

Investigating Slowness as a Frame to Design Longer-Term Experiences with Personal Data: A Field Study of Olly

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ABSTRACT

We describe the design and deployment of Olly, a domestic music player that enables people to re-experience digital music they listened to in the past. Olly uses its owner's Last.FM listening history metadata archive to occasionally select a song from their past, but offers no user control over what is selected or when. We deployed Olly in 3 homes for 15 months to explore how its slow pace might support experiences of reflection and reminiscence. Findings revealed that Olly became highly integrated in participants lives with sustained engagement over time. They drew on Olly to reflect on past life experiences and reactions indicated an increase in perceived value of their Last.FM archive. Olly also provoked reflections on the temporalities of personal data and technology. Findings are interpreted to present opportunities for future HCI research and practice.

CCS CONCEPTS

• **Human-centered computing** → **Interaction design**; *Interaction design theory, concepts and paradigms; Empirical studies in interaction design*;

KEYWORDS

Digital Music; Slow Technology; Temporality; Home; Personal Data; Research through Design.



Figure 1: Tom-H3's Olly kept on a desk in his bedroom.

1 INTRODUCTION

People's practices of acquiring and consuming music have and continue to play key roles in supporting experiences of self-reflection [10, 27] and social interaction [6, 55, 66, 76]. Today, many people's practices of listening to music are highly mediated by data-driven digital technologies and services. Currently, users of the service Spotify listen to over seventy million hours of music from their collections daily; over one trillion songs are streamed annually worldwide through digital music services [42]. As a byproduct of the widespread uptake of digital music listening applications and services, vast archives of personal music listening history metadata are now generated that log exactly what music people listened to and when.

These shifts pose new issues for HCI. The form and scale of contemporary personal data generation opens new opportunities to enable people to re-experience past tastes, patterns, experiences, and idiosyncrasies captured in one's music listening history archive in more precise and expansive detail than ever before. Yet, little is currently known about how to approach designing rich, meaningful, and sustained experiences with personal music listening history archives, and what concepts could help productively frame design inquiries in this emerging research territory. More broadly,

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there are growing calls in the HCI community to develop alternative approaches that enable people to interact with their personal data in more reflective, contemplative, and curious ways (e.g., [13, 77]). However, examples illustrating how such rich open-ended engagements with personal data can be supported through the creation of new design artifacts remains sparse in HCI.

Our research aims to contribute precisely to this intersection. We want to investigate new forms of interaction and experience design that might enable personal digital music listening history archives to be more temporally expressive and materially present in the service of better supporting experiences of reflection and reminiscence. We also want to investigate the application of *slow technology* [23] and how this concept could challenge the idea of domestic technology being always on and accessible, and lead to an interaction pace might sustain longer-term experiences with personal data in everyday life.

How can the reminiscence and reflection on personal histories of digital music listening be supported through the design of a new kind of music player? How might slowness, as a design strategy, enable emergent and ongoing experiences of music listening commensurate with a lifetime of one's personal history of digital music?

To investigate these questions, we designed and deployed *Olly*, a robust domestic music player that enables people to re-experience digital music they have listened to previously. *Olly* works by making use of its owner's personal music listening history metadata archive (via Last.FM [1]) to occasionally randomly select a song from its owner's past and make it available to be played. *Olly*'s central feature is its internal wooden disc encircled in aluminum (see Figure 1). When a song is surfaced from the past, it is not immediately played. First, the disc begins rotating to subtly indicate a song has been selected and is available to be played. The speed of the disc's rotation is relative to how deep into the past the song was listened to by *Olly*'s owner (e.g., the deeper into the past, the slower the rotational speed). To play the song, the owner must tangibly spin the rotating disc. If the song is not played within a relatively brief time window, *Olly* will abandon it and stop spinning until another song is eventually surfaced; the process continues indefinitely.

We deployed 3 *Olly* devices in 3 homes simultaneously for 15 months, using them to open a critical dialogue with participants about new ways of engaging with their massive digital music archives; and to probe on their experiences of living with a slow technology. Findings revealed participants adjusted reasonably quickly to *Olly*'s pacing and autonomous behavior, and drew on it as a resource to reflect on past

life experiences. Reactions also highlighted that our use of rotational movement to subtly express the 'age' of a song led to a range of valued 'pre-interaction' experiences with *Olly*. Finally, *Olly* provoked reflections on the temporalities of personal data and technology, and on how longer-term relations might be better supported.

This paper makes two contributions. First, it provides insights on how a slow technology design artifact can support and sustain a range of valued experiences with one's personal history digital music listening. Second, it is a rare example of a longer-term field study that offers new insights into how a slow technology is accepted into people's everyday lives and how relations to it change over time.

2 BACKGROUND AND RELATED WORK

Related work falls into three areas: material possessions and music; HCI research on reminiscence; and slow technology.

Numerous works in the social sciences have investigated the roles that material artifacts play in supporting reflection and reminiscence on the past. Researchers have focused on people's practices of possessing and listening to music, and how they mediate experiences of self-reflection (e.g., [4, 10, 27]) and self-presentation (e.g., [3, 66, 76]). This corpus of work illustrates how music collections can operate as cherished possessions that aid people in exploring the past and constructing a sense of self.

The digitization of music and music listening technologies, and the recent emergence of digital music streaming services, has greatly extended people's capacity to amass vast personal archives of music. Prior research in HCI has investigated the changing digital landscape of music and its implications for people's social practices of listening, collaborating, and sharing [2, 30, 35, 55, 63]. Researchers have also dedicated considerable attention to creating more efficient retrieval, recognition, and management tools for people's digital music [5, 9, 38, 44]. More generally, researchers have argued that the digitalization of music archives creates new opportunities for "a renewed presence of musical materialities in people's practices" [40, p. 19].

However, these shifts have also produced unintended consequences. Personal histories of digital music listening lack the material presence that might enable people to casually notice and engage with in everyday life [53]. Internet-enabled digital music applications, such as Spotify, also stress the recommendation and acquisition of new music. While valuable, this emphasis can inhibit people's use of digital music as a resource to 'look back' on the past [36, 48]. The shift to cloud-based systems can also cause losses in awareness of what is contained in one's digital archive, where 'it' resides,

and how to approach interacting with it [24, 50]. As a result, there is a growing need in HCI for more diverse design strategies to be developed to open up new possibilities for people to experience and engage with their expanding and aging personal digital archives.

The increasing prevalence of personal digital data, along with a growing interest in HCI toward designing for everyday life, has led to a stream of work exploring how reminiscence could be better supported. A key body of work has focused on the creation of new technologies to attach digital content to existing physical mementos (e.g., [15, 45]) as well as to support the capture and exploration of images, video, and audio recordings [31, 57, 58, 67]. In this, a growing strand of work has begun to highlight the value of *re-experiencing* digital data from the past, such as emails, chat logs, photos, and social media content, to support experiences of reminiscence [8, 56, 65, 74, 75]. The work of Leong and colleagues [32, 34] has shown that the re-experience of one’s digital music stored on personal devices can aptly trigger experiences of serendipity. Yet, little work has explored the design of new systems to support reminiscence with people’s digital music listening histories.

With the shift toward online digital music services, forms of metadata are now created that capture exactly what songs people listened to and when in more detail than ever before [14, 48, 72]. Yet, the use of such temporal metadata as a design resource for reminiscence is underexplored [22, 53]. In parallel, HCI researchers have highlighted the need to design technologies that express alternative representations of personal data and expand beyond “*an exclusive interest in performance, efficiency, and rational [self] analysis*” [13, p. 48]. Yet, Elsdén et al. [13] note, examples of new design artifacts that demonstrate how rich engagements with personal data can be supported are sparse.

Considering the rapid proliferation of digital music archives, we see an opportunity to explore how music from one’s past could be re-experienced through a slower form of interaction. In their seminal works on *slow technology*, Redström, Hallnäs, and Mazé argue that as HCI increasingly focuses on everyday life, design practice must evolve beyond on a focus on efficiency to “*creating technology that surrounds us and is a part of our activities over long periods of time*” [23, p. 161] and investigating “*what it means to design a relationship with a computational thing that will last and develop over time.*” [41, p. 11]. These authors project a vision of technology that encourages self-reflection and critical reflection on the appropriateness of technology itself. The Long Living Chair [61] and Slow Juicer [21] exemplify design artifacts that have explored slowness as a frame for extending object lifespans. A

handful of works have explored how slowness could support rich interactions with digital content (e.g., photos and text). Examples such as Postulator [25], FutureMe [46], Reflexive Printer [71], and Photobox [54] provide early evidence that a slowness framing can support digitally-mediated reminiscence. While these studies are promising, little is known about how a slowness framing might be applied to personal histories of digital music listening.

Collectively, these strands of research have made important contributions to understanding how technologies could persist in people’s everyday lives and how experiences of reminiscence might be better supported. They also reveal new problems are emerging as the growth and fragmentation of personal data threaten its ability to be a long-term resource for reflection. Our work attempts to bring these strands together. We want to investigate how technology can be designed to sustain experiences with personal digital music listening histories as they age over time. A second goal is to investigate how a slow technology might become accepted in the home and where frictions emerge. Beyond work that has come before, we report on a 15-month field study of Olly in 3 separate households.

3 METHODOLOGY

Previously, we have described and critically reflected on the process of designing Olly in detail with attention to decisions and alternatives explored across it [51][55]. Next, we summarize key parts of this design process to highlight important qualities of the final version of Olly.

Olly is designed to explore how slowly surfacing music previously listened to at a specific point in one’s past could provide pause for reflection on elements in the archive. We wanted to create a design artifact that might contrast the utilitarian qualities of many everyday devices to give rise to more open-ended experiences of reflection, reminiscence, and enjoyment. We also aimed to create a design artifact that projected an enduring character and manifested subtle changes over time. To support the goal of understanding people’s longer-term experiences with a slow technology, this design process was highly influenced by the concept of *research products* [52] – artifacts designed to drive a research inquiry and that have a high quality of finish such that people engage with them as is (i.e., a thing), rather than what they might become (i.e., a prototype). Another requirement of research products is that they are able to operate independently for long periods of time in everyday environments. Thus, the final version of Olly is highly resolved and designed to exacting requirements.



Figure 2: Left to Right. Olly can operate standing up (or lying flat); A pending song is played by gently spinning the rotating disc (pictured here when lying flat); Woodgrains move in and out of alignment as the disc rotates; 3 Olly research products deployed with participants.

Design Process, Rationale, and Implementation

Our design process began by exploring qualities of domestic music listening technologies, where the design team was drawn to the rotational movement of turntables. We ultimately arrived at a teardrop-like shape with an internal wooden rotating disc encircled in aluminum that is visible on both sides of Olly. This decision created a visible area for output and interaction, in a form that could operate in any orientation (Olly can function on any side or lying flat; see figure 2.). We anticipated this could invite owners to (re)configure Olly to their other domestic objects and places over time.

Through various material explorations after Olly’s form was determined, we found that by layering wood veneer cut from the same sheet across each disc and corresponding side, it was possible to represent subtle changes. For example, each time Olly stops rotating, the orientation of the wood grain on the disc in relation to the body is, in likelihood, different from the prior orientation. This tracing of change in wood grain alignments seemed apt to subtly express if Olly had become active (e.g., while the owner was away from home). The final version of Olly features boat-grade mahogany veneer (to prevent mutations from fluctuating humidity over the years), and anodized aluminum (to protect it from scratches); the external casing consists of 5-millimeter aluminum plates. These decisions were influenced by prior HCI works that demonstrated the value in crafting design artifacts with materials that inspire a sense of durability [49] and forms that can fluidly fit in people’s domestic environments (e.g., [47, 79]).

A crucial part of Olly’s implementation is its connection to its owner’s Last.FM [1] online database. Last.FM is an commercial application and online service that runs across a user’s devices (e.g., laptop, iPod, smartphone, etc.) and automatically creates a detailed, timestamped log of each instance of when they listen to a song. In simple terms, Last.FM is essentially a personal metadata repository of all of the music one has listened to in the past; it captures and logs when

digital music is listened to locally (e.g., mp3 song files stored on one’s phone) or via streaming services (e.g., Spotify, Tidal, YouTube). In existence since 2002, Last.FM offers unusually rare access to extensive personal music listening histories, which Olly uses to surface songs from its owner’s past.

We decided to develop an algorithm for random song selection that did not involve user input. Our choice was motivated by prior work describing how ceding autonomy to a system can enable new ways for people to meaningfully experience their digital content [32, 33, 54] and, more generally, open a space for pause and contemplation [18, 59, 78]. Through a 6-month testing process in which several members of our design team lived with Olly prototypes, we found that an average of roughly 8 songs per week struck an optimal balance. This frequency could subtly build anticipation while remaining undemanding; when living with Olly during this period, all design team members reported noticing a music selection instance from once to a few times weekly.

On a technical level, Olly conducts a ‘dice roll’ every six minutes that has a $1/200$ chance of success (which equates to an average weekly selection of 8.4 songs). When a ‘success’ occurs, Olly randomly selects a specific instance from its owner’s entire Last.FM library (i.e., a specific song with metadata indicating precisely when it was listened to in the past). Olly then enters a ‘pending’ state in which the song is temporarily made available to be played; the user can spin the disc during this time to trigger the song to play. During the pending state, Olly will complete a maximum of 224 rotations. If the user does not play the song, it is abandoned and Olly returns to a dormant state until another success occurs. This process continues indefinitely.

While we considered other modalities (e.g., light, sound), we found actuated motion to be the most unobtrusive. It also enabled us to use rotational speed to express a representation of the relative age of the selected listening instance. For example, if a listening instance of a song was selected that



Figure 3: 1) Olly’s algorithm has a ‘success’ and it randomly selects a specific listening instance from its owner’s Last.FM library; in this case, the song *Bittersweet Symphony* that was listened to on 18:11 June 7 2012 is selected. 2) The internal disc begins to rotate indicating that a song is availability to be played; in this case, the listening instance is quite old which causing the disc’s rotational speed to be quite slow; 3) The user notices the rotation and manually spins the disc to trigger the song to play.

was from deep in the user’s past, Olly will exhibit a slow rate of rotation compared to an instance of a song that was much more recently listened to (see Figure 3.). Supplying different voltage levels to the motor enabled us to change the speed of rotation. 4.4V is the lowest functional amount of voltage, which is used to represent the oldest instance in a user’s database; it requires about ten minutes to complete 224 rotations. 12V is the highest (and represents the most recently instance of a song previously listened to); it takes about 4 minutes to complete the 224 rotations. Understanding the rotational speed relative to each specific music listening instance will likely require the user to take time to interpret and make sense of. We speculated that, over time, these subtle differences may become more discernible and personally meaningful.

Our implementation of Olly also causes all instances in a user’s database to slowly age over time because their ‘age’ is relative to today’s current date. For example, Olly’s absolute fastest rotation could only be triggered if it selected an listening instance that the user had listened to the previous week. If new entries ceased to appear in a user’s Last.FM account, all of the songs in the Olly database will continue to slowly grow older irrespective of the actions of its owner. These decisions made it possible to use Last.FM metadata to encode an added layer of temporal expressiveness into Olly’s manifestation of songs listened to at precise points in a user’s past. Beyond the speed of rotation, no other information is offered about the specific listening instance when it is surfaced and made available to be played. This decision was motivated by the desire to support a range of experiences

with Olly that can evolve as one develops a sensibility for ‘reading’, interacting, and living with it over time.

The final implementation of Olly consists of the following. We developed a Java application on a Raspberry Pi 3 embedded inside Olly’s enclosure. It generates a database from Olly’s owner’s Last.FM database, which is used with the random selection algorithm; an updated Last.FM metadata archive is stored locally on the Raspberry Pi daily. Each Olly has its own dedicated Spotify account to play back songs that it selects. This decision helped avoid creating a feedback loop in which songs selected by Olly are re-introduced as new entries in into the user’s Last.FM account. In this way, Olly sits outside of the direct infrastructure of a user’s music listening devices and services; it does not directly influence nor can it be controlled by any other service or device. One limitation in the implementation is that a user’s Last.FM database has to be cross-referenced with the Spotify library; and, the songs that are not available must be excluded from the dataset. Yet, Spotify offered the most accessible, robust, vast, and diverse music library available.

When a song is triggered to play, the music is reproduced via another Raspberry Pi implemented with the Mopidy music server that plays music via Olly’s own Spotify account. This Raspberry Pi is implemented with a high-fidelity audio shield and communicates with Olly via WIFI to enable the user to easily listen to the high quality music playback with any audio system they have. We developed a web dashboard to remotely monitor the behavior of all three Olly research products and ensure they were operational throughout our field study (which they were).

Participants, Data Collection, and Analysis

We recruited 3 participants from the greater Vancouver, Canada metropolitan area to participate in our study. This approach clearly has limitations; for example, it makes the results hard to generalize to a wide population of users. Similar to the aim of the original technology probes paper [28], and several field studies since then (e.g., [17, 18, 26, 59]), we want to initially focus on a smaller selection of participants to gain a rich, descriptive understanding of the space as a whole to inform what might be salient issues for future research and practice. We recruited participants through flyers and online advertisements. No households had children and we use pseudonyms to describe our study participants in this paper.

All participants were familiar with technology, owned digital devices (e.g., music players, smartphones, computers), and had extensive Last.FM accounts that were still in use. Last.FM [1] captures precise records of digital music that a user listens to across their devices (e.g., smartphone, tablet, computer), applications that play locally stored music (e.g., iTunes, Winamp), and online streaming services (e.g., Spotify, Tidal, YouTube). We recruited participants that had large existing Last.FM archives; coincidentally all 3 participants' accounts were started in 2006. This enabled us to provide participants with glimpses into music from their past that stretched over a decade. It is important to note that due to our participants' pre-existing interest in using Last.FM, they likely already had some interest in exploring past music tastes and trends.

Household 1 (H1) consisted of Jim (mid-30s, full-time bike mechanic and freelance graphic designer). Jim lived with his wife Sally in a two bedroom apartment. Jim's Last.FM account contained 82,230 entries (an average of 18 songs per day over 12 years). **Household 2 (H2)** consisted of Suzie (mid-50s, massage therapist). Suzie lived alone with her cat Terry in a one bedroom apartment. Suzie's Last.FM account contained 136,988 entries (an average of 30 songs per day over 12 years). **Household 3 (H3)** consisted of Tom (mid-20s, restaurant waiter and part-time college student). Tom shared a house with 3 roommates. Tom's Last.FM account, which he started in early high school, contained 163,436 entries (35 songs per day over 12 years). The average amount of music participants listened to daily remained similar to their respective averages in our study.

We aimed to collect rich accounts from participants about the rhythms and activities of the home through semi-structured interviews that took place monthly. This interview schedule included an introductory interview when installing Olly and an in-depth final interview at the end of the 15-month

deployment. During our initial home visit (which lasted 1-2 hours), we aimed to develop an understanding of participants' everyday lives, common activities, interests in music, music listening practices, and technology-usage trends. Participants gave us a home tour and decided where Olly should be installed and where the Raspberry Pi for music playback should be connected. We designed Olly to be easily movable once connected to home WIFI, simply requiring it to be unplugged, moved, and plugged back in wherever desired. Using our web dashboard, we then manually triggered Olly to randomly select a listening instance to test for reliability and demonstrate how Olly works. We gave brief descriptions of Olly, noting it would continue to occasionally surface a song from its owner's past indefinitely. We wanted participants to develop their own interpretations of it over time. We did not explicitly encourage participants to interact with Olly. All were aware they could drop out of the study at any time.

After the initial home visit, we conducted monthly interviews to probe and record participants' unfolding experiences with Olly in a structured, yet informal manner. These sessions typically lasted 30-60 minutes. At the conclusion of the study, we visited each household to conduct in depth interviews (these sessions lasted 2-2.5 hours). We commonly referred to field notes and recordings capturing participants' earlier experiences to explore possible changes in attitudes toward and experiences with Olly and participants Last.FM archives over time.

All interview sessions over this 15-month period were audio recorded. Relevant segments of recordings were transcribed. Researchers also took field notes and documentary photographs during each interview. Field notes were reviewed immediately following each interview, and tentative insights were noted in reflective field memos [20]. Analysis of the data was an ongoing process. After each home visit, we conducted a preliminary analysis, searching for emergent, stabilizing, and shifting patterns across recordings, field notes, and photos to draw out underlying themes [43]. We coded raw documents with these themes. We also created affinity diagrams to model connections and differences among households. In what follows, we present several descriptions and examples taken from field observations to help illustrate the themes.

4 FINDINGS

Olly provoked a range of reactions in our field study. Participants exhibited changing attitudes characterized by initial delight, a brief period of tension, and a shift to acceptance. Next, we describe examples that illustrate how these experiences unfolded across households. We then report on Olly's

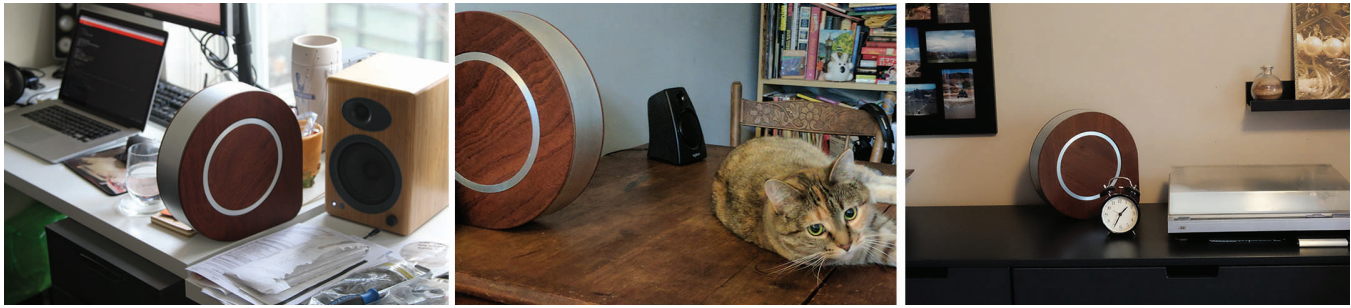


Figure 4: From left to right. **Jim-H1's** Olly, kept in his home office, was easily visible from the bed and living room; **Suzie-H2's** Olly kept in her living room with cat Terry; An earlier image of **Tom-H3's** Olly soon after he moved it from the living room into his bedroom.

role in mediating experiences between participants and their digital music archives; and, describe participants' reactions to living with a slow technology.

From short-lived tensions to integration & acceptance

Gaver et al. [17] describe people's cumulative experiences of new technologies during field deployment studies as moving across a *trajectory of appreciation*. A new technology might initially be embraced because of its novelty. As novelty wears off, tensions can emerge if initial expectations are unmet. Through time, people will develop a normalized understanding of the technology: it will either be abandoned or accepted into their lives. If accepted, people's experiences with it might improve as they develop ways to work around tensions and integrate it into their lives. While each household varied, all three exhibited a reasonably similar trajectory: initial excitement, followed by a brief period of tension, and, acceptance.

The first two months of the study were characterized by experiences of excitement and frustration. Participants commonly remarked on the enjoyment that came from when they played a song Olly had selected, as well as tensions that could result from its slow pace. **Jim-H1's** reflection on his early experiences exemplifies this tension:

"I've had my Last.FM [account] for a long time but didn't know how I'd 'use' it. ... When Olly started turning, it was like magic. When I'd catch it moving, I'd take a break, stop and listen. But, when the song was over, I was itching for another. I dreamed about having a remote control to flick on more [songs]. If I'd hear it turning when I was in bed, I'd run out to listen. When I'd go out, I'd put a post-it [note] on it to know if I missed anything. I became a bit obsessed. I wanted to have power over it, but logically I knew I couldn't. In the end that's probably for the best."

Suzie-H2 described a similar tension and workaround:

"In the first weeks I'd cringe if I missed it [surfacing a song]. Might

never have the chance again to hear it! ... I took to putting a bit of tape on [the inner disc] so I'd know if it worked when I was out the house. ... At one point I thought 'maybe it could tell me before it finds a song, like send a text' ... Mind you, this might ruin the surprise all together."

The tensions present in **Jim-H1** and **Suzie-H2's** early experiences with Olly highlight early frictions in reconciling its slow, unpredictable pacing with their desire to have more control over the system. Interestingly, the concluding statements in both of these passages illustrate their self-recognition that fulfilling such desires might inhibit the potential value of Olly in their lives. **Tom-H3** did not experience these tensions; however, an early tension did emerge related to Olly's initial domestic location:

"At first I put it in our living room. A great conversation piece, right? But it didn't feel right. What if my roommates heard I'd really been into *Lady Gaga*? [laughs]. ... but more seriously, there were a few years of my life I was in a tough relationship and I associate a lot of the music I was listening to at the time with it. One of the first songs Olly played was from that era. I didn't feel comfortable to have this 'out there'. I don't want to 'delete' those songs from my life, but it made me see how personal my Last.FM is. ... I moved Olly to my bedroom, which is a much better fit."

The reflection above illustrates how **Tom-H3's** action to physically move Olly to a more personal place helped it find a better fit in his life. As our study progressed, we found that tensions faded away across all of all households. For example, at the end of month 3, **Tom-H3** further reflected on his decision to shift Olly from his living room:

"Moving it into my room is what did it. That's where it belongs, at least for now, and that's when I started to love it. I haven't had a problem since. I don't mind not knowing when a track will be pulled or what it's going to be. It's what makes it always interesting. ... [Olly]'s not trying to replace what I listen to. It's doing something different by bubbling up bits from my past."

In contrast to **Tom-H3's** relatively smooth integration of Olly into his life, during month 3 **Suzie-H2** reflected on how the passage of time positively shaped her attitude towards Olly and its autonomous behavior:

“At first, I felt like ‘ah I don’t want this to stop. Keep playing more [songs]!’ But now, I appreciate the unpredictability. I’m not *expecting* something is going to happen. I’m going about my day and then ‘oop’ it goes off, so it’s not something I’m waiting for. This makes it feel a lot more natural. ... I’m not expecting it, so there’s not an immediate obligation to it. It goes when it wants and I decide if I want to interact with it. It actually gives you some control. I don’t know where I’d start if I had to choose a song.”

The sense of familiarity and acceptance that accrued through **Suzie-H2's** time with Olly, similarly emerged in an interview with **Jim-H1** in the month 3 of the study:

“Its cadence was hard to decipher initially, but it became more understandable. It had to *click* that it keeps on going. Rationally, I knew this, but it took a while adjust to it. It might bring up a song in 10 minutes, or it could take days. There’s a freedom in knowing that eventually there will be another. Sounds counter-intuitive, but once I understood this, it became more enjoyable to live with.”

These collective examples illustrate how participants’ attitudes toward Olly changed over time as tensions faded and they developed self-determined understandings of it. They also highlight that Olly’s unpredictable, yet persistent behavior eventually was perceived as enabling them with choice to engage with Olly on their own terms. Next, we describe experiences that emerged from Olly’s re-presentation of Last.FM data in the home. All of the remaining observations and reflections are taken from interviews after these points of acceptance had occurred.

Reminiscence, Serendipity, & Dealing with the Unknown

An early and consistent theme across our study was that songs surfaced by Olly and played by participants could operate as resources for reminiscing on past life events, stages, and relationships. For example, **Jim-H1** reflects on the wealth of past experiences tied to his Last.FM data:

“It made me realize how many memories and associations are locked up in music I’ve listened to. ... I’ve come to think of [Olly] like an indirect window into my past that I have to decode. Kind of like a ‘middle man’. It finds a song and offers a possibility, but I have to do the translation work to trace it back to a place or time in my past. ... It’s made my Last.FM [data] feel much more valuable in a way I didn’t expect.”

Tom-H3 elaborates on this theme by describing different

qualities of reflective experiences Olly triggered over time:

“Whenever it pulls a track, it could be from yesterday or a decade ago. This has kept it constantly interesting. ... Sometimes it pulled songs that reminded me of very specific memories, like of a road trip I took years ago. ... It could also be a more emotional feeling from a period of my life. ... I heard a song from *Death From Above* and I knew this was from around when I was in Grade 11 [of high school] and I had this general nostalgic feeling from that time. ... [It’s] like a wind from my past blowing back into my life for a few minutes that I’d stop to take it in.”

Echoing sentiments underlying **Tom-H3's** reflection above, **Suzie-H2** further describes how Olly maintained a perpetual yet understated sense of intrigue over time:

“I never know what’s going to be next and there’s so much [Last.FM data] in there. There’s this simmering sense of surprise about [Olly]. ... I say ‘simmering’ because it’s mostly quiet, on my table, but another one [song] will eventually be coming ‘round and I remain fascinated by what I’ll find.”

This sample of reflections highlights a theme consistent across our participants: the perpetual randomized way that Olly selected songs catalyzed and sustained a valuable ongoing sense of intrigue and subtle anticipation.

Serendipitous & Social Experiences Triggered through Olly
Although more rare, participants reported that Olly also triggered serendipitous and unexpected experiences. For example, **Jim-H1** recalled an instance in which Olly surfaced a song from the ‘Tragically Hip’ on the week following the death of the band’s singer:

“It was eerie. Gord [Downie] had just died. It was all over the news. And then, what happens? [Olly] picks a Tragically Hip song. I’d listened to [the band] on and off over the past decade. When it played, well after getting past the initial shock, I silently listened. Had a little impromptu memorial.”

Suzie-H2 described a more personal unexpected instance:

“Right around my Mum’s birthday, it played an electro version of ‘Heard it through the grapevine’. This caught me off guard. I had a ‘how can this be happening’ moment. My Mum didn’t like electronic music, but she loved the Temptations. I settled down and it was quite celebratory honestly. [It] made me think on the influence she’d had on my life and how I’m a different person. And, *that’s* all represented in *that* song, kind of poetic. ... The experience stayed with me for some time after the song was over.”

In addition to extraordinary encounters, all participants reported Olly catalyzed social interactions related to past relationships. **Jim-H1** described how an experience with Olly

prompted him to renew social relations with friends:

“It played a song I immediately recognized from when I was in Australia five, six years back. I met my wife then, made some good mates. [It] brought me back to that time. ... I realized I’d fallen out of touch with them [mates] too and made an effort to track them down. Now we’re back to chatting.”

Suzie-H2 described how the emergence of songs from *The Flaming Lips* prompted interactions with a close friend:

“Eight years ago I let her stay at my flat while I was on holiday. We didn’t know each other well at the time. She racked up like 1400 scrobbles [entries] in my [Last.FM] over two weeks. A good deal from the Flaming Lips. Now she’s my best friend. Here and there a Flaming Lips song came up [through Olly]. It’s not my favorite music, but it’s not about that. It’s a nice reminder of our friendship. ... I call or text her when the Flaming Lips come on.”

Jim-H1 and **Suzie-H2**’s passages exemplify several accounts that emerged across households that detailed positive experiences resulting from encounters with songs that were associated with valued social relationships.

Experiences of the Unknown and Difficult to Recognize

All participants reported that, in at least two instances during our study, Olly surfaced songs that they could not identify and, consequently, had no memory of listening to. Participants came to terms with these experience in varying ways. **Suzie-H2** suggested that Last.FM’s data capturing processes simply made such experiences inevitable:

“There are so many things that if you didn’t record them you’d never remember. Maybe I was vacuuming when [the song] was playing, or washing dishes and zoning out. It didn’t bother me but I did think about where I was then, which I couldn’t answer.”

Interestingly, **Jim-H1** likened the experience to encountering a misplaced part of his past:

“It’s the opposite of losing your keys. Instead of looking for something you misplaced, it’s like a misplaced bit from a time in your life has found you, but you don’t know where it’s from.”

These experiences could also prompt more direct actions. Both **Suzie-H2** and **Tom-H3** described using the music recognition app Shazam to uncover the identity of the song as it played in real time; although, in both cases they were ambivalently unsuccessful, a sentiment that is illustrated well in **Tom-H3**’s statement:

“I’d rack my brain over it. I’d use Shazam to figure out what the song was, but it didn’t help. I still couldn’t remember when I actually listened to it. ... but I was fine with it. It was interesting to hear

something that my ‘past self’ chose to listen to.”

Relative Absence of Negative or Difficult Experiences

Aside from **Tom-H3**’s early experience motivating his placement of Olly in his bedroom, our participants did not report significant negative experiences arising from songs re-emerging from their past. Following prior research on slow technology systems that re-surface personal digital materials (e.g., photos or messages) [19, 25, 46, 54], we anticipated more tensions would emerge. During our final interviews we asked participants to speculate on possible explanations. **Suzie-H2**’s reflection offers one explanation that also captures other participants’ positions well:

“Music is less direct and more abstract in a way. It can evoke very deep emotions and bring you back. But because of its nature I think it’s easier to associate different meanings to a single song and these also change over time. Whereas a photo or a handwritten letter, or even a text, can feel much more locked in time. They’re less prone to change because they’re so specific.”

The connection between music and personal memories is clearly complex. On a general level, the findings in this section capture how Olly triggered experiences that included: recollecting specific memories, contemplating emotional textures from past life stages, re-connecting with social relations, and reconciling encounters with unknown songs. Next, we take a deeper look into how Olly’s presence and form of interaction shaped experiences with it.

Perceptions of Temporal Traces and Changes

A core aspect of Olly’s design is its ability to abstractly represent the ‘age’ of a Last.FM listening instance associated with a song through differing speeds of actuated rotational movement. These representations are relative to today’s date (e.g., the rotational speed of all instances in the archive will have gradually become slower as they age). We wanted to explore how this technique might shape participants’ experiences of songs from their past. We found participants valued these temporal traces in terms of how they primed experiences pre-listening experiences, highlighted the uniqueness of listening instances, and expressed the evolving nature of the archive.

Priming a space for contemplation prior to interaction

Jim-H3 described how, over time, he became more attuned to using Olly’s rotational speed as a resource to contemplatively prepare for a listening experience:

“After a couple weeks, I could judge if [a song] would be older or more recent. It took a few months, before I noticed more differences, the middle zone between ‘old’ or ‘new’. ... As I became

more adjusted, I started to take a little more time to guess when [a song] was coming from. [I'd] try to mentally put myself back into that time. It was a ritual of sorts. Take a minute to think about what might come up. ... I wasn't always right (laughs), but it didn't matter. It helped me tune into a different mindset."

Other participants also reported on how the rotational movement could prime experiences prior to interacting with Olly. **Suzie-H2** reflects on this 'pre-interaction' space and Olly's role in supporting a place for contemplating past experiences in her daily life:

"I hardly ever jump up and immediately go for it. If I notice it, I'll start thinking on where it's grabbing the song from. The movement works well here. It gives you a very general sense of where in your past it might be from. Gets you thinking about different times in your past because it would be impossible to actually guess the song. So, it's worth taking a bit of time. ... Since I've had [Olly], I'm thinking more about my life, my past, in little bursts here and there in ways I hadn't done in a long time."

Differentiating Last.FM listening instances from songs

Participants also reported that Olly's expression of each Last.FM listening instance's temporal metadata helped differentiate the specific experiential element in the archive from the *respective song* it was associated with. During these discussions, participants commonly remarked on how the use of rotation, as a representation of a previous point in time in their past, was a valuable experiential dimension of Olly; a theme summed up well by **Suzie-H2**:

"The turning disc makes it a pinpoint from your past. It's not just 'a song'. It's not just saying this is something you listened to before. Whether you can place it or not, each and every song is from a particular time. This completely changed the experience of the music and how I approached [Olly]. It gave it more significance and this made me give it my attention."

Additionally, in three occurrences during our study, participants reported that Olly surfaced the same song more than once. **Tom-H3's** offers an intriguing account of his recognition and experience of Olly surfacing the same song twice, at two notably different rotational speeds:

"It was Whole Lotta Love, a Zeppelin song. When it first came up [in month 8], it was moving real slow. I knew this one had to be around when I was finishing high school. A few weeks later, it played again, but that one was much faster, probably from the last few months maybe. It was a memorable experience. I saw that Zeppelin's been an anchor in my life that I keep going back to. ... It made me think about how time moves on, but some music sticks, you know, becomes part of your life's soundtrack."

Recognizing the temporality and aging of data in daily life
Albeit in different ways, in our closing interviews, all participants reflected on the role that Olly played in expressing temporal qualities of their Last.FM data. Participants often contrasted their perceptions of differences between how digital and physical things change over time, and situated these differences in relation to their long-term music listening habits. **Jim-H1** remarks on how there is a general lack of visibility in terms of how data ages:

"We can't see our data and files and the like get older. ... the passage of time doesn't change them. Photos will fade, a book's pages might turn yellow. My [Last.FM] collection gets bigger, but that's it. Olly brought out the movement of time through it. Made it more visible and a big focus of the experience. ... Listening to music is something I am going to do for the rest of my life, so I've loved this. It's kind of like those yellowed book pages, which is hard to achieve with anything digital."

Suzie-H2 also reflected on her life-long interest in music listening in relation to the experience of living with Olly:

"One thing I appreciated is that [Olly] doesn't ask anything of me. The music I'm listening to day to day, just feeds into it. ... It's a physical version of my music history that keeps changing with me as long as I'm around. ... The [music] history I've logged over the past year when this [study] started is in there and it's growing older with me. It makes it feel like there's a sense of 'aliveness' to it. Like there's a longtail on the whole thing, my Last.FM but also my attachment to Olly. They're now hard for me to separate."

Collectively, these findings highlight ways that Olly's presence and behavior shaped, and perhaps extended, participants' relations to their Last.FM data by priming 'pre-interaction' experiences and by differentiating the relative age of listening instances in the archive. They also show that, over time, Olly implicitly accrued a co-evolving quality. Next, we dig deeper on participants' broader experiences of living with a slow technology.

Longer-Term Relations & Living with a Slow Technology

Beyond experiences focusing on music listening, participants also reflected on more general experiences with Olly. These freeform dialogues in our closing interviews revolved around perceptions of upgradability and obsolescence of consumer devices, often in relation to Olly. **Jim-H1** remarked on the importance of Olly's physical embodiment in relation to purely digital applications:

"I like the physical attachment to it, actually having to physically get up and interact with it. It makes you much more likely to pay attention to it and care about it. If it was an app on your phone,

there'd definitely be a disconnect. Then it'd be just sitting on your phone. And a notification pops up and it'd be easy to just swipe it away. It'd be much easier to dismiss. ... And, unlike an app, [Olly] doesn't need to be upgraded. It could keep on working for years and would still be interesting. It doesn't need anything else."

Suzie-H2 reflects on the potential longer-term relation to Olly, likening it to some of her valued material possessions:

"I wouldn't think it'd become obsolete. It has a specific function and it does it well. It's not like 'oh I wish it did this' and I can't wait until 'Olly 2'. I could definitely see myself having it for a long time. It's tech but not like any tech I have. It's not furniture but can sometimes feel like it. It falls into its own space when I think about all of the things I have. It's moved into a category of things I'd keep for a long time. Absolutely has a place in my life."

Similarly, **Tom-H3** reported having formed a high level of attachment to his Olly over time, despite facing challenges in reconciling it as a 'technology':

"I can't think of any 'technology' that's like it. It walks a fine line between being a 'technology' and an heirloom. I feel like it's more in the heirloom category. It has a distinct purpose and I don't see that changing. If I were to move to another house, it's definitely going to be in a box moving with me. Definitely."

Taken together, these examples illustrate participants' experiences with Olly remained valuable over time. In this, they highlight how participants became attached to Olly, which prompted speculations on the potential for it to attain a longer-term place in their everyday lives in the future.

5 DISCUSSION AND IMPLICATIONS

It is clear that music holds a significant place in people's lives. However, the transition of music from physical to digital brings new complications and opportunities as personal music listening data accumulate over many years into massive archives. A key contribution of this study is the investigation of this phenomenon to reveal how slowness might offer a productive frame to approach designing of longer-term experiences with personal data from one's past. Our findings resonate with the original vision of the slow technology design philosophy [23] and offer new insights into how this design practice could be extended. We see clear opportunities for mobilizing this expanded framing in future research, specifically in terms design inquiries into how rich experiences of reflection and reminiscence could be catalyzed through re-experiencing personal data; and, more generally, through investigations into how a longer-term place for technology could be carved out in everyday life. We see also see opportunities for qualities and dimensions related to time to be leveraged in the creation of future temporally expressive

design artifacts like Olly. Next, we present these research and design considerations for the HCI community as matters of anticipation and pre-interaction; long-term co-evolution of artifact, data, and personal histories; and temporality of data and metadata.

From Designing for Anticipation to Pre-Interaction

Designing for anticipation has been an ongoing area of interest in the HCI community, and recent works have explored how a slower interaction pace can open a space for anticipation over time [7, 29, 54, 69, 70]. In this, anticipation is often characterized as two temporal phases: the first, before an experience has happened as tension builds, and, the second, during the experience as one reflects on the content that has been revealed (see [60]). Yet, the first temporal phase of anticipation has rarely been directly explored in HCI. Our study contributes to this deficit by offering an expanded set of experiences that could be considered and designed for *prior to interaction*.

This temporal extension of interaction is reflected in the way Olly invited various experiences outside of direct interaction. For example, Olly expressed the relative 'age' of a listening instance through rotational movement that was a continuous, interpretative and gradually shifting. This nuanced expression led to open-ended experiences of pre-interaction that were characterized as 'simmering surprise', pause, contemplation, curiosity, and reflection prior to listening to a song. While diverse, these *pre-interaction* experiences primed a space where participants could "tune into a different mindset" and prepare to, as **Jim-H1** put it, "do the translation work" to interpretively connect the song to a prior point in one's life. This technique also supported participants in casually noticing that Olly had surfaced a song and feeling 'obligation free' to let it go unlistened if the timing did not feel appropriate. These design qualities helped alleviate tensions with Olly and enabled it to become highly integrated in participants' daily lives in ways that largely avoided frictions related to lack of control that have been common in prior studies of slow technologies [19, 25, 46, 54].

This extended temporal frame for interaction demonstrates an advance in how the HCI community can approach designing technologies. This points to how design artifacts, through temporal expressivity, can catalyze a rich range of particular experiences that lie outside of direct interaction. We see a need for future HCI research to explore how related techniques could give rise to a wider range of pre-interaction experiences that include, build on, and expand beyond anticipation. This foreshadowing of potential experiences could have a range of emotional valences from optimism to patience, as examples.

Designing Longer-Term Relations through Co-Evolution

Our approach to encoding multiple layers of temporal expression into Olly also opened a space for participants' relations with it to grow over time. Olly subtly evolved by expanding its metadata archive as participants continued their everyday digital music listening practices; and, by expressing the 'aging' of the archive as the rotational speed for each unique instance subtly became slower as it grew older day by day. It was also evident that Olly, as a material form, was designed and built robustly not as a matter of permanence per se, but as a way to age and adapt to the passage of time; for example, the mahogany veneer aged and acquired a patina over time. These techniques of digital and material adaptation, combined with its unpredictable yet indefinite behavior, generated a perceived sense of 'aliveness' in Olly as it emerged as a companion in everyday life whose combined physical materials and digital expression slowly aged alongside its owner. Each time participants encountered their Olly, it represented an up-to-date reflection of the totality of digital music listened to in their life. These design qualities came together as a synthetic experience that led to an increase in attachment to the Last.FM archive and to Olly itself. This resulted in participants' perceptions of a "long-tail" being cast onto their relations to the evolving data, the material form of the data, their daily practices and their respective life stories in ways that were difficult to disentangle. These instances help show how the temporal frame of slow interaction can also be seen synthetically, as a mutually formed co-evolution of the digital, material, and personal. This expression and synchrony of time through participants' personal data, prompted positive speculations on the role Olly could play in participants' life-long practices of music listening and the place it could have in their lives for the longer-term.

These findings suggest new opportunities for designing technologies that materially manifest personal data archives that co-evolve with people in their everyday lives. There is a need to better understand how the passage of time can richly 'change' data elements in the archive and how such representations could evolve over time. Due to digital music being a largely immaterial and temporal media, Olly's actuated rotational movement and the encapsulation of slow change in a material form emerged as successful techniques to temporally express and attribute aging qualities to the archive. Yet, this may not be appropriate for other forms of digital data. More research is needed to investigate how different assemblies of materials, forms, and computational behaviors can be designed to express the accumulation and movement of time through personal data archives.

Additionally, machine learning and prediction of user behaviors represents a dominant and important approach in HCI for creating systems that evolve with users over time. Yet, our study sheds new light on how data (and metadata) implicitly accrued through people's existing everyday practices with digital applications is an underexplored and potentially valuable alternative approach to guide future work in creating of systems that co-evolve alongside people. In this, we see an opportunity to investigate how new systems can be designed that fit in, resonate with, and enhance people's longer-term (or 'lifelong') practices.

Designing across Data Temporally

Our findings also suggest there is a need for the HCI community to more deeply explore the temporality of data as design resource. The temporal frame for slow technology can productively apply to data and metadata by offering a scaffolding for generatively exploring their temporal qualities. While successful, Olly leveraged temporal metadata in a relatively simple way. There is an opportunity for future HCI research to design new technologies that could express temporal qualities implicit in and across different kinds of personal data archives (e.g., photos, audio recordings, location histories, social media, etc.) as they accumulate and grow older with people in their daily lives.

In addition to exploring linear relationships (e.g., how old a personal data element is in relation to today's date), synchronic relations across time is another area for design exploration. This can include temporally organizing and slicing elements in personal data archives based on, for example, the time of day, the year, the lunar cycle, and/or the season. There is also an opportunity to investigate the creation of temporal assemblies of multiple types of digital data from different life moments, stages, or eras. While a limited amount of prior work has explored how different types of digital content can be combined to support rich experiences (e.g., audio and photos [16]), the temporal dimensions in and across such assemblies is notably underexplored. Our work helps extend parallel initiatives in HCI advocating for the design of technologies that open new possibilities for forming relations to personal data [11, 12, 64, 77] and expressing more diverse perspectives on temporality through design [37, 39, 62, 68, 73].

6 CONCLUSION AND FUTURE WORK

We designed Olly to critically investigate how its slow pace and temporal expressiveness could sustain longer-term experiences with participants' respective personal music listening history archives. Findings illustrated that Olly became integrated into participants' everyday lives, supporting a range of experiences around it, in addition to direct interactions. They also highlighted how, over time, participants' perceived

their relationship with Olly to develop and grow, reinforcing attachment to their Last.FM archive and to Olly itself. Our work highlights the need for future research to explore how new technologies could be designed that embrace unfamiliar constraints, operate independently, emphasize pre- or post-interaction experiences, in addition to moments of direct engagement.

Designing for slowness and longer-term human-technology relations represents an important area for future research in the HCI community. Our work contributes a rare account of how slowness can operate as a frame for creating design artifacts that can sustain valued, longer-term experiences with archives of personal data in everyday life. More broadly, our work explores what a different pathway for designing technology that supports rich human experiences of reflection and meaning-making might look like. An overarching goal of our work has been to constructively question normative assumptions in technology design (e.g., creating devices that are always-on, attention grabbing, and ‘waiting for you’). We believe that new possibilities for change can emerge through a design-led approach that combines the crafting of highly resolved design artifacts that offer a concrete ‘feel’ of future possibilities, with longer-term narratives of human experiences of them. Not only change that expands how we question assumptions in design, but also change manifested through envisioning, debating, and exploring real alternatives for a different way of being with technology. As new forms of technology mediate our everyday experiences, there is a critical need in the HCI community to delve deeply into seemingly mundane activities (like listening to digital music) to ask how our normative assumptions of design, technology use, and human experience are adequate, adaptive, and what we want.

The application of slowness and temporality as conceptual frames for design have clear links to growing initiatives in HCI investigating how enduring forms of technology can be designed and the implications this might have for people’s everyday lives over time. We hope this research offers another step toward nurturing future initiatives in the HCI community that bring the subject of human relations with technology over time more seriously into focus, now and long into the future.

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