

Attention-Capture Damaging Patterns in UI Design: In Search of a Socio-Technical Mitigation Strategy

Tales Gomes¹, Daniel Schneider¹ and António Correia^{2,*}

¹ Postgraduate Program in Informatics, Federal University of Rio de Janeiro, Rio de Janeiro 21941-916, Brazil

² University of Jyväskylä, Faculty of Information Technology, P.O. Box 35, FI-40014 Jyväskylä, Finland

Abstract

This paper discusses the potential effects of Attention-Capture Damaging Patterns (ACDPs) in designing socially and culturally sensitive interfaces based on their mechanisms and psychological impacts on users. Building on the concept of “dark patterns” and examining how they contribute to social polarization, this study explores the intersection between digital interface design, digital well-being, and polarization. The paper analyzes several examples of ACDPs present in popular social media apps and platforms such as Instagram, TikTok, WhatsApp, and Facebook, proposing a new taxonomic approach based on three main categories. In addition, a set of alternative design strategies that promote healthier interactions on digital platforms are discussed to mitigate the negative effects of these patterns and promote a more balanced digital environment.

Keywords

attention-capture damaging patterns, dark patterns, deceptive design, digital well-being, HCI, polarization, social media, socially sensitive design

1. Introduction

The rapid proliferation of digital platforms and social media has transformed how individuals connect, communicate, and interact globally. While offering unprecedented opportunities for social engagement and cultural exchange, these platforms have also introduced challenges that affect user well-being and societal dynamics. Among these challenges are Attention-Capture Damaging Patterns, which are designed mechanisms that exploit cognitive and emotional vulnerabilities to maximize user engagement. ACDPs, initially framed as “dark patterns” by Harry Brignull in 2011 [3], have evolved into a diverse set of strategies that manipulate user behavior to serve platform-centric objectives, often at the expense of individual autonomy and mental health. As platforms scale across diverse cultural contexts, understanding the socio-technical implications of these patterns becomes increasingly critical.

Social media platforms are not neutral entities but are deeply embedded within cultural and societal structures. The design choices made by these platforms influence individual user

Joint Proceedings of the ACM IUI Workshops 2025, March 24-27, 2025, Cagliari, Italy

✉ antonio.g.correia@jyu.fi (A. Correia)

ORCID ID 0000-0002-2736-3835 (A. Correia)



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CEUR Workshop Proceedings (CEUR-WS.org)

behavior and collective attitudes. Research indicates that ACDPs can exacerbate issues such as social polarization, digital dependency, and mental health decline, raising ethical concerns about their widespread use. For instance, Song and Boomgaarden's [11] exploration of reinforcing spirals highlights how selective exposure to content on social media intensifies pre-existing beliefs, fostering echo chambers and ideological divides. These dynamics are further amplified by ACDPs, which exploit emotional triggers like the Fear of Missing Out (FOMO) or employ mechanisms such as infinite scrolling to sustain prolonged user engagement [12].

The growing awareness of the harmful impacts of ACDPs has spurred calls for ethical design practices that prioritize user well-being. Büchi's [4] proto-theory of digital well-being argues for a shift in focus from mere harm reduction to the active promotion of practices that enable human flourishing. However, existing research on ACDPs often overlooks the cultural and contextual nuances that shape how these patterns are experienced and interpreted across different user groups. Social media platforms operate on a global scale, serving diverse populations with varying cultural values, social norms, and behavioral tendencies. These differences necessitate a more nuanced understanding of ACDPs, particularly in the context of marginalized or vulnerable groups, who may be disproportionately affected by predatory design practices.

This paper aims to address these gaps by examining ACDPs through a socio-technical lens, emphasizing the interplay between cultural, social, and technological factors. By investigating how ACDPs manifest and impact users in diverse cultural contexts, we seek to propose a framework for inclusive and culturally sensitive digital design. This approach aligns with the goals of the Intelligent User Interfaces (IUI) research community, which emphasizes the need to foster social and cultural inclusion through interactive systems and technologies.

2. Dark Patterns and the Cultural and Contextual Dimensions of ACDPs

The increasing integration of digital platforms into everyday life has transformed communication and social interaction. Yet, it has also raised concerns about the negative consequences of design practices that capture and sustain user attention. These practices, often referred to as ACDPs, are rooted in a platform-centric model that prioritizes user retention and engagement over individual well-being [3, 4]. These patterns exploit cognitive and psychological vulnerabilities, subtly steering user behavior in ways that often lead to diminished autonomy, heightened anxiety, and social disconnection [7, 11].

The term "dark patterns" initially described deceptive design elements that manipulated users into taking unintended actions, such as making unwanted purchases or disclosing personal information [3]. Over time, this concept evolved into what are now termed ACDPs, reflecting a broader range of manipulative mechanisms, including infinite scrolling, automatic video playback, and gamified engagement metrics. These mechanisms are pervasive on platforms such as TikTok, Instagram, and YouTube, where they are designed to maximize user interaction time [13]. While such practices benefit platforms economically, they often impose significant cognitive and emotional costs on users, including mental fatigue, stress, and reduced capacity for critical reflection [4, 7].

Although ACDPs operate across global platforms, their impact is not uniformly experienced. Social and cultural contexts significantly shape how users engage with and are affected by

these patterns. For example, patterns such as FOMO Alerts, which leverage users' anxieties about exclusion, may exert a stronger influence in collectivist cultures, where social belonging is deeply valued [11, 15]. In contrast, individualistic cultures, which emphasize personal autonomy, may find interface ambiguity patterns—such as misleading designs that obscure user options—particularly troubling [3, 4].

Marginalized and vulnerable populations, such as refugees, individuals with disabilities, and older adults, are disproportionately impacted by these patterns due to their unique challenges in accessing and navigating digital environments. Older users, for instance, are more likely to experience difficulty with ambiguous interfaces, while adolescents may be more susceptible to gamified engagement metrics, which exploit developmental vulnerabilities by incentivizing continuous interaction through streaks and rewards [2, 7]. These examples underscore the need for nuanced approaches to understanding ACDPs that consider the diverse experiences and vulnerabilities of different user groups.

Despite ACDPs' global reach, existing literature has primarily focused on their psychological mechanisms and general user impacts, often neglecting the socio-cultural variations that influence user experiences [1, 11]. Addressing this gap requires an intersectional approach that examines the interplay between design practices, cultural norms, and social inequalities. Such an approach can inform the development of culturally sensitive and inclusive digital design strategies that mitigate the negative effects of ACDPs while fostering equitable user experiences. Beyond their individual impacts, ACDPs contribute significantly to broader societal issues, particularly in the context of social polarization. Polarization, characterized by the division of societies into ideologically opposing groups [14], is exacerbated by digital platforms that amplify reinforcing spirals of selective exposure and ideological homogeneity [5, 11]. ACDPs such as rage-baiting headlines and emotionally charged notifications intensify this phenomenon by prioritizing content that evokes strong emotional responses, thus driving higher engagement metrics.

The reinforcing spirals model proposed by Song and Boomgaarden [11] provides a framework for understanding how ACDPs facilitate polarization. Through selective exposure, users are repeatedly presented with content aligning with their preexisting beliefs, creating echo chambers reinforcing ideological divides. Platforms like TikTok and Facebook exacerbate this dynamic by employing recommendation algorithms that favor sensationalist and provocative content, further isolating users from divergent perspectives [5, 10].

The psychological toll of ACDPs extends beyond polarization to affect users' mental health. Mechanisms like infinite scrolling and automatic story transitions disrupt natural stopping points, leading to prolonged periods of engagement that contribute to cognitive fatigue and stress [4, 7]. This sustained exposure to manipulative content diminishes opportunities for reflection and meaningful interaction, deepening both individual and societal challenges related to polarization and disconnection [2, 5].

The detrimental effects of ACDPs have spurred calls for a paradigm shift in digital design practices, emphasizing ethical principles and user well-being. Büchi's [4] proto-theory of digital well-being advocates for designs that promote autonomy, balance, and intentionality, marking a departure from the exploitative practices that characterize ACDPs. Rather than merely mitigating harm, this framework calls for proactive design approaches that support human flourishing.

Inclusive design principles provide a pathway for addressing the socio-cultural challenges posed by ACDPs. By considering the diverse needs and experiences of global users, inclusive design aims to create digital environments that are accessible, equitable, and empowering [2]. Alternative patterns, such as Comfortable Missing Out (COMO) Prompts, encourage users to embrace digital disconnection and focus on present experiences, reducing anxiety associated with FOMO. Similarly, features like batch notifications and user-controlled playback enable users to regain control over their interactions, fostering intentional and balanced engagement [6, 7].

3. Research Methodology

The initial phase involved a rigorous examination of academic and industry literature on deceptive design and its broader societal and psychological implications. Drawing from established databases such as PubMed, Scopus, Web of Science, and Google Scholar, the review aimed to provide a comprehensive understanding of the landscape of ACDPs and their evolution. Search terms included “dark patterns”, “deceptive design”, “Attention-Capture Damaging Patterns”, “digital well-being”, “social polarization”, and “interface design”. This broad range of keywords returned a breadth of relevant studies published between 2010 and 2024.

Key contributions from foundational studies were instrumental in shaping this phase. Brignull’s [3] exploration of dark patterns and deceptive design provided critical insights into the mechanisms employed by digital platforms to manipulate user behavior. Song and Boomgaarden’s [11] analysis of reinforcing spirals illuminated the relationship between selective exposure and social polarization, while Büchi’s [4] proto-theory of digital well-being underscored the need for design practices that prioritize human flourishing. These studies formed the foundation for understanding the interplay between ACDPs, user autonomy, and social dynamics.

Inclusion criteria were defined to focus on studies addressing the mechanisms and impacts of ACDPs and those proposing potential design alternatives or regulatory interventions. Exclusion criteria filtered out studies with limited empirical grounding or those that exclusively addressed technical aspects without considering user behavior or societal implications. This synthesis identified recurring patterns across platforms and significant research gaps, particularly regarding cultural and contextual nuances.

3.1. Platform-Specific Analysis

The second phase entailed a focused analysis of five major social media platforms: Facebook, Instagram, TikTok, YouTube, and WhatsApp. These platforms were selected for their global user bases, diverse engagement mechanisms, and significant socio-cultural influence. The goal was to identify specific ACDPs deployed on these platforms, analyze their operational dynamics, and assess their psychological and behavioral impacts on users.

Data for this analysis were collected through content audits, user interface testing, and secondary data from user experience studies. Particular attention was given to features such as infinite scrolling, automatic video playback, emotionally manipulative notifications, and gamified engagement rewards. Each platform’s unique design ecosystem was evaluated to uncover patterns and their implications. For instance, TikTok’s reliance on short-form video

and its algorithmically personalized feed fostered compulsive behaviors, while WhatsApp's notification structures contributed to continuous interaction cycles.

Three core criteria guided the platform-specific analysis:

Prevalence of ACDPs. Platforms were prioritized based on their frequent and visible implementation of attention-capturing features.

Diverse Engagement Mechanisms. Platforms employing varied design patterns, from cognitive manipulation to compulsive engagement, were emphasized.

Socio-Cultural Impact. Platforms with significant roles in identity formation, opinion shaping, or information dissemination were emphasized.

This analysis also incorporated findings from prior studies (e.g., [7]) to ground observations in real-world experiences. The patterns identified across platforms served as empirical input for the development of a taxonomy that captured the scope and nature of ACDPs.

3.2. Development of the Taxonomy

The third phase centered on creating a taxonomy to systematically classify ACDPs based on their operational mechanisms, psychological effects, and socio-cultural implications. This taxonomy was structured into three primary categories:

Cognitive Manipulation and Interface Ambiguity Patterns. These patterns exploit cognitive biases and emotional triggers, such as FOMO and emotionally manipulative headlines, to influence user behavior. Examples include notifications that induce urgency or anxiety about missed updates and interface designs that obscure decision-making processes.

Compulsive Engagement Patterns. These patterns foster prolonged usage through mechanisms like infinite scrolling, automatic transitions, and gamified engagement rewards. Such features create addictive behaviors by removing natural stopping points and reinforcing continuous interaction.

Disruption of Healthy Use Patterns. These patterns undermine users' ability to maintain intentional and balanced platform engagement. Examples include incessant notifications, automatic video playback, and time-wasting challenges that disrupt focus and contribute to digital dependency.

Each category was divided into subcategories to account for specific patterns observed during the platform analysis. The taxonomy also included an assessment of potentially violated rights, such as autonomy, privacy, and mental health, drawing from frameworks like Büchi's [4] proto-theory of digital well-being and Song and Boomgaarden's [11] reinforcing spirals.

3.3. Mapping Alternatives and Mitigation Strategies

The final phase involved identifying and evaluating alternative design strategies to mitigate the negative effects of ACDPs. These alternatives were informed by existing literature on ethical and user-centered design and emerging concepts such as COMO prompts, batch notifications, and customizable engagement controls [7]. The alternatives were mapped based on their potential to enhance user autonomy, reduce compulsive engagement, and foster healthier digital interactions.

Feedback was sought from design professionals and policymakers to ensure the feasibility and scalability of these interventions. Special emphasis was placed on addressing cultural and contextual variations, recognizing that user behavior and design reception vary across

sociocultural environments. Examples include tailoring notification structures to local norms and incorporating culturally sensitive interface designs.

The integration of these methodological steps resulted in a comprehensive framework for analyzing ACDPs, their impacts, and potential pathways for mitigation. This approach not only advances academic understanding of ACDPs but also provides actionable insights for designers, policymakers, and stakeholders aiming to create more ethical and inclusive digital platforms.

4. Taxonomy of ACDPs

The insights obtained through the execution of this study led to a detailed exploration of ACDPs in their varied scenarios, highlighting their pervasive presence across digital platforms, their socio-cultural and psychological impacts, and potential pathways for mitigation through ethical design. A systematic taxonomy was developed to categorize ACDPs based on their operational mechanisms and effects, complemented by an in-depth analysis of their manifestations on major social media platforms. These findings emphasize the need to address the cultural and contextual variations in how ACDPs influence user behavior and well-being.

ACDPs were categorized into three primary groups: cognitive manipulation and interface ambiguity patterns, compulsive engagement patterns, and disruption of healthy use patterns. The first category includes mechanisms that exploit cognitive biases and emotional vulnerabilities, such as FOMO alerts and emotionally manipulative headlines. These patterns are designed to induce anxiety and impulsive behaviors by creating artificial urgency or obscuring user choices. Cognitive manipulation patterns are particularly problematic in contexts where emotional or social pressures are deeply embedded in cultural norms, such as in collectivist societies that emphasize social cohesion and belonging. Platforms like Facebook and Instagram frequently employ such mechanisms to sustain user engagement, often at the cost of heightened anxiety and diminished autonomy.

Compulsive engagement patterns represent another critical area of concern. These patterns, such as infinite scrolling and gamified engagement metrics, are structured to sustain prolonged user interactions by removing natural stopping points and fostering addictive behaviors. Platforms like TikTok and Instagram heavily rely on these mechanisms, leveraging personalized content feeds and gamified rewards to reinforce user dependency. These patterns are particularly impactful among younger users, who are more susceptible to gamification due to developmental vulnerabilities. In contrast, the same mechanisms may manifest differently in older users, who might experience cognitive fatigue rather than compulsive interaction. This further illustrates the cultural and demographic nuances in how ACDPs affect behavior.

The disruption of healthy use patterns forms the third category of ACDPs, focusing on features that interfere with intentional and balanced digital engagement. Examples include incessant notifications, automatic story transitions, and autoplay features that discourage users from disconnecting. These patterns disrupt offline routines, hinder rest and recovery, and blur the boundaries between online and offline experiences. Platforms like YouTube and WhatsApp are significant contributors to this category, using automatic video countdowns and frequent notifications to maintain user attention. The psychological toll of these patterns often varies across cultural contexts, as users from collectivist cultures may feel heightened pressure to respond promptly to group messages. In contrast, users in individualistic cultures may

perceive these features as intrusive disruptions to personal autonomy. Table 1 summarizes the taxonomic proposal for ACDPs, emphasizing their presence in social media environments.

Table 1.
The proposed taxonomy of ACDPs.

Attention-Capture Damaging Pattern (ACDP)	Alternative Pattern	Category in the New ACDP Taxonomy	Social Networks where the ACDP Occurs
Endless Notifications and Engagement-Based Notifications Apps send constant notifications and interaction alerts to keep users engaged.	Batch Notifications Non-urgent notifications are grouped and sent at specific times.	Disruption of Healthy Use Patterns	Facebook, Instagram, TikTok, YouTube, WhatsApp
Streak Rewards Systems that incentivize continuous use through consecutive-day rewards.	Flexible Rewards Rewards based on healthy usage goals without penalizing interruptions.	Compulsive Engagement Patterns	Snapchat (reference), also in some Facebook Messenger features
Like and Share Pressure Content that encourages users to like and share constantly.	Reflective Interactions Encouragement of interaction based on meaningful comments and discussions.	Cognitive Manipulation and Interface Ambiguity Patterns	Facebook, Instagram
Emotionally Manipulative Headlines Platforms reward sensationalist headlines that provoke emotional reactions and clicks.	Neutral Headlines Platforms reward informative headlines that describe the content clearly and objectively.	Cognitive Manipulation and Interface Ambiguity Patterns	Facebook, YouTube
Fear of Missing Out (FOMO) Alerts Alerts that induce anxiety by suggesting users are missing something important.	Comfortable Missing Out (COMO) Prompts Messages that promote the importance of disconnecting and enjoying the present moment.	Cognitive Manipulation and Interface Ambiguity Patterns	Facebook, Instagram
Infinite Comments Scroll Continuously loaded comments encourage endless reading.	Comment Limit Display a limited number of comments with an option to load more.	Compulsive Engagement Patterns	YouTube, Facebook, Instagram
Gamified Engagement Metrics Use of scores, levels, or badges to maintain competitive engagement.	Personal Progress Track Tools that display personal progress on user-defined goals without social comparison.	Compulsive Engagement Patterns	TikTok, Facebook (badges), Instagram
Time-Wasting Challenges Challenges designed to keep users engaged for long periods without clear purpose.	Purposeful Challenges Challenges that promote activities with tangible and measurable benefits for the user.	Disruption of Healthy Use Patterns	TikTok, Instagram
Highlight-Reels on Social Media Reels or highlights that autoplay continuously.	User-Controlled Playback Users can manually select and control the start of each video/reel.	Compulsive Engagement Patterns	Facebook, Instagram
Autoplay of Shared Reels Shared reels automatically start the next video after the previous one ends.	Press-to-Play The system displays a thumbnail with a "tap to play" option.	Compulsive Engagement Patterns	Instagram
Friend Suggestion Disguised as Invitation Notification Notifications for "friend suggestions" appear similar to friendship invitations.	Clear and Distinct Notifications Different designs for each type of notification.	Cognitive Manipulation and Interface Ambiguity Patterns	Facebook
Deceptive Notifications in Archived Groups Archived groups send false notifications of mentions.	Accurate and Relevant Notifications Notifications only when the user is actually mentioned.	Cognitive Manipulation and Interface Ambiguity Patterns	WhatsApp
Automatic Story Transitions Stories automatically transition between different users.	User-Triggered Transitions Users control the transition between stories.	Compulsive Engagement Patterns	Instagram, Facebook
Pushed Viral Challenges Viral challenges that encourage continuous engagement.	Opt-In Viral Challenges Users explicitly opt-in to participate in challenges.	Compulsive Engagement Patterns	TikTok, Instagram
Endless Exploration Tabs Exploration tabs with infinite content based on past interests.	Topic-Specific Exploration Users choose a specific topic to explore, with limited and relevant content.	Compulsive Engagement Patterns	Instagram, TikTok

The platform-specific analysis revealed that cultural and contextual factors significantly shape how ACDPs are experienced and interpreted. For instance, in collectivist societies, FOMO alerts that emphasize social belonging may be particularly effective in driving user engagement. In contrast, patterns that obscure user autonomy through interface ambiguity in individualistic societies may elicit stronger resistance. Additionally, marginalized groups, including older adults and individuals with disabilities, often face unique challenges in navigating ACDPs. Older users may struggle with ambiguous interfaces, while adolescents are more likely to be affected by compulsive engagement metrics due to their susceptibility to social comparison and reward-based systems.

The psychological impacts of ACDPs extend beyond individual well-being [8, 9] to broader societal concerns such as social polarization. The reinforcing spirals model, as articulated by Song and Boomgaarden [11], demonstrates how selective exposure to content on social media can intensify ideological divides, fostering echo chambers and reducing openness to divergent perspectives. ACDPs such as emotionally manipulative notifications and rage-baiting headlines amplify these dynamics by prioritizing provocative content that drives engagement but deepens societal divisions. Prolonged exposure to such patterns exacerbates polarization and contributes to mental fatigue and reduced capacity for reflective thinking, further entrenching users in cycles of passive consumption and reactive behavior.

These findings underscore the need for culturally sensitive and inclusive design practices that account for the diverse ways in which ACDPs impact user behavior. Recognizing these patterns' varying cultural, demographic, and psychological dimensions is essential for developing effective mitigation strategies. Alternative design approaches, such as COMO prompts and batch notifications, offer promising solutions by encouraging users to disconnect and engage more intentionally with digital platforms. These interventions align with ethical design principles that prioritize user autonomy, balance, and well-being over short-term engagement metrics [8].

This work highlights the importance of integrating cultural and contextual considerations into the design and regulation of digital platforms. Social media operates on a global scale, serving diverse populations with varying cultural norms and behavioral tendencies. By understanding and addressing these differences, platforms can create more inclusive and equitable digital environments that mitigate the harmful effects of ACDPs while fostering meaningful and balanced interactions. These findings provide a foundation for future research and practice aimed at promoting ethical digital design in an increasingly interconnected world.

5. Discussion and Final Remarks

This study examines ACDPs across major social media platforms, offering a refined taxonomy that categorizes these patterns into three distinct types: cognitive manipulation and interface ambiguity patterns, compulsive engagement patterns, and disruption of healthy use patterns. By systematically mapping these patterns and analyzing their psychological impacts, the research contributes to understanding how design mechanisms in digital platforms influence user behavior, cognitive autonomy, and mental health.

The findings reveal the pervasive influence of ACDPs in fostering harmful user behaviors, such as compulsive engagement, emotional exhaustion, and diminished cognitive capacity.

Patterns such as FOMO alerts and rage-baiting may exacerbate brain rot, a state of mental fatigue characterized by reduced reflection and critical thinking. In addition, compulsive mechanisms such as infinite scrolling and autoplay disrupt users' ability to disengage from digital environments. Also, interruptive notifications undermine efforts to establish healthy offline habits. These patterns may not only compromise individual well-being but also contribute to broader societal issues, such as polarization and the erosion of social cohesion.

The proposed taxonomy serves as both an analytical tool and a practical guide for addressing the adverse effects of ACDPs. The exercise of categorizing these patterns based on their mechanisms and impacts creates a framework that enables researchers, developers, and policymakers to identify problematic design practices. More than that, it allows these interest groups to propose targeted interventions. Solutions such as COMO prompts, transparent interface designs, and customizable user controls represent promising avenues for mitigating the negative effects of ACDPs and fostering a more balanced digital experience. These interventions align with the proto-theory of digital well-being, which advocates for design practices that promote autonomy, intentionality, and human flourishing.

The implications of this study extend beyond theoretical contributions, offering actionable insights for the development of ethical design practices. The study does that by demonstrating that alternative design patterns can support long-term user engagement without sacrificing well-being. This research challenges the prevailing narrative that prioritizes short-term metrics over sustainable interaction. Moreover, the platform-specific analysis highlights the necessity of addressing the unique ways in which ACDPs manifest across different social media ecosystems, emphasizing the importance of tailored interventions.

Ultimately, this study underscores the urgency of a paradigm shift in digital design—one that places user well-being at its core. As digital platforms continue to shape societal interactions on an unprecedented scale, adopting ethical and user-centered design practices is not only a moral imperative but also a strategic necessity for ensuring the sustainability and inclusivity of these technologies. This shift has the potential to redefine the role of digital platforms in an increasingly interconnected and polarized world by fostering environments that respect user autonomy and promote collective mental health.

Declaration of Generative AI

The authors have not employed any Generative AI tools.

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