engaging Somatic Practice and Haptic Design in Felt Experiences of Personal Data	3rd International Symposium on Movement and Computing (MOCO '16)
Conference Paper	J. Simonsen; O. S. Jensen	2016	Contact Quality in Participation: A "Sensethic" perspective	14th Participatory Design Conference: Short Papers, Interactive Exhibitions, Workshops - vol 2 (PDC '16)
Conference Paper	P. Sun; S. Cuykendall; K. Carlson; M. Lantin; T. Schiphorst	2016	spaceDisplaced: Investigating Presence Through Mediated Participatory Environments	3rd International Symposium on Movement and Computing (MOCO '16)
Conference Paper	E. Temir; A. A. O'Kane; P. Marshall; A. Blandford	2016	Running: A Flexible Situated Study	2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI '16)
Conference Paper	M. E. Cecchinato; A. L. Cox; J. Bird	2017	Always On(Line)? User Experience of Smartwatches and Their Role within Multi-Device Ecologies	2017 CHI Conference on Human Factors in Computing Systems (CHI '17)
Conference Paper	A. Chamberlain; M. Bødker; K. Papangelis	2017	Mapping Media and Meaning: Autoethnography as an Approach to Designing Personal Heritage Soundscapes	12th International Audio Mostly Conference on Augmented and Participatory Sound and Music Experiences (AM '17)
Conference Paper	F. F. Mueller; C. T. Tan; R. Byrne; M. Jones	2017	13 Game Lenses for Designing Diverse Interactive Jogging Systems	Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '17)
Conference Paper	A. Singh; J. Gibbs; C. Estcourt; P. Sonnenberg; A. Blandford	2017	Are HIV Smartphone Apps and Online Interventions Fit for Purpose?	2017 International Conference on Digital Health (DH '17)
Conference Paper	R. Taylor; J. Spence; B. Walker; B. Nissen; P. Wright	2017	Performing Research: Four Contributions to HCI	2017 CHI Conference on Human Factors in Computing Systems (CHI '17)
Conference Paper	M. K. Wolters; Z. Mkulo; P. M. Boynton	2017	The Emotional Work of Doing eHealth Research	2017 CHI Conference on Human Factors in Computing Systems (CHI EA'17)
Conference Paper	M. J. Brueggemann; V. Thomas; D. Wang	2018	Lickable Cities: Lick Everything in Sight and on Site	2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)
Conference Paper	A. Chamberlain	2018	Surfing with Sound: An Ethnography of the Art of No-Input Mixing: Starting to Understand Risk, Control and Feedback in Musical Performance	Audio Mostly 2018 on Sound in Immersion and Emotion (AM'18)
Conference Paper	A. Desjardins; A. Ball	2018	Revealing Tensions in Autobiographical Design in HCI	2018 ACM Designing Interactive Systems Conference (DIS '18)
Conference Paper	D. Jain; B. Chinh; L. Findlater; R. Kushalnagar; J. Froehlich	2018	Exploring Augmented Reality Approaches to Real-Time Captioning: A Preliminary Autoethnographic Study	2018 ACM Designing Interactive Systems Conference (DIS '18 Companion)
Conference Paper	A. Light	2018	Writing PD: Accounting for Socially-Engaged Research	15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - vol 2 (PDC '18)
Conference Paper	A. Lucero	2018	Living without a Mobile Phone: An Autoethnography	2018 ACM Designing Interactive Systems Conference (DIS '18)
Conference Paper	A. Rapp	2018	Gamification for Self-Tracking: From World of Warcraft to the Design of Personal Informatics Systems	2018 CHI Conference on Human Factors in Computing Systems (CHI '18)
Conference Paper	A. Toombs; C. Gray; G. Zhou; A. Light	2018	Appropriated or Inauthentic Care in Gig-Economy Platforms: A Psycho-Linguistic Analysis of Uber and Lyft	2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)
Conference Paper	S. Conte; C. Munteanu	2019	Help! I'm Stuck, and There's No F1 Key on My Tablet!	21st International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '19)
Conference Paper	D. Jain; A. Desjardins; L. Findlater; J. E. Froehlich	2019	Autoethnography of a Hard of Hearing Traveler	21st International ACM SIGACCESS Conference on Computers and Accessibility
Conference Paper	S. North	2019	Imaginary Studies: A Science Fiction Autoethnography Concerning the Design, Implementation and Evaluation of a Fictional Quantitative Study to Evaluate the Umamimi Robotic Horse Ears	2019 CHI Conference on Human Factors in Computing Systems (CHI EA'19)
Conference Paper	V. Tsaknaki; M. Balaam; A. Ståhl; P. Sanches; C. Windlin; P. Karpashevich; K. Höök	2019	Teaching Soma Design	2019 ACM Designing Interactive Systems Conference (DIS'19)
	F. Bigoni; C. Erkut	2020		

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Source Type	Author(s)	Year	Title	Source
Conference Paper			DogDog: Soma-Based Interface Design for an Improvising Musician	7th International Conference on Movement and Computing
Conference Paper	L. Devendorf; K. Andersen; A. Kelliher	2020	Making Design Memoirs: Understanding and Honoring Difficult Experiences	2020 CHI Conference on Human Factors in Computing Systems (CHI '20)
Conference Paper	M. Friske; J. Wirfs-Brock; L. Devendorf	2020	Entangling the Roles of Maker and Interpreter in Interpersonal Data Narratives: Explorations in Yarn and Sound	2020 ACM Designing Interactive Systems Conference (DIS '20)
Conference Paper	Y. Ha; M. Karyda; A. Lucero	2020	Exploring Virtual Rewards in Real Life: A Gimmick or a Motivational Tool for Promoting Physical Activity?	2020 ACM Designing Interactive Systems Conference (DIS '20)
Conference Paper	S. Homewood; A. Karlsson; A. Vallgårda	2020	Removal as a Method: A Fourth Wave HCI Approach to Understanding the Experience of Self-Tracking	2020 ACM Designing Interactive Systems Conference (DIS '20)
Conference Paper	E. S. Kim; A. Crowe	2020	Lithium Hindsight 360: Designing a process to create movement-based VR illness narratives	31st Australian Conference on Human-Computer-Interaction (OzCHI '20)
Conference Paper	G. Klumbyte; P. Lücking; C. Draude	2020	Reframing AX with Critical Design: The Potentials and Limits of Algorithmic Experience as a Critical Design Concept	11th Nordic Conference on Human-Computer Interaction (NordiCHI '20)
Conference Paper	N. Koulidou; J. Wallace; M. Sturdee; A. Durrant	2020	Drawing on Experiences of Self: Dialogical Sketching	2020 ACM Designing Interactive Systems Conference (DIS '20)
Conference Paper	J. La Delfa; M. A. Baytas; R. Patibanda; H. Ngari; R. A. Khot; F. F. Mueller	2020	Drone Chi: Somaesthetic Human-Drone Interaction	2020 CHI Conference on Human Factors in Computing Systems (CHI '20)
Conference Paper	D. Lockton; T. Zea-Wolfson; J. Chou; Y. Song; E. Ryan; C. Walsh	2020	Sleep Ecologies: Tools for Snoozy Autoethnography	2020 ACM Designing Interactive Systems Conference (DIS '20)
Conference Paper	K. Mah; L. Loke; L. Hespanhol	2020	Understanding Compassion Cultivation for Design: Towards an Autoethnography of Tonglen	32nd Australian Conference on Human-Computer Interaction (OzCHI '20)
Conference Paper	S. Mironcika; A. Hupfeld; J. Frens; S. Wensveen	2020	I Am Not an Object: Reframing 3D Body Scanning for Co-Design	2020 CHI Conference on Human Factors in Computing Systems (CHI '20)
Conference Paper	B. Penzenstadler	2020	Leverage Points for Focus Flow and Communitas	7th International Conference on ICT for Sustainability (ICT4S2020)
Conference Paper	M. Prpa; S. Fdili-Alaoui; T. Schiphorst; P. Pasquier	2020	Articulating Experience: Reflections from Experts Applying Micro-phenomenology to Design Research in HCI	2020 CHI Conference on Human Factors in Computing Systems (CHI '20)
Conference Paper	G. B. Verne	2020	Adapting to a Robot: Adapting Gardening and the Garden to Fit a Robot Lawn Mower -	Companion of the 2020 ACM/IEEE International Conference on Human-Robot Interaction (HRI '20)
Conference Paper	J. Wallace; K. Montague; T. Duncan; L. P. Carvalho; N. Koulidou; J. Mahoney; K. Morrissey; C. Craig; L. I. Groot; S. Lawson; P. Olivier; J. Trueman; H. Fisher	2020	ReFind: Design, Lived Experience and Ongoingness in Bereavement	2020 CHI Conference on Human Factors in Computing Systems (CHI '20)
Conference Paper	S. Benford; P. Mansfield; J. Spence	2021	Producing Liveness: The Trials of Moving Folk Clubs Online During the Global Pandemic	2021 CHI Conference on Human Factors in Computing Systems (CHI '21)
Conference Paper	H. R. Biggs; J. Bardzell; S. Bardzell	2021	Watching Myself Watching Birds: Abjection, Ecological Thinking, and Posthuman Design	2021 CHI Conference on Human Factors in Computing Systems (CHI '21)
Conference Paper	K. Cochrane; L. Loke; M. Leete; A. Campbell; N. Ahmadpour	2021	Understanding the First Person Experience of Walking Mindfulness Meditation Facilitated by EEG Modulated Interactive Soundscape	Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '21)
Conference Paper	W. Cui; Y. Li; Y. Ma; L. Zhang; X. Ren	2021	Co-Drink: Exploring Social Support Water Bottles to Increase the Hydration Status of Individuals with Intimate Relationship	9th International Symposium of Chinese CHI (Chinese CHI 2021)
Conference Paper	R. Gibson; A. Aresty; I. Moo	2021	Apples and Oranges: Comparing Crafty Sonic Circuits for Electronics Education	2021 Interaction Design and Children (IDC '21)
Conference Paper	N. Hammad; O. Brierley; Z. McKendrick; S. Somanath; P. Finn; J. Hammer; E. Sharlin	2021	Homecoming: Exploring Returns to Long-Term Single Player Games	2021 CHI Conference on Human Factors in Computing Systems (CHI '21)
Conference Paper	S. Hedditch; D. Vyas	2021	A Gendered Perspective on Making from an Autoethnography in Makerspaces	2021 ACM Designing Interactive Systems Conference (DIS '21)
Conference Paper	K. Helms; Y. Fernaeus	2021	Troubling Care: Four Orientations for Wickedness in Design	2021 ACM Designing Interactive Systems Conference (DIS '21)
Conference Paper	D. y. Heyko; D. R. Flatla	2021	Identifying the Factors That Influence DHH Employee Success Under Hearing Supervisors	2021 ACM Designing Interactive Systems Conference (DIS '21)
Conference Paper	S. Ibtasam	2021	For God's Sake! Considering Religious Beliefs in HCI Research: A Case of Islamic HCI	2021 CHI Conference on Human Factors in Computing Systems (CHI EA '21)
Conference Paper	H. Jung; D. J. Trischler	2021	Exploring Generative Reflection by Agency of Visual Practice: An Autoethnographic Study on Reflection by Noticing and Making	2021 ACM Designing Interactive Systems Conference (DIS '21)
Conference Paper	Z. Liu; E. Cheng; X. Zhang; X. Ren	2021	LUNOST: Connected Tangible Messengers for Enhancing Off-Site ParentTeenager Relationships -	9th International Symposium of Chinese CHI (Chinese CHI 2021)
Conference Paper	K. Mack; M. Das; D. Jain; D. Bragg; J. Tang; A. Begel; E. Beneteau; J. U. Davis; A. Glasser; J. S. Park; V. Potluri	2021	Mixed Abilities and Varied Experiences: A Group Autoethnography of a Virtual Summer Internship	23rd International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '21)
Conference Paper	K. Michie; M. Mortensen Steagall	2021	From Shadows: Revealing Academic Anxiety through Graphic Design	10th International Conference on Digital and Interactive Arts (ARTECH 2021)
Conference Paper	F. F. Mueller; T. Dwyer; S. Goodwin; K. Marriott; J. Deng; H. D. Phan; J. Lin; K.-T. Chen; Y. Wang; R. Ashok Khot	2021	Data as Delight: Eating Data	2021 CHI Conference on Human Factors in Computing Systems (CHI '21)
Conference Paper	F. F. Mueller; Patib; R. a; R. Byrne; Z. Li; Y. Wang; J. Andres; X. Li; J. Marquez; S. Greuter; J. Duckworth; J. Marshall	2021	Limited Control Over the Body as Intriguing Play Design Resource	2021 CHI Conference on Human Factors in Computing Systems (CHI '21)

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Source Type	Author(s)	Year	Title	Source
Conference Paper	K. Spiel	2021	"Why Are They All Obsessed with Gender?" — (Non) Binary Navigations through Technological Infrastructures	2021 ACM Designing Interactive Systems Conference (DIS '21)
Conference Paper	P. Tennent; K. Höök; S. Benford; V. Tsaknaki; A. Ståhl; C. D. Roquet; C. Windlin; P. Sanches; J. Marshall; C. Li; J. P. M. Avila; M. Alfaras; M. Umair; F. Zhou	2021	Articulating Soma Experiences using Trajectories	2021 CHI Conference on Human Factors in Computing Systems (CHI '21)
Conference Paper	F. Altarriba Bertran; O. O. Buruk; J. Hamari	2022	From-The-Wild: Towards Co-Designing for and From Nature	2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22)
Conference Paper	J. M. Beuthel; L. Hofer; V. Fuchsberger	2022	Exploring Remote Communication through Design Interventions: Material and Bodily Considerations	2022 Nordic Human-Computer Interaction Conference (NordiCHI '22)
Conference Paper	P. Ciobanu; O. Juhlin	2022	Me, the Hill and My Browser – Investigating the Role of Time in Posthuman Interaction	2022 Nordic Human-Computer Interaction Conference (NordiCHI '22)
Conference Paper	J. Francoise; S. Fdili Alaoui; Y. au	2022	CO/DA: Live-Coding Movement-Sound Interactions for Dance Improvisation	2022 CHI Conference on Human Factors in Computing Systems (CHI'22)
Conference Paper	M. Gamboa	2022	Living with Drones, Robots, and Young Children: Informing Research through Design with Autoethnography	2022 Nordic Human-Computer Interaction Conference (NordiCHI '22)
Conference Paper	F. T. Giannini; I. Mulder	2022	Towards a Power-Balanced Participatory Design Process	Participatory Design Conference 2022 - vol 2 (PDC '22)
Conference Paper	K. Hakio; M. Dolejšová; T. Mattelmäki; J. H.-j. Choi; C. Ampatzidou	2022	Following Seals and Dogs: Experimenting with Personal Dimensions of Transformative Design	Participatory Design Conference 2022 - vol 2 (PDC '22)
Conference Paper	K. Helms	2022	A Speculative Ethics for Designing with Bodily Fluids	2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22)
Conference Paper	H. Jung; S. Cho	2022	Methodological Reflections on Ways of Seeing	2022 CHI Conference on Human Factors in Computing Systems (CHI'22)
Conference Paper	S. Laato; D. Fernández Galeote; F. Altarriba Bertran; J. Hamari	2022	Balancing the Augmented Experience: Design Tensions in the Location-Based Game Pikmin Bloom	2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22)
Conference Paper	E. Le Moignan; T. Feltwell; D. Kirk	2022	Experiential Value in Group Browsing of Curios on EBay and In-Person: Implications for Future Platform Design	2022 ACM Designing Interactive Systems Conference (DIS '22)
Conference Paper	K. Mack; E. McDonnell; V. Potluri; M. Xu; J. Zabala; J. Bigham; J. Mankoff; C. Bennett	2022	Anticipate and adjust: Cultivating access in human-centered methods	2022 CHI Conference on Human Factors in Computing Systems (CHI '22)
Conference Paper	M. Mainsbridge	2022	Feeling Movement in Live Electronic Music: An Embodied Autoethnography	8th International Conference on Movement and Computing (MOCO '22)
Conference Paper	D. Oogjes; R. Wakkary	2022	Weaving Stories: Toward Repertoires for Designing Things	2022 CHI Conference on Human Factors in Computing Systems (CHI '22)
Conference Paper	D. Ooms; B. Barati; M. Bruns; T. van Dongen	2022	From Concern to Care: A Transformative Reflection on Designing-with the Living	2022 Nordic Human-Computer Interaction Conference (NordiCHI '22)
Conference Paper	N. Rutten; J. Rouschop; L. Mathiasen; O. Tomico; B. Goveia Da Rocha; K. Andersen	2022	Flipping Pages: Exploring Physical Workbooks as Reflective Method for Documentation - Nordic Human-Computer Interaction Conference	2022 Nordic Human-Computer Interaction Conference (NordiCHI '22)
Conference Paper	P. Sanches; N. Howell; V. Tsaknaki; T. Jenkins; K. Helms	2022	Diffraction-in-Action: Designerly Explorations of Agential Realism Through Lived Data	2022 CHI Conference on Human Factors in Computing Systems (CHI '22)
Conference Paper	A. Ståhl; M. Balaam; M. Ciolfi Felice; I. Kaklopoulou	2022	An Annotated Soma Design Process of the Pelvic Chair - Designing Interactive Systems Conference	2022 ACM Designing Interactive Systems Conference (DIS '22)
Conference Paper	E. Tseng; M. Sabet; R. Bellini; H. K. Sodhi; T. Ristenpart; N. Dell	2022	Care Infrastructures for Digital Security in Intimate Partner Violence	2022 CHI Conference on Human Factors in Computing Systems (CHI '22)
Conference Paper	S. Turner; J. R. C. Nurse; S. Li	2022	"It Was Hard to Find the Words": Using an Autoethnographic Diary Study to Understand the Difficulties of Smart Home Cyber Security Practices	2022 CHI Conference on Human Factors in Computing Systems (CHI EA'22)
Conference Paper	C. Zhong; R. Wakkary; W. Odom; A. Y. S. Chen; M. Yoo; D. Oogjes	2022	On the Design of deformTable: Attending to Temporality and Materiality for Supporting Everyday Interactions with a Shape-Changing Artifact	2021 ACM Designing Interactive Systems Conference (DIS '22)

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