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Time in social media applications: a definition and a tool to analyse technological affordances of time

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Digital temporalities have been studied in depth from the point of view of how a user perceives them. However, a systematic analysis of how social media apps generate certain temporal experiences is still needed. The purpose of this paper is to analyse how social media applications structure the experience of time. To do so, we first propose a set of characteristics relating to time in digital media based on the literature; second, we design and validate a new system of analysis that allows the evaluation of the technological affordances of time in social media applications. The tool has been validated on a test sample of four social media apps (Facebook, Instagram, X (Twitter) and TikTok) proving that it is useful for evaluating if the apps include the five temporal characteristics identified: autonomy, uncertainty, eternity, expiration and fragmentation. Results confirm that the set of characteristics can be found in all the social media applications analysed showing a distinctive trend: uncertainty and autonomy have the greatest presence, and expiration the lowest.

KEYWORDS

time, social media, mobile apps, technological affordances, system of analysis

1 Introduction

Social media platforms have evolved from being just products to becoming a social phenomenon: 62.3 percent of people globally are using social media (Statista, 2024b) during an average of 151 min per day (Statista, 2024a). The adoption of these platforms into our day to day has been promoted by how the products have been designed (Orlowski, 2020) impacting our lives notably. Social media companies generate a large amount of their revenue from targeted advertising so, to a big extent, their success relies on the users using the application more often and for longer periods of time (Ytre-Arne et al., 2020; Lupinacci, 2020). To achieve their economic business goals, these applications have engagement mechanisms to change the user's behaviour with the end goal of turning the use of their product into a habit (Chun, 2017; Eyal, 2014). As Lupinacci (2020) describes in her work, social media apps generate a sense of a continuous unpredictable flow that produces unsettling sensations in their users. That forces users "to always expect the unexpected," keeping them hooked with the "Fear of Missing Out" and feeling the need to always be connected. In that sense, Vorderer et al. (2016) also refer to a psychological state in which even when not using the mobile phone, the user is permanently vigilant waiting for something to happen. The cue of events that happen in this flow are external to the user's action. Instead of the user triggering the events that happen in the app like in a text or image editor, it is the app with automated mechanisms and algorithms that generates and customizes the rhythms to every user by showing specific content or personalized actions. In this field, Artificial Intelligence (AI) has turned out to be an extremely

powerful tool since it allows the apps to offer the targeted content to the right user at the right moment (Lupinacci, 2024). This level of personalization is what Carmi calls *rhythmedia* (Carmi, 2020), which enables the app to increase the chances of getting the user's attention. As Eyal describes in his engagement model (2014), creating a flow of events that finds the proper balance between information that is interesting for the user and other information that it is not will increase the engagement of the user with the app by adding uncertainty to the constant flow of events. Although the same concept of flow can also be found on broadcasting, the main difference is that in that case it is a "planned flow" which is universal for all the users - including the distribution of both content and ads (Williams, 1974).

These ideas relate perfectly with the concept of Liquid Modernity (Bauman, 2010) which describes a society where continuous change is the new paradigm. Stability has been replaced by a constant flow, where surprise, interruption and incoherence are at the heart of our lives. This is reflected in the dynamic, fragmented, and personalized content of social media, which exemplifies the mechanisms used to drive user engagement (Lupinacci, 2020; Vorderer et al., 2016; Carmi, 2020; Eyal, 2014). As a result, the experience of time itself has been reshaped to encourage users' desire to engage with these platforms. Terms like "timeless time" (Castells, 1996) or "pointillist time" (Maffesoli, 1990; Bauman, 2010), highlight the perception shift from the homogeneous and sequential chronological experience of time of the clock, to a cumulation of disordered and isolated temporalities, which turns the experience into an individual one, as a collective narrative is missing (Wajcman, 2016; Harvey, 1990). Information and Communication Technologies (ICT) have an important role in this cumulation of fragmented and individualised experiences (Weltevrede et al., 2014; Leong et al., 2009), especially mobile phones, since they are everywhere (Ling, 2012; Kaun and Stiernstedt, 2014; Vorderer et al., 2016). This study aims to broaden the scope of research on digital temporalities, with a particular focus on time in social media applications and its impact on the users behaviour.

The aim of this paper is to facilitate the analysis of time in social media applications by developing a new tool to: (1) evaluate how the experience of time is constructed within these platforms, and (2) increase the knowledge and control we have of temporal design on applications and its impact. To do so, the new tool allows the analysis of the technological affordances of time in the apps, also known as temporal affordances (Tenenboim-Weinblatt and Neiger, 2017). Specifically, we want to understand how the sense of the continuous unpredictable flow that Lupinacci (2020) identifies as perceived by the users on social media is created through the app's design. To achieve this goal, first, we propose a set of characteristics of time in social media applications based on the literature review; second, we design a system of analysis to evaluate the technological affordances that build the experience of time in social media applications; and third, we apply and validate the tool by testing it on four social media apps, the most used (Statcounter, 2024): Facebook, Instagram, X (Twitter) and Tiktok. Although previous research has examined time in social media through case studies (Kaun and Stiernstedt, 2014) and proposed ways to categorize platforms based on their design (Zhang et al., 2024), there is still a lack of a systematic tool for analyzing how temporality is designed. This study is relevant because it allows us (1) to identify and confirm a set of characteristics of time present in social media applications; (2) to propose the first attempt of a definition of social media time and (3) to provide researchers and professionals a new tool to analyse time in social media applications in a systematic manner.

2 Time in social media applications: a literature review

Although an agreed definition of time in social media is still missing, existing research has pointed out some characteristics of the temporalities that can be found in these applications. Since the number of studies related to applications and specifically social media temporalities is still modest, studies that speak more generally about time in digital media have been also included, since they help to understand the context. With the aim of making the information easier to understand, the attributes of time found in the literature review have been grouped into five main characteristics: autonomy, uncertainty, eternity, expiration and fragmentation (see Table 1).

The first concept is the *autonomy of time*. Jordà (2008) and Sora (2016) refers to it to explain how media time moves forward without the need for any user interaction. This concept is similar to the "planned flow" described by Williams (1974) when talking about broadcasting, where the users can neither directly influence the content that is displayed. In both cases, a temporal continuum is created since the content is available without the need of direct human interaction. The main difference among these two cases is that broadcasting has a universal flow which has been previously defined for all the users. Personalization is not feasible in this case, therefore it could be argued that the system has less autonomy. Instead, digital media offer the possibility of showing the right content at the right time to each user (Bucher, 2020; Jacobsen, 2022; Carmi, 2020) thus increasing the personalisation of the products, thanks to the data that companies hold and by using Artificial Intelligence over it (Lupinacci, 2024). The autonomy of the system is reflected in the fact that users do not need to search for any content because it is brought to them. In contrast to the definition of flow defined by Csikszentmihalyi (1990), the user does not need to be immersed in the virtual world in order to experience the temporal continuum. That is, if the users only interact for short periods of time or receive all the updates after a long time away from the system, they will still perceive that the time of the application was ongoing, it did not stop despite them not using the app. The temporal affordances that make the autonomy of the system tangible are implicit interactions (Ju and Leifer, 2008) that could either be visible (for instance when the feed is being updated or a system notification when a user is not using the app) or invisible (such as saving images used in a specific app to the mobile phone automatically) to the user. Such temporal autonomy is amplified in globalized networked systems, creating overlapping and compressed temporalities reflecting a societal acceleration (Hassan, 2003; Rosa, 2013).

On top of that, Ytre-Arne et al. (2020) also point out how these interactions have an inherent sense of uncertainty, since it is impossible to know when they will appear. Therefore, *uncertainty* is the second characteristic of time that has been identified within the literature. As well as regarding uncertainty as a surprise or interruption, uncertainty can also be linked to how the user perceives a reward from the application (Eyal, 2014). For instance, the users can

TABLE 1 Characteristics of time in social media apps.

Characteristic	Definition	Authors
Autonomy	The application evolves without the user intervention by generating interactions proactively.	Sora (2016), Jordà (2008), Ju and Leifer (2008), Williams (1974)
Uncertainty	A reward is generated as a result of an action performed by the user on the product, but the time at which it is received is uncertain.	Ytre-Arne et al. (2020), Lupinacci (2020), Ju and Leifer (2008), Eyal (2014), Schüll (2012)
Eternity	A final goal is missing. There is no beginning or end, but a flow of constant changes.	Kaun and Stiernstedt (2014), Schüll (2012), Lupinacci (2020), Coleman (2020b)
Expiration	Content expires, so it's important to see it the moment it is published. Immediacy, ephemerality and even forgetting the memory or archive are predominant. The present prevails.	Kaun et al. (2016), Keightley (2012), Kaun and Stiernstedt (2014), Weltevrede et al. (2014)
Fragmentation	There are multiple temporal flows that appear disordered and isolated between them. That makes the experience individualized because it is unrepeatable. It also means that a collective narrative or global time is missing.	Kaun and Stiernstedt (2014), Maffesoli (1990), Bauman (2010), Melucci (1996), Carmi (2020), Weltevrede et al. (2014), Manovich (2012) Leong et al. (2009), Lupinacci (2024)

Source: own elaboration.

check the content of a social media feed but they do not know at which moment they will find content that is of interest to them. The fact that uncertainty is associated with time in applications makes it more difficult for the users to control the time they spend using them. That is because it triggers the user's "fear of missing out" (FOMO) and makes them feel like they are in a constant state of vigilance waiting for something of interest to happen (Vorderer et al., 2016).

The third characteristic identified has been *eternity*. Different studies analyse how the present time is prevailing over the past and future in social media apps, to such an extent that the latter might disappear behind a permanent present (Kaun et al., 2016; Keightley, 2012; Kaun and Stiernstedt, 2014). A good example of this is how social media applications trigger notifications to let the user know that new content is available on the feed while the user is actually scrolling through the same feed. The fact that the present time is prevailing over the others means that the app does not have a fixed form since it is experiencing constant changes, which can be seen as a lasting present (Coleman, 2020b; Rosa, 2013; Virilio, 1986). Another way in which social media apps create a feeling of eternity is because they are not used to carry out a specific task, and therefore the users never feel like they have finished, thus increasing the sense of an eternal time.

The fourth characteristic is *expiration* and it is very much related to the present being prevalent. The real-time temporalities available on digital media (Weltevrede et al., 2014; Coleman, 2020a) are reflected in the applications with features such as statuses on Facebook or stories on Instagram. Weltevrede et al. (2014) describe social media characterized by fresh, dynamic or continuously processed content in opposition to static or archival media. In these cases, immediacy, ephemerality, and even forgetting are encouraged over remembering or conservation (Keightley, 2012; Kaun and Stiernstedt, 2014; Kaun et al., 2016), which also increases the FOMO. This aligns with Virilio's (1986) argument that speed and technological acceleration transform our experience of time, producing a perception of constant urgency and immediacy. Although some studies also draw attention to time in social media as an archive (Kaun and Stiernstedt, 2014;), it is interesting to see how in fact the apps try to make the past present again with features like memories (Humphreys, 2020).

The prevalence of the present and real time experiences suppresses the perception of a hierarchical chronological time, since it is difficult to identify the cause-effect relationship between events when all of them happen at the same time thanks to the feasibility of instantaneity (Adam, 1998; Virilio, 1986). That introduces the fifth characteristic of time in social media: *fragmentation*. Kaun and Stiernstedt (2014) describe fragmented temporalities, which do not follow a narrative, where the content is not focussed on creating a story. In other words, there is no start and end or clear sequentiality, instead the idea is to create constant changes which generate an incessant flux. Rosa's (2013) framework of social acceleration also helps to interpret this fragmentation: accelerated systems disrupt traditional temporal hierarchies and produce overlapping, individualized rhythms. We found some terms in the literature to refer to this phenomenon, Weltevrede et al. (2014) have called it a pace, and Carmi (2020) rhythm, since what systems actually do is to process the content, rank or recommend it in a certain manner for each user (Lupinacci, 2024). This turns into a fragmented experience of multiple and individualised temporalities (Leong et al., 2009), which makes the collective or global temporality, that was created in other media such as radio and television, disappear (Manovich, 2012).

The characteristics of time in social media applications, as identified through this review of the literature, provide the conceptual basis for proposing a tool aimed at evaluating temporalities in these platforms.

3 Materials and methods

The methodological framework of this paper is based on the development of a new system of analysis that enables professionals and researchers to conduct a systemic evaluation of how social media applications structure the experience of time through their design. The system of analysis has been designed and validated following the recommendations of the System of Analysis of Digital Media, in Spanish *Sistema de análisis de medios digitales* (SAAMD) (Codina and Pedraza-Jiménez, 2016). It has been selected because its operation has already been tested not only on websites but also on mobile applications (Figueroa-Encina, 2018). The method they propose is particularly interesting for our needs because it perfectly matches one of the use cases described by their authors: a comparative analysis. Therefore, the new system of analysis has been defined following the

four phases of the SAAMD methodology: analysis, design, test and refinement. Furthermore, the evaluation of the applications' design, which is the object of study of the new tool, is grounded on the concept of design spaces that are defined as the boundaries and possibilities for design decisions (Gero, 1990; Maher et al., 1996; Dorst and Cross, 2001). Specifically, it follows Simon's (1996) view that all possible designs are limited by a specific set of technical features found in a group of systems. Accordingly, the analysis focuses on the technological affordances of time present in the applications, also referred to as temporal affordances (Tenenboim-Weinblatt and Neiger, 2017).

3.1 Analysis

The goal of the analysis phase is to identify what is intended to be analyzed with the system (Codina and Pedraza-Jiménez, 2016). In this case, our goal was to define the elements necessary to assess how social media applications structure the user's experience of time. To this end, we conducted a literature review using national and international scientific databases, specifically Scopus and Web of Science. We used the following keywords: "(Time OR temporal*) AND (social media)" and "(Time OR temporal*) AND (Facebook OR Instagram OR Twitter OR TikTok)." These initial searches yielded a large number of results, so we narrowed the scope by filtering for studies in English, within the field of social sciences and restricting the search to keywords, in the last 5 years. However, many of the retrieved publications were not directly aligned with our research focus. For example, several studies addressed topics such as screen time, time series analysis of social media activity, the impact of social media on health and well-being, real-time features on social media or technical aspects like app response time optimization.

Following a manual review of the titles to exclude irrelevant results, a total of 48 publications were shortlisted for their relevance to the concept of social media time, and excluding duplicates retrieved from both searches (see Figure 1). However, there remained a gap in studies explicitly addressing how temporalities are generated through app design. As a result, we conducted a second round of searches using more specific terms: "temporal affordances AND (time OR temporal*) AND social media" and "temporal affordances AND (time OR temporal*) AND (Facebook OR Instagram OR Twitter OR TikTok)," this time searching within titles, abstracts, and keywords. We applied the same filters, and this search yielded a smaller number of use case studies, from which 18 were identified as relevant based on title screening, also excluding duplicates (see Figure 1).

Finally, abstract screening and desk research were conducted on the resulting list of studies 58. It is worth noting that additional relevant literature was identified through a snowballing technique, reviewing the references cited in the initially selected studies. This process led us to include studies from adjacent fields, such as media studies and philosophy of time, that provided valuable theoretical grounding and contextualization for our work.

The final sample was of 24 studies related to time in social media, of which only one refers to temporal affordances of time in social media applications (Kaun and Stiernstedt, 2014). The vast majority of the studies show different points of view about how media impact on users' experience of time. In terms of the methodology of the studies, we found theoretical and qualitative research (mostly through interviews) but a systematic analysis of the characteristics of time on social media apps was still missing.

As a result of the literature review, five temporal characteristics were identified as being present in social media applications: autonomy, uncertainty, eternity, expiration and fragmentation (see Table 1 from section 2). These attributes served to ground the creation

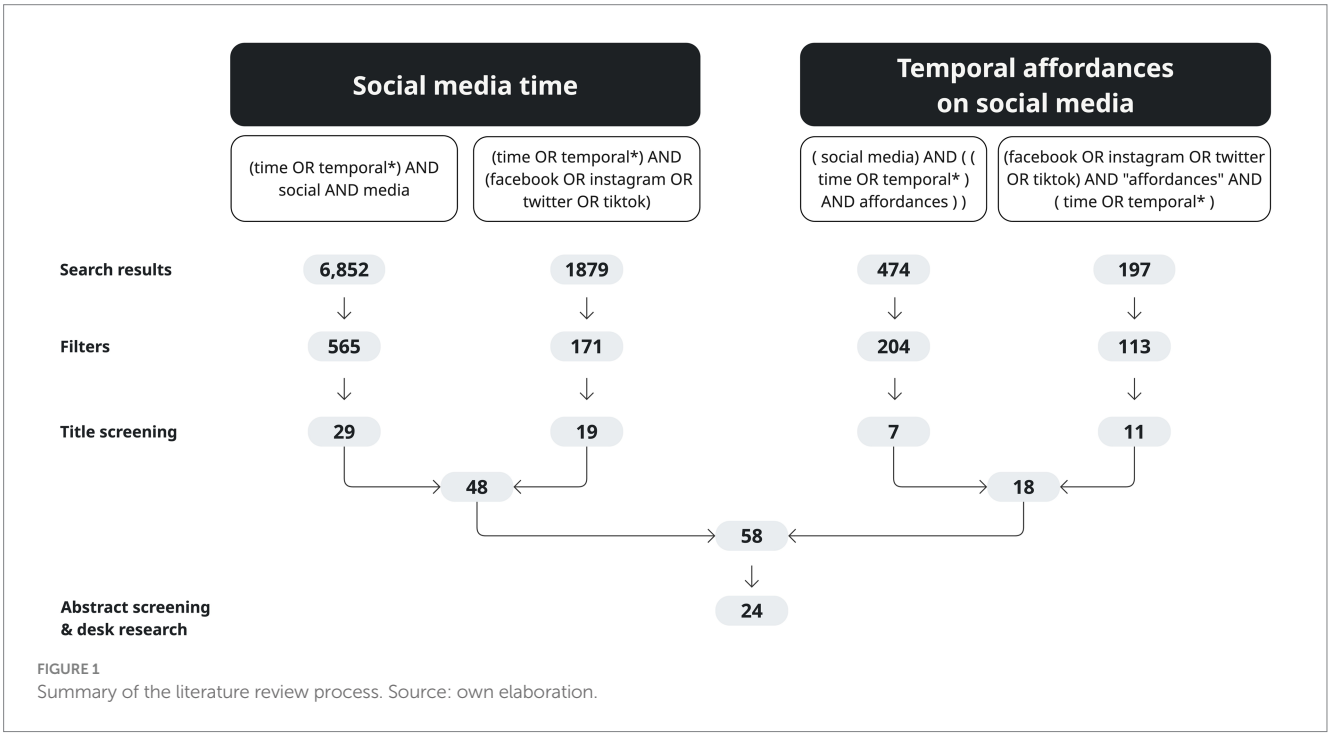

FIGURE 1
Summary of the literature review process. Source: own elaboration.

of the new analysis tool that allows to quantitatively validate the presence of these temporalities in social media applications.

3.2 Design and expert validation

The design phase of the SAAMD methodology for creating systems of analysis focuses on defining how the analysis can be enabled (Codina and Pedraza-Jiménez, 2016). The methodology suggests that the systems should be structured in two levels: (1) the parameters, general aspects of the object of study; and (2) indicators, the different attributes that represent each parameter and can be studied, analysed or compared. Specifically for this study, the parameters are the five characteristics of time identified in the literature (autonomy, uncertainty, eternity, expiration and fragmentation), and the indicators are the technological affordances that are used to structure the temporalities in an application (i.e.: contextual notifications). In order to identify these indicators, an exploratory analysis of a broad sample of social media apps (Facebook, Instagram, TikTok, X, Youtube, Pinterest, Linkedin, Telegram and Whatsapp) was carried out. As a result, 14 indicators were identified and categorized under the five parameters (see Figure 2). For the first parameter, *autonomy*, four indicators were identified: (1.1) system notifications, (1.2) contextual notifications, (1.3) living content, and (1.4) content personalization. Table 2 shows a summary of the systematic development of the indicators of this parameter.

The second parameter, *uncertainty*, includes two indicators: (2.1) unpredictable rewards and (2.2) unpredictable system interactions. Table 3 shows a summary of the systematic development of the indicators of this parameter.

For the third parameter, *fragmentation*, two indicators were defined: (3.1) lack of temporal hierarchy and (3.2) absence of narrative structure. Table 4 shows a summary of the systematic development of the indicators of this parameter.

The fourth parameter, *expiration*, includes three indicators: (4.1) ephemeral content, (4.2) real-time content, and (4.3) presentism. Table 5 shows a summary of the systematic development of the indicators of this parameter.

Finally, the fifth parameter, *eternity*, also includes three indicators: (5.1) endless local navigation, (5.2) contextual navigation, and (5.3) ceaseless flow of changes. Table 6 shows a summary of the systematic development of the indicators of this parameter.

To facilitate the coding process, all indicators were systematically developed, and a structured data sheet was created for each, including: (1) the indicator name and reference code used in the system, (2) the corresponding system parameter, (3) a clear definition, (4) an example, and (5) a description of the analysis procedure (Palomar-Garcia et al., 2025). Tables 2–6 summarize the systematic development of the indicators for each parameter. In the initial version of the analysis system, all indicators were measured using a binary scale (0–1), reflecting presence or absence.

As a result of this phase, the first version of the tool *System of analysis of time in applications* (SATA) was created: the analysis sheet (Palomar-Garcia et al., 2025) was produced to facilitate the application of the system, including a screening question for every indicator to help analysts start with the evaluation. However, the analysis sheet needs to be used together with the structured data sheets of the indicators (Palomar-Garcia et al., 2025) to ensure a trustful process and allow the replication of studies.

As part of the design phase, the proposed tool was reviewed by experts. Specifically, feedback from twenty experts from four different fields (digital temporalities, media experiences, behaviour design and systems of analysis) was asked. Seven responses were received from national and international experts, representing the four fields of study and associated with the following universities: Södertörn University; The London School of Economics and Social Science; Hanover University of Music, Drama and Media Universitat; and Pompeu Fabra. The feedback was collected using a survey asking the experts to rate two topics from 1 to 5: (1) the structure of the system of analysis and (2) the indicators. Both questions received positive responses: the first one had an average of 4.4 out of 5, and the second 4.8 out of five. Furthermore, we also included open questions asking for any suggestions, if applicable. The experts made interesting suggestions that could be included for future research as they were beyond the scope of this analysis - for instance that the system would also be able to analyse if the applications have the possibility to regain autonomy (enabling signal tones or pausing signals from apps like "do not disturb"). However, no additional revisions to the tool were considered necessary.

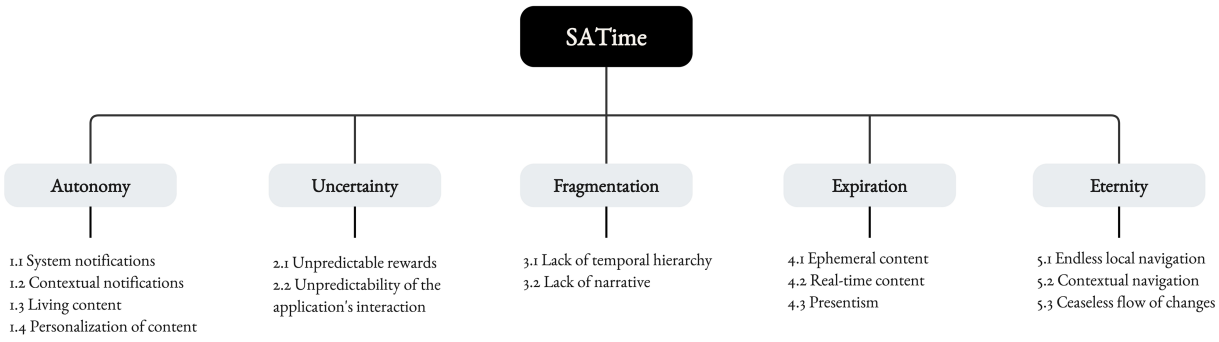

FIGURE 2
Overview of the SATime structure: parameters and its indicators. Source: own elaboration.

TABLE 2 Autonomy: summary of the systematic development of its indicators.

Parameter: 1. Autonomy				
ID	Indicator name	Definition	Example	Analysis procedure
1.1	System notification	System notifications are messages sent to mobile devices globally, rather than a specific application. They allow users to stay informed without them proactively interacting with the device.	Both iOS and Android offer three places where these notifications can appear: 1. On the lock screen 2. Notification center 3. If the mobile is being used the notification appears at the top of the screen.	Examination of the application during 1 week following the walkthrough process (Light et al., 2018). All notifications must be activated on the system preferences panel.
1.2	Contextual notifications	Contextual notifications are generated within the same app, so the user must be inside the app to receive them. They refer to a change of status or an informational message. Unlike system notifications, these are not configurable.	"New stories" button appears on Instagram as an overlay when the users are scrolling through the main feed. It informs users that new content is available at the beginning of the feed.	Examination of the application during 1 week following the walkthrough process (Light et al., 2018).
1.3	Living content	The application is updated or the content changes without the need of the user action. Unlike computer systems such as Word where the application does not change if the user does not intervene, in this type of application the content of the application is alive, it changes without the need for the user to be interacting or connected to the application.	User-generated content like posts, comments, or likes, for instance. Non-user generated content can also be an example if it gets updated frequently.	Examination of the application during 1 week following the walkthrough process (Light et al., 2018).
1.4	Personalization of content	The content of the application is adapted to each profile and each context of the user. That means that at the same time different users are seeing different content.	The content of social media feeds is different per user and it adapts based on my behaviour.	Examination of the application during 1 week following the walkthrough process (Light et al., 2018).

Source: own elaboration.

3.3 Test and refinement

The test phase of the SAAMD methodology consists of applying the first version of the tool to a specific sample, between three and five applications is recommended (Codina and Pedraza-Jiménez, 2016; Nielsen and Molich, 1990), to identify if any refinement is still needed. Thus, we validated the system by doing a pilot testing with a sample of four social media apps. First, we included in the sample the three social media apps that held the biggest market share in Europe during 2021 and 2022 (Statcounter, 2024): Facebook, Instagram, and X (Twitter). Second, since market trends were already anticipating how TikTok would scale up the market (Techcrunch, 2021), we considered that it would be interesting to include it in the sample as well. Social media definition[1] encompasses a broad spectrum of platforms, the four apps that were shortlisted are representative of a subgroup within the category (social networks) so they share some attributes (according to the Form-From model by Zhang et al., 2024): (1) they focus on sharing content in a common space rather than in private channels, and emphasize the structure of content in a threaded style, (2) and they enable replies and interactions to posts that increases the connections between existing content. By doing so, we make the validation process more reliable since the results are expected to be similar among the sample.

Each application was evaluated by three analysts who had a digital product design background. The number of evaluators was decided following the recommendation by Nielsen and Molich (1990) where the quality of the analysis improves notably with the "collected wisdom." To perform the analysis a technical walkthrough process was followed (Light et al., 2018) including: registration (only for analysts who did not already have an account on the app) and login, with attention to how the app communicates its vision and intended value; regular usage of the app, ensuring all available activity flows were completed; and finally, suspending usage to gain insights into how the app attempts to sustain user engagement. This last step did not involve deleting the account or uninstalling the app, as such actions were not relevant to the scope

1 Merriam Webster definition of social media: forms of electronic communication (such as websites for social networking and microblogging) through which users create online communities to share information, ideas, personal messages, and other content (such as videos).

TABLE 3 Uncertainty: summary of the systematic development of its indicators.

Parameter: 2. Uncertainty				
ID	Indicator name	Definition	Example	Analysis procedure
2.1	Unpredictable rewards	When the application helps the user solve one of her problems, we can say that she has received a reward. These rewards can stay stable over time, such as when a user transfers money with a mobile phone, but they can also be variable if they depend on the interaction of other people or other factors that cannot be controlled. For instance, the reward for posting a photo on instagram is the response of users, but we can not predict how or when it will occur.	• Content is not always aligned with the user's interests, for instance in a feed. • When creating a post on Facebook, the user cannot foresee when it will receive likes or comments, or even if it will receive any.	Examination of the application during 1 week following the walkthrough process (Light et al., 2018).
2.2	Unpredictable system interactions	The interactions that are generated autonomously by the system have a level of uncertainty inherent to them, as it is unpredictable to know when they appear and whether they will be of interest or not.	The user does not know when a notification will be triggered or when the feed will be updated.	Examination of the application during 1 week following the walkthrough process (Light et al., 2018).

TABLE 4 Fragmentation: summary of the systematic development of its indicators.

Parameter: 3. Fragmentation				
ID	Indicator name	Definition	Example	Analysis procedure
3.1	Lack of temporal hierarchy	The predominance of the present, and therefore of real-time experience, entails a loss in the perception of the chronological hierarchy of temporal elements. As a result, it is difficult to recognize the relationship between the cause and effect of actions due to the feasibility of instantaneity. In addition, the content is not presented chronologically. Instead, the order is customized for each user. It results in an individualized time to be unrepeatable.	The content on the main feed is not presented in chronological order.	Examining the application.
3.2	Lack of narrative	Content is not presented to create a story, it is not organized with a communicative purpose. Instead, there is a fragmentation of presents that do not respond to any narrative. Since this fragmentation is individualized as the content is customized for each user, and the collective narrative present for instance in radio or television disappears.	The feed displays posts that are not connected to each other.	Examining the application.

Source: own elaboration.

of this study. As stated by Duguay and Gold-Apel (2023), the automated personalization of the apps made it very difficult to expect an analysis based on a fixed picture of the app. Thus, having three evaluators helps to overcome the segmented vision of an individual experience but, on top of that, analysts that were regular users of the apps and others that had to create a new account for this analysis were included. The analysts were also given 1 month to perform the evaluation so that they would have time to see different states of the app.

From a technical point of view, the versions of the applications that were analysed are the following: Facebook v398.0, Instagram v.267.0, TikTok v.27.7.1, Twitter v.9.41.1. The conditions of the analysis were that only the version for iOS would be analysed since, as Figueroa-Encina (2018) suggested, the differences between the versions are not significant enough; and if the app had any payment plan, only the free version would be analysed.

The analysis was conducted independently by each analyst, and the results were later compiled by the authors of this paper (Nielsen and Molich, 1990). Each analyst received an Excel file containing the analysis template (Palomar-Garcia et al., 2025) and was instructed to follow the guidance outlined in the indicator sheets (Palomar-Garcia et al., 2025) for coding and evaluation. In addition to assigning scores, analysts were asked to include notes with observations and concrete examples to support interpretation. Once individual analyses were completed, the results from all three analysts were compared

TABLE 5 Expiration: summary of the systematic development of its indicators.

Parameter: 4. Expiration				
ID	Indicator name	Definition	Example	Analysis procedure
4.1	Ephemeral content	Some content or features of the application are only accessible to the user for a limited period of time.	For instance, instagram users can create a profile status that will be available temporarily. Profiles with an active status appear highlighted on top of the startpage.	Examining the application.
4.2	Real-time content	The app offers features that allow the user to share or view content streamed. It may only be accessible live or it may also remain registered and accessible later.	For instance, twitter allows users to start a live stream as a way to share content.	Examining the application.
4.3	Presentism	The present prevails over other temporalities, up to the point that the past and the future are in danger due to the creation of a permanent present. That means that reviewing historical content is unimportant, and in the case of being accessible, it is not the core content of the application. Instead, these applications promote immediacy, ephemerality and even forgetfulness versus remembering or preserving content.	Although instagram constantly sends notifications to inform the user of the latest posts, if the user is interested in one of those and she does not save it, it's very difficult to find it again.	Examining the application.

Source: own elaboration.

and consolidated by the authors. The final score for each indicator and application was established through a two-phase process: (1) identifying invalid scores—such as those based on overlooked functionalities or misinterpretations of the indicators—which were excluded from the final calculation; (2) calculating the average of the remaining valid scores for each indicator. The total score was calculated as the percentage of indicator presence, both by parameter and overall per application, to ensure comparability across parameters, as they contain differing numbers of indicators. The full dataset is available for replication studies (Palomar-Garcia et al., 2025).

The initial pilot test and subsequent unification of expert scores revealed that the parameters defined in the proposed system were consistently present in all the analyzed social media applications. In fact, every application scored 100%. However, this outcome highlighted a key limitation of the binary scoring system (0–1): it captured only the presence of an indicator, not its intensity or frequency. In other words, the system treated an indicator observed once the same as one observed repeatedly or as a central feature of the app. As a result of this limitation, we proposed refining the system by replacing the binary scale with a 0–3 rating system, similar to other evaluative frameworks (e.g., Nielsen and Molich, 1990). This revised scale allows for a more nuanced assessment of each indicator by capturing both its frequency and relevance within the app. The scoring criteria are as follows: (0) never seen in the app, (1) rarely seen or a hidden feature, (2) sometimes seen or a secondary feature, (3) often seen or a central feature in the app's value proposition. In this way, the updated system enables both a detailed categorization of app subcomponents—via the indicators—and a broader overview of the temporalities generated by aggregating these scores into the system's five parameters.

A second round of testing was conducted to consolidate the SATime model. In this phase, the analysts evaluated the same sample of applications using the refined 0–3 rating system. The enhanced scale enables the collection of more nuanced and detailed information, since the data gathered about the applications was significantly richer, allowing for deeper insights and more meaningful conclusions to be drawn from a qualitative perspective. Overall, the two phases of the pilot testing confirmed that the tool is understandable since all the analysts could perform the evaluations successfully. Additionally, the results demonstrated its usefulness for analysing temporalities in applications.

TABLE 6 Eternity: summary of the systematic development of its indicators.

Parameter: 5. Eternity				
ID	Indicator name	Definition	Example	Analysis procedure
5.1	Endless local navigation	Local navigation makes it easier to access content that is closer in the app architecture, for example within a single page.	The interface element most used in social media apps is the infinite scroll, but collections of cards are also used on Instagram's profile pages.	Examining the application.
5.2	Contextual navigation	Contextual navigation allows access to thematically related information even if it is far away in the app architecture. It is usually included within the content itself through links, tags or references to related content.	Hashtags (#) and mentions (@) are commonly used on social media apps to categorise content.	Examining the application.
5.3	Ceaseless flow of changes	The application is not stable, it does not have a fixed appearance or content, but seeks to generate constant changes that create a relentless flow. As a result, it is in constant motion, becoming eternal since it does not have a final goal.	The content is updated more than 3 times per day.	Examining the application.

Source: own elaboration.

4 Results

The first section presents the overall findings from the two rounds of pilot testing, emphasizing a comparison of the scoring systems and outcomes across the applications. The second section provides a detailed parameter-by-parameter analysis based on the second round of testing (utilizing the 0–3 scoring scale), as the minimal variations observed between applications support the extrapolation of conclusions.

4.1 Global results

The initial application of the SATime system using the binary scoring method revealed that all identified temporal affordances were present across the four social media applications analyzed, resulting in a 100 total scoring for all the sample. In the second round, the use of a non-binary (0–3) scoring system enabled the identification of subtle differences among the applications. Therefore, the non-binary system was ultimately selected for its capacity to deliver a more nuanced and detailed analysis, since it not only assesses the presence of each indicator but also captures its relative predominance within the application. Table 7 shows the different scores obtained for both approaches.

Besides, if we display the results of the second round of analysis on a radar chart (Figure 3) we can see how, despite the applications having similar total ratings and the slight differences that can be found for each parameter, a trend can be extrapolated from comparing the results of the four social media applications analysed: uncertainty and autonomy have the greatest presence, and expiration the lowest.

However, a detailed analysis of the results obtained for every parameter per app analysed (Figure 4) reveals that X (Twitter) deviates slightly from the rest since it has higher scores for *eternity* (X scored 100 and the rest of apps scored 88.9) and much lower scores for *fragmentation* (X scored 66 but the rest of apps scored 100). On top of that, it is also the application that has the lowest total score out of the four (Table 7). The design of this application can explain this score, since X has a section which offers a search bar, just as the rest of apps do, but it also includes trending topics and different thematic sections (like news, sports or entertainment). The fact that content can also be navigated through categories, first, strengthens the narrative experience since content is less fragmented when seen within a category; and second, it increases the contextual navigation elements of this app compared to the rest, which also increases the eternal experience. Finally, it is also worth mentioning that the fact that X has the lowest rating on *expiration* is because functionalities for viewing or sharing content in real time are rarely found. Historically, this application also had stories like Instagram, Tiktok and Facebook but decided to shut down the functionality because it was removing focus from the main goal of the app.

Although some differences were observed for X, the remaining applications showed very similar scores (see Figure 4). As a result, the following section presents the results organized by parameter rather than by application, since the conclusions are consistent across the entire sample.

4.2 Results per parameters

If we analyse the results per parameter, first, it can actually be seen that *uncertainty* scored 100% for all the applications (see Figure 4). Figure 5 presents the individual scores for the indicators of this parameter. For instance, the unpredictability of the reactions that the user-generated content will generate, such as a like or a comment, is an example of technological affordance found in most of the applications (see indicator 2.1. from Figure 5). Another example is the unpredictability of when the application sends a notification to the

user, for instance informing about new content that may be of their interest (see indicator 2.2. from Figure 5).

Second, all the applications also got high scores for *autonomy* (see Figure 4), which shows how all the applications have temporal affordances that happen out of the user's control. Figure 6 presents the individual scores for the indicators of this parameter. Examples that can be broadly found in all the applications analysed are system notifications encouraging the user to open the app, new content that is continuously included in the application or how the content of the application is personalised for each user. In-app notifications were less dominant on TikTok and Facebook (see indicator 1.2. from Figure 6), but they were still broadly found on Instagram and X, for instance informing that new content was added to the app while the user was actually using it. However, it is worth mentioning that some of these elements can be limited by the users if they configure the settings of each specific app or have some system mode that mutes notifications. Nevertheless the analysis of the four apps has been carried out with the default configuration to understand the preferred experience that product teams want to create on users.

Third, *expiration* was the parameter that scored the lowest for all the applications (see Figure 4) and that is because although this type of temporality is present in all of them it is not the only one. Figure 7 presents the individual scores for the indicators of this parameter. As the chart shows, both ephemeral content and real-time content can be found on all the applications but they are not predominant (see indicator 4.1 and 4.2. from Figure 7). They are features that users can take advantage of, but they are not the key value of these apps for the user. On the other hand, the predominance of the present is also combined with historical temporalities (see indicator 4.3. from Figure 7). For instance, all the applications have a feed of infinite content that is continuously being updated but, at the same time, they also have pages that display the same content but from a historical point of view: grouped by the author that created the content and displayed chronologically. They are often called profile pages and they allow any user to find a piece of content any time - if they know who posted it. On top of that, all the applications allow users to bookmark content, where they save the content in a folder that they can access when needed. Nevertheless, this is not a central feature and it is actually pretty difficult to find for some of the applications: on Facebook the action is hidden inside the menu of a post, and on Instagram in order to access the folder you need to go to your profile page and find the "Saved" option among another ten options on the menu. Therefore, although the main feed of social media applications may look prominent since it is located in the main page, when analysing the overall app it was shown that this characteristic is the least dominant.

Fragmentation generally scored high (see Figure 4). Figure 8 presents the individual scores for the indicators of this parameter. As the chart shows, both narrative and fragmented temporalities are present in the applications, the analysis shows how fragmentation is more dominant for Facebook, Instagram and Tiktok, but not for X. This is due to the fact that the main page of all the applications displays pieces of content that are not related to each other. However, although all the content displayed on a specific profile page shares a creator, it is up to the author to generate a narrative among all the posts. In this case, the application itself only displays the content in a chronological order but does not include any features that make the different pieces of information relate to each other in a causal manner.

Finally, *eternity* has also been found in most of the applications (see Figure 4). Figure 9 presents the individual scores for the indicators of this parameter. As the chart shows, while infinite local navigation systems and incessant flow of changes are found in every app (clearly represented in the feed), we can see that contextual navigation is less predominant in most of the apps (see indicator 5.1 and 5.2 from Figure 9). Hashtags are the contextual navigation elements most often found, but these rely on the user to add them. However, there are no fixed links to specific content in most of the applications.

5 Discussion

The main contribution of this paper is the design and validation of the System of Analysis of Time in Applications (SATA), a tool that enables the evaluation of temporalities generated within social media applications. A closely related contribution is the identification and structuring of five core temporal characteristics commonly associated with social media platforms in the literature: autonomy, uncertainty, fragmentation, expiration, and eternity. These characteristics form the framework of the new tool and, combined with a set of temporal affordances of time identified within the applications, allow for a systematic analysis. The application of the tool reveals not only how temporalities are structured in the applications analysed but also how they are intentionally crafted by product professionals during the design process. Existing research on how time is designed and utilized in mobile applications, particularly within social media platforms, is still scarce. In this context, the proposed tool will enable both researchers and practitioners in expanding knowledge in this field by: (1) enabling a more systematic analysis of temporal dynamics in social media applications, and (2) increasing awareness of how time can be intentionally designed within digital products—offering greater control over the impact that design choices have on end users.

TABLE 7 Comparison of the results of the first and second round of analysis: share of indicators found, aggregated by parameters for each application.

Scoring system	Autonomy		Uncertainty		Fragmentation		Expiration		Eternity		Total	
	0–1	0–3	0–1	0–3	0–1	0–3	0–1	0–3	0–1	0–3	0–1	0–3
Facebook	100	91.6	100	100	100	100	100	77.8	100	88.9	100	90
Instagram	100	100	100	100	100	100	100	66.7	100	88.9	100	90
TikTok	100	83.3	100	100	100	100	100	77.8	100	88.9	100	88
X (Twitter)	100	100	100	100	100	66.6	100	55.6	100	100	100	86
Average	100	93.7	100	100	100	91.6	100	69.4	100	91.7	100	88.5

Source: own elaboration.

First results of applying the SATime to a first sample, shows a temporal trend in social media apps that aligns closely with Lupinacci's (2020) description of social media time as a continuous and unpredictable flow. On one hand, the system's autonomy creates a sense of continuous temporality by notifying users that social media apps are evolving even when they are not actively engaged. Additionally, the constant influx of new content and its permanent availability, particularly through features like infinite scrolling, amplify the perception of an endless temporal flow. This can encourage users to spend more time within the app, as they do not perceive a clear

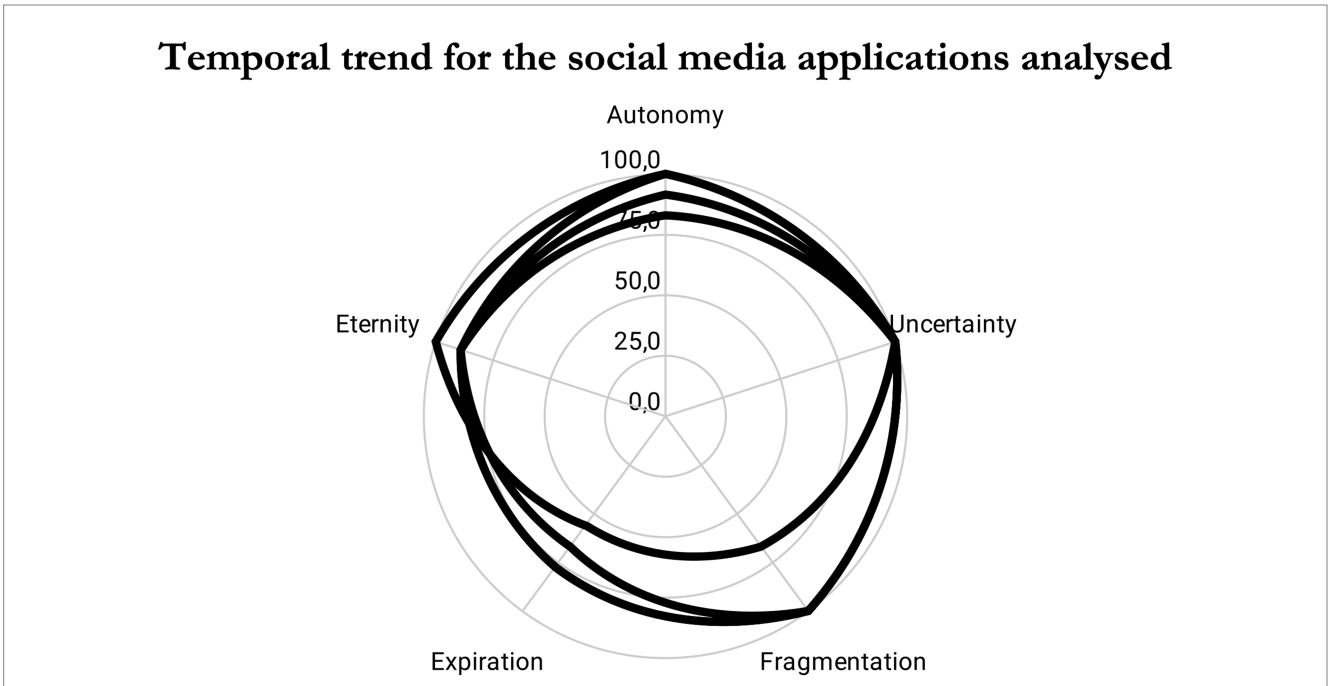

FIGURE 3
Radar chart showing the average scores for each parameter across the analyzed apps. This visualization enables comparison and correlation of the scores across different parameters, highlighting similar trends across all apps. Source: own elaboration.

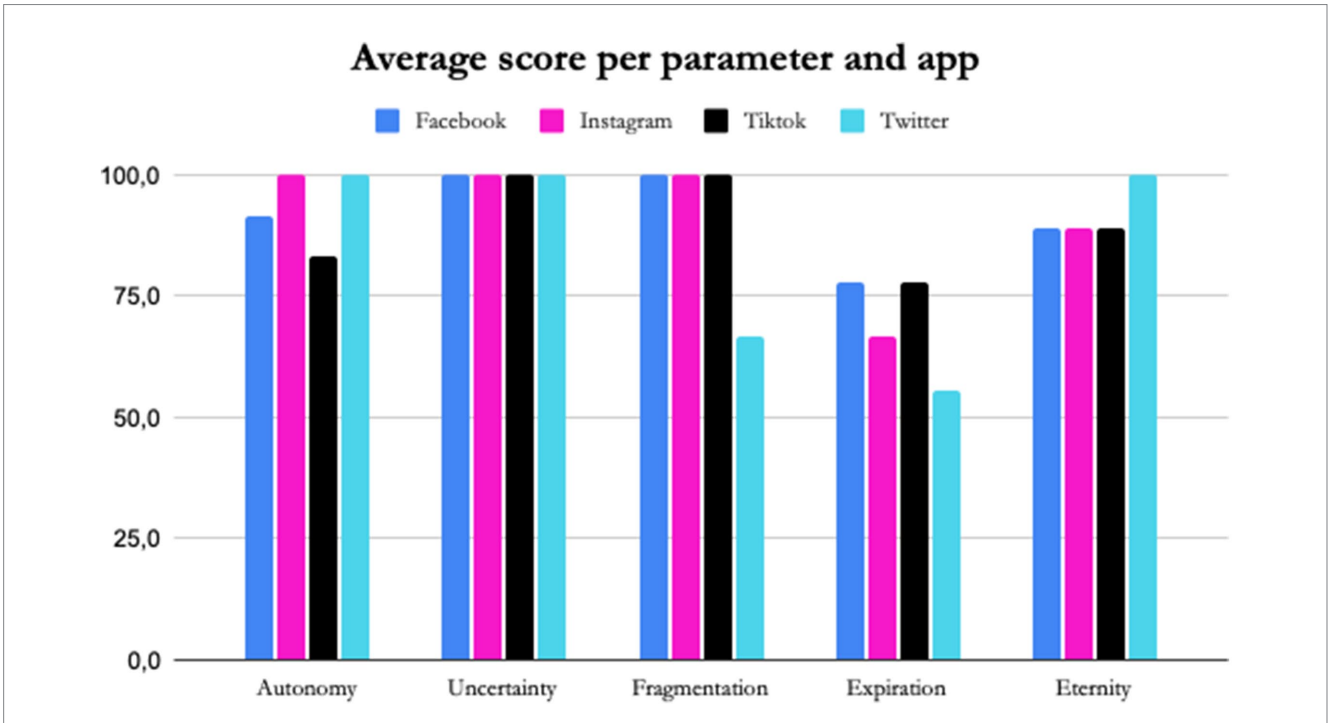

FIGURE 4
Bar chart comparing the scores for every parameter per app analysed. Source: own elaboration.

endpoint. On the other hand, the progression of events is highly unpredictable: feeds are personalized in real time without user control, and users cannot anticipate when interesting content will appear or when they will receive likes or comments. This results in a fragmented temporality, where content lacks chronological or causal coherence. This unpredictability functions as a variable reward mechanism, promoting continuous engagement in search of new content or social validation, as Eyal (2014) describes in his theory of habit formation in digital products. Overall, these results suggest that the temporalities generated through mobile app design can influence user interaction by fostering engagement and habit formation. However, further research is needed to confirm this hypothesis.

Following its testing and validation, the tool yields results that suggest new avenues for research into app design and temporalities. The SATime should be applied to a broader sample of social media applications to determine the extent to which the initial findings can be generalized across the category. Additionally, analyzing other categories of applications would help draw broader conclusions and enhance the validity of these extrapolations (Yin, 2013). We recommend applying the SATime model to app categories whose business models depend on frequent and extended user engagement, to determine whether similar temporal affordances exist. To gain a more holistic picture of app temporalities, future research should also examine how these temporal structures are shaped by cross-platform dynamics, offering insight into the interplay between individual apps and the broader smartphone ecosystem. Finally, it would also be interesting to analyse how much the user can control the temporalities of the system, i.e., pausing notifications, or selecting in which order to show the content on the main feed and by doing so modulating the experience of time of the app. This last feature proposed would help to better understand the ethicality of these apps by showing if users are allowed to adapt the product to their specific needs (Palomar-Garcia et al., 2023).

Overall, this study helps to expand the research of time in digital media and also social media research, and highlights the need to study not only time in social media applications, but also the impact that the experience of these temporalities has on the final users. Given that most social media applications and other digital business models are based on the attention and engagement economy, and that many design patterns are specifically crafted to manipulate users' perception of time in products with a global impact affecting millions of users, this research sheds light on a largely underexplored area with mass effect that needs more attention. At the same time, it opens up a necessary line of inquiry and also serves as a tool for design practice. Raising awareness about the societal impact of digital products is essential not only for enhancing ethical standards within product design professionals, but also for empowering individuals to engage with their mobile devices in a more reflective and informed manner.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written

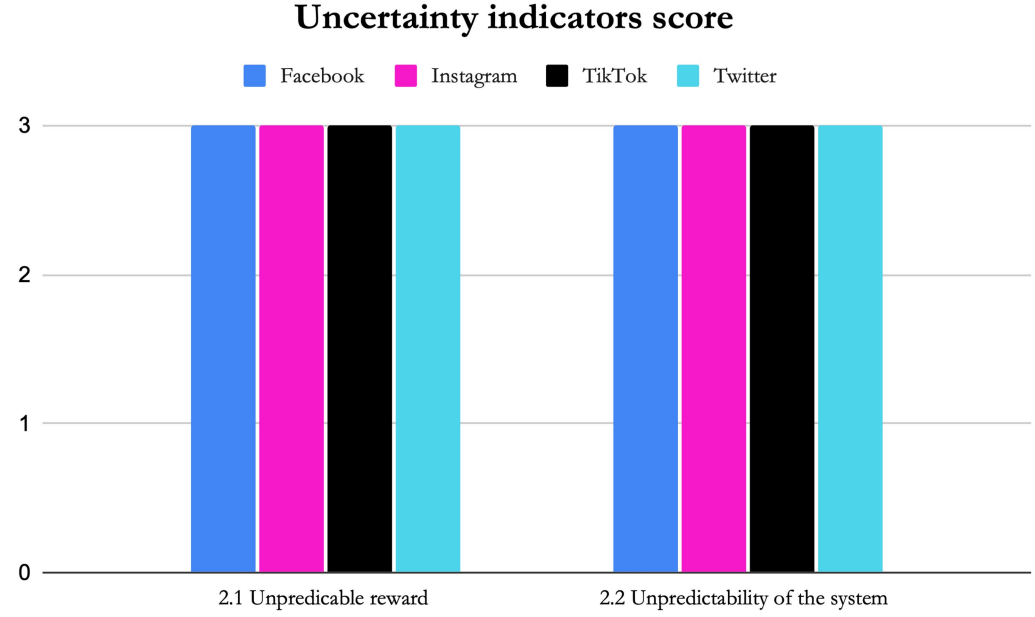

FIGURE 5
Uncertainty indicators score: bar chart comparing the scores obtained for every app analysed. Source: own elaboration.

informed consent to participate in this study. The social media data was accessed and analyzed in accordance with the platform's terms of use and all relevant institutional/national regulations.

Author contributions

CP-G: Writing – original draft, Writing – review & editing. AF-P: Writing – review & editing. CS-D: Writing – review & editing.

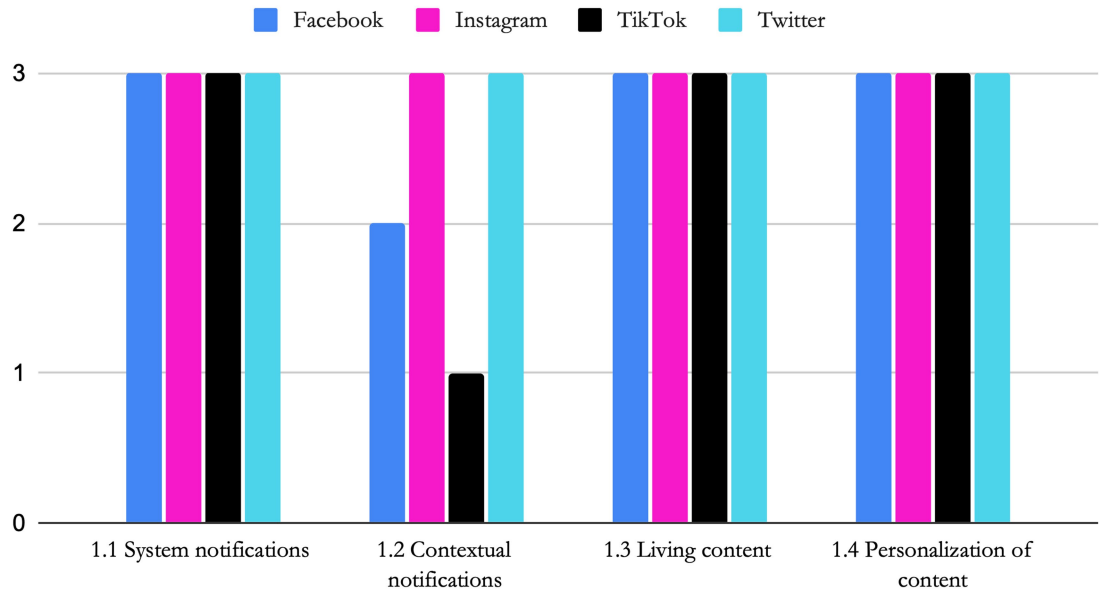

FIGURE 6
Autonomy indicators score: bar chart comparing the scores obtained for every app analysed. Source: own elaboration.

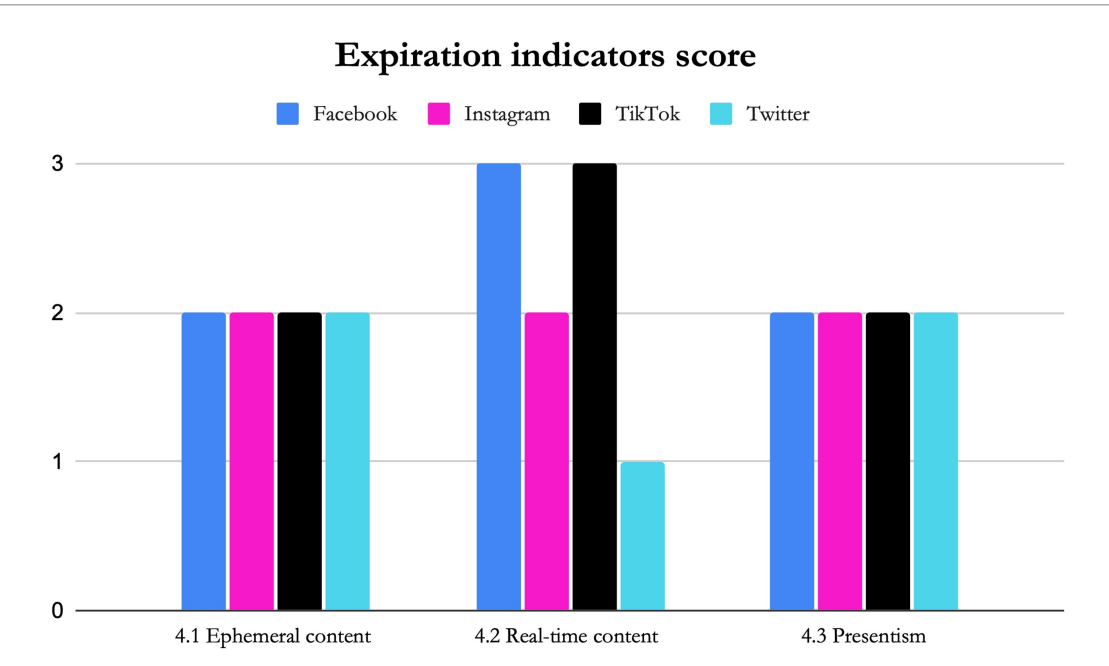

FIGURE 7
Expiration indicators score: bar chart comparing the scores obtained for every app analysed. Source: own elaboration.

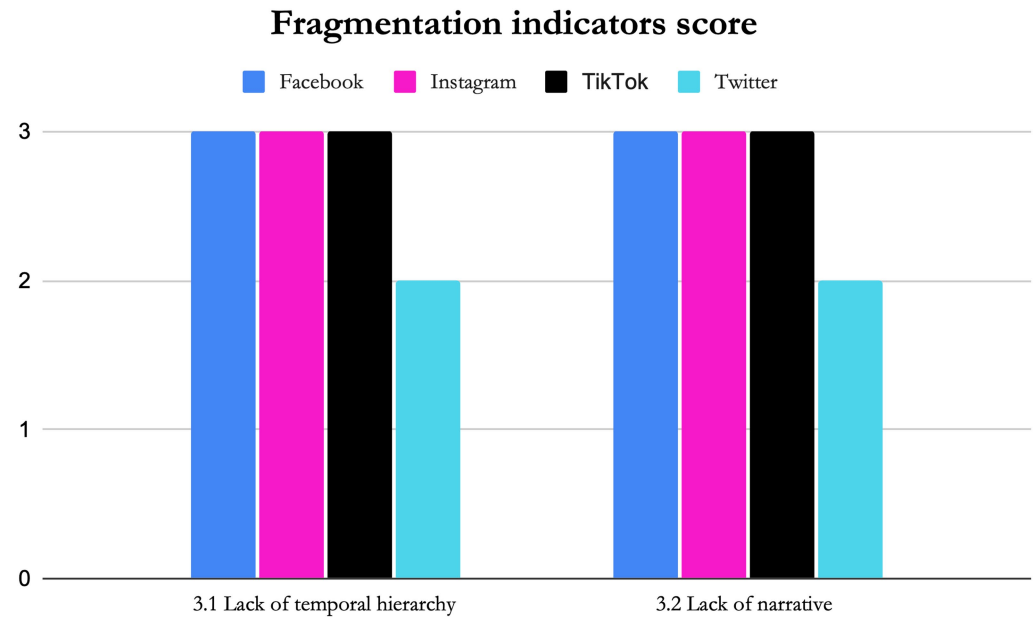

FIGURE 8
Fragmentation indicators score: bar chart comparing the scores obtained for every app analysed. Source: own elaboration.

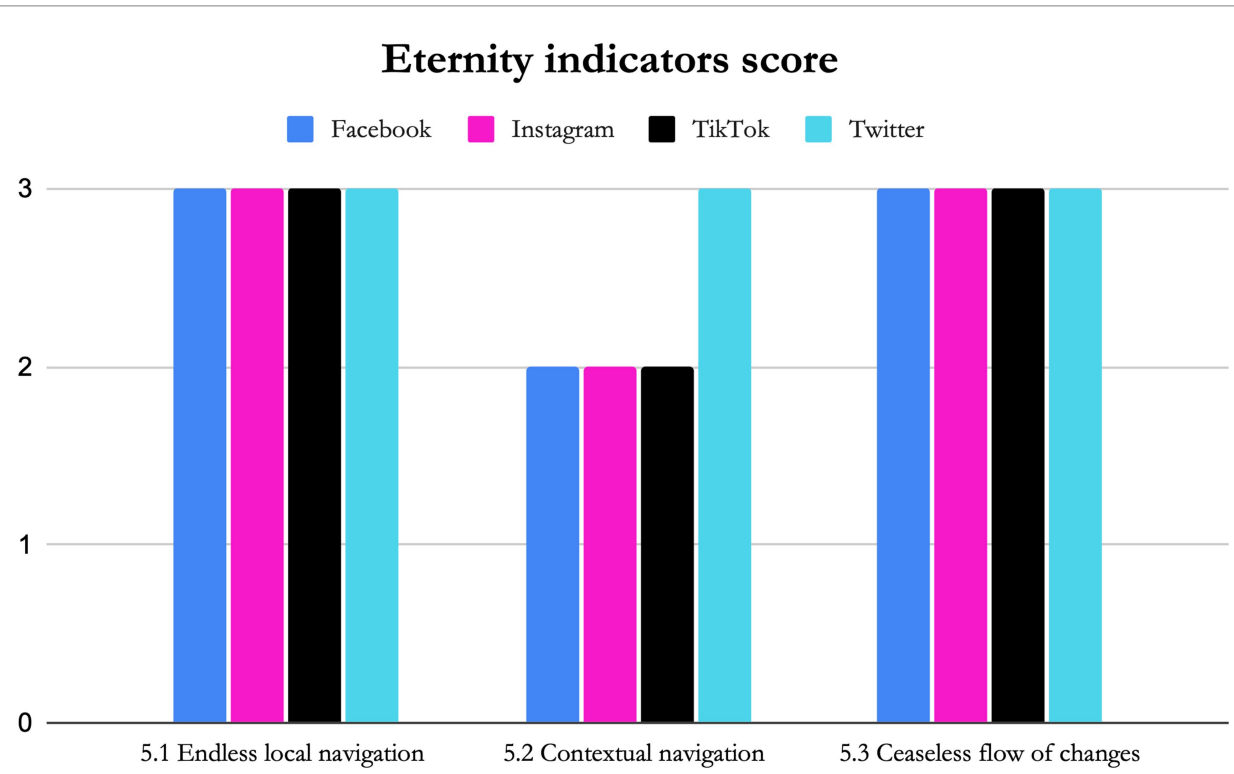

FIGURE 9
Eternity indicators score: bar chart comparing the scores obtained for every app analysed. Source: own elaboration.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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