

ARTICLE

Digital geographies of miscarriage: A ‘sister-ethnographic’ approach to pregnancy apps and loss

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Abstract

Pregnancy apps have become a popular healthcare tool with millions of users worldwide. While branded as inclusive, they nevertheless normalise a particular pregnancy journey: one culminating in birth. Knowing that pregnancies end for various reasons – with one in five resulting in miscarriage – we seek to challenge this narrow framing. Deviating from existing literature, our paper explores the emotional geographies of pregnancy apps when birth is not the outcome. Set through a series of ‘app annotations’ by two sisters navigating pregnancy loss, our paper explores how a leading app was intimately encountered. Drawing inspiration from graphics literature, we advance a new method and activist tool that centres the body – and particularly embodied loss – in digital debates. In so doing we hope to turn geography’s ‘digital turn’ towards a more creative set of tools, heeding feminist calls to engage technological intimacies. Vitaly, this work illuminates those lives (and losses) systematically excluded – often in the name of life itself.

KEYWORDS

creative methods, digital, feminist geographies, fertilities, loss, pregnancy apps

1 | INTRODUCTION

This paper follows a conversation about loss between two sisters, Carly and Jen, one of whom experienced consecutive ‘silent miscarriages’.¹ The news of pregnancy loss came as a shock, twice, when Carly was told during a routine scan that her baby did not have a heartbeat.² This type of miscarriage is called ‘silent’ because the body does not register the loss: it continues to produce pregnancy hormones and thus symptoms and a positive test. We explore how this loss is not only silent within the body but largely silenced within wider discourses. Our work joins a growing field of geographical literature that addresses the persistent neglect of pregnancy loss (Browne, 2022; Fannin, 2018; McNiven, 2016). We particularly explore the erasure of loss in relation to a popular tool for expectant parents – pregnancy apps – and offer creative methods to unsettle this political erasure.

As has been well documented, apps are now commonly used by those expecting, informing reproductive imaginaries (Hamper & Nash, 2021; Shipp & Blasco, 2020). We argue that what remains overlooked is how these apps not only

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frame expectation but also powerfully shape loss. We examine this in relation to a leading app called Pregnancy+, which Carly used throughout her first pregnancy and ultimately deleted. Despite her choice not to re-engage with the app, we illustrate how the tools' data-afterlife continues to haunt. This free, industry-leading app had more than 50 million downloads worldwide as at December 2023. Based on data published by the main mobile application digital distribution platforms (Google Play and Apple's App Store), this is the most-used pregnancy app in the United Kingdom, the USA, and Germany. It is the most frequently downloaded in Brazil, second most popular in South Africa, and third in Iran, and the tool receives 4.9 reviews out of 5, based on 51.7k reviews (December 2023). Indicative of its global reach, Pregnancy+ is available in over 20 languages. Vitality, such apps are part of a growing trend towards mobile health (mHealth), the practice of medicine and public health supported by mobile devices.

Increasingly such mobile health tools supplant clinical care, especially in contexts where mobile phones are more accessible than under-resourced medical facilities (Rampazzo et al., 2022). A recent United Nations report celebrates these apps as 'life-saving' in Global South contexts, for example in displacement camps (Schönbauer, 2018). Examining intimate user-experience in these diverse settings is beyond the reach of this paper. We do, however, call for greater critical exploration in contexts where we know options for care remain restricted and pregnancy loss disproportionately high (Bagelman & Gitome, 2021). Developing methods that democratise these digital spaces – making them more accessible not just to use but critique – is thus a related urgency we aim to address in this paper.

Advertised as a supportive and affordable tool, we show how this platform nonetheless contributes to a profound silencing of pregnancy loss (Pittman, 2016). It reduces reproductive journeys to a linear progressive timeline imagined to only result in birth, despite research estimating 15–20% of pregnancies end in loss (Sagili & Divers, 2007). We demonstrate how Pregnancy+ vividly casts 'normal' development onscreen, simulating what we call a vicarious pregnancy where birth is projected as a given outcome and through various digital strategies becomes felt as real. Through interactive tools, this app compels its user to mitigate loss through regular forms of self-governance while at the same time erasing any trace of loss as lived reality. We show how loss emerges as a horizon to be defeated through acts of self-care and associated acts of consumerism. 'Productive' life sells. While we ground this critique in a particular platform, we demonstrate how this productivist logic is endemic to digital fertility platforms more broadly.

With hundreds of millions using these tools worldwide, pregnancy apps have attracted wide-ranging academic attention from anthropology, computing, communication, technology, arts, and design studies (Blair et al., 2021; Byrt & Dempsey, 2022; Healy, 2021; Ortiz Juarez-Paz et al., 2023; Smith et al., 2017; Thomas & Lupton, 2016). Geographers have also notably exposed the way apps inform reproductive lives (Hamper & Nash, 2021; Shipp & Blasco, 2020). Though diverse, we argue this literature problematically entrenches a productivist logic: focusing almost exclusively on biological reproduction, eclipsing questions of loss. The impoverishment of pregnancy loss in this literature reflects a wider discourse that places primacy on birth as *the* event worthy of particular attention and care (Coddington, 2021; Fannin, 2018; McNiven, 2016). We argue this erasure is compounded by a limited methodological imagination. Methods exploring pregnancy apps rely heavily on analysing visual and discursive content created by designers. Such an approach pulls us towards design, failing to adequately reveal the complexly lived geographies of these digital health worlds – especially where loss is concerned.

Pregnancy apps are a part of a wider landscape of new and centuries-old pregnancy advice literature, such as *Expecting Better* (Oster, 2013) and *What to Expect When You're Expecting* (Murkoff & Mazel, 2008), which serve as commonly used and culturally powerful resources on pregnancy. While many of the same issues explored in this paper are relevant to this pregnancy advice literature – such as biopolitical governance/discipline of the pregnant body through advice on how to eat, exercise, and prepare – we focus on pregnancy apps, given their claim to customise advice with user data generating seemingly more personal and relevant care. We also note that there is a distinctive affective dimension of apps with personalised animations of, for example, the user's imagined foetus.

In this paper we hope to make a threefold contribution. First, we conceptually challenge the normative birthing journey produced through pregnancy apps. Expanding existing critique that demonstrates how such apps produce a 'good' maternal subject, we show how pregnancy apps simulate and affectively shape a consumptive–productive subject imagined to be successfully reproductive, in a biological sense. Critically, we argue that by normalising and placing disproportionate care on the experience of birth itself, these apps deepen a sense of loneliness and alienation when loss is encountered. To take seriously the question of loss, we put into conversation the 'political geographies of fertility' literature with work examining the proliferation of pregnancy apps (Coddington, 2021). While the former offers an important entry-point into examining questions of loss, it has not fully engaged with the latter exploring how the geography of apps profoundly shape fertility.

Second, drawing on insights from creative geographies, we offer a new tactile method to better grasp the lived dimensions of digital-health spaces, particularly the intensities and intimacies of pregnancy loss. Here we offer zine-like

'app annotations'. This creative method embraces fair dealing policy and therefore does not depend on app-owner permission to repurpose app content.³ In so doing, we make a third contribution: to turn the 'digital turn' in geography (Ash et al., 2018) towards a creative set of tools that heed feminist calls to deeply engage technological intimacies (Elwood, 2021; Koch & Miles, 2021; Schurr et al., 2023). We present our app annotations as both a method and activist tool that might be deployed as part of a broader tactic to reclaim agency in ever-expanding digital landscapes.

Our entire approach is one we describe as sister-ethnographic: that is, a methodological orientation that processes, explores, and analyses loss collectively in shared conversation. This approach resists the hyper-individualising and silencing of loss, which has been widely noted as a persistent problem (McNiven, 2016) and which we see auto-ethnographic accounts (emphasising the individual) as maintaining rather than upending. While we are biologically related sisters, we also offer this as a relational method that might be held within wider communities of non-cis, non-biological sisterhoods (El Masri, 2023) to address various reproductive justice struggles in their lived expansiveness.

2 | POLITICAL GEOGRAPHIES OF FERTILITY AND APPS

We are not the first to address pregnancy loss. Geographers have led critical research exploring abortion (Hiemstra, 2021), miscarriage, and stillbirth (Browne, 2022; McNiven, 2016; Middlemiss, 2024). Others have importantly mapped out the loss of choice to abort (Calkin, 2019; Freeman, 2017). Some document their own fertility challenges in relation to a politics of waiting linked with precarious work (Hughes, 2021). It is towards a (still relatively minor) body of experiential knowledge-sharing that we offer this paper. Conceptually, we join a growing field of 'political geographies of fertility' (Coddington, 2021) that approaches fertility as a 'continued state of being, an anticipatory weight, that influences lives, behaviours, and politics at a variety of scales' (Coddington, 2021, p. 1; England et al., 2018). In this paper we explore, for instance, how a sense of anticipation and indeed failure is produced through a pregnancy app that compels users to imagine a linear trajectory of pregnancy progress. Thinking through 'political geographies of fertility' shifts us away from a focus on distinct biological events of reproduction (notably birth); instead, it calls attention to various processes and 'what gets made political through fertility' (Coddington, 2021, p. 1678). Our work adds to these political conversations, specifically exploring the intersections between digital health tools and pregnancy loss with a critical eye to countering apps' harmful – yet understudied – forms of biopolitical governance.

We seek to connect the political geographies of fertility and pregnancy literature with its orientation towards forms of loss, with interdisciplinary scholarship exploring the proliferation and impacts of pregnancy apps. The work on mobile digital platforms highlights the ways in which digital tools shape how fertility is understood, managed, and embodied (Hamper & Nash, 2021). This work contributes to a wider and growing scholarship examining oft-overlooked 'intimate geographies of the digital' (Richardson, 2018, p. 254; see also Datta, 2020; Koch & Miles, 2021; McLean, 2020; Nash & Gorman-Murray, 2019). The geography of these apps, both in terms of where they are encountered in daily lives and how they construct reproductive imaginaries and spaces, has garnered critical attention. This literature focuses on the various ways in which these apps secure life against loss. What has been less explored, however, is how loss is shaped and indeed experienced through these digital spaces.

Existing work on pregnancy apps examines both their generative possibilities and more harmful dimensions. With regard to the former, scholars have pointed out how apps can function as a pedagogical tool to enhance maternal outcomes (Blair et al., 2021); promote cross-cultural health literacy by rendering medical information more accessible (Smith et al., 2017); and enable connection by functioning as a 'convenient new way for women to connect and exchange information' (Ortiz Juarez-Paz et al., 2023, p. 41). On the other hand, research has illustrated the insidious ways apps reinforce ableist expectations for pregnant parents and developing babies, as well as gendered expectations of parenthood and heteronormative familial structures (Byrt & Dempsey, 2022). Such work has emphasised the need for more inclusive and gender-neutral app design (Byrt & Dempsey, 2022). Extending these critiques, informatic experts have demonstrated how rendering these tools more inclusive will not address the intractable problem of these platforms; namely, their inherently exploitative purpose. Indeed, most pregnancy apps are not only an advertising tool, but also collect and sell user data, often without explicit consent (Mehrnezhad & Almeida, 2021). A recent study shows how apps are not complying with GDPR in terms of their privacy notices and tracking practices (Mehrnezhad & Almeida, 2021). In their work 'How private is your period?' Shipp and Blasco (2020) make a similar argument, examining menstrual app privacy policies.

We approach pregnancy apps as part of a wider landscape of tools that are branded to both care for and control various forms of reproduction. Natural Cycles app, the number-one birth control app (as of December 2023), is used to monitor fertile windows using the user's basal temperature data and an algorithm to predict ovulation for the prevention

of pregnancy. This is also a reliable and widely used method for conception, so the app can be used for either purpose. Similarly, many menstrual tracker apps (the top two being Clue and Flo as of) take user inputted data of period dates and cycle lengths to predict periods and fertile windows (December 2023). While some may use these for contraception, or simply for information on their cycles, these tools are also used for conception.

Under the pointed title, ‘Zuckerberg, get out of my uterus!’, Healy (2021) explores how pregnancy apps mine intimate data, making users potential targets for commercial marketing while shaping expectations of femininity. Appearing ‘harmless and empowering’, Healy argues such apps medicalise and regulate the female body through consistent digital interventions and micro-managements that are ‘remaking the female body as a digitalized reproductive subject’ (Healy, 2021, p. 407). In their critical discourse analysis, Thomas and Lupton (2016) show how these apps function as a responsabilising tool, compelling users to mitigate risk. They illuminate how these technologies portray the body as a ‘site of risk requiring careful self-surveillance’ through the apps’ careful monitoring to reduce potential harm (Thomas & Lupton, 2016, p. 405). Through a compelling visual analysis of apps, Hamper and Nash (2021) demonstrate how apps work to secure a sense of the ‘good’ bonded maternal subject, through interactive monitoring and tactile design.

We might understand these practices as part of a wider set of technologies aimed at governing and controlling life itself (Foucault, 2007). When put in conversation with a seemingly distinct literature examining border surveillance strategies, for instance, parallels become evident. To predict and secure against ‘risky’ subjects, border agents are regularly enrolled in scanning, mining, and ‘dissecting the body’ at various checkpoints (Amoore & Hall, 2009). Pregnancy apps, we argue, work along a similar, though distinctive logic: promising to eliminate the unknown by rendering intelligible the body. In the case of Pregnancy+, it is not the terrorist at the border but the pregnant body as the risky site to be controlled. Rather than rely on an agent in a contained security cell, the individual app user becomes the governmentalised agent patrolling their body anywhere and on-the-go. In the workplace, bedroom, or on the train, one can ostensibly monitor pregnancy and alter habits (such as diet) to ensure a ‘successful’ birth. We show how this promise of total biopolitical control (in its clearest sense: producing life) offered through the app is a myth in a double sense. First, what happens onscreen is only ever a simulacrum performed as a real-time reflection of the user’s embodied development. Second, dutifully following the app does not secure procreation. While Pregnancy+ does not make an explicit promise to its users that engaging with its content promises full-term pregnancy, our paper demonstrates how the experience of using this app cultivates a strong sense that prudently following guidance will result in positive outcomes. For instance, one Pregnancy+ article suggests: ‘To make sure you have a healthy baby, here are some nutritional guidelines to follow’ (December 2023). Following a particular pregnancy diet cannot mitigate factors leading to loss, or indeed issues like low birth weight. However, these complexities are left out in favour of simplified information that made Carly feel as though being proactive in the ways identified leads to a healthy baby. The intimate and mobile geography of this app insidiously enrolls users to perform prescribed acts of self-care and securitisation.

While the questions and mechanisms for securing life against loss are well documented in the literature on pregnancy apps, the question of loss as a lived reality is relatively neglected. When considered as part of a wider political geography of fertility, loss is recognised as an integral part of fertility itself. With this orientation in mind, we ask: how does one encounter an app designed to promote life when death occurs? How might these ostensibly caring tools intensify experiences of loss (Massov, 2018)? In addition, we pose a related methodological question: how can we document intimate geographies of digital healthcare tools, especially in ways that might be empowering?

3 | EMBODIED STUMBLING: INTIMATE DIGITAL METHODS

Where apps have been explored, they are prominently examined in terms of their design. To do this work, methodological approaches are often restricted to a discourse (Healy, 2021; Thomas et al., 2018), visual analysis (Hamper & Nash, 2021), or policy analysis (Shipp & Blasco, 2020). These approaches illustrate the marketing strategies and discursive-visual worlds produced. Where user experience is explored, this tends to be limited to surveys, focus groups, and interviews (Ortiz Juarez-Paz et al., 2023). Alternatively, ‘walk-through’ methods attempt to map the space of apps (Byrt & Dempsey, 2022). Walk-throughs move systematically through a particular platform, carefully noting different dimensions, such as the imagery, textual tone, and content, symbolic representation (e.g., logos, symbols, illustrative tools), and interface arrangement (Light et al., 2018, p. 891). This method seeks to understand the apps’ ‘purpose, target user base and scenarios of use’ (Light et al., 2018, p. 889). In each case, these methods rely on and reify visualisations of apps as imagined by designers. These methods typically provide screenshots; however, due to copyright rules, reproduction of such images ultimately depends on permissions from the app owner. While revealing important aspects of digital platforms, such

methods do not fully bring the app user into the digital space as an active agent. How can intimate, embodied layers be introduced into this geography?

Though pregnancy apps have been widely understood from the perspective of designers, the intimately embodied experiences of users have been relatively obscured. Here, there remains limited methodological space for users themselves to meaningfully enter and rework digital spaces. We address this gap through our experimental method of 'app annotations'. These are hand-drawn, personal testimonials designed to map out Carly's experience of using and ultimately deleting the tool Pregnancy+ during the first 10 weeks of her first pregnancy.

These annotations begin with physical printouts from a mobile application. The printouts are then drawn and written over, with cut-out images overlaid. Printouts are also tactically positioned above lively ephemera. These analogue annotations are interventions into a virtual platform whose design is intended to be engaged with digitally. We argue that developing accessible mediums to intervene into digital space is vital work, given that such platforms centre designers as the dominant architects and those who retain agency over the reproductive narrative. While apps are not unidirectional, in that they encourage users to input data actively and regularly, they nonetheless provide a delimited space for that engagement. User-provided data is almost solely intended for consumer targeting (Healy, 2021). Various pregnancy apps mobilise user-data to identify desired items for pre- through to post-natal support. The annotations we develop here expose and refuse this extractive circulation, which situates app-designers as profiteers of our intimate data and worlds. Most importantly, these annotations are a method of speaking back to a powerful platform that has absented experiences of loss that remain central to many pregnancy journeys.

The annotations provided are less interested in the intentions behind design and more in the various ways they might be subverted. To that end we offer less of a walk-through of digital space and more a complexly embodied stumbling. The annotations move back-and-forth: between memories of encountering an app during the early weeks in a pregnancy to its impact throughout pregnancy loss. This embodied multi-directional reading provides less of a linear map of the app and more a complex emotional geography of this tool. Unlike the walk-through method, which seeks to interpret the 'app vision' as imagined by its creators, our approach centres the felt sense of engaging from the perspective of a user. Disorientation, the loss of barring, and the need to just keep going emerge as part of this felt sense of stumbling.

These annotations are zine-like in form, in that they include a process of cutting-and-pasting existing material (Bagelman & Bagelman, 2016). However, in this case the material being repurposed is digital. In a moment where zines are increasingly going digital (Alexander, 2002; Clark-Parsons, 2017), we suggest the analogue and tactile quality of zines holds radical potential for challenging digital platforms. We hope these annotations might encourage ongoing experimentation into digital realms in ways that place primacy on the user rather than app expert. This approach also overcomes an inherent hurdle posed by copyright law, because we sufficiently cut into the 'original' digital image.

Here we also draw on a growing field of 'graphic medical pathographies' emphasising the importance of visual text crafted by a non-medically trained expert as a vital way to interrupt the dominant one-way download of medical knowledge (Czerwicz et al., 2020). There is a blossoming field of medical humanities and social science work that centres patient experience and agency to illuminate a more robust and radical medical engagement (De Leeuw et al., 2018). This work shares a visual sensitivity with graphic novels, such as Jennifer Scuro's 'The Pregnancy [does-not-equal] Childbearing Project', which pictorially documents the loss of her baby (2017). Despite how commonplace, it is precisely these accounts that fall out of pregnancy apps and indeed wider medical discourses. Knitting together insights from graphics literatures and zine praxis, we attempt to illuminate these lively accounts. We now turn towards a series of journal entries that provide context to the subsequent app annotations.

4 | APP ANNOTATIONS: EXPERIENTIAL GEOGRAPHIES OF LOSS

In the days following Carly's miscarriage (on New Year's Day), we spend a full week together, mostly cuddled under a blanket consuming the dredges of holiday films supported by stocking-stuffer sweets and hot water-bottle refills. We talk about many things. The things that are lost. The shifted plans, timelines, hopes. At the end of the week, Carly realises 'it was a sort of a shiva' – the Jewish mourning period for relatives. The ritual lasts 7 days following a burial. There is no burial. Christmas tree ornaments and the menorah are packed away. So too, a few of the expecting objects: a book or two. Not many things have been accumulated in those first 10 weeks.

Carly was careful not to surround herself with baby futures. However, now that her pregnancy has ended there is one somewhat intangible artefact that remains and requires a surprising amount of thought: an app that keeps flashing on her phone. After seeing the two-blue lines following her missed period, Carly downloaded the app Pregnancy+, one of the most well-reviewed digital healthcare tools, receiving a top-star by *Forbes Magazine* (November 2023).

This app is still pinging away now on the coffee table. It sends reminders of what to eat, what activity to avoid, and ever-growing to-do lists. The image of a foetus continues to grow onscreen. It is now the size of a plum. 'I guess I have to just delete it?' Carly says, tentatively.

Despite the fact this app compels its user to consistently input data (possible baby names or dream items for registries), there is no visible option (like a button on the screen) to inform this app that pregnancy has ended. It continues to simulate an imagined reproductive world where, now, the baby is losing its tail and growing fingers and nails. The app's *raison d'être* is to mitigate against loss (selling relevant products to do so). It is incapable of acknowledging loss when it does occur.

The loss is hard either way, but these flashing reminders add another sting. 'Like, you are irrelevant, you're no longer in the pregnancy club', Carly says as she looks down at the glowing screen. Weeks ago, it felt like a safety net: reading its rules and filling in data-fields like a promise for the future. But now the app is cast in another light. Keeping the app no longer feels possible. But equally, dragging it into the bin does not feel right. Reflecting on these tensions, the following section delves into a series of annotations crafted by Carly documenting her use of this fertility app.

These annotations explore both how this app shaped reproductive imaginaries and how loss was sanitised in this digital space. An analysis section co-written by Carly and Jen introduces each annotation. Here we identify our primary annotation tactics: handwritten notes and images, overlays, filters, collage. Each of these tactics, which centre embodied experiences, seek to intervene into the app's geography. Traces of the app's intimate use, such as phone battery life and time of day, are also intentionally included to further emphasise the lived aspects of this digital landscape.

This method was carried out together as sisters – one who experienced pregnancy loss, and one who journeyed through this loss figuratively and quite literally beside her. As sisters close in age and relationship, our life-worlds have always been deeply entwined, with major losses grieved together. Writing with your sister is already an intimate practice, one that we have taken up many times. In this instance we felt our approach (which involved zine-ing screenshots of the app, journaling, and analysing the larger context of pregnancy apps and loss together) could not be confined to the 'auto'-ethnographic, given its highly relational quality. Auto-ethnographic methods are widely used in exploring both pregnancy loss (Chaudhary, 2019; Leith, 2009; McClure, 2019) and apps (Fletcher, 2023; Hughes & Mee, 2019; Rudenko, 2016). While akin to these approaches that attend to 'the slippery nuances and particularities of experience – emotions, feelings, bodily responses', we explicitly avoid the 'auto' to better capture the togetherness of our methodological process (Butz, 2010). The exercise of writing and analysing together offers another way to not only address certain silences but cultivate shared spaces of catharsis. Carly determined that while there are of course ethical risks implied in sharing her journey of loss in this way, more was to be gained and reclaimed in doing so – namely a sense of community, visibility, and critique.

5 | DOWNLOADING

While stumbling through the app together, Carly takes screenshots, prints out, and annotates (through first-person) key visuals in conversation with Jen. These are later layered with cut-and-paste objects and illustrations to form zine pages. The journal entries then serve as a further reflective space to explore the experience of using an app and how it inflects on loss. This first annotation below documents the experience of finding and downloading a fertility app. After passing by the privacy settings in small-faded print (which states that data will be used by Philips Avent), the app becomes a prominent phone-fixture. Philips Avent produces baby products and is a subsidiary of the company Philips, responsible for various familiar household electronics such as the toothbrush featured in Carly's annotation. Many of the medical information guides offered through the app are written by Philips Avent 'in collaboration with scientists' – a fact that the app casually suggests is 'pretty cool huh?' (Pregnancy+, Google Play, 18 March 2023). The app's tone establishes a sense of intimacy while it sells you baby products. As noted below, this is the exchange: personal data (including one's location, date of birth, gender, weight) for pregnancy information. A deal that at first felt for Carly fair (Figure 1).

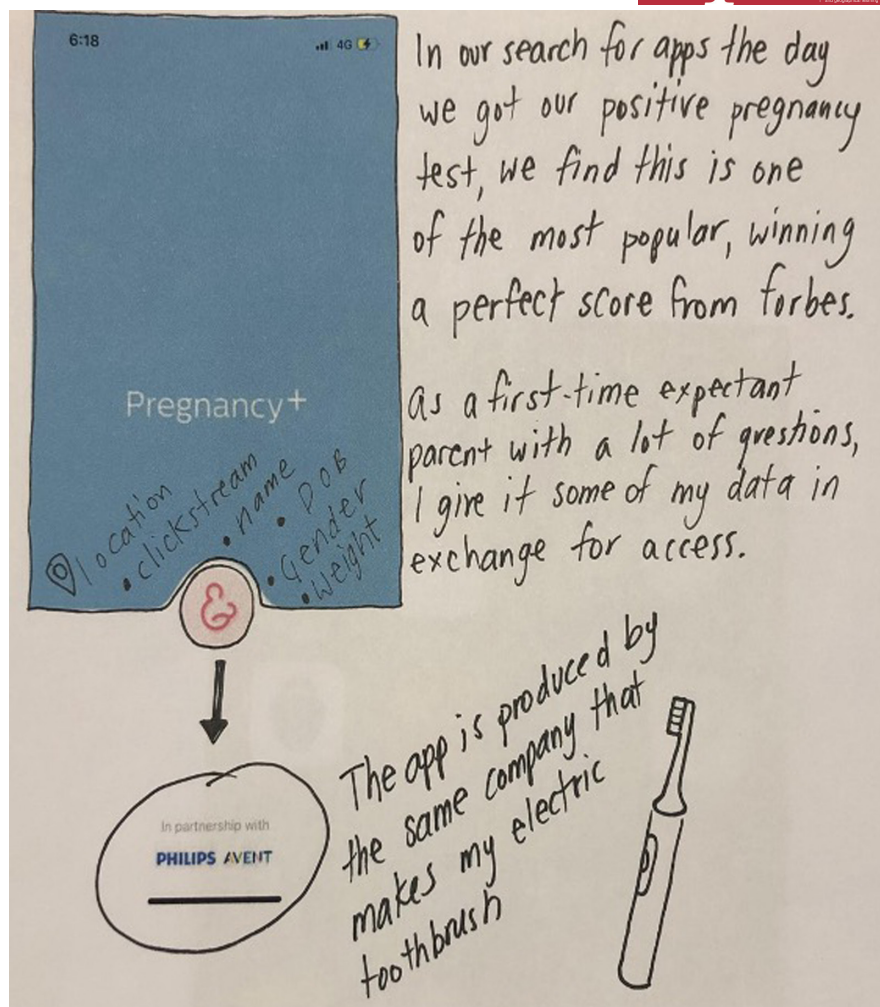


FIGURE 1 Downloading fertility app.

6 | MOVING INTO THE HOME (SCREEN)

The next annotation reflects the geography of the app itself. It lives on the home screen amid daily life. Here the app is nested alongside tools used regularly to book transportation, write notes, and check the weather. It lives just down and below from the phone button. With its persistent updates, it quickly becomes a go-to for help. Its presence is more regular than midwife appointments, thus easily becoming somewhat of a surrogate for prenatal care. Though on a private phone, its presence is also publicly visible; the nosy neighbour on the bus is privy to the user's (supposed) internal world (Figure 2).

7 | EXPECTATION

This annotation shows the powerful sonar functionality present in pregnancy apps, and the use of a fake Doppler to mimic the sound of a beating heart. As highlighted with the small hand pasted below, the digital tool relies on Carly's touch and swipes. Responding to touch, a 3D foetal image appears and is easily pivoted around 360 degrees. This intimate tactility produces a sense of connection. The annotation demonstrates how these simulations felt at week 10 when the embryonic tail magically disappeared.

This simulation of a foetus extracts the mess, tissue, blood, and organs to present an abstract image that feels like a mirror into the womb. Here a vicarious pregnancy (a simulated pregnancy onscreen) began to feel embodied. As others have shown, aestheticising the foetus creates a certain relationship that demands care or 'bonding' (Hamper &

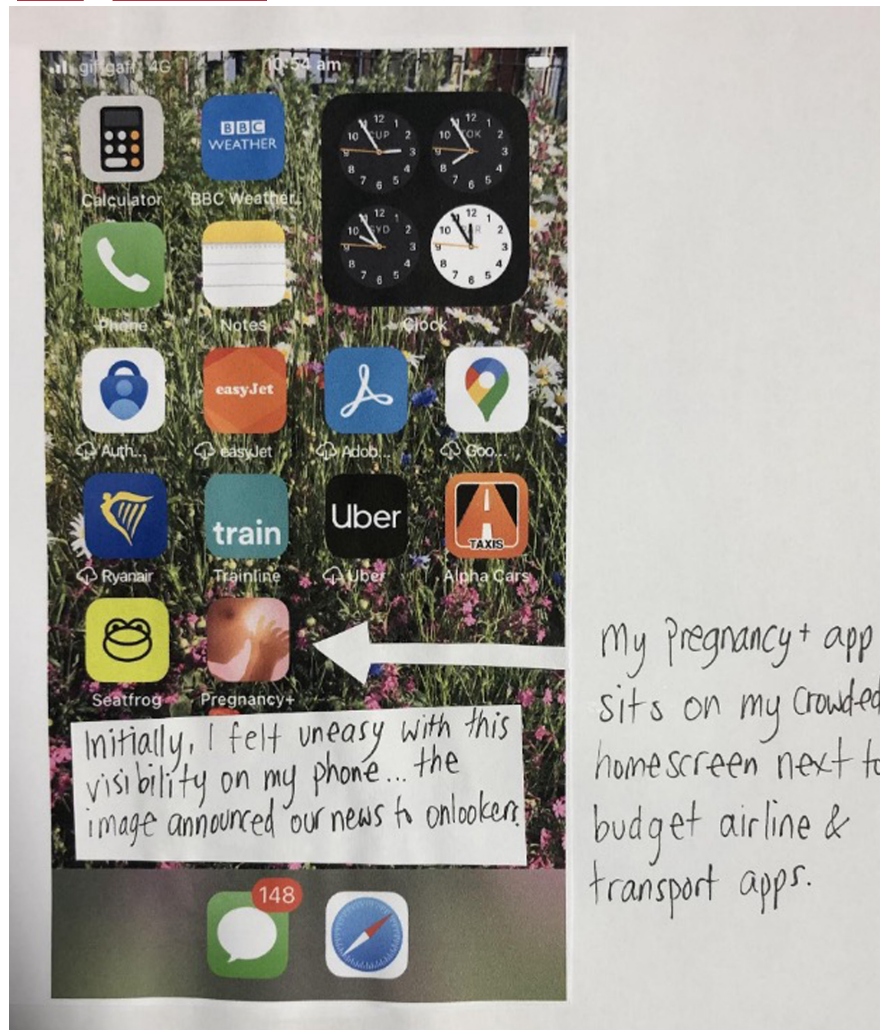


FIGURE 2 Home screen.

Nash, 2021). That the user is offered to select the foetus' skin colour builds a certain intimacy and imagined realism. The app encourages naming and sharing this image. While an imagination of pregnancy may be tempered with doubt, the app's images (alive and scientific in their presentation) replace imagination with certainty: this is what the foetus looks like now (Figure 3).

8 | EARNING ACCESS

Like many pregnancy apps, there is a strong ludic dimension to this tool. The user is encouraged to gain 'points' by reading articles, inputting possible baby names, and watching ads. Like wearable fitness devices that encourage users to meet physical goals such as a 5 km run, many apps propel users to reach goalposts such as reading enough articles to receive bonus content (Healy, 2021). On the other hand, without reaching the desired metrics or targets a sense of guilt and overwhelm can set in (Figure 4).

9 | 'RARE' EXPERIENCES

Alongside the fun, there are more didactic rules constantly popping up onscreen, warning of the risks one might incur. As documented in the annotation below, the risk of miscarriage is noted in the app; however, it is framed as a potential that can be defeated through proper care and consumption of products. Avoid this food, do that exercise with that

branded activity ball. This is what some scholars have referred to as the dual ‘threats and thrills’ features of such pregnancy apps (Thomas et al., 2018). Although pregnancy loss is in fact quite common, here it is framed as a rare experience – later, when miscarriage occurs, this can feel like you must not have been careful enough (Figure 5).

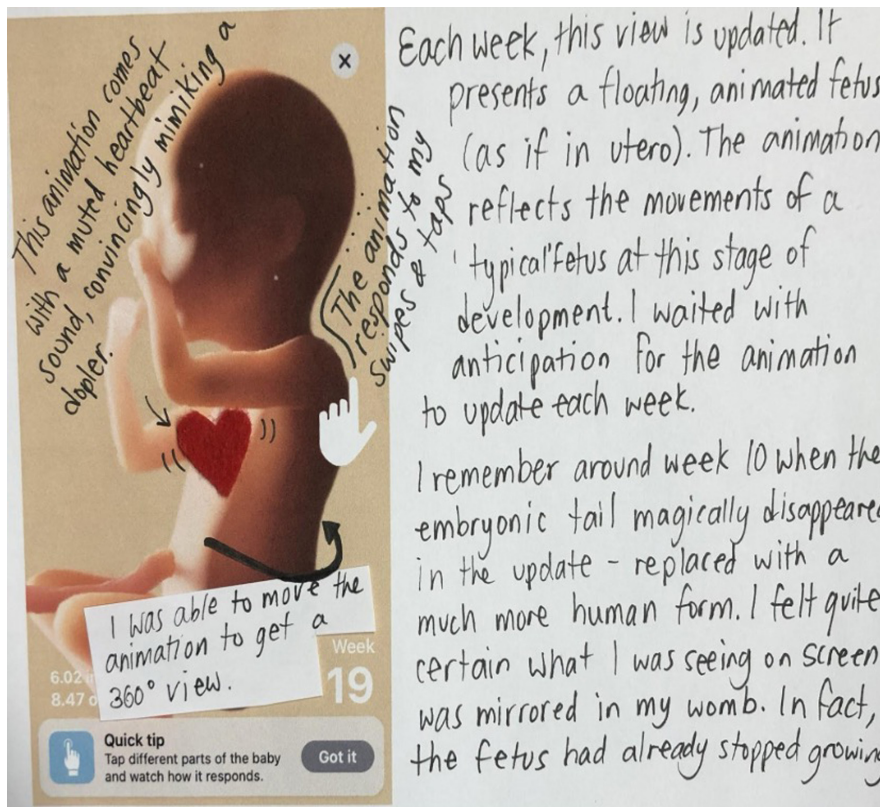


FIGURE 3 Simulated foetus.

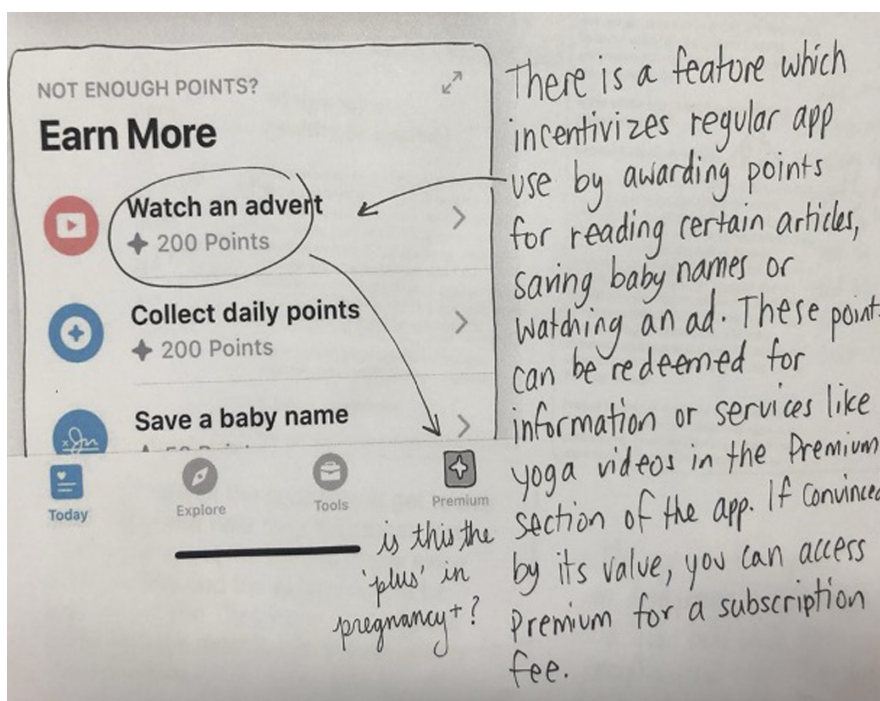


FIGURE 4 Points system.

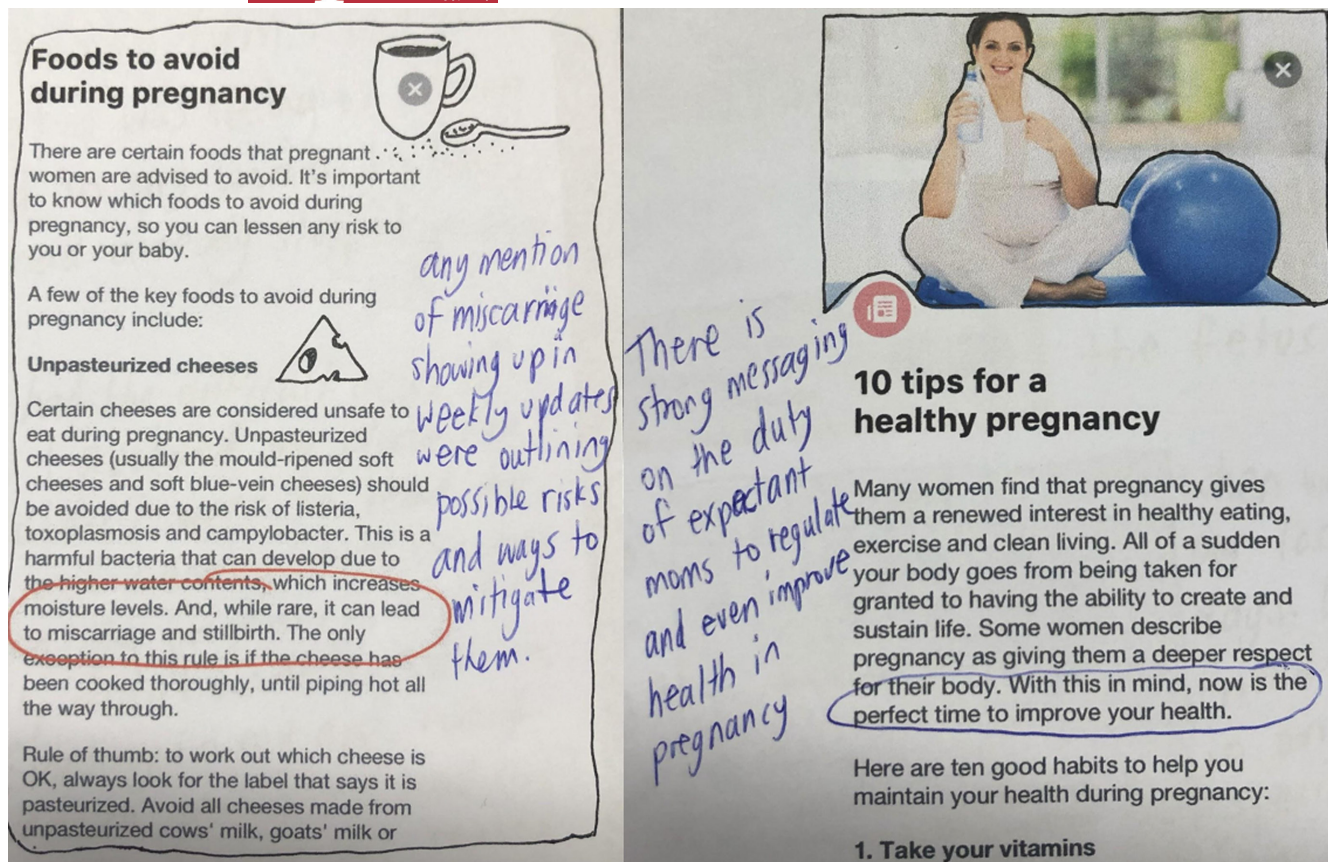


FIGURE 5 Tips.

10 | ULTRASOUND IN YOUR POCKET

This annotation features a computer-generated image presented on Carly's fertility app as a 'scan'. It has the aesthetic quality of an ultrasound image from the clinic: black and white, shape of internal organs, and grainy quality. These visual cues, along with the fact that it is named a scan, cultivates a sense that one is looking inside. But of course, there is no medical scanning process here involving a pregnant user. The image is an abstraction: it is a non-scan. In this annotation Carly has layered this non-scan with a filter called rippix, which marks the image, making it appear well-worn and distressed. Although this non-scan existed only as a digital image, its worn quality here seeks to remind how it nonetheless became a vitally intimate object in Carly's early pregnancy.

Carly positioned this scan above the pages of our late mother's pregnancy journal. Overlaying the app image onto this intimate artefact serves to juxtapose two birth journeys: one mediated heavily through an app performing certainty and another where such technologies were not available. The diary identifies the questions, guesses, and uncertainties of pregnancy in 1980s Canada. On one page she notes her doctor suggested a predicted due date for Jen, but Michele writes: 'I feel it will be later'. This is in sharp contrast to the sense of precision and certainty produced through weekly scans and timelines living on Carly's phone (Figure 6).

11 | DELETING LOSS

This next annotation represents and repurposes the app screen that emerged when Carly deleted the app. As shown here, the only way to delete the app is to 'reset data'. Carly drew the pattern of her hospital gown worn during her manual vacuum aspiration (MVA) required after learning of her pregnancy loss as the background of this annotation. It brings the material experience of miscarrying into a digital space that does not grapple with such loss. As the annotation indicates, clicking 'pregnancy loss' is the end-of-the-line for app use within Pregnancy+: there are no forums or spaces for user comments in which people might explore topics such as pregnancy termination or loss. After

looking for a button within the app's main interface to mark pregnancy loss and finding nothing, Carly eventually finds a space to mark loss, hidden away in a profile page. The pregnancy loss button is the only item without an icon, making it difficult to spot and engage. The painful 'materiality of data' (Nost & Goldstein, 2022) that persists is noted in Carly's annotation. A sharp pang is felt as the app continues to send updates of presumed pregnancy growth long after miscarriage. It documents alienation with the phone itself – an object previously felt like a tool for connection (Figure 7).



FIGURE 6 'Scan'.

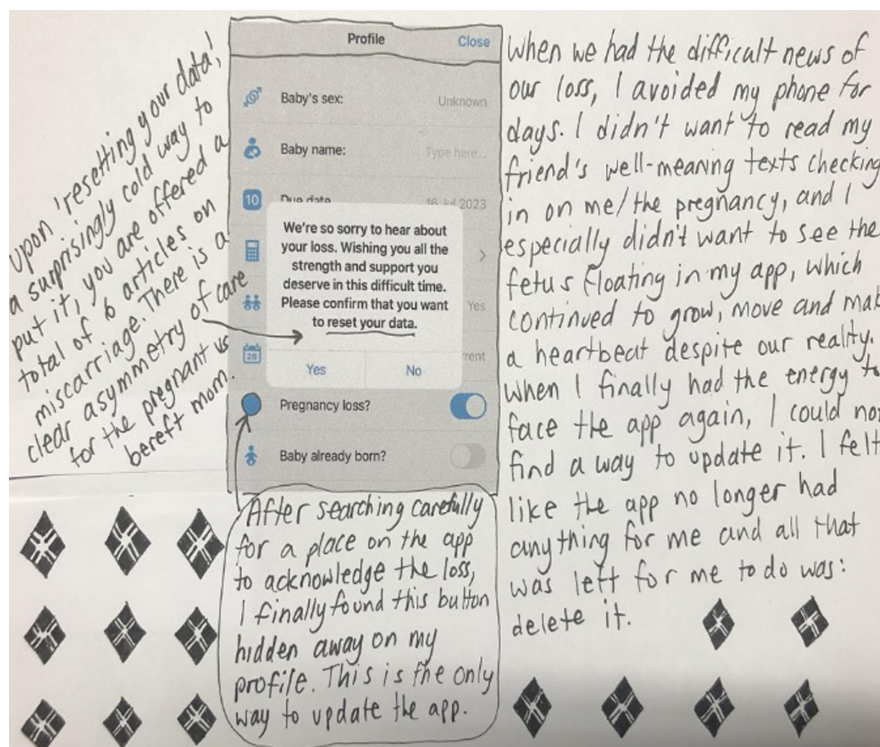


FIGURE 7 Deleting fertility app.

12 | 'REAL' TIME

Here is a collage of screens, repurposed to illustrate the disorientation of deleting an app once imagined as supportive. This annotation highlights the retreat of care in the face of loss. Through simulation, interaction, personalisation, and the geography of the app itself, a sense of vicarious pregnancy is produced. Each of these features culminate in a powerful trick, as Carly puts it: where you sense that the thing you are looking at on the screen is a window into your own womb (Figure 8).

These issues are not unique to Pregnancy+. A number of apps similarly normalise this reproductive imaginary. For example, another leading app called BabyCentre visualises growth according to an abstract timeline represented as real time. If one falls off this simulated timeline for whatever reason (abortion, miscarriage, etc.), there is no way to inform the app. Further, there is no care provided if loss is encountered. While the app claims users will 'receive support, advice, reminders, laughs, and everything else you need', this emotional support withdraws when loss is encountered (BabyCentre, Google Play, 22 March 2023). There are no articles exploring MVA, medically managed miscarriage with pills, or passing an incomplete pregnancy at home. No timelines for common miscarriage symptoms or for when the body-twisting contractions and clumpy bleeding might stop. No entries on mourning, burial, or cremation options. Apps boast an array of videos showing baby's development, but no such resources are provided to demonstrate alternative futures such as miscarriage. It might be argued that visualising such loss would be traumatising for users; however, its absence serves to shape an unrealistic image of pregnancy that can ultimately compound feelings of alienation if such loss occurs. The empty screen included in this annotation serves as a visual reminder of loss and its absence from this digital space.

13 | RECLAIMING LOSS

This annotation features a poem written by Carly. The experience of miscarriage and mourning, disavowed in the app, is inserted into its linear timeline. Cutting up this app (with scissors), the annotation seeks to contribute to creative work rupturing the conspicuous silence of pregnancy loss (McNiven, 2016). The words below interrupt its chronological

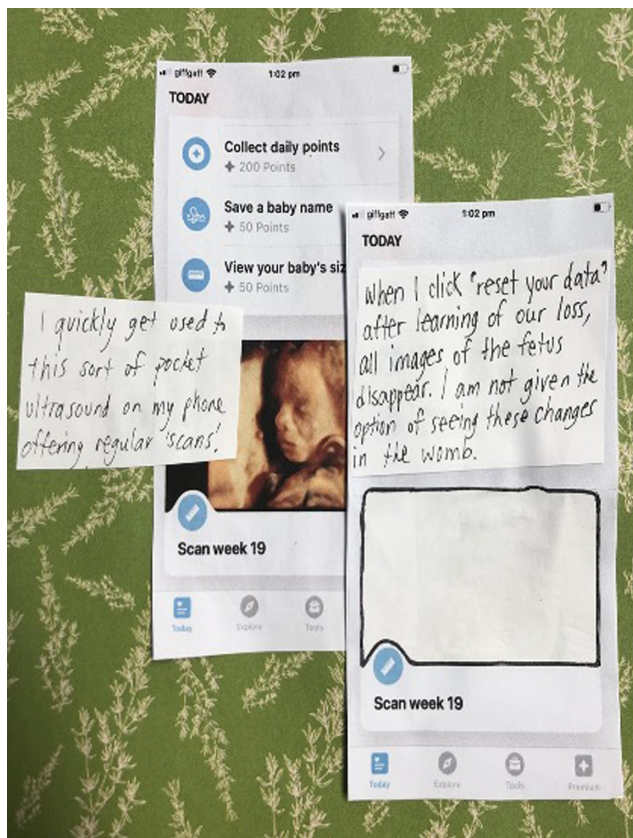


FIGURE 8 'Real-time' weekly scans.

structure. The medical bracelet worn during surgery rests atop imagined steps: (1) sex scan, (2) heartbeat. The realities of loss refuse to abide by this projected plan (Figure 9).

14 | ACTIVIST DIGITAL GEOGRAPHIES: A LEGIBLE LOSS

This paper reflects on an intimate pregnancy journey ending in miscarriage. Though grounded in Carly's deeply personal experience, this paper veers away from conventional auto-ethnographic approaches that prioritise the individual. Instead, we mobilise a sister-ethnographic method that moves in an explicitly dialogical and collective way to reclaim that which remains largely individualised and silenced within powerful app spaces: the pain of loss. We explore how experiences of loss for Carly were compounded through a tool intended to help, a leading pregnancy app. Though framed as neutral and inclusive, we expose how this app politically constructs a limited reproductive imaginary that prioritises linearity, production, and ultimately birth. As feminists have taught us, this political framing, which reduces fertility to a particular biological event, is neither new nor unique (Coddington, 2021). In fact, this biologically productive lens, which denies various forms of embodied experiences, is arguably dominant (Fannin, 2018; Lewis, 2018; McNiven, 2016). What is intensified in the case of pregnancy apps is how deeply embedded into daily life this logic can feel. Living in one's back-pocket or on the bedside table, such apps play a powerful role intimately shaping reproductive imaginaries and expectations. Complete with a beating heart and demanding constant attention and interaction, they almost take on a life of their own. Unlike other pregnancy advice literatures, the app has a certain afterlife, with data collected continuing to haunt and shape one's ongoing reproductive imaginary. After miscarrying, a growing foetus continues to pop up on Carly's phones for days. Even after deleting the app, emails continue to be sent reminding the importance of healthy daily rituals that might prevent loss.

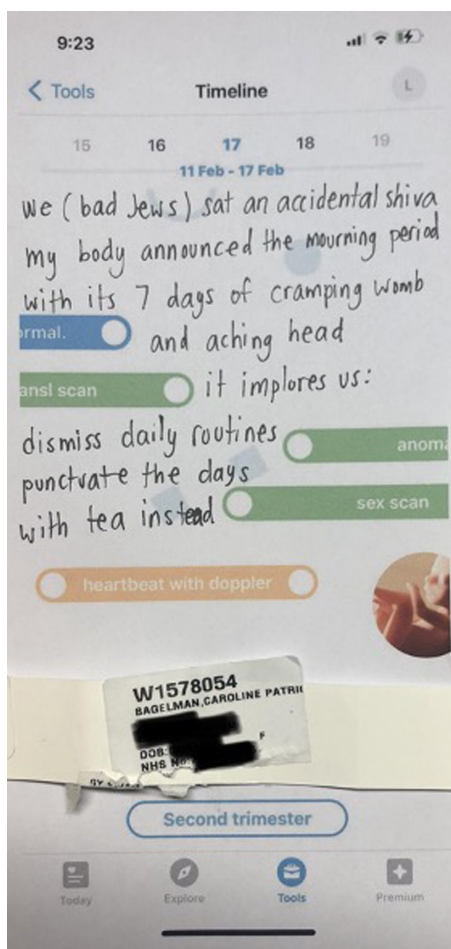


FIGURE 9 Timelines.

Although paying careful attention to a specific platform, we show how these political processes are not confined to a single tool. Rather they are part of a wider discourse that assumes the subject-to-be-cared-for is a biologically productive one. Troublingly, this assumption is not confined to apps themselves. As we have shown, even critical scholarship exploring pregnancy apps has largely sidelined questions of loss (Byrt & Dempsey, 2022; Healy, 2021; Shipp & Blasco, 2020). While pregnancy loss is certainly acknowledged in this app literature as a biological actuality, the intimate encounters with and negotiations through loss remain relatively underexplored. Knowing that pregnancies end for various reasons, with birth loss particularly high in global south and other under-resourced contexts, we argue that this frame is misleading and even harmful.

Indeed, we have shown how vividly simulating pregnancy as linear while withdrawing care when loss is encountered can deepen a sense of shame, loneliness, and even rejection. Responding to this, we develop a creative and collective method to document these intimacies. Here we take inspiration from and contribute to creative geographies exploring the role of zines as a participatory process, rather than simply a product, in making legible shared struggles (Hawkins, 2019; Smith, 2020; Valli, 2021). Our visual zine method, which bridges the digital and analogue, specifically counters the silencing and isolating experiences of pregnancy loss. This method follows the stumbling experiences of silenced miscarriages. These accounts intervene into digital spaces, specifically making known some of the realities of miscarriage: one of the most prevalent pregnancy-related health issues. This analogue method is intentionally simple. It requires inserting fragments from daily life (such as a medical bracelet) into a digital app narrative. This method does not rely on technical expertise nor exceptionally high levels of digital literacy and in this way helps to democratise such influential digital space. It provides a tactile way to mess up the rules of the app game. Without code knowhow, the user is empowered to directly interrupt: the interface, the visual-audio story, and intended user experience. An added political benefit of repurposing these digital spaces is that, given fair dealing policy, it undermines the app-owner's authority when it comes to visual reproduction. Materially engaging into this space opens new forms of digital ownership and possibility.

We see this as critical work beyond that of pregnancy apps. As mobile health and related apps marketed to improve life increase, so too must our critical tools for engagement in these digital geographies. Set within this broader context, we hope our material method may specifically contribute to digital feminist activism, generating tools and tactics for critique (Clark, 2015; Schurr et al., 2023). While app annotations serve as a method to document and process loss, they can also function as an activist tool to establish wider solidarities. By way of example, Carly's app annotations were shared with The Miscarriage Association, a charity established by and caring for those directly impacted by loss. The charity now features her personal annotations on their website, noting that this resource is vital to opening a wider conversation about apps and how they play an oft-overlooked but increasingly powerful role in fertility journeys. Here, these annotations have sparked discussion about how loss is encountered specifically in relation to and through digital spaces. While these annotations were created through conversation between two biological sisters, they have reached out towards a wider sisterhood of (non)birthing people, cultivating new ways to articulate, process, and reclaim loss.

A sister-ethnographic approach is offered as one that might move beyond the silencing of loss that is powerfully perpetuated through anything-but-innocuous app spaces. We offer this approach as one that might politicise other overlooked digital experiential geographies. Specifically, we see these tools expanding current research beyond how mobile tools are designed, towards a more serious focus on how diverse communities encounter such complex spaces. This work seeks to make visible – and more collective – the intimate geographies eclipsed in digital platforms (Pratt & Rosner, 2006). We suggest that tending to intimate user experience is not simply about tweaking a particular tool to make it more productive. Rather, this is processual and political work about exposing creases in enticingly smooth digital space. It is about carving out a place for critique that undermines designer permission and thus control. As we have shown, this process is vital in that it renders legible those lives (and losses) that have been excluded – often in the name of life itself.

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DATA AVAILABILITY STATEMENT

Data openly available in a public repository that issues datasets with DOIs.

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ENDNOTES

- ¹ Silent miscarriage is also referred to as a ‘missed’ miscarriage, and we have used the former in this paper as we identify not only the biological silence involved in this form of pregnancy loss (due to pregnancy hormones that remain high despite loss, giving the impression of a continued pregnancy), but also the social/structural silences surrounding miscarriage as experienced through the use of pregnancy app.
- ² In experimenting with new intimate methods to articulate accounts of loss we aim for this paper to create space for others to do the same. We hope this ongoing work will complicate and extend the conversations offered here, which reflect our partial view as two white, able-bodied women writing from northern England.
- ³ Fair usage or ‘fair dealing’ policy UK is a framework designed to allow the lawful use of reproduction of work without having to ask permission from the copyright owners(s) or creator(s) or infringing their interest. This we see as a critical workaround where the user, whose own agency is often secondary to that of the designer, is more fully engaged.

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