Computing and Mental Health: Intentionality and Reflection at the Click of a Button

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ABSTRACT
Automated passive sensing applications and self-reported smart diaries seem to hold promise for the management of anxiety in autism and other mental health conditions. However, passive sensing often struggles with noisy data, ambiguous feedback and weak user agency over the device, whilst self-reporting relies on user-entered data which can be time consuming and cognitively demanding. To address these limitations, we explore a different approach, whereby individuals consciously actuate personal data capture and are in control of it at all times; yet, the interaction solely involves clicking a button, thus avoiding cognitive overload whilst supporting immediate reflection. We call this approach *intentive computing*. Through our initial investigations we found that conscious interactions cannot only provide real-time relief in anxiety management, but can also function as memory anchors irrespective of the content captured and even prior to data visualization.

Author Keywords
Human Agency; Mental Health; Anxiety; Autism; Participatory Design; Human Data Interaction; Reflective Design.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
The metaphor of 'the click of a button' is often used to signify actions that, although simple in their essence, can trigger hard-to-predict chain reactions: from science-fiction

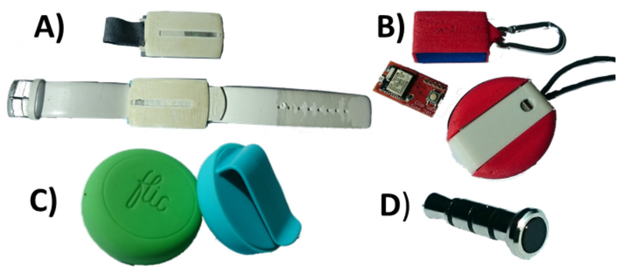
Figure 1 SnAPP data capture and visualisation platform

to politics[1], it is not the act of pressing a button that is hard to imagine, but the full extent of its consequences.

In the context of digital health the fundamental question is whether we want to learn about ourselves through intentional interactions with computing devices or let computers automatically infer about our own selves through passively captured data. Passive and active interactions do not necessarily conflict, as health tracking systems can combine both; however, an intentive and reflected approach to interaction is relatively underexplored and a number of recent papers [1, 2, 41] have questioned the lack of substantial support for reflection through technology. This is particularly important in mental health research where aspects of an individual's agency play a key role in the management of conditions such as anxiety [26].

The aim of this paper is hence to explore the role of 'reflections in action' in digitally supported anxiety management [38] by first introducing and motivating an intentive computing approach to Computing in Mental Health (CMH) and then exemplifying this approach through the 'SnAPP' anxiety data platform (Figure 1). Our objective is three-pronged: to reflect on current approaches to CMH, introduce intentive computing as a means to address some

[1] References to the Brexit debate and The Twilight Zone: www.theguardian.com/politics/2016/jun/25/article-50-brexit-debate-britain-eu www.imdb.com/title/tt0734727.



A) Custom 'Snap' wristband / belt clip has push and pull gestures for mood capture
B) Custom 'Click' device electronics, showing keyring and lanyard alternative 3DP cases
C) Off the shelf 'Flic' BLE button, self adhesive or clip mounting - http://flic.io
D) Pressy audio jack button mounted to smartphone - http://get.pressybutton.com

Figure 2 SnAPP compatible device family

of the CMH challenges, and report on emerging findings from SnAPP case study.

Reflections in action - The concept of *intentive computing* has been introduced by Simm et al. [38] as an alternative to the prevailing 'prosthetic' [3] view of technology in mental health. The intentive computing concept has been built around the notion of "*intentional interactions*" [40] and developed through reflective practice [35]. In this paper we extend this concept by qualifying intentional interactions as *reflections in action*: in other words, we stress the importance of sense-making [6] at the time of interaction even more than at the time of shared and delayed reflection [4, 8]. Our notion of reflection in action is theoretically informed by recent work in reflective informatics [1, 2, 41], particularly by two of Baumer's dimensions of reflection: reflection as conscious *inquiry* and reflection as *transformation* or vehicle for change [2].

Practice - Our research is practice-oriented [35] and it focuses on the anxiety needs of people diagnosed with autism: over the past five years, we have co-designed and deployed digital interventions in partnership with mental health care providers and service users. This paper reflects on the applicability of our research findings beyond autism and reports on the last six months of our work using SnAPP as a case study. SnAPP is a mobile application designed to capture a person's mood through tactile interactions and has been designed to work across several devices. Figure 2 shows the range of SnAPP compatible devices; this paper looks at its minimum interaction unit: the click of a smart button.

TOWARDS INTENTIVE COMPUTING

This section frames the concept of *intentive computing* by introducing its definition, motivation and approach; it briefly introduces SnAPP as an example of an intentive computing platform, summarizes the 'Research in the Wild' (RIW) [5] approach, its key findings and implications for CMH. The rest of the paper is designed to iteratively expand on each aspect briefly introduced in this section.

Definition – The concept of intentive computing has been introduced by Simm et al. [38] as an alternative to the prevailing 'deficit' or prosthetic view of technology in CMH [3], which is often offered as a seamless extension of human capabilities or compensation for their lack [13]. In contrast, intentive computing deliberately challenges the seamless human-machine continuum not so much as a design provocation [12] or ludic act [19], but as a means to promote human agency and reflection through intentional interactions requiring a person *"to consciously and knowingly trigger a system - for example push a button or make a certain gesture*" [40]. We build on this notion of interaction by extending it with the concepts of 'affect' as interaction not reducible to information [4] and of 'reflection' as a transformative inquiry [2, 41]. We therefore define intentive computing as a CMH approach that *deliberately leverages on intentional interactions as reflections in action.*

Defining aspects - Although the concept of intentive computing is applicable to other domains [7], the focus of this paper is on mental health, and in particular on anxiety management. In this context, the following three aspects are identified as core characteristics of our approach:

1) *Intentionality*: we value mindful human-device interactions over seamless passive sensing and automated inference [29, 30, 32];
2) *Minimality:* we favor minimal gestures for data input over cognitively demanding screen-based interactions such as the ones used in self-reporting mood diaries [11, 25]; we also favor minimal, or 'light', *data capture* (e.g. time and location stamps) over content-heavy information capture of audio/visual material capture [36] and digital phenotyping [30];
3) *Sense-making at interaction time*: we stress the importance of sense-making *present* to the interaction [9], in addition to *shared* and *delayed* reflection [4, 8]. We argue that this aspect is currently unexplored in CMH [1, 2, 18, 37].

Approach – SnAPP emerged from a six-month co-development research practice which included three RIW cycles, namely: a four-week *"non-clinical peer evaluation"* [11]; a five-week Technical Pilot; and a two-month Extended Study. The RIW studies investigated if intentive interaction data can 1) help in identifying anxiety triggers, 2) facilitate accurate recall of anxiety incidents, and 3) prompt discussion about both positive and negative experiences, and perception of 'self'. In total ten participants were involved in the RIW cycles with seven successfully installing SnAPP on their own phones and using it for a minimum of four weeks.

Emerging findings – From the three RIW cycles, we find that intentional interactions, *irrespective* of the content captured and even *prior* to any visualisation, are reported by participants to provide real-time relief. We also find that bringing intentionality at the core of human-computer interactions can challenge self-perception in a variety of ways: from positively *"I did not realize I was such a happy* *person"*, to problematically *"I think it would actually be easier for me not to be as aware of how I felt"* (RIW participants). Both preconceptions about the self and the recognition of one's own mood are key targets of cognitive behavioral therapy (CBT), which is one of the most utilized psychological therapy for treating common mental health difficulties such as anxiety [31]. In addition, intentional interactions are found to promote alternative ways for communicating anxiety: SnAPP was also used by the participant diagnosed with autism as non-verbal, gesture-based communications to visually signal anxious moments to health care staff when verbalization was difficult.

Implications – One of the most important lessons learned from this initial study is that the actual *content* recorded during an anxious or positive moment seems to be often irrelevant for self-management purposes; instead, the conscious and mindful act of marking a mood with a click of a button seems, in itself, to be able to bring some relief. One of our RIW participants sums this up quite effectively *"For me it's like the old saying, a problem shared is a problem halved, even though I've shared it with a machine"*. Support-staff were particularly impressed by the role that SnAPP had in avoiding a major anxiety incident or *"meltdown"* with one of their service users (RIW participant): the simple click of a button helped their client to communicate and open up about a particularly difficult situation.

In summary, the concept of intentive computing describes the characteristics and purpose of technology outputs (e.g. to facilitate conscious reflection at the time of interaction), not a methodology. The methodology we use draws from action research, agile development, and participatory design (PD) and builds on a tradition of software development and design [15, 21].

RELATED WORK

Broad Context: Computing in Mental Health.

Research in computing and mental health has a broad and long history spanning more than a quarter of a century developing new tools to include *"self-help Internet sites, computer-administered psychotherapy, adjunctive palmtop computer psychotherapy, virtual reality psychotherapy, interactive voice messaging systems, biofeedback via ambulatory physiological monitoring, synchronous and asynchronous online support groups, and use of electronic mail by psychotherapists"* [27]. Here we focus on the most current drivers of CMH research.

Big data and mental health - Developing new tools is certainly important and several CMH tools have been invented over the years with many more entering the market, however we observe that the majority of these tools follow an information-processing based paradigm [20] which seems to favor *heavy* content (e.g. big data) over (*weak)* human agency; examples include research in digital phenotyping [30], automatic mood swing prediction [23], and machine learning for suicidal tweet detection [29]. We argue that there is scope for balancing the weight given to data by supporting human agency during interactions with computing devices.

Complexity and rich narratives - Mental conditions are complex and situated [16]: they emerge from a multiplicity of concurrent reasons including cultural, social, environmental, and physical [17] thus not amenable to reduction to traditional information system models [20]. This work addresses such complexity with tools specifically designed to be augmented by individual experiences of the evolving nature of the condition. Our research findings indicate that combining *light data* with *strong human* agency can trigger rich narratives that can help to unpick complexities. Rich narratives are typically elicited by PD approaches [4, 18]. However, such approaches are often challenged by an almost infinite possibility of complex design outcomes and the responsibility placed on designers' expertise which is difficult to scale up or transfer [17, 18]. SnAPP emerged from an agile and PD process, yet we argue that it can provide a platform for narrative elicitation across domains and devices.

Memory and reflection

Talk-based therapies such as CBT are frequently used to help people manage their difficulties with anxiety [26]. A key part of both methods involves keeping a record of instances when the person experiences acutely stressful episodes: recalling this information can help identify what may be triggering and reinforcing the anxious behavior. In mainstream mental health it is usually the person with anxiety who is asked to keep these records. However, mental health difficulties can impact upon the specificity of memory recall [10] and also lead to particular biases in what is recalled [22].

Smart diaries and life logging - Self-reported smart diaries [11, 25] hold promises for supporting memory and recall in the management of anxiety and other mental health conditions. However, they rely on user-entered data which can be cognitively demanding for the individual, and ethically challenging for the researcher [11]. Yet, when it comes to reporting anxiety incidents, an unambiguous, timely and transparent capture of incident triggers is crucial for later analysis and reflection. Eldridge et al.'s work [13] was one of the first to introduce the role of digital technology as *"memory prosthetics"* and to investigate how recall can be augmented through video logging. Sellen et al. [36] built on this work and used video logs for *continuous* and *automatic* life-logging. Our approach, instead of focusing on continuous and unobtrusive logs, looks at capturing *discrete* and *intentional* interactions to mark and be mindful of specific 'states'.

From mindful acts to memory cues – Psychology research has investigated the effect of mindfulness on memory recall in anxious or depressed individuals and observed that engagement in mindful acts can support memory specificity [9]. People with conditions such anxiety *"are less likely to produce specific memories"* as they tend to have over-general memory leading to 'rumination'. The click of a button, aims at cutting through the rumination cycle through intentional and mindful acts, requiring presence (e.g. the focus on current action) and acceptance (e.g. no further elaboration is required) [9]. Mindfulness has also been explored in CMH, Thieme et al. [36], for example, designed digital artefacts for women with severe learning disabilities. However, this work is affected by design challenges such as the limited portability of the artefacts, and the inappropriateness of their use in public settings. Finally, research also exists on the use of tactile interfaces that capture interactions as cues for later reflection [38]. However, such objects are found to be bulky, needing recharging and fraught by connectivity problems, whereas the addition of a smart button to a familiar object [11] such as a person's own mobile phone can address these issues.

CONTEXT: ANXIETY

Anxiety is the sensation of fear and apprehension related to a tangible or apparent threat resulting in intensified levels of worry and tension. Although anxiety is recognized as a natural response to threatening, if levels increase they can result in functional impairment. The National Institute for Health and Clinical Excellence (NICE) asserts the principle of being aware of the individual's needs and wishes in order to encourage autonomy around care [26]. This is based upon the rationale that people worry less if they feel that they are in control of their circumstances.

Anxiety and autism – The main characteristics of the Autistic Spectrum Condition (ASC), in this paper referred as 'autism' for simplicity, are related to difficulties around communication, social interaction, empathy and flexible thought patterns; there is also a considerable amount of research into sensory impact on individuals and how it affects their ability to process information. Anxiety is the most prevalent co-morbid psychiatric condition in the population of individuals with autism. This relates closely to the concepts of people with autism preferring systematic, logical rules to follow in order to have clear expectations and self-control, however, in everyday life there are uncertain outcomes as rules from certain situations do not necessarily transfer to others.

Wass and Porayska-Pomsta [44] indicate how valuable technology can be for individuals with autism particularly as it is logical and predictable. However, such systems can also be too rigid and prescriptive, as currently available therapeutic tools seem to be programmed with intended outcomes around cognitive training. In doing so they are intended to 'teach' people something rather than supporting them to apply their knowledge. Research [44] has also found mixed outcomes in relation to technological cognitive training programs such as Computer based CBT

Figure 3 SnAPP data visualization: start page & 5 data views

(CCBT) both for people with autism and 'neuro-typical' individuals with anxiety conditions.

In conclusion, the current recommended approach for supporting people around managing their anxiety, whether they are neuro-typical or are diagnosed with autism, are prescriptive therapies using self-help methodology that work by supporting the person's awareness and ability to foster coping mechanisms. However, it has been noted by one of the project health practitioners *"that prescriptive systems, looking for specific measurable therapeutic outcomes are also more likely to cause anxiety and confusion for individuals with autism"*.

SNAPP DATA PLATFORM

SnAPP was conceived to rapidly prototype a personal data capture and visualization platform for a family of intentive computing devices (Figure 2) to support the *unique needs* of people with mental health conditions by enabling deployment across a large number of devices without having to support custom made hardware. SnAPP was developed to run on Android mobile phones - by far the most popular phone used by our participants. In earlier studies it was found that deploying custom prototype hardware 'in the wild' [34] was significantly challenging.

Therefore, to explore the potential of a data platform, a minimal off the shelf product was chosen to augment the smart phone. An extra button whose interaction could be captured by custom apps was used - the Pressy smart button. Through the use of a third party app called AutomateIt we can trigger the SnAPP app on interaction with Pressy. We can also deliver SnAPP updates by email to our participants - not requiring them to be physically present. This means we can support a wider system trial than if we used custom hardware.

SnAPP was developed iteratively, with new features proposed by the participants and developed with them. The final version of SnAPP (v0.4.1), has two core functionalities: (a) it captures two different interactions (one click for an 'up' or positive moment and two clicks for a 'down' or less positive moment) with location and timestamp via the press of a button and (b) it visualizes these interactions for later reflection through five Views as Figure 3 shows – 'up' moments are visualized in orange, the 'down' ones in blue. Finally, SnAPP interactions are customizable - users can set their own triggers and define labels to describe their moods.

SnAPP Anatomy

Due to the rapid development of SnAPP and the early stage of the prototype, deployment relies on a number of third party apps. During the trial the system had five components, and participants were invited to download and install the required apps before the induction by following links sent via email. Researchers guided the participants through the setup at the trial induction. The five SnAPP components are:

1) *Pressy*, a physical button inserted in the audio jack.
2) *Pressy app*, which registers the Pressy button on a smart phone.
3) *AutomateIt app*, which defines the mood trigger rules and invokes SnAPP to record the moment.
4) *AutomateIt Pressy Plugin*, which allows the rules defined by AutomateIt to be triggered by Pressy.
5) *SnAPP*, the bespoke app that captures and visualizes the interaction with time and location stamps.

When a user clicks the button, the Pressy background service notifies the AutomateIt background service of an interaction through the Pressy plugin. If an AutomateIt rule exists for that interaction, then it is triggered. Two AutomateIt rules were setup on our participants' phones: one click would trigger the 'UpReceiver' intent in the SnAPP app, and two clicks the 'DownReceiver' one.

This cross-app communication means the SnAPP visual interface is not loaded, and the SnAPP app can record the timestamp and location in the background without the user needing to unlock the screen. The visualization is loaded and the locations geocoded when the user starts the SnAPP app through the Android launcher. SnAPP was developed to be interaction hardware agnostic to support the range of custom hardware in future, therefore it also works perfectly with other third party hardware, such as Flic (see Figure 2).

SnAPP 'Simplicity'

Over the years we have worked on several bespoke and co-produced CMH digital artefacts. Such artefacts are technically appealing but difficult to maintain, scale, and transfer. For this, our partners have called for the development of a system that, first, could provide full control and ownership on the data collected and, second, was discrete, portable, robust, affordable, and low maintenance. These requirements translated into very tight design constraints. The idea of a clicking device with a tactile feedback emerged through prior research and wearable prototypes were co-designed and implemented as shown in Figure 2.

However, the possibilities for custom designs are so great, that we jointly resolved for the development of a data platform that could work across several devices instead of trying to anticipate all possible custom designs. To this end SnAPP co-development team and partners have opted for the most affordable and portable tactile interaction unit: a smart button costing as little as 50p. The apparent simplicity of the tool may come as a slight disappointment for designers and technology developers. However, the resulting simplicity is seen as strength not as weakness by our participants and clinical partners.

CO-DEVELOPMENT & EVALUATION APPROACH

The six-month co-development and evaluation phase builds on a previous year-long research phase (Phase One) which included a series of co-design activities and evaluations in the wild. Phase One has been extensively described in previous research [38, 40], this paper focuses on Phase Two.

SnAPP Co-development RIW Cycles

SnAPP evolved through a co-development phase that included three RIW research cycles: 1) a four-week peer-evaluation carried out by the interdisciplinary research team under the advice of a clinical psychologist; 2) a five-week Technical Pilot, during which the data platform was co-developed and evaluated by four participants (one person diagnosed with autism and three of her support staff); and 3) a two-month Extended Study during which an additional six staff were engaged. In total ten participants were involved in the process with seven installing the system on their own phones and using it for a minimum of four weeks. The names assigned to the participants are <u>pseudonyms</u>.

RIW Peer-evaluation - The four-week Peer Evaluation study was carried out by the design team made up of four interdisciplinary researchers; during this time one of the researchers kept logs of use, usability, and impact 'on self' of an early prototype of SnAPP; these logs were discussed during weekly meetings with the team while the main design decisions were cross-checked with a clinical psychologist acting as team advisor.

The most important design decision taken during this cycle was to install SnAPP on participants' own mobile phones instead of lab phones because of their familiarity [11]. This requirement presented the technical challenge of designing an interface capable of detecting SnAPP smart button vs all possible audio jack uses in a very short time (4 weeks). For this, we opted for the Pressy and AutomateIt bundle to handle the smart button detection and rule triggers together.

RIW Technical Pilot (TP) – This five-week study aimed at the technical refinement and initial evaluation of SnAPP. It was carried out by four participants: one service user diagnosed with high functioning autism (<u>Nelly</u>) and three support staff (<u>Tim</u>, <u>Neal</u>, and <u>Rose</u>). The staff had more than twenty-five years of combined experience in mental health care and all worked with Nelly. Nelly has been engaged with our research, on and off, for more than three years, hence she was comfortable and keen on the idea of contributing to the final stage of development with three of her support staff.

The pilot consisted of five one-week development cycles paced by four face-to-face group sessions with our participants. Two sessions (the *Group Induction* and *WK1 Feedback*) were held at the researchers' university; the other two (*WK2 Feedback* and the *Final Group Session*) were held at the supported-living residence where all the participants were based.

Each session was of a two hour duration and split into four parts: 1) individual feedback via a short usability questionnaire; 2) group feedback on technical issues and user experience; 3) individual and shared narrative elicitation; 4) introduction of a new SnAPP functionality (mood capture, data visualisation). Each functionality was separately introduced and evaluated every week. The pilot concluded with a two-week evaluation and a final group discussion.

RIW Extended Study (ES) - This two-month RIW study aimed to evaluate SnAPP readiness for wider user trials and was specifically designed for staff. The study started with a four-week use of SnAPP, which kicked-off with a *Group Induction* and concluded with a *Group Discussion*. During these four weeks there was no face to face communication with the research team: the newly recruited participants were asked to fill in individual on-line feedback forms every week (three forms in total).

On 'Induction Day', the Technical Pilot participants helped the new participants with SnAPP installation. Only two new participants (Haley and Max) were able to install SnAPP: Nigel's phone had a broken audio jack hence the smart button could not be installed; as for the others, SnAPP had permission issues with Android v6 – these issues were resolved later in the study. SnAPP was also installed on Mike's phone at a later stage and his feedback was collected through a phone call.

SNAPP FEEDBACK: FINDINGS

This section presents a thematic summary of the feedback collated from the RIW Technical Pilot and the RIW Extended Study. The transcriptions were independently analyzed and thematically annotated [42] by two researchers and then jointly discussed. We split the findings in two sections: one relating to the usability and usage of the tool; the other on its usefulness and the impact.

Usability and usage

The responses from the self-feedback open-text forms indicate that the participants found SnAPP mood capture **easy to use** *"it felt natural, especially the 'up' moments"* (Max), **discrete** *"I like the fact that it's discreet: a phone is something that I always have with me"*(Neal) and **tactile** *"I like the feedback I like the click"* (Rose).

All participants used the mood capture every day or most days for at least four weeks, and accessed the data visualisation with regularity (two or three times a week). The section expands on the feedback from two angles: mood capture and data visualisation.

Mood capture - All participants used SnAPP mood capture functionality for both **up** and **down** states: *"on Monday I felt like using it: I'd had some really irritating news" "and yesterday I wanted to press it every time I did something fun*" (Tim); however, the participants found recording a 'down' more useful than an 'up' *"I prefer to double click, that's me trying to deal with my problem, whereas when I am happy there is no problem to deal with."* (Tim); this was echoed by Neal and Nelly more inclined to double click when stressed than single click when happy. Rose went further and qualified herself as *"a natural double clicker"* because *"if you're having a happy moment you don't stop that moment"*, but she would stop and mark a 'down' moment with a double click. Hesitation around **mixed emotions** was reported: for example, Rose's sister was coming back from Africa and Rose was not sure what to click *"Happy? Anxious? Excited?"*. Participants suggested a different type of stress *"a happy stress"* (Neal).

Data visualisation - The use and the motivation to use this functionality changed over time; during the first week, all participants seemed to access it out of **curiosity**: *"the first couple of times were probably just curiosity, see how things are registering, how it's working"* (Nelly). Behavior changed over time as participants started looking back at their data *"if I'm having a particularly good week or bad week I wouldn't check because at that point I'm still aware of that; after two or three weeks I might think 'I'll look back and see'"* (Neal), while others preferred a shorter timeframe for **reflection** *"I'm definitely an immediate person; when I was reflecting, it was probably either immediately or an hour after it happened"* (Rose).

Participants preferred the month-view, the seven-day view or the day view over the overview page (Figure 3), "*There's so much you could actually read into the overview, but it doesn't actually say anything specific"* (Tim). The day view was found useful especially for the display of the location and time "*The location helps, I was at the hospital yesterday and I pressed it there I think a few times"* (Neal). Although most of the participants reported finding capturing a down moment more useful than an up one, Neal preferred looking back at the up times "*Definitely - I like looking back on that, it's kind of a reminder of, yeah, we had a real good day there."*

SnAPP role in anxiety management

Participants found that using SnAPP can bring relief, reflection and distraction. We summarize their reflections on SnAPP role in anxiety management across six main themes.

Sharing with machines – knowing that a stressful moment was logged on a digital device was reported to bring relief *"I think it's because I know it's logged; I think it's the old saying, a problem shared is a problem halved, even though I've shared it with a machine"* (Nelly). This aspect was met with the surprise of one of the staff who admitted that *"if I've had a conversation and I found that quite stressful I'd* *double-click, I'd be like, oh, it's recorded now so I can carry on with my day"* (Neal). Participants appreciated that SnAPP was on their personal phones, especially Nelly who has been using her phone to deal with anxiety for years *"this it's another way of using it, rather than going and doing a Sudoku, to distract me with the thinking patterns. Pressing the button is another way"*.

Recording the unspoken – many people with autism find it difficult to verbalize their state of anxiety, Nelly found that SnAPP acted as a *"signal"*; Rose suggested that for Nelly this was a way for *"recording the unspoken*" noting that *"Nelly is very difficult to understand, but when she uses the double click I know she is getting stressed"*. Finally, SnAPP was used for humor in non-verbal messaging among staff and service users, and between staff and their families: *"my girlfriend is more curious when I am double-clicking than to single clicking" "So I was winding her up saying that I'm going to double-click it every time I'm around her"* (Neal).

Curating deception - Consciously interacting with the system make false triggers easier to spot when looking back at the data; for example, a single click can be triggered by carrying the phone in a pocket. Suggestions were made for editing out data mistakenly captured: *"An option is to get rid of the click if you thought of having mistakenly done so"* (Nelly). However, concerns were raised around potentially deceptive data curation*: "it could also be used to mask anxiety; as I am looking at your data, Nelly, and you are very clever and you would mask yours"* (Rose).

The participants discussed the aspect of deceptive data curation at length: *"it is a good job I can't delete things because I would have definitely deleted it; then I can hide everything and pretend that everything is ok"*; Tim introduced the idea of playing characters "*for each given situation"*. Bringing ownership and control over data has its challenges: *"The ownership has to be with the persons themselves, otherwise they are not in control of how they use it and share it, then again they could manipulate it"* (Tim). From a design perspective, we jointly decided not to add a data deletion functionality but one that could hide mistakenly captured data and flag them as hidden.

Defusing an incident - Staff reported that SnAPP prevented *"a serious incident"* from happening - this came as a surprise for both staff and research team. The incident involved Nelly and two of her support staff, Rose and Neal. Here we provide a summary of how the event unfolded and SnAPP role in it. *"I remember when it started; I remember clicking and trying to defuse the situation. Looking at the data that's when me and Nelly were interacting"* (Neal).

"I was telling you that I was sympathetic. I think it as a partnership" (Nelly). *"Nelly double-clicked on the train. Then she went, "Oh I've Pressied" and that seemed to distract the conversation because instead of talking about the problem, it defused it"* (Rose). According to staff this was the first time in six years of service that were able to defuse a severe anxiety incident.

Exposing vulnerability - Fast-forward a few weeks and for a number or interplaying reasons, Nelly's situation has deteriorated and she could not attend our group discussion. Rose and Neal reflected on what had happened and advanced her need for 'control' as one of the reasons for having stopped using SnAPP: *"I think it made her feel quite vulnerable because we were working it out"* (Rose). *"That's why we've seen that she's disengaged; it's her way of taking control back; she knows that we know that there's something, but we're not going to know, she's not ready to tell us yet."* (Neal).

Facilitating staff communication - Support workers reflected on how SnAPP could support staff tasks: firstly as a way to complement paper reporting with easily captured data, secondly for staff communication, a particularly challenging task since all staff follow a rota and rarely overlap. Finally, the data visualization functionality was seen to play a key role in relationship-building amongst staff: *"it would be a really valuable tool to build a relationship between colleagues, because everyone's got their own strengths and weaknesses […] if they've got some kind of visualisation we can then use it to open a conversation about things they are struggling with"* (Neal).

IMPLICATIONS

Here we discuss the implications of our findings for current mental health care provision, and the CMH community.

Opportunities for mental health care integration

Drawing from our work with support staff, we identify three areas where SnAPP could contribute to current practices in mental health care, namely: 1) open up discussion between staff on current process of personal data and information capture - currently highly formalized thus missing important personal aspects; 2) provide tangible and quantifiable evidence on people conditions and progress; 3) elicit narrative through the capture of 'light' yet meaningful data. In other words, a system like SnAPP could help to address the "*strange but necessary paradox*" (Tim) of trying to care for specific individuals' needs with a 'fit for all' reporting structure.

The generic to specific paradox - In the UK, health care providers have to produce Person Centered Plans (PCP) for each service user; all the documentation within the PCP files is on set formats though the information contained in them is individualized to the person and to the services they receive. This format is used to collect information and is shown to funding authorities and other stakeholders. All of the above reporting structures are constantly being adapted and changed to enable care providers to produce quantitative and qualitative evidence to justify what they do and to develop a proactive approach to all support.

This is problematic since, by trying to accommodate so many different expectations, such documentation can be extremely extensive, repetitive and "*having rigid frameworks can sometimes mean that important details could be missed as they do not fit in*" (Tim).

Rich narratives and light data - The reporting process in the current mental health system is also challenged by the way questions are formulated in the documentation. For example, the word 'happy' in expressions such as "When do you feel happy?" may be meaningless or inadequate for some service-users. A system like SnAPP can provide the opportunity to associate personalized meanings to a 'data capture' gesture. This could be done in partnership with the service user and their family and adapted over time *by changing its meaning and without changing the code*. In addition, the evidence currently collated is subject to multi-stakeholder criteria and as a result detail can be missed or lost; likewise, each staff member makes her own individual observations, which leaves scope for inconsistencies in the evidence.

Systems such as SnAPP can start bridging the gap between the general and the individual, with a data capture process that can be adapted to individual needs and enriched by personal narrative. This could link with Narrative Therapy approach which involves developing 'thick' descriptions - narrative therapy is a minority therapy that is most well-known for working with children rather than adults with anxiety [31].

Considerations for CMH

This final section introduces considerations related to research transferability and future work.

Contribution, constraints and transferability – This paper is a case report reflecting on the impact of a digital intervention (SnAPP) in the every-day-life of ten participants: nine staff and one person diagnosed with autism. Our research contributes to new knowledge in terms of both the insights into anxiety and autism extracted from qualitative narrative, and the SnAPP system itself – a cross-device digital platform specifically designed to elicit such narrative and to afford the participants full agency and control on the device and on the data captured.

The design of this study has been motivated but also constrained by a) the research scope, b) participants' selection and c) the study context: a) much of our prior work focused on anxiety management from the end-user perspective, this time we wanted to focus on the staff's perspective to reflect on how the platform could be integrated in their practice; b) the participant selection was guided by professional advice: due to the volatility of the autistic condition and the associated risk of using an untested system, staff suggested we work with only one of their clients; c) lastly, and most importantly, case reports relying on a relatively small participant number (<10), are a common practice in clinical psychology [16].

An intentive computing technology such as the cross-device platform SnAPP can be adopted in a range of CMH applications (e.g. post-traumatic syndrome, addictions); outside CMH SnAPP data bookmarking approach has already been transferred and piloted in a smart cycling campaign [7] which uses a smart button mounted on a bicycle bell to bookmark cyclist experiences on-the-go and elicit a dialogue between road planners and cyclists. SnAPP has also been used to chart personal reflections during a 'walk & talk' with environmental scientists, historians and creative writers and the data captured has been turned into a data-art display [28].

Limitations and future work – A systematic quantitative data analysis was not an objective of this study for two reasons: firstly, it was agreed with our participants that the data would remain on their own phones and under their control – this meant no access to the data for the researchers; secondly, given the small number of participants, we were more interested in the narrative-eliciting capability of the system rather than in extracting statistics from data logs. We are currently focusing on wider user trials involving (neuro-typical) members of the general public to start extracting insights from the quantitative data captured by SnAPP (time stamps / location logs).

CONCLUDING REMARKS

"An interactional approach moves the focus from helping computers to better understand human emotion to helping people to understand and experience their own emotions" [4]. The concept of intentive computing has emerged over the years from working in research partnerships across different domains and disciplines (e.g. public space design, homelessness, and community renewables [39]). During this time, we have observed and tried to address the tension between the values driving CMH research and those held by the people we design with and for: the desire for agency over the digital tools and for transparency of the inferences made from such data [14].

One of the key findings is that the evaluation of a system success may no longer be fixed a priori *"in measures said to be universally valid"* [20]. Such measures may need to be adapted and changed over time, often in partnership with the service user. By ignoring that, we may fail to take into consideration the unanticipated impacts that digital interventions can have on each single individual.

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