Soft Persuasion: Persuasive Technology in A Sensitive Context

Improving Milk Donor Motivation using a Mobile Application

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ABSTRACT

Human breast milk is an irreplaceable source of nutrition for preterm infants. Milk banks, and more recently, peer-to-peer milk sharing schemes facilitate the distribution of breastmilk to those in need. This review provides the context necessary for the development of a mobile application for Milk Matters' Milk Donors. Education, as a method of motivating donors, is explored – with an interest in the motivational role of testimonials. Fogg's Behavioural Model and the Persuasive System Design model are investigated as potential tools to understand and introduce persuasive design into the application. However, the uniquely personal and sensitive realm of motherhood requires careful consideration when implementing persuasive design. The development of technology through participatory design with breastfeeding mothers will pose certain challenges; yet they can be effectively navigated with sensitivity and empathy.

CCS CONCEPTS

• Human Computer Interaction • Persuasive Systems • Persuasive Design

KEYWORDS

Human Breast Milk, Breast Feeding, Milk Banks, Milk Donations, Peer-To-Peer Milk Sharing, Donor Motivation, Educational Videos, Testimonials, Persuasive Systems, Persuasive Design, Co-design, Participatory Design

1 INTRODUCTION

Milk donation provides women who cannot breastfeed their own child with donor milk. Preterm and sick infants are particularly at risk, making donor milk a potentially life-saving source of food. While milk banks have been the main source of donor milk, peer-to-peer milk sharing has become more popular due to social media [1]. Throughout this project we will be working with Milk Matters, a community-based milk bank in Cape Town, improving their mobile application developed by Wardle et al. [34].

Aspects of persuasive design are being introduced into many more facets of our technological lives, being increasingly used to persuade, and motivate people to engage in certain behaviour [32]. Whether it is used to help educate women about maternal health or improve the motivation of blood donors; it is fundamentally changing the way we interact with technology [11, 30].

Education is essential in improving the availability of breastmilk for infants – whether it be educating mothers on the importance of breastfeeding or exposing potential donors to the drastic impact their milk donations can make [8].

This review aims to provide insight into the current milk donation landscape, from traditional milk banks to more inclusive peer-to-peer milk sharing schemes and defining what motivates milk donors. It highlights the impact of technology in education, with a focus on public health. Persuasive technologies are discussed as a tool for changing behaviours, but particularly those of donors. Fogg's Behavioural Model and Persuasive System Design were investigated, providing insight into the thought behind persuasive design and persuasive system design principles. As no relevant literature exists for milk donors, case studies on persuasive technology use in blood donation applications were investigated with parallels drawn between the 2 types of donation. Finally, the intersection of Human Computer Interaction and motherhood is explored; reviewing relevant literature on the challenges of designing with mothers and some design considerations for systems designed for breastfeeding mothers.

The snowball method was used to gather literature the for this paper – reviewing relevant literature cited in other papers. The work of Wardle et al. was used as the starting point of the review, as the project it describes is very closely linked to our future work with Milk Matters [34].

2 HUMAN BREAST MILK

The health benefits of feeding infants with human breast milk have been studied extensively, with a consensus that human breast milk is the natural and recommended way of supporting the

growth and health of infants [2]. Feeding infants with human breast milk leads to improved feeding tolerance and has beneficial effects on cardiovascular health [2, 4]. Human breast milk also helps prevent Necrotising Enterocolitis, a concern when feeding preterm infants with formula. In addition, breast milk contains a host of bacteria which plays an extremely important role in the development of an infant's immune system [4].

Research over the past decades have confirmed the importance of feeding preterm infants human breast milk, resulting in its widespread use in Neonatal Intensive Care Units (NICUs) [4]. A recent meta-analysis, written by Arslanoglu et. al., concluded that a mother's own milk should be the first choice for preterm infant feeding, followed by donated breast milk and finally formula [2]. Official bodies, such as the World Health Organisation, have also recommend that donated breast milk be used as the first alternative for feeding preterm infants when maternal milk is not available [35].

3   MILK DONATIONS

There are several reasons that an infant would not have access to maternal breast milk. Mothers may be unable to provide milk due to lactation issues, risks associated with certain medication or latching problems. In addition, evidence shows that mothers of preterm infants, those who are in most dire need of breast milk, often have lactation issues and can often not provide the milk their child needs [2, 27]. For many mothers or caregivers in this situation seeking out donor milk is the only available course of action [1].

3.1   Milk Banks

Milk banks play an integral role in providing donor milk globally – with the vast majority being provided to critically ill or preterm infants cared for in NICUs [15]. Acting as an intermediary between donors and recipients, milk banks ensure the safety of the donated milk – which is of utmost importance due to the potentially deadly implications of providing tainted breastmilk to preterm and at-risk infants [2]. This involves rigorous screening of donors and the preparation/treatment of donated milk (pasteurisation and fortification) to maintain microbial safety and to ensure the absence of any chemical pollutants [2]. In addition, they are also a primary creator of educational material aimed at convincing new mothers to become milk donors [28].

4   PEER-TO-PEER MILK SHARING

Milk sharing between mothers is not a new phenomenon, with practices, such as wet nurses and mothers in social circles sharing milk, having existed for much longer than commercial milk banking [14, 26]. The advent of the internet, and subsequently social media, has made the practice of milk sharing much easier – with more than 170 Facebook milk sharing groups across 50 countries [15]. Organisations such as *Human Milk 4 Human Babies* and *Eats on Feets* are just two examples of globally operating, commerce-free peer-to-peer (P2P – abbreviated for brevity) milk sharing networks [26].

Much of the literature on P2P milk sharing share similar limitations and shortfalls. In almost all the studies mentioned in this paper [14, 15, 26, 27], data was gathered through voluntary participation – potentially only recruiting mothers who are interested in, and wiling to contribute to, milk donation research. Perrin et al. makes mention of this and broadens the claim – stating that studies into this area are limited by the sample of women involved, as well as research participants preferring to give socially desirable answers due to the topic's emotional load [27].

4.1   Why Peer-To-Peer?

Academic research into why mothers donate to milk sharing schemes has increased dramatically as the trend has gained popularity. A consensus is reached in the reviewed literature as to why mothers donate to P2P schemes rather than milk banks. Gribble and Perrin et al. both state that one of the main reasons for mothers donating to P2P schemes rather than milk banks is due to a perceived lack of access to a milk bank [14, 15, 26, 27]. The lack of personal connection, something which is present when donating milk via a P2P scheme, is another reason why many mothers do not donate to milk banks [14, 15, 26, 27].

Donating to a milk bank introduces hoops that potential donors need to jump through in order to donate. Potential donors are required to go through intense and sometimes invasive screening procedures, requiring extra effort from mothers – of which many fail even when their breast milk is safe [15]. Mothers who meet the donor criteria are discouraged by the minimum required donation amounts [15], costs and efforts associated with donating and the financial intentions of the milk banks [14, 27]. It needs to be mentioned, however, that most of these studies were conducted in the United States of America and European countries. This leads one to question the validity of generalising such findings to an African, and particularly South African context. Issues such as education, additional health risks (particularly HIV), access to technology, transport and potential donors could lead to alternative motivations for participating in P2P milk sharing.

As mentioned, breastmilk plays an important role in the health of infants. For many mothers who are unable to provide milk to their children and are denied milk from milk banks, P2P milk sharing schemes are their only means to ensure their child gets the breast milk they require [1, 15].

4.2 Health Risks

Many health agencies have expressed concern over the increased popularity of P2P milk sharing – with all the reviewed literature mentioning that it is strongly discouraged by public health institutions and other organisations [1, 14, 15, 26, 27]. As mentioned above, milk banks play an important role in pasturing and ensuring the safety of the donated milk. Akre et al. state that the unknown health of the milk donor and potential pathogen risks posed by the use of unpasteurised milk as the main reasons P2P is advised against [1].

4.3 Impact on Milk Banks

Some public health organisations have raised concerns about the P2P milk sharing community reducing the donations provided to milk banks, reducing the availability of milk to preterm and hospitalised infants often requiring milk to survive – whereas P2P sharers often donate milk to infants in less critical conditions [1, 15]. Gribble suggests an alternative; donations to P2P and milk banks come from different donor pools and that the decrease in availability of milk from milk banks is due to an increase in demand, rather than reduced supply [15]. Akre et al. also remain critical on the topic, stating that health authorities should work together with P2P groups and organisations to provide practical support to ensure the safety of infants feed donor milk [1]. The advent of regulated P2P milk sharing in hospitals in Malaysia and Kuwait suggest that such an approach is possible, and perhaps the future of ensuring availability of breast milk for all infants [15].

5 DONOR MOTIVATIONS

There are numerous motivators for donors, with comparatively much more of the existing literature focusing on blood donation [28]. After reviewing the included literature, it appears that many of the factors motivating donors apply to both milk bank and P2P donors. Several authors have identified that classical altruism – the desire to help others at one's own expense – is the main source of motivation for milk donors [14, 27, 28]. Gribble found that many mothers who donate to milk banks were approached by health professionals informing them of the need for breast milk donations, motivating them to donate [14]. Thomaz et al. had similar findings, new mothers were motivated to become donors when health professionals explained the importance of donor milk and recommended that they become donors [28]. Several other studies have also reported that health care professionals have an influence on milk donor practices [5, 18].

Reciprocal altruism – the desire to help others in the hope that they would in-turn be helped if necessary – is an important motivator of P2P donors [14]. P2P donors also were reported to have much greater empathetic motivation; imagining themselves in a similar position with their own child and the resulting need for donor milk [14]. All donors experience a sense of fulfilment

when donating, with milk donors being no different [28]. Gribble found that the level of satisfaction experienced from donating is extremely similar between milk bank and P2P donors [14].

6 TECHNOLOGICAL INITIATIVES IN EDUCATION & PUBLIC HEALTH

Educational initiatives, such as creating video content, text or even interactive educational interfaces have been shown to have impacts on important societal issues, ranging from maternal health to agriculture [12, 19, 21, 30]. The existing educational content of the Milk Matters application developed by Wardle et. al. could be improved by implementing some of the methods to follow [34]. Beyond merely providing educational content, the possibility exists to tailor the educational material such that it improves donor self-efficacy.

Improving people's access to health information and their capacity to use it is critical to their empowerment [23]. Nutbeam argues that without addressing the social position of the target population, any health education goals will fail to be realised [23].

6.1 Educational Initiative Case Studies

Education can act as a powerful tool in bringing about social change, empowering people to become critical decision makers and driving them to question the world around them. Through education projects, such as those mentioned by Edwards et al. and Kumar et al., mothers have been educated on the importance of breast milk [8, 19]. Their methodologies could be slightly altered to educate mothers on the importance of donating breast milk, potentially saving the lives of many at-risk infants.

6.1.1 Educational Videos

The use of educational videos is a topic that has been widely explored, particularly in the field of ICT4D (Information and Communication Technologies for Development). The Digital Green project aimed to educate marginalised rural farmers in India about advanced farming techniques and improving their general agricultural knowledge [12]. Through a participatory content creation process they were able to create a locally generated digital video database. This elicited more responses and participation of farmers compared to other methods of agricultural education. Their project stressed the importance of working with the target audience when creating content - building an educational video database that allowed farmers to learn from their peer's experiences rather than unfamiliar educators.

In the north Indian state of Uttar Pradesh, Kumar et al. took a page out of Digital Green's book when implementing their educational system to aid mother's preparation to care for their child and their health [19]. They adapted the successful Community Video Education (CVE) model to create an

"information spiral", aiding the dissemination of information amongst communities. Their project was a success, validating the methodology behind the CVE model in this case.

Molapo et al. went further, creating a software tool that empowered community health workers in Lesotho. With the software tool they developed, health workers were able to create multi-media videos for their communities which focused on and addressed localised health issues, conscious of their local contexts, communities, and language. They too were inspired by the Digital Green's concept of local content creation, and found similar results; the health workers felt empowered by being able to effectively disseminate health knowledge within their communities [21].

All of the above mentioned projects [12, 19, 21] realised the importance of local content generation when creating educational material. By involving the communities, they were able to improve the participation in their initiatives and furthering their goals of education. An important aspect of two of these projects [12, 19] was the constant feedback loop between content creators and the communities they target, indicating the necessity of community involvement in educational initiatives. Both projects echo and strengthen the arguments of Nutbeam: health education needs to go above and beyond functional health literacy (providing access to educational material), towards interactive (providing practical health training) and critical health literacy (prompting informed decision making) [22].

6.1.2 Educational Messages

Messages displayed on mobile phones was the basis for health education researched by Ramachandran et al. To explore persuasive technologies in health education, health workers in rural areas in India were provided with mobile phone based dialogic messages in an attempt to persuade women to make use of public health services [30]. While the study was inconclusive with regards to the impact of these persuasive messages, they reported that the informal, conversation style messages improved the health workers ability to provide counselling for, and open dialogue with the women.

6.1.3 Interactive Experiences

Edwards et. al. introduced an interactive computer agent to help educate new mothers on the importance of breastfeeding [8]. The agent provided information and support to mothers who were currently, or going to, breast feed their child. The use of 'face-to-face' interaction with the virtual agent improved trust between it and the mothers, improving its ability to convey educational material. While initiatives of this type are few, especially in the area of maternal education, the initial pilot project they launched produced encouraging results [8]. The introduction of such a system into the Milk Matters application could have extremely beneficial effects, both in educating mothers in a more engaging way and providing motivational support for struggling mothers.

6.1.4 Testimonials

The use of testimonial videos, those focusing on the positive impact of initiatives experienced by individuals, can be an incredible tool in providing motivation and persuading target users [29].

The Digital Green project included testimonials in their videos where community members with high social influence spoke about their positive results when utilising farming techniques they had learnt from Digital Green [12]. Similarly, Ramachandran et al. used testimonial videos in two interesting ways [29]. ASHAs (Accredited Social Health Activist) with limited education, training and status were ostracised by the communities in which they worked, reducing their motivation. Testimonials featuring local influencers (those with high social status), praised the work of the ASHAs and improved their motivation and gave them a newfound pride in their work [29]. These testimonials also helped raise the community's opinions of the ASHAs, allowing them to play a more impactful role in the community [29]. This shows the multi-faceted impact that testimonials could have.

In Limpopo, Molapo et al., reported a similar phenomenon. Community health care workers and those being educated were motivated by videos featuring prominent community members [21]. The testimonial videos also became powerful persuasive tools when trying to educate community members.

The use of testimonial videos provides an interesting tool for the project. On one hand they could motivate struggling donors, who often feel demotivated by the tiresome and incredibly burdening processes of donating breast milk [15]. In addition, the videos could be used as a resource to educate potential donors on the importance of breast feeding and breast milk donations, as shown by Edwards et al. [8].

7 PERSUASIVE TECHNOLOGIES

In recent years, technology has been increasingly utilised to persuade, or motivate, people to embody certain behaviours or attitudes. Within the field of persuasive technology, two main schools of thought exist: persuasive design and gamification [16].

7.1 Persuasive Design Method

The infancy of the persuasive design field means that there have been few empirical studies on the topic, with most academic literature limited to specific situations and implementations [16]. As a potential designer of a persuasive system one must consider the behaviour or attitude change which the system is intending to make. Fogg warns designers of the potential outcomes of a persuasive system; they can be extremely successful – or a dismal failure [10]. All reviewed literature shares that sentiment – the system's persuasion needs to be intentional, well planned and

directed to effect potential change user behaviour or attitudes [16, 24, 32]

Two dominant paradigms exist for designing persuasive systems, with Persuasive System Design (PSD) being more widely explored in academic literature than Fogg's Behavioural Model (FBM). While PSD provides a more practical approach, FBM looks at persuasive systems through a more user-centric and theoretical lens. As with many user-centred design paradigms, persuasive systems cannot be designed with a "one size fits all" approach [11] – one should carefully consider the target user, milk donors, and their motivating factors when making design decisions.

7.1.1 Fogg's Behavioural Model

In FBM, three principal factors exist: motivation, ability and triggers [9]. Motivation and ability are the two main factors that influence whether the intended behaviour will occur; the greater the motivation and ability (simplicity, or ease of use) to perform a task, the greater the chance of the desired target behaviour occurring. Ability and motivation have an interesting 'relationship'. Ability could increase motivation if the behaviour (or task) is extremely easy to perform, and motivation could increase ability if the behaviour is extremely desirable or appealing. Fogg argues that a balance needs to be struck between ability and motivation in order to have a greater potential for persuasion. Motivation includes pleasure, hope, or social acceptance, while ability includes lower time, financial or physical requirements.

While ability and motivation set the scene for the target behaviour, the trigger is the catalyst that invokes action in the user; without it the work put into providing motivation and the ability for the behaviour will be wasted. While triggers are imperative to invoking the target behaviour, poorly timed triggers will be annoying and have negative associations. Fogg describes three broad types of triggers: 1) sparks, useful when there is a lack of motivation, 2) facilitators, when there is an ability deficiency, and 3) signals, subtle and well-timed reminders [9].

While FBM provides a useful conceptual model for understanding key components of a persuasive system, it lacks suggestions of concrete 'features' that could be implemented to make a system persuasive.

7.1.2 Persuasive System Design

While FBM provides a theoretical model, PSD was created to prescribe persuasive designs and software requirements [32]. There exist three broad aspects of PSD. The intent: the behaviour which the system designer hopes to achieve; the event: the context of the system (the problem domain, user context and technological context); and the strategy: what content will be used to urge behavioural changes in the user, and how will the content be presented to the target user [24].

PSD identifies four design principles that should be incorporated into a persuasive system. 1) Primary task support – aiding the user in using, or improving their experience of, the primary task of the system; 2) Dialogue System – provide feedback to the user, aimed at guiding them towards the target behaviour; 3) System credibility support – providing information that validates the credibility of the system; 4) Social support – the inclusion of facilitated social interactions that will 'nudge' the user towards the target behaviour [16, 24, 32].

When implementing PSD it is important for designers to decide whether the system is supporting a user's desire to have a behaviour or perform a task, or to persuade them to adopt a desired behaviour [16]. In the case of an application for milk donors, the system would be providing motivation for mothers who already have the desire to donate.

7.2   Designing for Increased Motivation

A main goal of persuasive design is to motivate users to perform a task and improve their self-efficacy [10]. While the use of persuasive systems has not been explored for milk donations, several applications exist which aim to improve blood donor motivation. There also exist numerous applications that aim to use gamification to motivate people to live a healthier life.

7.2.1 Gamification

Gamification, a facet of persuasive design, aims to incorporate features traditionally found in digital games, such as working towards 'in-game' goals and rewards. Compared to traditional persuasive design, gamification aims to invoke a user's intrinsic motivations through "gameful experiences and affordances" [16].

One such example of using gamification is in a mobile application developed by Katule et al. aimed at reducing obesity and related health issues [17]. The application rewarded certain user activities using a virtual garden and fish tank. The step comparison aspect of the application led to social comparison by the users, in turn leading to social support, relatedness and competition.

Gamifying donations poses an ethical dilemma. Donors may feel pressured to donate, potentially donating their milk instead of adequately feeding their own children. Introduction of gamification could lead to competition between the milk donors. However, the potential exists to implement aspects of gamification that lead to social support could be extremely valuable.

7.2.2 Persuasive Design for Blood Donation

Young people play an important role in blood donation, however are the least likely to return after their first donation [11]. Foth et al. aimed to develop an application which, using PSD techniques, would improve motivation and loyalty rates of young blood donors [11]. They identified user archetypes to better understand

what motivates young donors and used these findings to guide development. Several features described in the PSD model were implemented – such as self-monitoring, social recognition and comparison, and several features that improved the primary activity's ease of use. Similarly, Pradhana et al. implemented features in their blood donation application that drastically improved the task of donating blood, subsequently increasing donor motivation [7].

It is becoming apparent that traditional methods of motivating donors no longer engage younger donors [36]. Mobile phones are an integral part of our lives, especially so for younger generations. As such, technology that reaches younger audiences, such as social media and WhatsApp [33], must be utilised fully. An investigation, by Shan et al., into the potential of a mobile application for blood donors brought to light findings that have relevance to milk donors as well. They found that users mostly desired efficiency improving features – supporting the primary task activity (as mentioned in PSD) [36]. Concerns about privacy and learnability were also raised.

Many of the factors that motivate blood donors – altruism, empathy and social responsibility – are the same as those for milk donors, albeit in a different context [31]. The concepts used by Foth et al. provide valuable insight into how to discover donor motivators and implementing them in mobile applications [11].

7.3   Reservations of Persuasive Systems

In a review of literature published in the field of persuasive design, Hamari et al. argues that the current documented success of persuasive systems may be due to the small sample sizes in evaluations of such systems, and potential publication bias – with only papers with successful results being published [16].

Understandably, there are many ethical concerns regarding persuasive systems. In a review by Torning et al. the concern was raised that very few papers contained mentions of the ethical implications of their systems at all [32]. A persuasive system ultimately aims to alter user behaviour to one envisioned by the designer. There exists great potential to abuse such power, however, by involving the users in the design process one can at least have user input on such issues and allow them to raise concerns that they may have. Above and beyond this, we as researchers need to ensure that any persuasive systems that we design remain ethical.

8   DESIGNING FOR BREASTFEEDING MOTHERS

The advancement of the field of Human Computer Interactions has led to a greater understanding of technological design, leading to interfaces that are closer to the expectations of users than ever before. Interest in interfaces designed for breastfeeding mothers, and mothers in general, is relatively new but growing [6]. Guidance from existing literature on designing for and with mothers is discussed in the following section.

8.1 Collaborating with Breastfeeding Mothers

Early motherhood is an extremely draining period, with mothers suffering from social isolation, physical exhaustion and elevated stress levels [6]. It is important that when doing collaborative design with breastfeeding mothers one remains sensitive to their context and circumstances. As such, designers need to understand that a young mother's separation from her child is near impossible – characterised by Balaam et al.'s recommendation to design for and with "mothers and babies".

8.1.1 Methods
Several methods have been utilised when performing participatory design with mothers, with some more popular than others. D'Ignazio et al. took a crowdsourcing and participatory design approach, involving over 1000 mothers, to identify issues with current breast pump technologies [6]. By adopting a feminist Human Computer Interaction (HCI) approach, they remained conscious of postpartum experience's complexity, taking an empathetic stance when interacting with mothers.

Yurman utilised cultural probes to investigate and define the design space, further exploring through design-led workshops and collaborative analysis where mothers shared their valuable insights and opinions [37]. She too navigated using a feminist standpoint theory, viewing interactions through the lens of the marginal user.

In the development of *FeedFinder* – a mobile application helping breastfeeding mothers find, review and share places for breastfeeding – Balaam et al. made use of an iterative user-centred design cycle [3]. Sensitising interviews, design workshops and cooperative evaluation were used in order to better understand the context of breastfeeding mothers.

Wardle et al., working to build a milk donor application with Milk Matters, utilised a host of methods when exploring co-design with mothers [34]. They used workshops to gain feedback and discuss the mothers shared experiences. Similarly to D'Ignazio et al., surveys were used to gain insight from mothers who were unable

to meet and preferred the freedom and flexibility of responding remotely [6, 20]. Cultural probes were utilised to better explore the design space, however required extensive planning and long-term participant investment which is perhaps less considerate of busy mothers. Wardle et al. also aimed to remain sensitive to their participant's contexts, providing positive reinforcement when mothers contributed and empowering them through feedback and choice [34].

8.1.2 Challenges

All those who conducted participatory design with breastfeeding mothers found the situations challenging. Design workshops were often interrupted by nappy changes, feeding sessions or unhappy babies [3, 34]. Balaam et al. suggest flexible, quick and undemanding design tasks as interruptions are common and mothers often only have 1 hand free [3]. They suggest limiting any design tasks that the mothers are required to do to 10 minutes.

Wardle et al. and Balaam et al. make specific mention of consideration how little free time the mothers had available, impacting their ability to participate in workshops, focus groups or interviews [3, 34]. As a potential work-around, both Wardle et al., and Pedersen and Buur recommend research be conducted online [25, 34].

The National Lockdown because of the COVID-19 pandemic presents challenges in itself – as physical distancing will most likely prohibit face-to-face interactions during our research. However, this may provide an opportunity to interact with mothers online, potentially increasing the number of mothers who may be able to participate in the research.

8.2 Design Considerations

Surprisingly, almost all the reviewed literature lacks concrete design considerations that one should keep in mind when designing for breastfeeding mothers. Wardle et al., however, provide four potential 'design principles' when designing for breastfeeding mothers [34].

Interrupted interactions should be accounted for, allowing mothers to pause and return to in-app activities at will [34]; accounting for the predictable unpredictability of their babies. Breastfeeding mothers will often only have one hand with which to use their mobile devices; simple interactions should be used in favour of precise ones. Elements that may distract a baby, such as audio or videos, should be omitted or made optional. Finally, Wardle et al. found that mothers responded well to features that empowered and gave them freedom of choice, perhaps due to their loss of identity; a feeling common in early motherhood [13].

Gibson et al. identified smartphones as a device that helps mothers "get through the day" [13]. Mothers value the devices ability to provide them with autonomy when much of their life is

devoted to their young child. Improving confidence, connecting to the outside world and identity preservation are afforded by smartphones and may aid in identifying features that mothers would be particularly interested in.

Technology continues to encroach on our everyday activities, becoming increasingly interlaced in our lives. Yurman raises concerns around the ambivalence of the smartphone's role in breastfeeding and motherhood in general [37]. Mothers had mixed feelings about over utilising their smartphones, to the point of feeling guilty for usage during childcare. This needs to be considered or at least explored during the design process. The intersection of persuasive design with conscious and conservative smartphone use provides a contradictory but interesting approach when designing for mothers.

10   DISCUSSION

From the literature reviewed it is evident that there has been minimal research on utilising technology to support and motivate milk donors. This could be due to the ethical implications of persuasive systems in general, compounded by the sensitive context of motherhood and milk donation. The foremost concern of a mother should be the health of her and her child. A persuasive system aimed at motivating milk donors could have unforeseen negative consequences, such as mothers favouring donating milk over the health of their child. Other potential issues relating to the connection fostered between mother and child during breastfeeding exist as well. A persuasive mobile application could distract, entertain, and comfort mothers during breastfeeding; however, this has been linked to feelings of guilt, frustration, and anxiety [36]. These implications need to be thought through and reflected upon before implementing any persuasive system, preferably in collaboration with breastfeeding mothers.

A mobile application, as with any software, requires maintenance to remain useful. Issues of longevity and sustainability need to be considered when developing the application, ensuring that the benefits of this project are enjoyed even after its completion.

After reviewing the literature testimonials stand out as a tool that has been used to motivate, educate, and improve self-efficacy. Social influencers who are milk donors, or advocates of milk donation, could create testimonial videos encouraging and praising donors. In addition, testimonial videos or messages created by mothers whose children were milk donation recipients could be used to give mothers feelings of fulfilment and purpose. It would give donors a glimpse into the impact that their donations are making, directly or indirectly. This could make the act of donating milk more bearable for struggling mothers and may lead to more mothers becoming milk donors. However, as mentioned above, the ethical implications surrounding the implementation of such features would need to be carefully assessed and discussed.

11 CONCLUSIONS

This paper has provided an overview and review of existing academic literature that fall within the requirements of improving upon a mobile application for milk donors and Milk Matters.

Breastmilk is the advised source of nutrition for infants, providing benefits unmatched by feeding formulas. This review has discussed the important role that donor breast milk plays in caring and supporting preterm infants in NICUs. Milk banks and Peer-2-Peer sharing schemes are both reviewed as a means of distributing donor milk, with a specific focus on donor motivations.

Education is an integral aspect of empowerment and could improve donor motivation. Some of the techniques discussed, specifically testimonials, could be implemented in order to improve donor self-efficacy, with other forms of educational material being used to further educate and engage with donors.

Using persuasive design, we hope to improve the donor experience – helping and encouraging them using technology to perform the cumbersome but important task of donating. While minimal literature exists on using persuasive systems to improve milk donor motivation, Fogg's Behavioural Model and the Persuasive System Design model provide insight and constructive methods on implementing persuasive systems. Importantly, ethical implications should be carefully assessed before any features are introduced.

Finally, literature relating to design with and for women in early motherhood, particularly breast-feeding mothers, was reviewed. Several papers detailing methods for designing with mothers with young children provided insight into the specific co-design landscape – even though our circumstances and methodologies may be severely influenced by the COVID-19 pandemic.

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