

On Looking at the Vagina through Labella

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ABSTRACT

Women's understandings of their own intimate anatomy has been identified as critical to women's reproductive health and sexual wellbeing. However, talking about it, seeking medical help when necessary as well as examining oneself in order to 'know' oneself is complicated by social-cultural constructions of the vagina, i.e. it is something private, shameful and not to be talked about. In response to this, we designed Labella, an augmented system that supports intimate bodily knowledge and pelvic fitness in women. It combines a pair of underwear and a mobile phone as a tool for embodied intimate self-discovery. In this paper, we describe Labella, and its evaluation with fourteen women, aged 25-63. We show how through situated embodied perception Labella empowers 'looking'. We highlight how the simple act of augmented looking enables the construction of knowledge which ranges from establishing the 'very basics' through to a nuanced understanding of pelvic muscle structure. Finally, we highlight the role of awkwardness and humour in the design of interactions to overcome taboo.

Author Keywords

Wellbeing; women's health; women's experiences; pelvic floor muscles; learning; feminist HCI; smartphone technology; intimate care; wearables; on-body interactions

ACM Classification Keywords

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

INTRODUCTION

Labella (figure 1) is an augmented wearable and smartphone system that uses non-traditional on-body interactions to enable discovery and learning about hidden parts of the body. It combines a pair of underwear for embodied intimate interaction, and a mobile phone as a tool for embodied discovery. The underwear comprises a surface printed bespoke visual marker, which is positioned in the

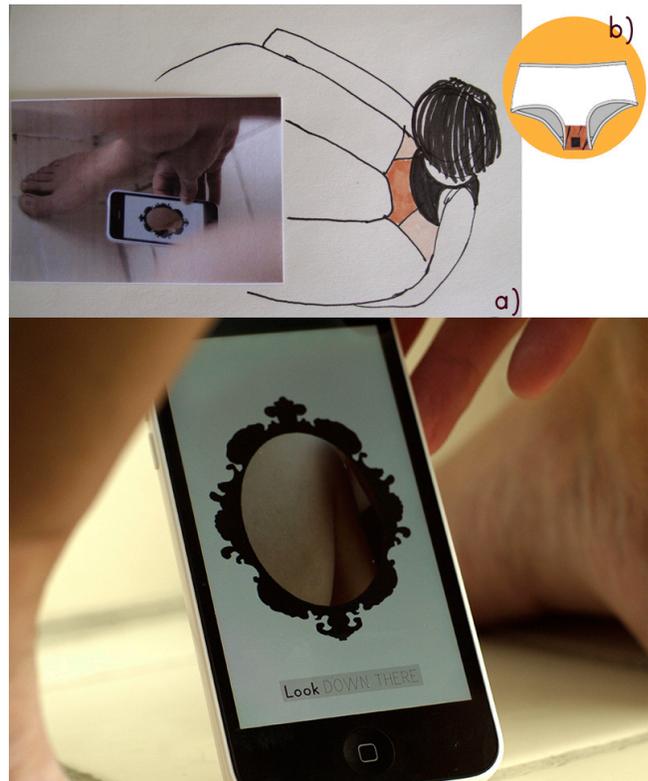


Figure 1. Labella: a) Using the mobile phone as an interactive mirror; b) Wearable visual marker on underwear

middle of the crotch area. The crotch textile pattern has a distinct print that combines the marker, a base colour, and varied shapes. Once the camera phone recognizes the marker it starts a series of on-screen interactions to promote self-discovery. The experience is something akin to looking at oneself through an interactive mirror (Figure 1).

Recent work in wearable e-textiles has begun to explore the impact of on-body technologies in learning [29,30]. Further work has investigated interactions within clothing that interface with mobile technology [32]. In addition mobile interfaces for women's health and wellbeing have investigated the design of technologies with a focus on intimate care work in relation to hidden parts of the body [6] and involved in sexual functioning [7]. This work situates itself in this previous research by exploring how body-worn and digital interactions might support health and education in relation to intimate parts of the self. We argue that wearable and mobile technologies can support women's bodily experiences in relation to the reproductive

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system, continence and sexual pleasure [14,26] by promoting literacy to enable self-care.

Framing Labella as a technology probe [18], we deployed Labella with 14 female participants to explore the experience of intimate discovery and self-learning. We illustrate how Labella can contribute towards an enhanced self-learning experience for women, through which they can gain awareness of the intimate parts of their body. We show how designing for awkward learning experiences, on-body interactions and humour can break the taboo related to learning about hidden parts of the body, which in turn can enable better self-care or care of others.

Pelvic Fitness in Women's Health

Learning about and maintaining pelvic fitness is critical to incontinence prevention and therefore fundamental to women's health across the lifecourse. While urinary incontinence in women is generally accepted as a consequence of childbirth or aging, it is also one of the primary predictors that results in an older adult entering a care home [31]. Yet, simple intimate care practices, such as pelvic exercise, can be adopted throughout the lifecourse, and can contribute to prevent urinary incontinence [13]. Nonetheless, literature shows that women have misconceptions about their intimate personal bodies [10], and this hidden part of the body (pelvic floor) is mostly learned about after the woman becomes a patient body, for instance during or after childbirth. As such, the preventative health practice of pelvic floor exercise is generally overlooked in women's health care and inhibited by a lack of body knowledge [35]. This lack of body knowledge can be thought of as intertwined with taboo, since these parts of the body are both hidden, and related to bodily fluids, bodily and sexual functioning [1]. We developed Labella as a tool for use by women, which provides a unique perspective on women's pelvic fitness. This incorporates learning about the biological (i.e. reproductive system), medical and personal health (i.e. incontinence), and positive health and wellbeing (i.e. sexual pleasure).

RELATED WORK

The design of digital technologies for intimate care, pelvic floor fitness, and body knowledge falls at the interstices of research on issues such as health and wellbeing, body-worn technologies, and technologies for self-learning. Here, we explore the application of wearables designed for use in wellness; on-body technologies with a focus on learning and self-discovery; as well as the uses of augmented reality and the body as a space for embodied interaction; and lastly, we consider the expression of humour in design and health care.

Wellness Awareness Through Wearable Interfaces

On-body and worn mobile technologies for health and wellbeing have seen an exponential growth in the last few years. An increasing number of body-worn devices for self-tracking, for example [41,42], collect data on bodily functions, such as heart rate, pulse or calories burned, and HCI research has already explored wearables toward

promoting health and wellness, for example [3,4]. At the same time, a wide diversity of 'smart' objects, such as [14,26,43], have been made commercially available. Amidst such variety of digitized body data, a great number of these devices aim to promote health and fitness with the goal of empowering self-care among experts and non-experts alike.

Most relevant to the focus of this paper are [14,26], which combine smartphones with smart objects to encourage and support assisted tracking in pelvic fitness. Both *kGoal* and *Elvie* are interactive training systems that guide, correct, and visualize pelvic exercises in real-time. Moreover, [2] recognizes a lack of literacy that might hinder these wearable digital products from being useful, by identifying a gap between these items and practical or anatomical knowledge of the intimate part of a woman's body. In spite of the fact that self-tracking technologies that make accessible the continued monitoring of personal health proliferate, so do misconceptions and misunderstandings about intimate care work, and the intimate anatomy [10]. With this in mind, we address the design of wellness technologies that focus on intimate care by evoking learning with and through body-worn interactions.

On-Body Technologies in Learning

Wearables for teaching and learning that speak about and to the body vary in approaches that support and enable the construction of knowledge. We focus here on technologies that combine embodied learning and intimate self-discovery. Body literacy among school children is developed through exploring tangible "body organs" in [29,30], and body organs that are intimate, but also problematized by touch and visibility, are explored in [2]. All of these examples explore engagement and learning with technology to stimulate knowledge of body organs that are "invisible and untouchable" by composing and mapping material representations of the body landscape. Furthermore, [30] shows evidence of how such on-body approaches can successfully engage children in learning about anatomy and physiology by exploring wearable interactions. A wearable technology that embodies playfulness can be seen in [37], where a 'body object' is used to perform in unexpected ways, with the self and in interaction with others, in order to compose sounds. This work can also be understood to enable learning about how bodies are particular in their morphology, material similarities, and differences from other bodies [39], as demonstrated by the amusement provided by each individual performance.

Our system follows previous research which consolidated the design requirements for exploring body literacy and intimate care in HCI [2]. In this research a kit that integrates e-textiles as the core material was used to teach and learn about intimate parts of the self and to support body literacy. The wearable e-textile kit enabled conversations around intimate care and afforded participants the ability to shape

the educational content to their own bodies. The results of this work reveal that qualities of body knowledge can be affected by topics of taboo, misinformation, and lack of self-awareness. The deconstruction of the female body in light of these qualities and the evidence that a wearable interface supports situated learning about the intimate body, and the ways in which taboo interactions were negotiated with humour prompted us to conceptualize and develop Labella.

Augmented Reality and Embodied intimate Interaction

Broadly defined, augmented reality (AR) supplements reality, rather than completely replacing it [5]. To date, AR systems have been used in combination with a wide range of wearable interfaces for a variety of purposes, such as entertainment and education [22]. In healthcare, medical handheld projection devices have been explored to improve doctor-patient communication, such as in [28], where AR technology is projected onto the body to embody in an outward form and render visible a variety of bone fractures. AR and medical imaging that explore intimacy within the body and self-perception is discussed in [19], and tangible 3D interactions using mobile devices for medical imaging specialists exploring internal body parts (for example chest), in [34]. In each of these the use of AR by specialists promotes communication with patients in clinical settings.

In our work we explore AR as a tool to help reveal the body to the self in an intimate way. This exploration is prompted by wearable and mobile technology, and by providing a humorously magnification of an utmost intimate part of the body. We inquire how the use of this digital technology can make accessible a reality laden with stigma and taboo and support embodied interaction, intended to promote self-awareness and preventative, intimate care practices.

Humour in Interactions

While there are well defined cultural differences in the expression of humour [24], humour enables the expression of ideas which would otherwise be rejected, criticized or censored. It can facilitate communication, prompt amusement, and it has a disinhibiting effect [40]. In its review of humour theories, [9] refers to “humour as the enjoyment of the socially taboo”. As a therapeutic tool, humour has been broadly discussed in health care. It is regarded as valuable for promoting patient-centered care [33] and coping with diagnosis and treatment of illness [9],

positive for managing embarrassment [25], or advantageous for teaching [40]. Further, it is regarded as a method to support learning of sensitive topics [20].

Moreover, the design of systems that promote learning through play within digital gaming [15] explore humour as a mediating tool to make the game experience more enjoyable and stimulate affective learning. Humour as a method of support in engaging an audience has been explored in [37,38], where an augmented body-device doubles as a musical instrument. Here, the interface is primarily concerned with the body and its design interaction incorporates humour, which is instrumental in welcoming the social awkwardness of core-body movement necessary to enact the interface as a sonic system. We contend that humour is beneficial for managing bodily awkwardness. Further, it contributes to promote access to learning and it helps diminish the taboo nature associated with sensitive topics, such as looking or talking about intimate parts of the body, which we explore in our work.

LABELLA

Labella combines a pair of underwear for embodied intimate interaction and a mobile phone as a tool for embodied discovery. After putting on the piece of underwear (all interactions happen with the underwear on) the participant launches the app on the mobile phone, which invites her to ‘look down there’. When a surface printed bespoke visual marker on the underwear is recognised by the camera phone it moves forward to a new screen. This new screen shows an augmentation of the female perineum (Figure 2 – screen 3). This reveals to the participant an illustrated representation of a hidden part of her body. Initially, it gives an interactive illustrated mirrored image of her external genitalia, using a 3D model, inviting her to touch and discover more about the different parts. Afterwards, it provides a visualization of the female pelvic floor and its muscle structure. A simple animation of the pelvic floor contracting and relaxing also offers a new perspective on how this muscular structure works while learning about ‘the subtleties of the technique’ to exercise it. Lastly, the mobile application invites the participant to exercise and the screen on the mobile phone switches into front camera mode, showing this time the participant herself. The participant is offered ideas on what and when

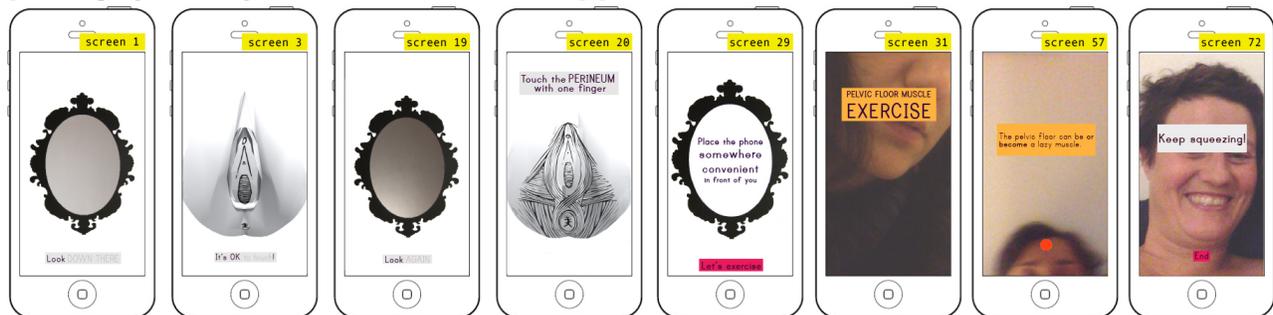


Figure 2. Labella: A selection of screen designs

to incorporate this fitness exercise into daily routines, and given the opportunity to take a ‘selfie’ while contracting her pelvic floor muscles to emphasise the invisibility of the exercise (Figure 2).

System Overview

Labella uses underwear which has been designed with a printed fiducial marker that can be located using the mobile phone App. Rather than use existing Augmented Reality software e.g. ARToolkit [23] we created our own marker recognition algorithm on top of OpenCV [44] and a bespoke marker. This was necessary to achieve an appropriate design aesthetic, and because worn underwear is often stretched as it conforms to the body shape of the person wearing it. This can warp any printed patterns and is therefore unsuited to many AR algorithms which make assumptions about the lie of the shapes derived from “perfectly” interpreted geometry.

The marker was created as a simple deep violet square, with the intention of leaving space to explore perspective transformations at a future date. This pattern was embedded in a more complex printed design at the bottom of the underwear (see Figure 3). The marker faces directly forward when worn and is picked up by the mobile phone camera as it is held between the legs (approx. 6 inches from the underwear). In contrast to existing algorithms that might fail to recognize the marker because of stretched fabric, our solution has to deal with the opposite problem – and limit the number of false positives. To do this, the software uses a heuristic approach to identify our marker: we record the most likely identified marker in a small time and leveraging the knowledge that we know when they are looking, and that we know the exact printed colour - allowing us to reject shades that lie outside our range. The algorithm begins by making a greyscale representation of each capture frame in order to limit the effect of specular light and other similar artifacts. We use an “erode” function to remove high frequency noise, before using a threshold function to convert the image into black and white removing the lightest greys.

We then use this cleaned and binary colour source in order to create a contoured representation of the image. This allows the software to identify and analyse four sided shapes which are possible candidates for our deep violet mark. We then find our final match by picking the most square shape - where we look for similar lengths of side –



Figure 3. Visual marker on a) underwear; b) a fabric swatch

with near perpendicular angles – finally picking the pattern that has the closest approx. area (as in cm^2). We then use a hysteresis that establishes whether our target square has remained the most likely over a series of frames. This recognition algorithm is not perfect, but we can increase its accuracy by carefully setting up and framing the interaction so that the size of our problem space is reduced.

Underwear Design

The iPhone mobile app connects to the female body through the recognition of bespoke printed markers (figure 3). These markers are screen-printed on textile-based specialist underwear. The location for the marker was chosen based on suggested bodily interactions with the phone, as indicated by the simple instruction on the screen, which in turn requires the participant to ‘explore’ her piece of worn-underwear with the handheld device (similarly to the way she would explore her body with a mirror [27]).

THE STUDY

Participants

A total of 14 women participated in our study. All participants were recruited to elicit as great a variety of backgrounds as possible and included, among others, mothers, Yoga and Pilates instructors, an anthropologist, a dancer, women’s health physiotherapists, designers, and a marine biologist. The age range was 25-63 years old.

Learning about the body was not new to most participants, with some having had a formal introduction to the reproductive system as teenagers while in school, such as Sophie, Alexandra, Beatrice and Anne. Elizabeth had further studied anatomy while attending University. Participants such as Birgitte describe this previous learning as superficial and vague or, in the case of Camilla and Marie culturally constrained. Marie, however, is interested in gender and volunteers as a sex educator. Louise and Sarah are women’s health physiotherapists and view knowledge about the female anatomy as fundamental. They believe everyone is familiar with the “basics”. Eugenie acknowledges knowing the basics but nonetheless she is confused with the terminology and has misconceptions about some of its parts and fitness. Agnes and Katharine incorporate pelvic floor exercise in their core workout of Yoga and Pilates teaching and practice. The fitness of the pelvic floor muscles as a health practice was unfamiliar for five participants, and the pelvic floor was generally unknown to most in that it creates a support for external genitalia, or pertains to preventative care and is essential for the wellbeing of women.

Research Process

Following informed consent from the participants we presented them with Labella. The system was delivered to the participants as part of a materials kit. This included a customized piece of underwear in their size, simple instructions, an information sheet about the project, an audio device to record thoughts post-experiment, and three note tags to write thoughts were also included. A mobile

phone with the app installed was also available, and 10 participants used it. The remaining four participants provided their own phone. Participants kept the materials kit for the duration of a week.

To understand more of our participants' experiences with Labella we conducted a semi-structured interview with each participant. Three interviews took place via Skype and 11 in person, at a place of convenience to the participant. Interviews lasted between 30 minutes and an hour.

FINDINGS

The interview data were analysed using an inductive thematic analysis approach [11], with the coding of the entire dataset undertaken by one researcher. Three researchers then discussed the coded data set, and worked together to develop themes based on these codes. Our interest in this analysis was broad, to understand participants' experiences of Labella. In what follows we show how Labella can act as a device for transforming learning on the body and awkward learning as a valuable tool to talk about the 'unmentionable' [12]. As women talked, their experiences with Labella were naturally intertwined with their own personal histories. This coupling of stories and experiences is presented in what follows. In accordance with the consent given by our participants pseudonyms are used throughout.

It's My Body (You Should Know This Stuff, Right?)

Both Louise and Sarah consider that "the majority of people know where their genitalia are", and Marie also comments that everyone should know "the basic level of education that was in the app". However, these three women have expertise in the area of women's and sexual health, which, as Louise acknowledges, might conflict with her perception of what others know. For Camilla, Labella led her to recall "words" learned in the past within the context of childbirth [i.e. pelvic floor], and to remind her to exercise [i.e. pelvic floor muscles], which she has been "lazy" to do. Asked if she had learned anything new, she comments:

"Of course! Of course, I learned a lot of new things. Actually, it makes me feel quite dumb because (laughs)... things that as a woman I should know. But I didn't know... I must confess, I didn't know...(...) I wouldn't use the word dumb, I would use the word.... Blurred might be better (laughs)." (Camilla)

In general, the technology contributed to enhance the participants' body knowledge, either by consolidating previous knowledge on their external body organs:

"It was reassuring that I knew where things were (laughs). And I can see that if I did this test when I was 18 I probably would have learned a lot." (Elizabeth)

Or by adding new knowledge:

"I didn't know about this, what is it again... perineum." (Camilla)

"I think I went online searching for perineum" (Kate)

"I didn't know where the clitoris was..." (Birgitte)

Although most participants have the memory of learning about the subject in school, they also refer to the fact that these were covered "briefly" and "with not so much detail". Asked if she was familiar with all the body parts, Sophie remarks:

"No... not as much as I think I should. It was interesting to see it [Labella]... you know, I had classes about, you know. All of this, but I don't think they went that deep into it..." (Sophie)

Obstructions to Constructions of the Female Body

The lack of confidence in communicating with others and one's own bodily taboos contribute to inhibit literacy about the female anatomy. According to our study, the female body continues to be a mystery in everyday knowledge. While this mystery was well documented and researched fifteen years ago [10], and is well instituted within medical practice, it continues unresolved for the lay person. Through enquiring with Labella we collected various personal histories of misinformation and the awkwardness of learning experiences at both informal and formal circumstances.

Colloquialisms applied to the intimate parts of the body were common in the way the women talked about learning about their bodies. Most people acknowledge knowing about their bodies in that way, i.e. urethra is commonly known as the "pee hole", and generally the vulva is understood to be the vagina, hence generating further misconstructions about it. Furthermore, employing awkward metaphors to describe intimate body parts or how they function appear to be frequent not only in personal but also in professional settings. For example, Marie took ballet classes for 10 years, during which she was told to "tighten those muscles" [pelvic floor muscles]. However, she was never explained exactly what and where those muscles were, or how to correctly exercise them. She comments:

"They just said that there were some muscles that were not your butts but in some way there... like, if they had specified like where the muscles were it might have been easier to identify. And I remember for years 'taking the elevator up, and stay there', being used very often ... and I was like, which elevator am I thinking of? You know, in that position you're also doing the elevator thing on all your muscles here, so I'm like, and I really didn't understand, and I was just like squeezing which is wrong, actually..." (Marie)

Labella finally helped her understanding the elevator metaphor, she notes, "so that was really helpful, in understanding why it was a lifting idea (laughs)."

Furthermore, both Eugenie and Birgitte assert self-awareness. However uncertainties such as being "familiar with Kegel exercises, I just didn't realize that was for the pelvic floor" or "so you roughly know where... aaah, the

main things are, but you wouldn't know the specific positions" demonstrate how enacting Labella contributed to further understanding of their own bodies.

The informal learning experiences of our participants, and as a result their body literacy, were undoubtedly culturally influenced. For example, for Camilla, who at the time of the study is sixty-three years old, the awkwardness is a reflection of people's cultural background. Having been raised embedded in a Chinese culture, she thinks back at how intimate body knowledge was passed from mother to daughter, and the taboo associated with it within such utmost familial relationship:

"But even when I had menstruation my mother found it awkward to explain. So, I came back one day and then there were some marks on my uniform and my mother said come here, come here, let me look and I said why? Because there's a stain on the back of your and I said oh, I had art class maybe I sat on the paints, you know... can you imagine how awkward, they don't talk to you about it." (Camilla).

Camilla also considers that the difficulty in talking about natural body functions inhibits women's bodily experiences. Gaining agency of the body involves managing embarrassment and social-cultural constructs alike. When asked if she had had that conversation with her own daughter, she remarks *"Aaah I did, I did. I did tell my daughter when the time came."*

Social learning outside of the family happened at times when there is an urgent need to care for oneself, enabling the individual to gain knowledge about body taboo topics, as noted by Sophie:

"It was a Biology kind of trip and we went to the beach and someone needed a tampon at that particular time but never used one. So it's like, where does it go? You know? And you should know, at that point we should all know, where that goes... and you know, the girl who had an older sister that told her... ok, ok so I'm going to tell you, you do this and this and that... it shouldn't hurt (laughs)." (Sophie)

In this example, this lack of control in intimate self-care revolves around a lack of timely knowledge, i.e., by the time she starts menstruating she is expected to know how to care for her natural bodily functions and should be aware of options available for maintaining her personal hygiene; and the awkwardness experienced in the practice of trying to understand one's physiology.

As we have shown, sharing of informal knowledge in a timely manner, regardless of whether the conversation is with a family member, or in the school context, can be awkward. Sophie comments on her personal experience of sex education within a mix school: *"because when I had those chats, conversations, it was always an uncomfortable moment, maybe"*. She considers that learning about the reproductive body and, more broadly, sexuality is

challenged by perceptions of the self (puberty) and the willingness to confront change:

"because of the age, it's not an age you really want to look at that, because it's already embarrassing, I think, when you're hitting puberty cause it's a change and you don't want it..."

Physiological and psychological pubertal changes might present obstacles to learning within a formal structured environment. Learning is awkward for the student who is going through puberty, as much as it is awkward for the teacher. Professional and knowledgeable, the teacher should also feel comfortable when introducing such bodily matters in class:

It's not something they talk about [in school], maybe because when they talk about it, then it's this sexual thing and then when you're at that point maybe you feel uncomfortable..." (Sophie)

Look Down There

"Look Down There" is the only written language indicator on the initial screen after launching the application; the screen subtly designed to reflect the idea of a mirror. In the absence of clearly defined instructions on how to use Labella, participants began their interaction with different levels of uncertainty. In most cases, they understood the suggestion offered with the materials kit of wearing the underwear before launching the application on the phone. However, some initially failed to associate the on-body interaction to that of the digital space. For instance, Kate comments:

"So I was wearing this and then I used the app, I started the application, and it took me ages to understand what "look down there" [i.e. focus the camera of the phone on the crotch of the underwear] was (laughs). Like, it was like... look down there... my professional side, I was like, I was reading it like... then I realised it is super cool, I mean, I think that it's super funny. When I was discussing, I was sharing this (with friends), I said "look down there", it's like "look down there" in the digital world, so I was scrolling down, you know. It said look down there, look down there in the app, so I was trying to scroll down. But also, I was scrolling down forever, I didn't realize "look down there", what (laughs)." (Kate)

And Alexandra's interpretation was solely embodied in her physical reality:

"Aaaah because it wasn't quite specific the instructions, "look down there", so, I mean, it could be anywhere, right...? It's not specific... yeah. (...) So, I think it's not... common enough. I was like, I mean, "look down there", and I look down there, and I see my feet!" (Alexandra)

Moreover, some participants associated 'Look Down There' to their earlier 'awkward' formal learning experiences:

"It's something I remember, you know, talks when I was at school, and getting diagrams and actually I remember the nurse saying to you, if you get a mirror... and you look down there... but it is very, I think, awkward as well because you're like aaa [surprised caused by looking at one's own genitalia for the first time]..." (Agnes)

Using the mobile phone as a mirror might be a rather common practice in personal care practices both public and private, for example, putting make up on. However, using the phone as a 'mirror' in such intimate parts of the body furthers self-reflection in ways that challenge self-consciousness, bodily taboos, or the physical indignity of looking at oneself. Marie remarks:

"It made me kind of giggly, at first. You know how people say oh, take a mirror and look at yourself, and you're always told to do that, get to know your parts, and get comfortable with yourself. So, I strongly believe in that. In getting to know your own body. But I found the actual process of putting a mirror between my legs like a bit awkward and I always felt a bit stupid like, like... also because it's very strange to see your external genitalia reflected at a distance from the rest of your body, right? Which is what is happening when you're looking at the mirror... yeah. But this one, because it was like legitimate and I had to get to that awkward position, in order to move on in the app, it made me feel like aaah, I could get used to it. I could get used to holding a mirror in an awkward position (laughs)." (Marie)

Unsurprisingly, the combination of a piece of intimate apparel and a smartphone is the catalyst for reflection on body taboos and the necessary awkwardness of looking at oneself. Overall, only two participants reported to have had difficulties finding "an easy position to get into". By "getting into funny positions", or putting oneself "in positions that are "very strange", the majority engaged with the technology. Ultimately, this is the interaction involved in starting the experience with the app, which progresses to untangle the 'mystery of the female body' through a process of trial and error and exploration.

Trial and Error

Finding the 'right' position to successfully enact this interaction involves probing the boundaries of weird and that of the interface. Putting oneself in "positions that aren't really glamorous" is necessary for managing some bodily functions, such as menstruation. Products to manage this require different levels of body knowledge and comfort and, similarly to pointing the camera phone on the crotch to ignite the digital interaction, imply some trial and error, and comfort in exploring the body in this way. Marie compares her experience with Labella to that of her own intimate care experience:

"And I was just like 'why isn't it working, why is it...' [no response from the interaction], tapping it [the screen on the phone]. I mean, I also use a menstrual cup. So this is like

weird positions, I think I had to trial and error as well, so it was all familiar to me, like what... in which position does it go in the easiest." (Marie)

Moreover, the interaction – the looking down there, and needing to find the right spot - made Marie feel "kind of giggly", and Alexandra recalls "smiling" to herself. Camilla also considered it initially "strange" and afterwards "cool" and "fun". She remarks:

"I could not imagine peeking myself down there, but anyway, you made it in such a way that it was fun, you know! And aaah, you made me recall a lot of words, like I said the pelvic floor and then you made me be aware to touch those parts and remind me, you know, where they are because to start with you don't normally peek down below, it was a... it was a fun way of 'examining' myself, if I may say so." (Camilla)

Comparable to the awkwardness of the nurse, who comes in to school and recommends Agnes to get a mirror and look down there, therefore making it an allowable interaction conveyed within a formal learning environment, Labella too is acceptable for Marie, regarding it is positioned within a research study. Further, she welcomes this strangeness of distance and disembodiment, as she positions awkward as necessary for self-learning.

Learning through Externalizing the Body

Labella is introduced as an interactive artefact and as another 'language' to talk about the body:

"it is more interactive, it is a more interactive way of learning and it's very approachable and it's not really patronizing" (Marie)

For Marie, this interactivity is empowering. When asked about different approaches to talking about bodies in the sex Ed workshops she conducts, she comments:

"yeah, I find it helpful when people are laughing and go uh, what's that? Or like, if it's a part that is not specific to any person and, yeah... it just helps with look, look how funny it looks, the body is really funny also kind of weird, right (laughs). I think we look really weird." (Marie)

Moreover, Sophie compares Labella to learning in school. Usually, this body knowledge is delivered at a time when "the body is changing" (puberty) and which might make people "uncomfortable". She feels that Labella has introduced a new approach to learning with and through design:

"It's not a picture, but it's the graphic way. But it looks scientific in a way. You know, it doesn't look like anything else... I mean, it gives you another language of the thing. It is another language you're using for the same subject. It's how you present it." (Sophie)

Visualizing the body as external to the self and held within a digital space grants the participant a new reality embedded in the technological artefact. At the same time,

embodying interactivity explores the interchange between the body and the phone, for example, when prompted to touch [textual indicator on the screen that accompanies the illustration of the female perineum], some participants were unclear on whether to touch on screen or their own bodies. Agnes remarks:

“And when it showed you, it said touch here or something. I didn’t know whether to touch on the phone, touch the bit on the phone, if it actually meant touching it on the phone or touch me (laughs).” (Agnes)

Interpreting this action led to uncertainty, since *“we don’t often do that”*. Seeing the illustration on the screen, which once ‘touched’ translated into movement [animation] the pelvic floor [contraction/relaxation], was a novel approach to learning within the intimacy of the screen. Nevertheless, Labella gives participants something that they had *“never been able to visualize”*, now giving them something *“to imagine”* when doing pelvic floor muscle exercises. Initially prompted by interaction on the body, through the wearable, it supported participants to perceive that particular body space more accurately:

“Yeah... I thought it was like the back of my hips (laughs).” (Eugenie)

“I thought they were a floor, right. But then I didn’t understand where the floor was (laughs) so I thought maybe it was just like, like a plain of muscles, I don’t know (laughs).” (Marie)

As a result of using Labella, Marie *“learned that it’s called the pelvic floor... that that is where the pelvic floor is”*, and Eugenie reviewed her understandings of pelvic floor muscle exercises: *“I’ve never thought it looks like that [pelvic floor], like a ‘sphere’ so that was really interesting to see it contract like that. And yeah, yeah, yeah that was cool. And now when I do Kegel exercises I imagine that ‘sphere of muscle’.”* A distinct quality of this exercise is that if done correctly no one should notice it. This was a quality that many participants found ‘interesting’ and ‘empowering’. Kate remarks:

“And then I realised that I was doing it correctly and it was super fun. The fact that people... you could do this, but people should not understand that you’re doing this, it’s actually kind of powerful! Powerful... because then I did it in my office, I did it in the office!” (Kate)

The intangible quality of the exercise to be invisible to others strengthens the possibility of incorporating it into everyday reality and the understanding of how it is performed gives oneself the confidence to do so. In contrast, being asked to memorialize the experience of exercising the pelvic floor as a visual token [digital photograph] had a negative impact on some of the participants. Although Labella queries a photo as evidence of workout to underline the distinct invisibility of this

[pelvic muscle] exercise, some of our participants thought Labella was requesting something quite different. While Alexandra *“didn’t think much about it”*, Sarah considers that *“taking pictures and things like that”* is *“crossing that barrier of intimacy”*. Marie agrees that she generally feels OK with talking about her intimate body, however she would hesitate before considering taking a photograph of its parts. She comments:

“I would feel kind of strange, not really so much to do with privacy as just general aaah, embarrassment, perhaps. Like, it’s a weird kind of photo to have (laughs). Or to give!” (Marie)

The purpose of this photograph might have been unclear to some in part due to its expected mirroring component. Nonetheless, Birgitte wondered about its role in her personal, intimate experience. This experience with Labella made her look and she would like to know more:

“I’m just thinking whether people should be wearing underwear or not, when they are doing this. I mean, it’s something very personal... to just take a picture of your vagina. Then you have, let’s say... the picture that you have is like a drawing, but I’d have your own picture so you can compare where things are. Yeah! I personally, if I’m doing it by myself I don’t mind the to have my own ... yeah, so I would know...” (Birgitte)

Same, Same, but Different

Curiosity through the body can be beneficial toward learning, and where similarities and differences between women’s bodies are visible they also share common features. For Camilla (and in contrast to Birgitte’s earlier comment), enacting Labella would have created discomfort if it had required her to expose her naked body [the physical indignity of looking at oneself], as she feels self-conscious of her surgical cuts, or having someone else looking [judging]. While this made her feel vulnerable, she was determined to partake in the study. Labella was a valuable experience that emphasized both the normal and the unique. She remarks:

“(...) it’s not such a taboo subject after all, and I’m among women, I always say what you have I have, rather it’s bigger or smaller you know (laughs).” (Camilla)

Whereas Sarah comments that hers *“looks nothing like that”* of Labella’s [illustration of the female perineum], Camilla notes that Labella made her aware to *“sometimes have a peek”* [with a mirror]. By making her look, and however awkward this self-reflection might be, the confidence to do it is newly achieved to Camilla:

“Since it happened hey, it’s not so bad sometimes you can have a peek! I mean, otherwise it would never occur to me in my mind... to have a peek!” (Camilla)

By ‘giving permission to look’ in weirdness, and having provoked a wide range of reactions from ‘fun’ to ‘awful’, Labella compels looking anyway through exploring this

technology that is personal (the medium and the data) and by reinforcing a non-traditional body interaction. Nonetheless, it suggests a distinctive tone of learning and interaction conducive to intimacy with the self.

Strange, But Fun

The role of the intimate wearable is critical to enable situated learning about intimate parts of the body through exploring the physicality of the interaction. Awkward learning, as discussed previously, combines ‘weird funny’ and ‘weird not funny’, challenging weirdness as prohibitive although helpful in breaking awkwardness. Avoiding problematic knowledge or feeling self-conscious contributes to inhibit discussion. Moreover, laughter makes the conversation more accessible and puts people at ease therefore contributing to the social component of the interaction required to talk about bodies that are ‘funny’ and look ‘kind of weird’. Alexandra relates how amusing situations and humorous products can contribute to get the message across:

“Yeah, it’s like in general I think humour always helps in delivering a message, you know, it breaks the ice, it makes people remember the message... or if they don’t remember the message they remember they laughed and they found it funny. And then, even if they don’t remember the exact details they remember roughly what the gist of it was. So, just... making an impression.” (Alexandra)

Making an impression can help delivering the message, as one participant notes about her experience:

“You know, it’s not the kind of experience [Labella] you’re going to forget for a while (laughs). Because it’s a bit strange but fun at the same time, and I think that definitely helps more than seeing a picture or a model.” (Elizabeth)

Humour also makes such bodily topics easier to share, and works well as a conversation starter:

“I think it will be good, it’s humorous, right? So you can start sharing with your friends. Talking to my girl friend about oh, this app, I just learned that... sort of teaches you where, how the vagina works. Yeah, that would be interesting! Instead of, let’s talk about it, right.” (Birgitte)

Birgitte thinks “people want to know more about this”, and talking about the vagina is something that can be amusing between female friends. Camilla relates how the humour in Labella can support conversations:

“Because this topic is rather sensitive, you know, and you... because it’s very sensitive by creating a bit of humour, and fun, then people how should I say, they open up because it’s not such a taboo subject after all).” (Camilla)

DISCUSSION

HCI research has recognized the intimate body and women’s health more broadly as areas that are important, yet avoided designing for [8,17,21]. With Labella, we bring these topics forward and explore how digital technologies

can be harnessed in support of managing embarrassment and sexuality in self-care and care of others in these intimate spaces [25]. In the following sections we outline how embodied interactions inform looking to promote learning about hidden parts of the body. We discuss how learning is awkward when applied to sensitive and intimate topics, but that such awkward learning can be facilitated by humour. Finally, we show how a contextualized exploration of the body is embedded in our physical, social, and emotional settings, and is affected by different kinds of everyday technology.

On Looking

Labella asks participants to look at their own body in an unusual way. Looking can be awkward and our data suggest evidence of this through the accounts of our participants. Whether it is looking at oneself or envisioning oneself through the look of others, the vulnerability associated with exposing the body may cause embarrassment and apprehension. While looking away might contribute to prevent discomfort, looking back with Labella encourages accepting awkward as inevitable enabling the construction of self-knowledge.

The participants gained insights into their bodies and, as suggested by our data, Labella helped them not only in understanding the “basics” (external genitalia) but also to nourish their knowledge of pelvic anatomy and experience of fitness exercise. Moreover, the physicality of the interaction in Labella introduces an alternative way to observe and materialize the body, by requesting participants to wear a piece of intimate apparel that supports embodied perception and encourages situated learning. In doing this, the embodied experience extends to the digital screen, which offers a personal experience of non-specific individual anatomy, somewhat mimicking the experience of having one’s anatomy reflected back (similarly to a mirror).

Labella shares much with the traditional resources of 3D anatomical models or images in supporting women to learn about their bodies. I.e. these visual and even tangible replicas are representative of the specificities of one’s anatomy but, and similarly to Labella, they are non-specific to the individual. However, in using these traditional resources, the learning takes place through establishing relationships between what is observed and represented outside the body, with what is experienced in relation to one’s own body. Such a mechanism for learning can prove problematic as these models and images can seem only remotely connected to the realities of the female anatomy. Contrarily, Labella connects this interaction more intimately to the body through its invitation to explore the body by looking through the body, thereby making interacting with it seem more likely and familiar [12].

We suggest therefore that Labella empowers ‘looking’, through situated embodied perception [36], which is magnified by integrating the on-body underwear and by holding to the body’s ability to expand in a sensorial way

through the mobile application. As such, through Labella, participants were able to explore perceptions of their bodies and look (in an interactive way) at a naturally ‘hidden’ part of the woman’s body that is not only physically concealed but also concealed from body knowing. The participative status [16] required by the system allows women to investigate their bodies in ways they had not contemplated before or considered a ‘weird’ prohibitive effort. By presenting self-discovery of such bodily taboos through a combination of body-worn and mobile interactions, Labella allows participants to situate the learning on their bodies as they see suitable for them. Embodying the technology advances the experience with the app, which contributes guidelines and suggestions regarding pelvic wellbeing and fitness. Furthermore, this interaction, which manifests not only in the digital interface but also in one’s physical reality, encourages it as a tool for managing awkwardness and as a method to support memorable learning on the body.

Awkward Learning

While our participants had varying knowledge of their bodies prior to our study and in response to the variety of perspectives and affirmed knowledge held by each of them, they each engaged with Labella as a process of revealing self-discovery. We frame this discovery as a process of ‘awkward learning’, which intertwines the physical and experiential interaction with Labella into the embodied learning of the self. In doing so, we reflect the delicate management of privacy and dignity [25] in the learning of many topics essential for women’s health and wellbeing. We found evidence of this hesitancy and awkwardness, not only in our data, but also in our experiences recruiting women to participate in the study, where to our knowledge, the ‘awkwardness’ of the experience kept three women from taking part.

We contend that *making oneself comfortable* is the first step to engaging in learning about this body space, and argue that the humour and strangeness entwined in the design of Labella offered a mechanism through which comfort was offered. The fact that the research kit includes a piece of underwear is ‘funny’ but bizarre, and in addition having to handle the mobile phone close to the worn underwear makes it ‘strange’. By presenting the participant with an interaction that starts by asking her to look at her body in such a strange way helps break ‘the first barrier of taboo’, while offering a fun way to examine oneself. Some of our participants noted that it was this sense of fun and strangeness that in the first instance motivated the ‘peeking’, but through having peeked once through Labella, participants maintained they would now peek again.

A small body of existing literature promotes humorous interactions and design in an attempt to help break social awkwardness [37,38]. We note also that the expression of humour in health care interactions is a mechanism for managing awkwardness [25], since it provides relaxation

and physical ease [9,24]. Similarly, the giggly and funny experience of interacting with Labella provides both psychological and physical ease to look at and understand the self, sometimes for the first time. In addition, the technology provides a (physical and digital) space in which looking at oneself is acceptable (the app suggests so) and legitimate (research). Moreover, women’s accounts of the body being “weird” or “funny” seek to strengthen the notion that humorous interactions within the body can be advantageous to encourage conversations and breaking taboos. In this regard, interactions that incorporate humour in design have the possibility to support awkward learning, which may be charged with not only physical or social but also emotional stigma and taboo. More so, we find evidence that this awkward, funny interaction which involves physicality and the social emotive taboo results in an affective experience [36], that may contribute to *making an impression* and a memorable learning experience.

Conclusion

Technologies for intimate health and wellness often aim to remind and motivate the user to take action to improve their own fitness. But, what if the user doesn’t know enough about their own anatomy to know that they could be healthier or fitter? In designing and deploying Labella we have identified opportunities for embodied interactions to enable and support body literacy, with the ultimate aim of empowering wellbeing through enhanced self-knowledge. We show how while awkwardness is entangled with self-knowing of intimate parts of the anatomy, harnessing such awkwardness can lead to funny and strange experiences that help to ease the burden of taboo.

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