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Threats and Thrills: Pregnancy Apps, Risk and Consumption

Gareth M. Thomas^a and Deborah Lupton^{b*}

^aCardiff University School of Social Sciences, Cardiff, UK and ^bFaculty of Arts and Design,
University of Canberra, Canberra, Australia

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Abstract

In this article we draw on the findings of a critical discourse analysis of pregnancy-related mobile software applications designed for smartphones ('apps') to examine how such apps configure pregnant embodiment. Drawing on a detailed analysis of all such apps available in June 2015 in the two major global app stores Google Play and Apple App Store, we discuss how such technologies (the 'threats' mode of representation) portray the pregnant body as a site of risk requiring careful self-surveillance using apps to reduce potential harm to women and particularly their foetuses. We show that the second dominant mode of representation ('thrills') constructs the pregnant body and self-tracking in more playful terms. App developers use ludification strategies and encourage the social sharing of pregnancy-related details as part of emphasising the enjoyable aspects of pregnancy. We found that both types of pregnancy-related apps endorse expectations around pregnancy behaviour that reproduce heteronormative and gendered ideals around sexuality, parenthood, and consumption. These apps are socio-cultural artefacts enacting pregnant bodies as sites of both risk and pleasure. In both cases, users of the apps are encouraged to view pregnancy as an embodied mode of close monitoring and surveillance, display, and performance.

Keywords

Mobile apps, consumption, digital media, pregnancy, risk

Introduction

In this article we draw on the findings of a critical discourse analysis of pregnancy-related mobile software applications designed for smartphones ('apps') to examine how such apps configure pregnant embodiment. We identify how apps portray pregnancy and foetal bodies in particular ways as well as the implications these representations have for ideas about risk and health with respect to human fertility and reproduction

Digital apps and pregnancy

Digital technologies are playing an increasingly important role in healthcare and the communication of information about risk and health (Lupton, 2014b, 2015a, 2015b; Rich & Miah, 2014). Mobile software applications (apps) are a central technology in digital health and risk communication. There are now over 100,000 health and medical apps available for use by lay people and healthcare workers (Jahns, 2014). Apps directed at pregnancy constitute a major genre. Hundreds of apps are available that focus on pregnancy, and many of them are very popular. Yet little social research has been conducted that has attempted to address the content of such apps and how they seek to attract interest from potential users. In this article we draw on the findings of a critical discourse analysis of all pregnancy-related apps available in June 2015 in the two major global app stores Google Play and Apple App Store. We use these data to identify the ways in which pregnant and foetal embodiment are represented in these apps, including the discourses and practices related to health and risk that they portray.

Pregnant women have employed online technologies for information and support since the internet became available for general use. In the early years of online communication (often characterised as the Web 1.0 era), they interacted on discussion forums and sought information from pregnancy information websites and blogs (Doty and Dworkin, 2014). The diversity of media available to pregnant women has expanded since the advent of new digital media and mobile ubiquitous computing devices (or what have been described as Web 2.0 or the social web technologies). They are now able to use a range of digital media - such as websites, blogs, podcasts, YouTube, and social media (Facebook, Twitter, Instagram) - and access these using mobile devices.

Pregnancy apps are among this new range of technologies available to women and their partners. Download figures from the major app stores demonstrate the high level of interest in pregnancy app among mobile device users, with the 'I'm Expecting - Pregnancy App' attracting between 1 to 5 million downloads from the Google Play store alone. Likewise, the Apple App Store's list of popular health and fitness apps in June 2015 featured several pregnancy-related apps such as 'Period Diary' (a fertility and ovulation tracker), 'My Pregnancy Today', 'Pregnancy & Baby - What to Expect' and 'Baby Names'.

Recently researchers have shown that pregnant women are using apps in significant numbers and finding them helpful sources of information and support (Declercq et al., 2013; Derbyshire & Dancey, 2013; Hearn, Miller, & Fletcher, 2013; Kraschnewski et al., 2014;

Peyton et al., 2014; Rodger et al., 2013). A large-scale survey conducted with American women who had recently given birth (Declercq et al., 2013) found that 56 percent of first-time mothers rated pregnancy apps as providing valuable information, as did 47 per cent of experienced mothers. Another American study (Kraschnewski et al., 2014) involving a series of focus groups carried out with pregnant women revealed that they used online sites and apps for pregnancy information since prenatal care was not meeting their needs. Australian research (Rodgers et al. 2013), drawing on qualitative interviews with pregnant women, found that many of them had downloaded a smartphone app. Researchers who conducted a survey of pregnant women at an Irish maternity hospital (O'Higgins et al., 2014) showed that 59 percent had used a pregnancy app. These apps were viewed as particularly important for disadvantaged women who may lack access to other educational resources.

Healthcare and public health professionals have begun to suggest that women's use of apps will influence maternity care and that they should be considered in the future planning of care provision (Hearn et al., 2013, 2014; O'Higgins et al., 2014; Robinson and Jones, 2014; Rodger et al., 2013; Tripp et al., 2014). From the perspective of midwives, for example, Robinson and Jones (2014) stress the importance of professionals acknowledging the widespread use of apps by pregnant women. They assert that apps may empower and inform women so that they take more responsibility for their health but that the quality of information offered is often dubious and may supplant professional advice.

Apps, like any other form of media, are forms of texts and sociocultural artefacts that both draw on and reproduce shared norms, ideals, knowledges, and beliefs (Lupton, 2014a, 2015b; Lupton & Jutel, 2015), including those related to health and risk. They are worthy of sustained critical analysis that is able to identify these features. Health and medical app topics can suggest trends in health and medical regimes, treatments, and conditions as well as methods in medical education and training. The ways in which they verbally and visually represent the human body provide insights into contemporary notions of embodiment, health, disease, and risk. Thus far, however, few researchers have adopted this perspective on apps of any type. While there is a growing body of research related to the content of health and medical apps, this tends to focus on evaluating the accuracy or validity of their content rather than seeking to identify their wider social, cultural, and political implications.

Despite their popularity, little comprehensive research has been conducted into the content of pregnancy-related apps, with a few important exceptions. Tripp et al. (2014) analysed 430 apps judged to be related to pregnancy and divide them into four categories: informative; interactive; tools; and social media. Tripp et al. found, based on the number of reviewers per app, that the informative (non-interactive) apps were the most popular, followed by interactive apps that allowed women to upload information and customise displays. Johnson (2014) adopted a more critical approach in discussing the implications of a limited selection of apps, as well as other digital technologies, for the responsabilisation of pregnant women in the context of monitoring their own and their foetus's bodies. Finally, Lupton's (2015b) work on sexuality and reproductive self-tracking apps found there was a strongly heteronormative dimension incorporated into these apps. Female sexuality and reproductive capacities were represented as oriented towards careful self-monitoring of fertility, avoiding and facilitating conception, and risk avoidance. In contrast, male sexuality was portrayed as performative and competitive.

The research we draw on in this article enables us to build on these studies by combining a comprehensive overview of pregnancy-related apps with a critical discourse analysis approach to their content. We identify how apps portray pregnancy and foetal bodies in particular ways as well as the implications these representations have for ideas about risk and health with respect to human fertility and reproduction (Coxon, 2014; Lupton, 2013).

Methods

Critical discourse analysis focuses attention on the social, cultural, and political dimensions of texts, and what they reveal about tacit assumptions and power relations. Discourse is viewed as a form of social practice that is socially constitutive and shaped (Fairclough, Mulderrig, & Wodak, 2011). As we note above, apps are cultural texts and communicative agents that make certain truth claims, and their developers use carefully chosen images and discourses to represent their use and function to attract downloads. Critical discourse analysis is able to identify these tacit assumptions, norms, and truth claims that such texts articulate and convey to their audiences.

Google Play and the Apple App Store are the two major platforms offering apps; they have a combined market share of 91 percent of apps installed on mobile phones (Seneviratne et al., 2015). As of May 2015, 1.5 million apps were available to download on Google Play while 1.4 million were available on the Apple App Store (Statista, 2015b). From June 2008-June 2015, the cumulative number of apps downloaded from the Apple App Store reached 100 billion (Statista, 2015a). We undertook a search for all pregnancy-related apps offered in these platforms in June 2015, using key terms including pregnancy, childbirth, conception, foetus/fetus and baby. After both authors agreed on the types of apps that we intended to include in our sample, the first author (Gareth Thomas) carried out the preliminary searches. These were shared with the second author (Deborah Lupton), who conducted further searches to identify apps missed in earlier searches, thus ensuring that the process was rigorous and consistent. When the inclusion of particular apps was thrown into doubt by one author, this was discussed with the other author and a decision was made about inclusion or exclusion in the sample.

As we wanted to explore the complete range of different portrayals of pregnancy for the full variety of purposes and audiences, we included all human pregnancy-related apps in our analysis, including those directed at fertility monitoring and preconception care and those that involved games and other entertainment-related pursuits. After eliminating apps listed in these searches that were clearly not human pregnancy-related, we were left with 665 apps on Google Play and 1,141 on the Apple App Store for inclusion in our study (many of these apps were shared across the stores). We undertook a critical discourse analysis of the descriptions of these apps offered on the two app stores. In undertaking our analysis of the app descriptions in our corpus, we paid attention to the title of each app, the textual accounts of its content and use, and the images that were employed, such as the logo of the app and the screenshots that were used to illustrate its content and style.

Findings

In the apps we reviewed, we noted that the vast majority of pregnancy apps could be grouped in three main categories: 'entertainment', 'pregnancy and foetal monitoring' and 'pregnancy information'. The first category, 'entertainment', included games, pregnancy test and ultrasound pranks, shopping for pregnancy-related products, quizzes to test pregnancy knowledge, gender predictors, and baby name generators. The second category of apps, 'pregnancy and foetal monitoring', provided functions that encouraged women to monitor and survey the foetus and pregnant body. This included tracking weight and waist measurements, diet, water consumption, symptoms, moods, medications, cravings, appetite, and energy levels. Other apps in this category allowed women to input due dates and appointments, record foetal heartbeat and movement, write journals and create scrapbooks, and share ultrasound images and biometric data such as foetal movement (e.g. kicks, heartbeats) with health professionals as well as friends and family members via social media. Taken together, these apps allowed for the production of a repository of personal medical information.

The third major category, 'pregnancy information', offered a range of information about pregnancy, including details about foetal development, nutrition, and exercise in pregnancy and substances and behaviours that should be avoided by pregnant women in the interests of maintaining their own health and promoting the health and optimum development of their foetus. Some information apps also provided women with access to online forums in which to connect to other pregnant women (for example to share and compare stories and experiences).

There were also several additional (separate) categories but these were much fewer in number. This included the categories of 'labour and childbirth', 'medical', 'preconception and fertility' and 'for fathers'. Labour and childbirth apps were mostly those which allowed women or their partners or both to measure and monitor contractions, but could also include those which provided relaxation techniques for labour and created a birth plan and checklist for both the birth and new born equipment and products. A group of apps provided medical information and training for health professionals and students (including quizzes for medical exams). Whilst there were several apps available for preconception and fertility (such as giving advice about fertility and infertility, apparent pregnancy tests, ovulation and menstruation trackers), only a small number of pregnancy-related apps were explicitly directed at fathers.

In analysing our corpus of apps, we started to recognise how, across these categories, apps could be divided into two major themes: one in which pregnancy was enacted as a highly-risky state in need of careful management (characterised by us as 'threats'), and one in which it was constituted as a site of pleasure, enjoyment, and entertainment (or 'thrills'). While these themes may appear very different, we noted that both incorporated ideas about the importance of pregnant women tracking their bodies, and in some cases, sharing their personal data with others. We elaborate on these themes below.

Threats: pregnant and foetal bodies at risk

There are a plethora of apps allowing pregnant women to monitor their body (weight, diet, mood, etc.) and that of the foetus (growth, heartbeat, etc.), access information on health for pregnancy and childbirth, and share concerns and data with health professionals together with other pregnant women, family, and friends. Such apps, we argue, frequently render the pregnant body as risky and in need of self-monitoring and surveillance. This is achieved in many different ways, from alluding to the importance of *attaining* a 'normal' or 'perfect' pregnancy to citing scientific endorsement to provide legitimacy.

This 'risk' and 'health management' discourse emerged in apps like 'Ovia Pregnancy Tracker', a popular app with 100,000-500,000 downloads on Google Play alone, which adopted a 'high-tech, personalised approach to tracking your baby's development and pregnancy week by week'. In order to 'have a healthier pregnancy', users were encouraged to gain 'immediate feedback' by using 'data science and your personal information' to track weight, sleep, and symptoms (among other things) and 'deliver personal and baby development milestones' as well as 'immediate health risks'. The app encouraged women to track their weight gain, pregnancy symptoms (and receive alerts if these symptoms 'indicate a health risk'), food, fluid and vitamin intake, sleep, moods and exercise. The app provided users with the opportunity to research symptoms to determine 'is this normal for pregnancy' as well as medication and food safety. One screenshot, for instance, was headed by 'Are my symptoms normal?' accompanied by a photograph of a woman holding her bare bump and the tagline 'know when to call your doctor'. Like other apps, Ovia was advertised as allowing women to 'have a healthier pregnancy' by receiving daily updates on pregnancy and baby size/development, 'critical health alerts for pregnancy risks on analysis of your data', and over 400 articles and 'tools'.

The legitimacy of 'Ovia Pregnancy Tracker' was claimed by reference to positive user reviews and news media coverage. It included a lengthy paragraph on the 'history and science behind Ovia' (that is the use of algorithms), and the claim that it has been developed by 'Harvard scientists, pregnancy specialists and fit moms'. Claiming expertise and legitimacy by referring to a specialist's involvement in app development was a common trend we observed. Similar to Ovia, 'Pregnancy Companion by OBGYN' was described as 'the ONLY pregnancy app written and recommended by Board-certified OBGYN doctors' and as 'like having your own doctor's trusted advice (and lots of cool tools!) right at your fingertips'. Similarly, the developers of another app targeted at mothers, 'First Time Pregnancy', asserted that using the apps would 'keep you safe', especially during a first pregnancy where 'many questions and lack of information can lead to confusion or even anxiety about your own health'. This 'educational tool' was framed as being 'developed by a medical doctor with nothing but your health in mind' and a device to use 'as your personal tracker'. Screenshots of the app likewise invited users to 'get foetus details' and weekly updates, calculate due date, and 'plan ahead'.

This promotion of accomplishing foetal and maternal health via apps was also enacted by 'Pregnancy Health Help and Advice Free'. Since mothers 'want to give your baby a healthy start', this app discussed 'the most important topics in pregnancy health' (for example caesarean-section, childbirth, diabetes, foetal alcohol syndrome, genetic

counselling) and was directed to – as well as health professionals and students – ‘lay people who just want to learn more about pregnancy health’ (although with a disclaimer that it is ‘for informational purposes only’ and should not displace medical recommendations/professional advice). Further, the description of ‘Pregnancy 41 Weeks’ contained only medical information around how pregnancy begins and develops while one screenshot encouraged women to ‘organise and get ready well in advance for motherhood’. This was achieved, according to the app, by taking measures ‘to keep you protected’ such as abstaining from alcohol and drug use as they ‘may lead to serious respiratory complications, serious alcohol syndromes, birth defects, and so on’.

There were also apps available for prenatal screening, high-risk pregnancies, and genetic conditions. For example, ‘Guide to High-Risk Pregnancy’ provided women with greatly detailed medical information on ‘maternal and foetal problems, ultrasound images, foetal monitor tracings, and a list of worrisome conditions that can happen before or during pregnancy’. Based on a book ‘Your High-Risk Pregnancy’, the app had sections on diabetes, hypertension and preeclampsia, and ‘normal foetal growth ultrasound measurements’. The app also contained another feature which provided women with the means to search over 4000 keywords ‘to let you check out virtually any test, ultrasound or exam finding, or condition - in the doctor's office, in the ultrasound room, or in the hospital’. Others apps like ‘Pregnancy Risk Calculator’ offered ‘pregnancy risks based on certain test factors’ while ‘Panorama NIPT’ supplied users information on how non-invasive prenatal testing for trisomies, triploidy, gene micro-deletions, and monosomy X ‘fits into their pregnancy journey’.

Related to this, ‘Pregnancy Birth Defects’ was an app which, due to ‘recent medical advances’ that remain unspecified, ‘helps you to prevent your baby from having Down syndrome and other birth defects’ as well as muscular dystrophy, Tay-Sachs disease, fragile X syndrome, Thalassaemia, sickle cell disease, cystic fibrosis, and cerebral palsy. According to its description, this ‘obstetrician recommended’ app gave women with the opportunity to monitor foetal heartbeat, gather instructions on baby care and managing potential pregnancy problems, view images of foetal development, and ensure they could ‘take steps to protect your baby's health before he is born’. One such ‘tip’ was ‘preventing’ cystic fibrosis and sickle cell anaemia by ‘testing at the first visit or before conception’. Other features of the app, like many others, included a hospital appointment planner (‘record your doctor's answers to your questions’), to-do list templates, a hospital bag checklist for delivery, a list of obstetrician-recommended ‘new born essentials’, a personalised timeline which ‘adjusts to your baby’s milestones, and both a weight and contraction tracker.

Interestingly, this constellation of responsible practices directed at pregnant women was very different from the expectations inherent in the pregnancy apps that were directly targeted to prospective fathers. Although these are fewer in number, the available apps often contained ‘titbits’ of information rather than the vast realms offered to pregnant users (see also Johnson, 2014). As with the pregnancy apps discussed above directed at pregnant users, those for men are embedded within (hetero)normative and highly gendered ideologies assuming certain interests and capacities. One app for fathers, mPregnancy, offered advice on building furniture for and fitting out nurseries for the new infant and

managing family finances, while very few, if any, apps designed for women provided similar information.

Further, pregnancy apps for men – often grounded in humour – frequently suggested that the expectant (and ‘good’) father would need to discipline his sexual interest in other women, offer constant reassurance to his pregnant partner that she is normal and attractive in his eyes (despite her altered physical state), and take an interest in the biometric information of their partner. In addition, fathers-to-be were framed as inherently uninterested in pregnancy and as holding little knowledge, with fatherhood depicted as ‘keeping up appearances’ rather than as a serious engagement with parenthood (Johnson, 2014). Whilst pregnancy apps for men were designed to be terse, matter-of-fact, humorous, and simplistic (as if men did not have enough interest for large tracts of information), apps targeted at pregnant women constructed them as serious experts responsible for ensuring a ‘normal’ and healthy pregnancy outcome.

Thrills: the ludification of pregnant and foetal bodies

In conjunction with the many pregnancy-based apps which constructed the pregnant body as a site of risk, there was a larger collection of apps framing pregnancy as a form of entertainment and pleasure. The term ‘ludification’ is used in the academic literature on gaming (sometimes referred to as ‘ludology’) to refer to elements of games reaching into other aspects of life beyond leisure pursuits (Frissen et al, 2015). This was a clear element in many pregnancy apps, including those directed at audiences other than pregnant women themselves (Lupton & Thomas, 2015). In some cases, the pregnant body itself – and the foetus within – was constituted as a consumable. Hundreds of apps allowed users to play games related to pregnancy, shop for pregnancy and baby products, predict a baby’s gender, write journals, take photos, generate baby names, research baby size and compare this to inanimate objects such as fruit (such as ‘Cute Fruit’), participate in quizzes, pull pregnancy ‘pranks’, and monitor foetal heartbeats and kicks to share with others using social media.

These apps are worthy of consideration because like the more serious apps to which we refer above, they reproduced both popular and problematic discourses around pregnancy, motherhood and fatherhood, families, and the unborn. This was particularly true with respect to a significant genre of pregnancy-related apps directed at young girls. These apps positioned them as helpers, friends, or medical professionals interacting with pregnant women. One app, ‘Barbara Goes Shopping’, has 1 to 5 million downloads on Google Play and involved users playing the game as Barbara’s ‘closest friend’. The app description began with the following:

I've got wonderful news for you girls: our darling Barbara is expecting a baby! Barbara and Ben are so happy and excited, but yet a bit worried: they will become parents soon, and it is a great responsibility. They have already bought everything their baby will need: a stroller, loads of diapers, bottles and dummies of all kinds, pretty teddy bears, dolls and rattles and so on. But still Barbara is feeling a bit unconfident. Don't you think she needs something

to cheer her up? And every girl knows that there is no better way to raise girl's spirits than a nice shopping spree!

In this statement it is clear that the happily expectant couple, Barbara and Ben, had already invested in their infant with the purchase of many products and were now ready to focus their attention on spending money to make Barbara attractive and, thus, more confident. Gamers were encouraged to visit boutiques and help Barbara purchase an outfit to 'make her feel beautiful throughout her pregnancy'. Once the game was completed, the user was notified that 'Barbara is her fashionable self again and feels prepared to welcome her baby!' The advertising image for the app was a shot of a heavily-pregnant Barbara, with long blonde hair and blue eyes, wearing a pink dress and smiling as she held a blue dress (very similar in appearance to Mattel's Barbie Doll). In supplementary screenshots, Barbara – again with a pink-coloured store as a backdrop – tried on dresses, browses shoes and jewellery, and experiments with different hair styles before purchasing her goods.

This app represented the many games directed toward young girls in the market related to pregnancy that we found in the app stores. Their intended audience was clear both explicitly (that is having the term 'girls' in the title or in the app description) and implicitly (through colours and imaging typically associated with young girls). Such games frequently asked users to either care for pregnant women or their new born baby (or both), help pregnant women shop for clothes and food (for example 'Lila Pregnant Shopping'; 'Pregnant Mom Shopping'; 'Pregnant Mom Food Shopping'), engage in domestic cleaning ('Mother House - Cleaning Games'; 'Pregnant Barbara Bath Cleaning'; 'Princess Cleaning Room'; 'Pregnant Mom Washing Dishes') and give pregnant women makeovers and beautify them so that they were able to feel more confident and looked more attractive ('Pregnant Princess Beauty Salon'; 'Pregnancy Nail Art Salon'; 'Pregnant Mommy Makeover Spa'; 'Pregnancy Beauty Dress Up').

These apps portrayed the 'yummy Mummy' idealised archetype of pregnant embodiment, described by Littler (2013: 227-8) as a 'social type' of a mother who is 'sexually attractive and well-groomed, and who knows the importance of spending time on herself'. An archetype gaining force as it is repeated across different media, the yummy-mummy 'bodies forth' a new framing of mothers and 'espouses a girlish, high-consuming maternal ideal as a site of hyperindividualised psychological "maturity"' (Littler, 2013: 227). Whilst the apps described above were chiefly designed for young girls, the reproduction of gender expectations in conjunction with the idealised 'yummy-mummy' figure (such as being well-groomed) was evident. Mothers in such games were also frequently cast in gender-based fantastical, popular, or fairy-tale roles including princess, mermaid, queen, fairy, nurse, or celebrity, while male characters appeared beside women as princes, kings, doctors, and/or supportive husbands or partners.

Other sets of apps directed at pregnant women themselves also placed emphasis on the woman's bodily appearance and/or that of the foetus. These included apps for photographing pregnancy bumps and creating time-lapse videos of transformations over time, creating 'foetal albums' of ultrasounds or for manipulating foetal ultrasounds so that they looked more appealing. The apps then provided users with the opportunity to share these images with others on social media. Many self-monitoring apps provided

opportunities for pregnant users to enter names and photographs of themselves so that the notifications they provided can be customised. Users were thus invited to 'insert themselves' into apps so that they might better be enrolled as active users. 'Ovia Pregnancy Tracker', for instance, allowed users to add a customisable baby name and gender to the app while also adding photos and milestones.

Via the pleasures and performative qualities (rather than risk-aversion strategies) of monitoring and tracking, women were urged to 'document your special pregnancy moments and milestones' by adding photos of bellies, ultrasounds and baby showers. 'BumpDocs', as well as providing women with 'wisdom to deliver a healthy baby', also let them 'capture selfies' and share these with other pregnant women, while 'CineMama' pushed users to 'celebrate your weekly progress' by '[documenting] your pregnancy and [tracking] your belly's growth'. Taking photos of their bare stomach, women were told to turn these 'into a keepsake movie'. In conjunction with more 'serious' features such as a maternal weight tracker and following foetal growth via 'an informative video for each month of pregnancy', the app offered other features for women to 'track your memories and milestones in the app diary and personalise them with photos and our mood meter' to share in the digital world. Such features were a mainstay of many pregnancy apps on the market.

It is notable that many apps use the term baby rather than foetus, thus suggesting a stance that positions this entity as already a person. Nonetheless, foetuses themselves were often personalised in these apps. Apps like 'First Time Pregnancy', for example, contained screenshots of babies framed as 'little boxers' or as babies with their 'eyes open' who are growing larger and strengthening bones and muscles. One app, entitled 'Kick to Pick', involved placing a smartphone on a pregnant abdomen to monitor foetal kick patterns and suggesting names for the baby based on these patterns (supposedly allowing 'the whole family to get involved in the naming of your child, even the baby itself'). This configuration was enhanced via apps providing information by assuming a foetus's voice speaking from within the womb: for instance, 'Pregnancy 41 Weeks' contained information in week 9 starting with 'Hi Mom. I am growing'.

Here, we can see how apps constructed pregnancy as pleasure (or 'thrill') but also blurred the boundary between risk-avoiding practices and entertainment. Another example of this is apps which allowed women to monitor a foetal heartbeat or movement ('kicks'). The app 'Fetal Doppler Unborn Heart', with 100,000-500,000 downloads from Google Play, allowed users to 'share the joy of expecting a baby with your loved ones'. The developers of this app - used with a mini-Doppler ultrasound attachment for the smartphone sold by the same company - described it as making 'listening to your baby's heartbeat an entertaining and social experience by providing a way to record the foetal heart sounds and to share them with your family and friends [...] via e-mail, text message, Facebook and Twitter'.

Together with similar apps on the market (such as 'Cocoon Life Pregnancy'; 'BabyScope'; 'Flutter'; 'My Baby's Beat'; 'SKEEPER Fetal Heart Rate'; 'BabyWatch'; 'Lullabeats'; 'Tiny Beats'), monitoring and listening to foetal heart rates was configured as an 'entertaining and social experience' to share with family and friends using various digital resources. In so doing, mothers and fathers were expected to 'bond' and 'connect with her unborn baby', with a father's absence of embodied knowledge, in particular, being framed as a diminished capacity to connect with their baby. Likewise, the 'Baby HeartScope

Doppler' app gave parents the opportunity to 'bond with your baby before he is born' and to 'hear your baby hiccup, swallow, move, kick, push, tap, and roll'. According to the description, the app also allowed parents to predict the baby's gender and let siblings hear the heartbeat 'so that they can be happy about their new sister or brother'. In such apps, the serious (medical) and playful (social) boundaries of apps became muddled (see Lupton and Thomas 2015, for further discussion of pregnancy games)

Discussion

In this article we have examined an interesting and important issue: that is, the ways in which pregnancy apps frame pregnancy as a period of danger (which they can help mitigate) and as a period of pleasure (which they can help enhance). The new modes of portraying pregnancy represented by the apps we analysed here bring together the private with the public spheres, the commercial with the personal, in unprecedented ways. As we have demonstrated, a discourse of risk and responsabilisation is central to these apps. The pregnant body has increasingly become a highly public and tightly-monitored condition. Risk discourse brings out social accounting practices in particularly forceful ways (Horlick-Jones, 2005); it becomes a 'forensic resource [...] a language with which to hold persons accountable' (Douglas, 1992: 22). In this context, women must contain risks to, and be solely responsible for, both the foetus and the pregnant body, with risk - connected with apparatuses of bio-politics in neoliberal societies creating docile and productive bodies - emerging at various levels of meaning from the structural to the cultural and symbolic (Lupton, 1999, 2012; Rothman, 2014).

Pregnancy has increasingly become both a highly public and a tightly-monitored condition, with women invited to take up a diverse array of discourses and practices focusing on how they deploy and manage their pregnant bodies (Burton-Jeangros, 2011; Lupton, 2012, 2013; Ruhl, 1999; Weir, 2006). Since pregnancy is both a public and private activity and has been increasingly colonised by processes of medicalisation, women are 'policed' and become vulnerable to advice, criticism, and surveillance (Burton-Jeangros, 2011; Longhurst, 2005; Nash, 2013; Rothman, 2014). Pregnancy involves heavily prescriptive moral codes of expected behaviour administered through a scrutinising public gaze depicting pregnant women as fragile and as in critical need of intervention, especially to negotiate risks - before a baby is even born - viewed as calculable and preventable (Burton-Jeangros, 2011; Lupton, 2012, 2013; Warren & Brewis, 2004).

Our critical analysis of pregnancy apps has shown that many of these apps seek to fulfil a similar function. Located in a context of neoliberalism and disciplinary power valorising self-tracking and the generation and display of personal biometrics, apps can afford close and highly detailed self-monitoring of pregnant and foetal bodies and facilitate the sharing of these data with others. Our analysis suggests that perhaps now more than ever, pregnant women and the unborn have become highly visible, aestheticised and monitored, both for medical and for entertainment and consumption purposes. While apps may be used for connectivity and convenient access to a mass of information, they may also play a crucial role in the everyday practices of the contemporary maternal subject. We have already noted the popularity and common use of such apps by the current generation

of pregnant women in countries such as the United States, Australia and Ireland. Apps arguably constitute one more regime of ritual purity in the avid pursuit of attaining a 'normal' and idealised pregnancy outcome. Not only may the apps arouse feelings of anxiety, self-responsibility, and blame, but they also may offer a solution for women, who are entirely accountable for maternal and foetal health (Landsman, 2009; Lupton, 1999, 2013; Sutherland, 2010), as part of their sales pitch (that is this will keep you/your baby safe).

Equally, as we have shown, many pregnancy apps offer entertainment and construct pregnancy as a social event. Taken together, we shown how the apps loosely categorised as 'thrills' - games and heartbeat/movement monitors particularly - are premised on notions of consumption and playfulness. Beneath these obvious notions, however, lie more problematic assumptions and normative expectations. First, they rely on heteronormative and gendered stereotypes related to pregnant women's (aestheticised and well-groomed) appearance and conduct as well as the expected presence of a male partner. Focusing on apps designed both explicitly and implicitly for young girls, the enactment of femininity, coupledness, parenthood, and particularly motherhood is often clichéd and sexist.

We suggest that these apps for girls are deeply rooted in - and act to reproduce - cultural ideologies of female sexual beauty and heteronormative gender assumptions. They are both playful and located in a framework of stereotypic expectations of appearance and conduct. The pregnant woman depicted in these apps is represented as interested only in her appearance or the accomplishment of domestic duties and preparing for the birth of her baby while maintaining a glamorous appearance into the labour suite and beyond (we did not find any apps games for girls involving 'pregnant mommy' engaging in paid employment, for example). She is also frequently accompanied by her handsome, doting husband. The point here is that while the self-monitoring and pregnancy information apps directed at risk focus intently on the medicalised pregnant body, these games for girls portray an equally distorted view of pregnant embodiment as *ideally* highly fashionable and well-groomed.

Previous research into video games has demonstrated their highly gendered nature and the ways in which both female and male bodies in these games are portrayed using a restricted set of meanings and codes relating to hegemonic masculinities and femininities (Dickerman, Christensen, and Kerl-McClain, 2008; Thornham, 2008). Apps similarly depict a narrow and partial perspective of women's (pregnant) bodies as, ideally, primed and beautified. Men are also not immune from gendered and sexist stereotypes in apps; they are often caricatured as disinterested, bumbling sidekicks requiring training and encouragement to become an idealised father and partner.

In short, we suggest that such apps enact problematic discourses, especially when directed toward young girls. Such artefacts can be dismissed as harmless diversions yet early preconceptions of gender roles are reinforced and may, arguably, have enduring effects for educating young people about gender, parenthood, and identity. We found that the apps we examined overwhelmingly do not account for family diversity. Whether directed at health monitoring and risk avoidance or for entertainment purposes, these apps tend to assume a pregnant woman who is partnered with a male who is the biological father of her child. Little awareness or representation is provided of single mothers, same-sex partners, those who achieved pregnancy using donor gametes, or surrogate parenthood.

Furthermore, the types of pregnancy apps we have examined transform the foetus into babies for women and partners (transformed into parents) to enjoy and consume. This arguably becomes an expectation; celebrating transformations during a pregnancy (mostly online) and the growth, development and appearance of the foetus can become a tool for women to produce appropriate performances of pregnancy and 'successful' maternal femininity (Littler, 2013; Longhurst, 2000, 2005; Nash, 2013; Neiterman, 2012). Paying close attention to the developments in one's foetus, celebrating such changes, and taking care to share details about it with others, thus, becomes a signal of appropriately involved and caring motherhood. Such apps enact pregnancy as a matter of consumption which distinguishes the unborn as a consumable entity and so a conscious and sentient (human) actor (Mitchell and Georges, 1997; Taylor, 2008) 'with its own rights and privileges' (Lupton, 2013: 9).

Apps that involve the aestheticisation of fetuses conform to broader moves towards rendering the unborn body a public entity that is celebrated for its preciousness and beauty (Kroløkke, 2010; Lupton, 2013). These spectatorship apps, much like the 'consumption' of ultrasound imaging (Kroløkke, 2010; Mitchell, 2001; Taylor, 2008), make pregnancies seem more 'real' in the absence of embodied knowledge and allows parents to rework pregnancy experiences by providing a way of knowing and feeling *their* baby. Furthermore, they frame the foetus as a separate and conscious agent; the foetus is humanised and personalised, represented as an already social, autonomous actor.

Conclusion

In this article, we have shown how apps, far from being neutral technologies which purport to simply providing information and advice (as well as entertaining opportunities), represent women's bodies in problematic ways. The two distinct forms of pregnancy apps that we identified (those based around 'threats' and those around 'thrills') are not necessarily mutually exclusive. Taken together, the apps rest on neoliberal ideologies concerning the management and responsabilisation of the self/body. Whether they are explicitly directed at the identification and containment of pregnancy-related risk or at ludifying pregnancy, users of the apps are encouraged to view pregnancy as an embodied mode of close monitoring and surveillance, display, and performance. Our analysis has also highlighted how pregnancy increasingly becomes a marketable moment. This is not an entirely new development, but it has been assumed swiftly by apps. A key example here is apps which allow parents to monitor foetal movement and heartbeats. In conjunction with other apps framing pregnancy as a risky condition requiring intervention, foetal heartbeat/kick monitors offer a solution, commonly supplemented by the purchase of a 'personal' foetal Doppler available on online shopping sites.

In the past, pregnant women have been offered many forms of media as part of encouraging them to learn about and perform pregnancy. We suggest that what makes apps different, and more potent, are the following: their sheer volume (with more apps released onto the market regularly); their accessibility both in relation to economics (often available to download free-of-charge) and their convenience (anyone with a mobile device, such as a smartphone or tablet, can download apps and use them across temporal and spatial

locations); the near-absent regulation of app developers and the content that they create, and; their huge implications for data security and privacy.

As is the case with other medical and health apps, the monitoring and regulation of pregnancy apps, given their proliferation, remains a challenge for regulatory bodies (Yetisen et al., 2014). The UK Government has released guidance on apps and other standalone medical devices under the policy of 'patient safety' (MHRA 2014). Exploring and evaluating whether this government guidance and associated regulatory frameworks are well-equipped enough to handle the wealth of apps currently on the market, not just for pregnancy but health more broadly, is of paramount importance. So too, the implications for users of data security and privacy issues deserves further attention. Several studies have revealed the ways in which the often very private information that people upload to apps (regularly simply as part of agreeing to terms and conditions when downloading apps) is subject to data breaches and exploitation by app developers and third parties to whom they sell these data (Huckvale et al., 2015; Ackerman, 2013). These problems are also evident with pregnancy apps (Dembosky, 2013; Scott et al., 2015).

As for the relationship between pregnancy and apps as a new form of digital media, much ground remains uncovered. Though many apps are on the market little scholarly focus has been directed toward these digital media artefacts, this is a crucial and timely opportunity to examine the interactions between expectant parents and these technologies, particularly with respect to how they use them, what impact they have on their experiences of pregnancy, and how they draw on, reproduce, and initiate new discourses of performing parenthood. This, we argue, will reveal vital insights for uncovering the relationship between health, risk, society, and digital technologies.

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