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DOSSIER

My body is mine: menstrual apps and the sociotechnical normalization of gender

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Abstract: The use of mobile applications to track menstrual cycles is becoming more widespread. The proliferation of applications raises concerns about the normalization of the binary construction of gender identities by means of technological innovation and its impact on human rights. Some of these issues include an opaque treatment of users' personal data, the reproduction of gender stereotypes in design, and algorithmic biases. This study adopts a qualitative approach to examine those implications in the lives of menstruating people in Mexico City. The qualitative study included 32 in-depth interviews with young adult users aged 18 to 25 to learn about their experiences with various menstrual tracking apps. The analysis revealed that users were dissatisfied with the gender bias in the design, with the inadequate treatment of personal data by the apps, regarded as an invasion of privacy, and with app performance, which contributes to standardizing experiences and normalizing binary conceptions of gender by techno-social means. This study suggests that the design of period tracking apps should consider the experiences and needs of menstruating persons in their diversity, based on a non-binary definition of gender. Fair design should begin by engaging with menstruating people in order to improve their experience and quality of life, with their rights at the forefront.

Keywords: menstrual apps; gender and sexual diversity; gender binarism; data feminism; design justice.

Mi cuerpo es mío: apps menstruales y la normalización sociotécnica del género

Resumen: El uso de aplicaciones móviles para el seguimiento de los ciclos menstruales es cada vez más popular. La proliferación de aplicaciones plantea interrogantes relativas a la normalización de la construcción binaria de las identidades sexo-genéricas a través de desarrollos tecnológicos y su impacto en los derechos humanos. Algunas implicaciones asociadas con el uso de aplicaciones van desde el opaco tratamiento de los datos personales de las personas usuarias, pasando por la reproducción de estereotipos de género en el diseño, hasta los sesgos algorítmicos. A través de un estudio cualitativo, esta investigación analiza tales implicaciones en la vida de las personas menstruantes de la Ciudad de México. El estudio cualitativo consistió en 32 entrevistas en profundidad con personas usuarias adultas jóvenes entre 18 y 25 años, para ahondar sobre su experiencia al utilizar estas herramientas de seguimiento menstrual. A partir del análisis, se observó la incomodidad de las personas usuarias con relación al sesgo de género en el diseño, al tratamiento inadecuado de datos personales por parte de las apps, que afecta la privacidad, y al desempeño de la aplicación, que, a través de la tecnología, contribuye a estandarizar las experiencias y a normalizar las concepciones binarias de género. A partir de este estudio se sugiere que el diseño de aplicaciones para el seguimiento menstrual debe considerar las vivencias y necesidades de las personas menstruantes en su diversidad, partiendo de una concepción no binaria de género. Un diseño basado en la justicia debe partir de acercarse a las personas menstruantes para mejorar su experiencia y su calidad de vida, poniendo en el centro sus derechos.

Palabras clave: aplicaciones menstruales; diversidad sexo-genérica; binarismo de género; feminismo de datos; justicia de diseño.

Meu corpo é meu: aplicativos menstruais e a normalização sócio-técnica do gênero

Resumo: O uso de aplicações móveis para monitorar os ciclos menstruais está se tornando mais difundido. A proliferação de aplicações suscita preocupações com relação à normalização da construção binária de identidades de gênero através de inovações tecnológicas e seu impacto sobre os direitos humanos. Algumas das consequências do uso de aplicativos incluem o tratamento opaco dos dados pessoais, a reprodução de estereótipos de gênero no design e os enviesamentos algorítmicos. Este estudo adota uma abordagem qualitativa para examinar

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tais implicações na vida das pessoas que menstruam na Cidade do México. O estudo qualitativo incluiu 32 entrevistas em profundidade com pessoas jovens adultas entre 18 e 25 anos de idade para conhecer suas experiências com várias aplicações de rastreamento menstrual. A análise revelou que as pessoas não estavam satisfeitas com o viés de gênero no desenho, com o tratamento inadequado dos dados pessoais pelos aplicativos, considerado uma invasão de privacidade, e como desempenho do aplicativo, que contribui para padronizar experiências e normalizar concepções binárias de gênero através da tecnologia. Este estudo sugere que a concepção de aplicativos de monitoramento periódico deve considerar as experiências e necessidades das pessoas que menstruam em sua diversidade, com base em uma definição não binária de gênero. Um desenho justo deveria começar por envolver as pessoas para melhorar sua experiência e qualidade de vida, com seus direitos em primeiro plano.

Palavras-chave: aplicativos menstruais; diversidade sexo-gênero; gênero binário; feminismo de dados; justiça no design.

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My body is mine: menstrual apps and the sociotechnical normalization of gender

Menstrual tracking apps are among the most popular in the health category, with more than 500 million downloads worldwide (Rampazzo et al., 2021). The women's health sector of the technology industry is expected to reach a value of 50 billion dollars by 2025 (Ramírez, 2021). Like other applications, they facilitate the recording and analysis of users' state of health by collecting their data. It is true that the use of these applications makes it easier for users to monitor their menstrual cycle. However, from a fair design perspective, we argue that they should be subject to scrutiny, as they involve data collection and algorithmic mediation processes and their design and functionalities reproduce binary, heteronormative conceptions of gender (Costanza-Chock, 2020). Menstruating people[1] may use apps to monitor their health, but they are not necessarily aware of the datafication and self-quantification practices (Swan, 2013) associated with the business model of surveillance capitalism (Zuboff, 2019).

Epstein et al. (2017) highlight five main reasons why people track their menstrual cycles: to increase their body awareness; to better understand their body cycles; to prepare for menstruation; to try to get pregnant; and to communicate observations to their medical care providers. However, the anticipation of body behavior based on data analysis and algorithmic prediction also responds to another logic. These applications have the general purpose of predicting the approximate dates of the next menstrual cycles, ovulation, fertility, and expected days of PMS (premenstrual syndrome), but they do not always interpret their data accurately. For this reason, it is relevant to analyze how, from their development, their algorithms incorporate biases or hegemonic ideas about what menstruation is and is not, as well as how people experience it. Similarly, in terms of their design, we are interested in exploring how app functionalities reproduce binary and hetero-normative ideas about what it means to be a menstruating person. Finally, we are interested in exploring the manifestation of body datafication pro-

[1] For the purposes of this work, a menstruating person is understood as any person with a uterus and whose health conditions allow them to menstruate, regardless of their sex assigned at birth or the gender with which they identify.

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cesses and of the processing of that data. To address that problem, we analyze the sociotechnical construction of gender in menstrual tracking applications, as well as their algorithmic biases and the datafication of bodies, based on their users' perceptions. The question that guides the study is how, by means of their design, functionality, results, and data management, menstrual tracking applications construct a gender notion.

This article is structured as follows: first, we present a review of the critical literature related to the use of menstrual tracking applications, based on the categories defined in our model of analysis: design, functionality, and privacy. Then, we describe the method used for data collection and, finally, we present the results and discussion. Our findings account for the sociotechnical construction of gender in its different dimensions and the discomfort of users with the ways in which this construction materializes in applications, as well as the opacity of their data management.

A feminist approach to the design of applications

Among the critical studies on menstrual apps, Della Bianca (2021) analyzes the different dimensions that intersect the problem of menstrual monitoring. In her view, applications promote a very specific relationship with the body and the people who use them. Menstrual and fertility monitoring can, on the one hand, be a mechanism of resistance to the pathologization of female bodies and, on the other, reinforce their role within the neoliberal hegemonic scheme under the perception that they are responsible reproductive people. The author proposes a reformulation of menstrual and fertility monitoring that focuses on social justice and on the recognition of experiences that are usually overlooked. In that way, technologies can include a feminist approach so that users are agents with the possibility of constructing and deciding on their bodies. This implies considering aspects such as the hierarchies of power related to racism, ableism, and discrimination towards sex-gender dissidence that are reinforced by technology (Della Bianca, 2021).

Although this type of tools can empower people by enabling the knowledge and recognition of their own body (Ford, Togni and Miller, 2021), it is necessary to identify when this empowerment occurs with regard to conventional regulations and modeled by the neoliberal market and by surveillance capitalism. If, on the one hand, users can resort to these applications to improve their quality of life, on the other, menstrual cycle management can result in pressure to feel good within a social context that is defined between dualities: subjective vs. objective, good and bad, illness and health, the individual and the social, medical and the non-medical.

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Amid these tensions, the user tries to define and standardize the complex and variable process of the menstrual cycle. On the other hand, the fact that menstruation has been socially pathologized generates an apparent need to regulate it and to have control over what revolves around it, which leads to self-monitoring practices (Hohmann-Marriott, 2021).

Design and gender binarism

Research on the binary construction of gender in technological development seeks to account for how social conceptions such as binarism and heteronorm, as well as cultural values and modes of interaction materialize in technology (Bivens and Haimson, 2016). Trans researcher Sasha Costanza-Chock (2020) analyzed how the algorithms of body scanners at airports are biased. People inhabit a world in which software dictates how they should identify themselves, what their identity means, and their limits in social practice. Binary gender categories hinder the possibility of a viable social life for people who do not fit into this identity construction. In the case of menstrual apps, the binary construction of gender is expressed by their feminized design, the standardization of the menstrual experience, the pre-eminence of the reproductive function of menstruating people, and the stigmatization of menstruation.

In menstrual apps, there is a prevalence of elements associated with the stereotype of femininity. According to Ford, Togni, and Miller (2021), menstrual apps have been criticized since their inception for making heteronormative assumptions about users and for following the femtech mantra that "pink it and shrink it", whereby companies adapt male products to female consumers by making them smaller, more colorful and "girlish". In other words, many are developed based on heteronormative assumptions not shared by people with menstruating bodies who do not participate directly in their design. These design elements have to do with physical appearance (beauty, clothing, physical attributes) and women's behavior in society (ways of speaking, ways of being, values and attitudes). This design assumes that the users are women and links them with colors such as pink, purple and white, referring to purity, innocence and vulnerability. Likewise, they feature symbols such as flowers and hearts, suggesting delicacy and the emotionality associated with femininity. They do not allow for identities outside the gender binary, where associations with the feminine change.

Menstrual applications standardize the experience of menstruating people. They are designed under the premise that menstruating people have regular cycles, that is, with a duration of 28 days and where ovulation occurs on day 14 (Wors-

fold et al., 2021; Grieger and Norman, 2020). However, of the 1.5 million people who use the "Flo" app, only 16% have a 28-day cycle, and around 13% ovulate on day 14. In another study, it was found that 54% of apps only use calendar dates to make predictions and do not consider other elements that may alter the cycle, such as basal body temperature, changes in cervical mucus, or the luteinizing hormone.

The design of menstrual apps is based on the premise that menstruating persons must fulfill a reproductive function. In addition to reinforcing associations between menstruation and femininity, their "pinkified" design also reproduces stereotypes regarding reproduction. Levy (2020) points out that many menstrual monitoring applications tend to present sexual intercourse as a main component, linked to reproductive desires, thus excluding people who are not heterosexual or cisgender, as well as those who do not have sexual relations and use the applications for other purposes.

These apps reproduce the stigmas associated with menstruation. The menstrual function is conceived as a taboo, something that must be hidden or is an object of shame for women. Lutz and Sivakumar (2020), who studied a sample of university women in the United States, reported that most users prefer features that allow them to hide their use of this type of technology. The design of the applications or its interface promote "discretion" and the idea of "managing" the situation, reinforcing prejudices about menstruation and making it difficult to understand it as a natural biological process.

Functionality, algorithms and heteronorm

Due to their social nature, as "part of broader rationalities and ways of seeing the world" (Beer, 2017), algorithms can be understood based on the social values and biases associated with their design and deployment. Algorithmic models determine their results from instructions that are encoded by human actors who are themselves inscribed in specific social contexts. Thus, the codes that govern the application algorithms materialize normative behaviors that are used as input data that do not necessarily correspond to the series of behaviors that are monitored (Gómez Barrera, 2018). Some examples of these tensions between the algorithms and functionalities of menstrual apps are the lack of precision in their predictions, the congruence with their purpose of use, and the ways non-heteronormative persons are represented by them.

Prediction inaccuracy refers to the extent to which applications can correctly predict the fertile, infertile, and bleeding days of users who do not have regular menstrual cycles (28 to 30 days), based on the data they collect. The analysis of

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various applications has shown that their predictions can have a large percentage of error (Zwingerman, Chaikof and Jones, 2019). Error, due to the equivocal nature of the algorithms, is constitutive of the functioning of the applications.

Apps should present users with different possible purposes for menstrual tracking (reproduction, contraception, medical purposes, etc.). The algorithm is expected to be faithful to that choice in terms of the type of information or functions it enables. This implies that the application does not favor one type of goal over another. However, application algorithms privilege certain purposes associated with reproductive obligations, resulting in a negative experience for those who do not fit this pattern (Hohmann-Marriott, 2021). This limited vision about the management of menstruation and fertility rules out other objectives, as well as diverse representations of women's life course, their intimacy, and their sexual life, which may or may not be heteronormative (Holst et al., 2022).

The design of menstrual apps assumes that their users are girls and women who share a single life experience. However, menstruating persons are characterized by living biological and social processes that give them different life experiences (Pichon et al., 2021). Fox and Epstein (2020) showed that applications make binary predictions and do not allow people to model them in case they are inaccurate or to seek to adjust them to their own life experiences.

Privacy and agency

Turégano Mansilla (2020) describes the problem of privacy in the digital environment as something that goes beyond the control of personal data. The growing datafication of social life means the increase in the volume of data collected and new possibilities for its access, treatment, dissemination and commercialization. The misuse of data can operate in an opaque way. In the case of menstrual apps, four aspects are problematic: the type of data they collect; the accessibility of their terms and conditions; the transfer of data to third parties; and agency over data.

- Type of data collected. The amount and diversity of data collected by applications are extremely wide.[2] Parameters include: identification information (name, email or cell phone, location); body data (weight and height); medical conditions; data on lifestyle and consumption habits; emotional states; and

[2] For a graphic sample of the type of data collected by menstrual monitoring applications, see Coding Rights' Menstruapps project, at: https://chupadados.codingrights.org/en/menstruapps-como-transformar-sua-menstruacao-em-dinheiro-para-os-outros/

intimate information such as the frequency of sexual activity; condom use; position and firmness of the cervix up to the date of the last sexual intercourse; and whether this was with or without the use of contraceptives; the type of bleeding and/or pain experienced in the cycle; among other symptoms (Hohmann-Marriott, 2021). Since those are sensitive pieces of data,[3] it must be identified whether or not the platforms guarantee the full protection of data or if it is shared with third parties for other purposes. Lastly, data that is collected from the person outside the application (web searches, profiles in social media, etc.).

- Accessibility of the terms and conditions. It refers to the ease with which users can locate and access the content of the terms and conditions,[4] as well as that they are readable and understandable. The terminology used in the writing of the text must be clear. Terms of use and privacy policies often contain obscure language that makes it difficult to understand. Likewise, they usually include a warning about how people use app services "at their own risk" and are presented as "without any guarantee", limiting company responsibility. Thus, use of data different than the one that users had planned is legitimized (Hohmann-Marriott, 2021).

- Explicit mention of the use of data and permissions to third parties. The use of data and the permissions related to data access by other companies must be made explicit, stating what data is specifically shared, to which companies, for how long, etc. It must show prominently and not be placed down below in the terms and conditions. According to a study, 17% of health-themed apps share people's data with third parties (Kwong, Ramírez and Cirino, 2021).

- Agency over data and data control. Anonymity is considered one of the most relevant aspects within the menstrual monitoring process (Levy, 2020). Fowler, Gillard and Morain (2020) report that the expectations of users of menstrual applications regarding the privacy of their data are frequently not

[3] According to the Federal Law on Protection of Personal Data Held by Private Parties currently applicable in Mexico, sensitive personal data are those that "affect the most intimate sphere of its owner, or whose improper use may give rise to discrimination or entail a serious risk. for this one" (Chamber of Deputies, 2010).

[4] In this study we do not distinguish the policies by level of accessibility, which is a limitation. However, we agree with the suggestion that a useful proposal to identify accessibility levels could be: 1) if the privacy policy can be accessed from the application library (App Store or Google Play); and 2) if the privacy policy can be accessed from the application itself.

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aligned with what is stipulated in the appçlication's Terms of Use and in the Privacy Policies. Applications can violate privacy, specifically in cases where gender dissidence or situations such as the interruption of pregnancy play an important role (Hohmann-Marriott, 2021).

Method

The study is based on a qualitative analysis of semi-structured interviews with young menstruating adults from Mexico City between 18 and 25 years of age. To identify users of menstrual tracking apps and the most frequently used apps, an initial survey was carried out with a questionnaire distributed online. Fifity people participated in the preliminary survey, of which 32 were subsequently interviewed according to the inclusion criteria. The interviews were analyzed thematically using the MAXQDA software. The inclusion criteria in the study were defined based on the following criteria: (i) being of legal age; (ii) menstruating; (iii) owning a smart device and internet connection; and (iv) having used an app to monitor their menstrual cycle in the last three months.[5]

This cut implies a bias toward privileged populations, given the existing digital divide in Mexico. The interview was structured around three themes: (i) design based on interface characteristics; (ii) functionality based on use (objective, efficiency, reproduction of stereotypes); and (iii) privacy based on the use of personal data. Participants were informed of the purpose and characteristics of the study, their informed consent was requested, and participation was anonymous.

Each of the categories above was evaluated according to the following parameters:

Binary design

Stereotypes

- Predominance of graphic elements such as: flowers, hearts, smiley icons, stars, butterflies, among others;
- App logo colored in pink, purple or white.

[5] For the purposes of this research, use contemplates that the user has the application installed on one or more devices, in addition to having interacted with it for at least three months in which menstruation occurs.

Stigma

- Alerts and advice regarding one's appearances, keeping one's spirits and ensuring that the bleeding (or anything related to it) does not show.

Usage bias

Algorithmic precision

- Number of successful predictions in the last three months about: fertile days, infertile days, bleeding days, ovulation.

Purpose of use

- Possibility to choose the purpose for use of the app and to display personalized content based on that;
- Not prevalence of reproduction alerts.

Representation

- Inclusion of diverse gender categories at signup and in the app's various functionalities;
- Inclusion of heterosexual and non-heterosexual relationships in preferences.

Privacy

Readability of the terms and conditions

- Willingness to read policies;
- Use of simple and easy-to-understand semantic structures;
- Use of familiar vocabulary and non-specialized terms.

Personal data care

- Interest to know about it;
- Concerns or doubts about data;
- Explicit mention of data protection and management;
- Explicit mention of third-party involvement.

Perception of targeted advertising

- Amount and type of fed information (mood, symptoms and discomfort, daily routines, use of contraceptives, etc.);

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- Perception of the number and types of ads presented on various platforms at particular times in the cycle;
- User behavior and consumption patterns.

Analysis and results

Among our interviewees, the menstrual tracking app most used was Clue. [6]Other apps mentioned included Flo, Period Tracker, Eve and the iPhone Health app. The applications, all developed abroad, have different approaches to privacy, depending on the regulations of their development contexts.

Interviewees have used the application for an average of 4.2 years. The person who has used the application the longest has done so for 11 years and, the least, three months. In other words, users have made extensive use of these applications and have extensive knowledge about their functionalities and general characteristics. This fact that interviewees continue to use the applications, despite their flaws, suggests they find a value in them. They responded that their main objective in using the app is to use the calendar for menstrual tracking. Among other functions, they mentioned: the prediction of bleeding days, the analysis of symptoms and moods; and knowing their ovulation days and fertile windows. They started using the app, to a great extent, due to the recommendation of a family member or close friend. Other reasons include its availability in the download catalog; ads on social media, on the internet or an influencer's recommendation; the need to keep track of menstruation in a practical way; an intuitive, visual design; and finally, its being built on the respondent's cell phone.

Design

The design of the applications is relevant to the user experience. Interviewees pointed out that the apps' simple and direct graphic elements facilitated their use greatly, as well as the recognition of each of its elements. While binary respondents were generally satisfied with the design, non-binary interviewees indicated that they were not completely satisfied. Regarding the latter's observa-

[6] Since this app is of German origin, its privacy policies are governed by European data regulation. The Eve application is governed by less strict data protection policies. https://chupadados.codingrights.org/en/menstruapps-como-transformar-sua-menstruacao-em-dinheiro-para-os-outros/

tions, one non-binary interviewee mentioned not being satisfied with the application's aesthetic design. While they agreed that the graphics were well designed and practical, they mentioned aspects that made them uncomfortable regarding their own identity.

Despite a consensus about the applications being well design, the issue of femininity was highlighted in the interviews as an element of non-conformity. In the first place, menstruation was reported as a women's process. One of the interviewees pointed out: *"All the images represent a heteronormative woman, so I think it is quite influenced by this gender image that we have, right? which is that only women can menstruate."*

The issue of motherhood is another aspect also present in the design. Specifically, users are uncomfortable with the rabbit icon when registering their sexual activity since, socially, it is related to the idea of procreating, and they feel that the application seems to impose the idea that sexual relations have that sole objective: *"It's not cool, because not everyone has sex to have children"*. They consider that these types of graphics are not consistent with the idiosyncrasy of current generations: *"there are elements that are like ideals... like for ideas of the past."*

Another problematic design element is color. In applications, pink is used as a universal color, a color socially assigned to women. This discomfort is present among non-binary respondents, but also among those who identify as cisgender women. For example, one interviewees pointed out: *"it does have a very marked stereotype and everything looks like that, very pinky"*, while another, when talking about the logo, said: *"that would be like a super cliché of a woman"*. Although most women said that pink was not a completely conflicting aspect for their particular cases, in many cases, the interviewees confirmed that the design tended to be completely feminine. This was reflected in the use of expressions such as *"it becomes the norm" and "it is very hegemonic"*.

In addition, an attitude of resignation towards feminized design was observed, both among women and among non-binary interviewees, as they mentioned that it is a normalized practice that will not necessarily change. However, in the case of the Clue application, interviewees agreed that it is the application friendliest to diverse profiles and, in terms of design, more neutral. The use of white and red colors as the first option before pink and that it does not have images of flowers or elements related to menstruation is positively valued, as this makes it not as flashy and potentially aimed at a more diverse group of users.

The experiences of trans people or those who seek to distance themselves from conventional femininity take issue with how applications make them uncomfortable or encourage their exclusion and promote normative discourses around gender. In the words of some research participants:

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> *It was very strong in stereotypical femininity, and I feel that it can be painful, harmful, and confusing for people who try to get away from that concept and continue to menstruate.*
>
> *For people who are trans, for example, men, I imagine it must be a joke. First, struggle [against] social pressure. Then, well, your period to go on happening, because, in the end, your biological sex is female, so I feel that it is edited for women who identify as women, not for all genders.*
>
> *[The app] is being aggressive with these messages about how femininity should look and feel like. Perhaps because many of these people do not even download applications like this, precisely because of the design and because everything is focused.*

In addition to the colors, the illustrations also tend to reflect hegemonic conceptions, for example, showing people with physical features, haircuts and clothing that are traditionally female, couples involving only people of the opposite sex, among others. Design neutrality could be achieved by offering customization options for users to express their diverse identities. Some interviewees mentioned that it would be useful and more comfortable to be able to modify some of the colors, icons or backgrounds, in a way similar to avatars in video games or mobile phone wallpapers.

Likewise, phrases, alerts and news tend to be "feminized": *"what is not cool is that when you talk to the little person, it speaks to you as a woman, as if that is already assumed"*. This type of message is especially prevalent with regard to the menstrual period and by mentioning "girls only" experiences. In turn, by their discursive construction, the applications perpetuate the idea that menstruation should be a private matter. On the one hand, they include motivational phrases that encourage menstruating persons to maintain a positive attitude and behave "as if nothing were happening". Although, for many in this case, it can also be harmful to those who suffer from the process. On the other hand, they present compassionate comments, alluding to how tedious and difficult it is to cope with menstruation, which, according to one participant, conveys the message that it is something negative and should be hidden. An inconspicuous design and the fact that oy does not suggest a relationship with the menstrual cycle is what makes women choose one app over another. Faced with this situation, another interviewee added that a demure design responds to negative social conceptions about the subject and pointed out that *"menstruation should not be hidden either,"* but rather normalized.

Other biases that intersect with gender have to do with the overrepresentation of white women with thin bodies. One interviewee stated: "I'm not going to look

like this because I menstruate." She also questioned whether the applications are accessible to people with disabilities. Likewise, another interviewee added that the applications reinforce established canons of beauty even during menstruation because, with icons such as a peach to represent the skin, they rule out the experiences of people who could have some symptomatology related to it. *"Saying, 'no, it has to be okay' (...), they make you fulfill a stereotype, I feel, or they make you feel like you're wrong."* The "whiteness" of the applications is another element that is associated with the fact that these technologies, developed in countries of the global north, are used by racialized populations that do not share the same physical traits.

Features

The features offered by menstrual tracking applications are varied. Among the ones most used by interviewees are the calendar; the cycle and symptoms track; predictions of coming menstruation dates contraceptive methods; personal lifestyle; hormonal alterations during menstruation; ovulation; fertile windows; menstrual cycle analysis; and sexual activity track.

In general, users mentioned that the applications met their usage needs, which largely consisted of using the calendar to track and obtain predictions about their menstrual cycle. Unsatisfied users noted that the applications do not meet their expectations and that they do not feel comfortable with their results or with their business model. For example, they mentioned that it is impossible to record certain information, such as sexually transmitted diseases or that you must pay for more information.

The application's insistence on purchasing the Premium version to access more features is considered a major restriction. An interviewee pointed out that she could not access certain content that interested her because she did not have the full version, which bothered her. Other testimonies point out that services related to sexual and reproductive health should not be expensive but could be free and support public health.

As for the functionalities associated with sex-gender diversity, the applications do not allow personalizing the gender with which each person identifies or the different types of sexual activity, and even present themselves as elements "for all women". In the words of one interviewee: *"I don't think it's a friendly thing because… It never asks you how you identify or what your gender is, nothing like that… It kind of assumes… women"*. However, some interviewees shared the opposite experience. They pointed out that within the informative articles section

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of the application, there was an exclusive section for the LGBTQIA+ community, and they consider this a very positive factor for the user's experience. Even those who do not consider themselves part of the community stated that they identify few sites where there is information on topics such as pregnancies of trans men and non-binary people, myths about bisexuality and the relationship between menstruation and hormone therapy, among others. However, some interviewees commented that this content was again restricted because it was necessary to have the PRO version, which they perceived as a half-inclusion. As an interviewee pointed out, *"they somehow limit certain knowledge, especially in this aspect."*

Thus, among the functions that menstruating people would most like to see implemented in the application they use is the dissemination and strengthening of communities of menstruating people that can be created within the apps. It was mentioned that the use of forums had been very helpful to go through the experience of menstruation and looking for people with whom to identify: *"It helps you feel less alone (...) I feel that through the Internet we can enrich our passage through menstruation"*. Likewise, non-binary users assure that asking the user's pronoun of choice at the beginning of the signup process, in a way that at least the messages do not refer to female users by default, is important so that the inclusion efforts of the applications are noticed. They consider it valuable to include a section dedicated to gender dysphoria, where one could keep track and have related tools. Finally, one interviewee perceived that the process could be more humanized. She added a comment about how the interactions between people and the application are interpreted; she said that she would *like "not to be an entity that the app is tracking, but to be able to make more decisions with the help of the app"*.

Algorithmic biases

Errors are recurrent in the predictions that the applications offer. That is because the algorithms work better if the cycles are regular. Half of the interviewees in our study reported having an irregular menstrual cycle. Of these, 90% are not satisfied with the app's prediction performance. The applications take the last three periods to calculate and predict the next one; however, this system does not seem to be adjusted if the cycle is not regular*: "What happens is that it changed, you as a woman are changing all the time and sometimes [the app] does not do it along with you…"*. Participants agreed that the application is designed for women and people that have or tend to have regular cycles, and that it was in those cases where it really performed well and could mark the days with greater accuracy: *"Yes, the predictions can improve, but at least they have noticed that about the*

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loss of the cycle. And sometimes it's horrible because they tell you that you've stopped menstruating...you go to the bathroom, and you're stained. And that's ugly, really." Some also mentioned that sometimes failed predictions discouraged them from continuing to use the platform or made them feel like there was something wrong with their body or their cycle because their circumstances did not match those shown on the application.

Although, in most cases, people use the app only as a calendar, the app sends additional notifications and messages to users. A number of interviewees claimed to have received unsolicited messages with the intention of gestating and conceiving a baby, their possible fertile window, breast examination or notifications to obtain the "PRO" version of the program. That was reflected in comments such as: *"I mean, when I go in, it tells me 'it's a possible fertile day.' And I didn't even ask that."* or *"The first year I did receive notifications and I remember that one said, 'time for a breast exam'... it made me feel strange"*.

Finally, the record of bleeding in the applications does not seem to be a problem for the interviewees, since it is approached in a neutral way, and it allows feeding–or not–the information that one considers necessary. It is important to mention that almost none of respondents use other menstrual tracking tools in their daily life; they depend more on the tracking and prediction that these applications provide.

Privacy

Privacy is a complex issue in this type of health application. For users, the adequate handling of personal data by the application is not considered a relevant criterion for downloading it. The choice depends on reviews by someone they know or the app store. Some interviewees mentioned that they do not care about how the platforms use their data; that is, they have no concerns or opinions regarding the management of their information, since their greatest interest is to access the content and/or services offered by the application. Only one of the participants answered that she does read the privacy policies carefully, but she emphasized that it is because she studied Law. According to one testimony, unless a person is immersed in that area of study, it is practically impossible to fully understand the terms that are being accepted. Another of the interviewees added: "It's a lot, a lot of text."

A perception shared among the interviewees is that the type of data they record in the application does not put them at risk; that is, they consider that it does not imply a threat to their privacy. *"It is important to protect myself, but I know*

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that data is used as a method to sell me things", one interviewee commented; and another one:

> *Evidently, we are at a point where that is something very important, and corporations and many people make money with; people's data...many times, I do end up saying that the truth is that I am not such an important person, my data is not that important, the things that I put in this application are not that important.*

The fact that there are limited options in terms of privacy creates a degree of disempowerment. Interviewees mention that what bothers them the most in matters of privacy is the impossibility to refuse. That is, if they need to use any application, whatever the policies say, they will be forced to accept them in order to access the service. Respondents expressed that they are in a conformist position, since they do not see what else they could do regarding the situation of their personal data: *"Well, I think it is something inevitable. And yes, be aware of what you are accepting when you are entering an app that asks for your data and tracks your information".* All interviewees agreed that it is inevitable that their data will be used without their being aware; Thus, they were disappointed by that lack of possibilities of action. One interviewee even added that she has not had good experiences sharing her data: *"I mean, I always prefer to give a minimum because I don't want anything to happen. I have had many cases in my family where their identity is stolen and there are children, so I avoid putting the least possible information."*

Finally, nobody is totally sure how third parties are using their data. Interviewees are generally informed by something they read or saw in a documentary, but very few come close to the privacy notice or have close experiences in this regard:

> *Well, part of it scares me because I don't know 100 percent what they can do with that information. (...) I don't feel attacked, I don't have any problems, but then yes when I download, if I am very, very, very careful (...). So, for me, the applications that later have some reference from another person, like I say, 'ah, yes, it is safe'.*

Two interviewees indicated that they read news about their preferred application where it was confirmed that they sold user data to third parties for marketing purposes, which was a major issue of conflict for both. However, none had looked for alternatives. Another one said that she is skeptical about and mistrusts the ap-

plications she uses: *"I have it on the same level as Facebook, like all applications, and I have Facebook in a very low regard."*

Discussion

The results of our research corroborate that menstrual tracking applications' design, functionalities and predictions are based on a binary conception of gender. They reinforce a conservative and homogenizing conception of femininity that causes discomfort to users, whether or not they are binary (Fox and Epstein, 2020; Hohmann-Marriott, 2021; Pichon et al., 2021). This standardization of the conception of the menstruating person ignores users who do not identify as women. It also ignores the diversity of life experiences that do not respond to the design decisions, functionalities or predictions offered by the applications. From a fair design (Costanza-Chock, 2020) perspective, the inclusion and visibility of dissident sex-gender identities and diverse sexual orientations is important in the design of the application's interface and functionalities. In other words, non-binary people, transgender men and non-heterosexual women, among others, must be included within the basic categories of use and accessibility of the application, as well as allowing a certain level of personalization according to the user's profile. In addition, the applications must consider that the users belong to diverse social, cultural, ethnic, age and ideological groups.

Conclusions

The analysis of users' perceptions regarding their experience using menstrual tracking applications shows problems directly linked to the normalization of binary conceptions by technology, gender biases, and effects on users' privacy.

As for design, hegemonic female representations have been generalized and normalized. The design of the applications usually includes colors such as pink, purple and red and is accompanied by graphics such as flowers, hearts and happy icons, all aspects considered characteristic of what is socially accepted as feminine. The design symbolically assumes that the only bodies that can menstruate are those of women, further reinforcing the gender dichotomy. We found that these symbolic expressions are deemed violent by some people. The reproductive function is also a female stereotype reinforced by the symbols and icons used in some applications. The study found that some apps still use symbols that are perceived to represent a heteronormative and binary view of gender.

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The main functionalities used are the calendar and menstrual cycle predictions. The rest of the functionalities receive little or no attention. Likewise, the study showed that most interviewees are comfortable with the range of functionalities available within the applications. Finally, a considerable number of the interviewees perceive the "premium" functionalities offered by the apps as something useful but inaccessible due to the cost they entail. Regarding the algorithm, this study revealed that the applications cause greater satisfaction to those with a regular cycle, since they tend to offer more accurate predictions to them.

In terms of privacy, only one of the participants stated that they carefully read the privacy policies. In none of the cases was privacy protection considered a requirement to install it. However, the study shows that people do know the different ways in which their data can be used; they are simply in a passive position because they do not see feasible solutions that they can carry out individually and practically to protect their personal data.

Our analysis shows the heterogeneity of perceptions regarding the apps and the complexity involved in identifying more specific aspects, closer to the users' experience, as well as the gender assumptions behind the development of menstrual monitoring applications. Based on this study, we suggest that the design of applications for menstrual monitoring should consider the experiences and needs of menstruating people in their diversity. A design based on justice must start by approaching menstruating people to improve their experience and their quality of life. Lastly, privacy issues require an in-depth treatment in the development of applications that use sensitive personal data so that they can make informed decisions about how to handle their data and know the implications of how their data is handled. We hope this contribution will broaden the critical debate around the sociotechnical construction of gender.

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