Shades of Manipulation: A Large-Scale Analysis of Deceptive Design in Brazilian Mobile Applications

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Abstract. Introduction*: Interfaces with Deceptive Patterns (DPs) manipulate users against their best interests, but most Human-Computer Interaction research about DPs focuses on WEIRD context (Western, Educated, Industrialized, Rich, and Democratic).* ***Objective:*** *This study looks at the Global South, specifically identifying, quantifying, and classifying the prevalence of DPs in 100 popular mobile applications in Brazil, and contrasting it with two high-income countries.* ***Methodology****: We analyzed DP classes in 100 popular mobile applications in Brazil from nine categories.* ***Results:*** *DPs presence (96%) and average (7.51) are comparable across countries, but their distribution greatly differs. We discuss how these results relate to the different socio-cultural contexts, the particular use cases in Brazil, and their impact.*
Keywords *Deceptive Patterns, Deceptive design, Mobile Applications, Brazil, Human-Computer Interaction.*

1. Introduction

Deceptive Patterns (DPs) – otherwise known as Dark Patterns[1] – are techniques employed in user interfaces to intentionally manipulate, force, or trick users to take actions that somehow benefit the application creator, impairing user's autonomy, decision-making or choice [Brignull et al. 2010]. They are present in several domains of the software development industry, such as e-commerce [Singh et al. 2024], social media [Seyson e Willett 2025] and games [Zagal et al. 2012]. DPs usually exploit cognitive biases to make users buy something they didn't want in the first place, spend more time than they desired, or give them more data than they intended [Brignull et al. 2010, Mathur et al. 2021, Narayanan et al. 2020].

Several studies have been conducted to understand better how DPs work [Koh e Seah 2023, Kitkowska 2023], how users perceive them [Schäfer et al. 2024, Oyibo 2025], and how they affect the user [Koh e Seah 2023, Gray et al. 2021]. Besides, there are efforts to describe and catalog DPs [Mathur et al. 2021, Gunawan et al. 2021, Owens et al. 2022]. Although there are multiple initiatives to study this phenomenon, they mostly tackle DP-related issues that are Euro- and US-centric [Seaborn et al. 2025],

[1]In this paper, for simplicity we use the term "deceptive" to refer to this type of interface, while acknowledging that other terms such as "manipulative", or "misleading" might be more precise in some cases. The Tech Policy Design Lab of the World Wide Web Foundation, advises against the use of the term "dark pattern" to avoiding language that might inadvertently carry racist associations.

which may not fully capture the situation in the Global South, as this term, proposed by Santos as a metaphor, represents a part of the global population that lives under the oppression caused by colonial countries that invisibilize the knowledge, culture and research of that part of the world population [Santos et al. 2016]. That context may not consider that how they appear, how common they are and how their consequences may occur in non-WEIRD countries. Also, as pointed out by Linxen, most of the papers in the Conference on Human Factors in Computing Systems (CHI) build their research sample biased, since most of the work published comes from countries that fit the Western, Educated, Industrialized, Rich and Democratic (WEIRD) classification [Linxen et al. 2021]. Hence, the results cannot be readily used as a reference in all parts of the world because are often based on taxonomies developed in those contexts.

Furthermore, the socioeconomic differences [IBGE 2024], the lack of digital literacy [Gov 2024a] and the non-uniform way that the technology spreads within the Brazilian society [IBGE 2022] create a unique scenario on how the DP research can and could be approached, since the Brazilian scenario can't fit in a single framework such as WEIRD. Although the Brazilian context doesn't seem to be WEIRD, Mueller analyzes and compares it to contexts of countries such as India, Argentina, and United States and concludes that it could be WEIRD [Mueller 2020]. But, by analyzing this matter from a cultural metric and economic perspective, Mueller's proposal weakens, as it can affirm the WEIRD status of the Brazilian society is true only in a behavioral premise. Thus, all the complexity present in that context reinforces the necessity of this work as, not only, a exploratory study on the presence of DPs in the Brazilian society, but also to bring light to discussions of Brazil's socioeconomic specificities and the need for more contextualized and decolonial approaches in HCI research on DPs globally[de Oliveira et al. 2024].

The purpose of this work is to give an overview of the DP situation in the Brazilian context, considering the specifics of the culture and society. We aim to report the findings of the first quantitative comparative analyses of the popular apps in Brazil, comparing it to prior studies from United States [Di Geronimo et al. 2020] and Japan [Hidaka et al. 2023], since they were limited to either societies they were inserted - the former was conducted in a WEIRD context and the second in a Educated, Industrialized, Rich and Democratic (EIRD) context. Thus, creating depth in the knowledge, not only in the prevalence of DPs but also on how they spread, in different contexts.

In addition, this study also contributes to the literature by identifying and reporting specific DP use cases that could be unique to the Brazilian context, as we did by adding six new DP cases to the taxonomy used in our analyses ("Ads with Layers", "Terms/Policy in Another Language", "Terms/Policy Out Of Bounds", "Task-based Rewards", "Ad-locked Rewards", "Evoke Emotions to Take Action"). Also, to outline evidence that, even with a similar distribution, the types of DP were different when compared with the contexts considered. And finally, to create a solid base to discuss the Brazilian characteristics that could influence the appearance of those DPs, such as socioeconomic, educational, and life quality metrics. Those results highlight the importance of a multicultural and decolonized research of DPs, to understand this problem in a broader perspective. In this work, we extend the discussions and results presented in Ribeiro's work by deepening the reasoning on the results and their relation with the Brazilian culture, considering potential causes and possible outcomes [Ribeiro et al. 2025]. We also contribute a database of the

analysis [Dataset 2025], aiming to stimulate further Brazilian HCI research on DPs. We encourage replication with larger corpora, including less trending apps.

Therefore, we answered four questions: (RQ1): How many DPs appear in these Brazilian apps and the frequency of their appearances? (RQ2): What kind of DPs exist in Brazilian apps? (RQ3) What is the classification of the DPs by class and subclass, and their presence in each category? (RQ4) What are the differences between the findings of the research and the ones by Di Geronimo et al and Hidaka et al., in terms of the first three research questions? To perform that, we used the Qualitative Expert Classification Protocol [Di Geronimo et al. 2020], adapting and expanding the original protocol to better capture the Brazilian context, including the new DP sub/class proposed by Hidaka and 6 new DP use cases we found. We gathered 100 popular apps, across 9 categories, from the Play Store and distributed them between 6 macro classes, 5 of them found by Gray, and the last one proposed by Hidaka [Gray et al. 2018, Hidaka et al. 2023]. Unfortunately, the algorithm of selection of those apps isn't public, and the Play Store seems to use metrics such as downloads, date of publication, and rating. The ways of selecting those apps will be discussed further in this work.

2. Deceptive Patterns and their Categorization

The way digital interfaces impact users' lives has been a growing concern in the Human-Computer Interaction (HCI) research field. This concern has led to a great number of studies focused on digital well-being [Peters et al. 2018, Darin 2024] and the identification of factors that contribute to negative impacts on the user experience [Søraker 2016]. Based on the results of these studies, researchers have identified a series of manipulative and deceptive elements in digital interfaces, known as Deceptive Patterns (DP) [Brignull et al. 2010, Gray et al. 2018]. Despite this being an important concern, most studies analyze [Zagal et al. 2012, Gray et al. 2024, Mathur et al. 2021] and seek to understand the presence [Zagal et al. 2012, Gunawan et al. 2021], occurrence [Hidaka et al. 2023, Di Geronimo et al. 2020], and impact [Seaborn et al. 2024, Mildner et al. 2025] of DPs from the perspective of developed and Western countries. As a result, few studies reflect the reality of different regions of the world, resulting in a notable research gap.

Gray et al. categorize DPs as any instance in which designers use their knowledge of human behavior and the desires of end users to implement deceptive functionality that is not in the user's best interest, generally favoring applications over users [Gray et al. 2018]. Based on a previous study [Brignull et al. 2010], Gray divides the DPs into five primary categories (also described as "macro class") and reports more specific manipulative patterns ("subclasses") in each macro class. Di Geronimo et al. expand Gray's taxonomy based on their findings and use a structure of 16 subclasses within those five macro classes in their methodology [Di Geronimo et al. 2020].

Nagging manifests as a persistent interruption to the user's current interaction. It often appears as popups redirecting the user to another activity that may not interest them (e.g., advertisements interrupting the current task).

Obstruction appears as a barrier that blocks user interaction, making it difficult to perform the desired task. Three subclasses divide this macro class: Roach Motel - makes it easier to get into a certain situation, but difficult to get out of it, trapping the

user in something they no longer want (e.g., not possible to delete an account); Price Comparison Prevention - makes it harder to compare item prices (e.g., unable to select product names); Intermediate Currency - instead of using real money to buy something, the user needs to purchase a virtual currency to spend in the app, resulting in different perceptions about how to handle this currency compared to a real one (e.g., buying coins in the app to purchase products or services).

Sneaking involves disguising information relevant to the user to manipulate their choices. It includes four subclasses: Sneak into Basket - when purchasing an item, the application puts another additional item in the user's basket (e.g., buying a single product, but there are accessories attached to it in the basket); Bait and Switch - an interaction seems to lead into something, but ends up with an undesirable outcome (e.g., clicking on a feature that appears accessible but prompts you to download new content to access it); Hidden Information - when information relevant to the user is hidden or illegible (e.g., making small links to the Terms of Service); Preselection - preselected information that benefits the system rather than the user (e.g., send usage data preselected).

Interface Interference appears as a manipulation of UI elements to distract or privilege actions over others. This macro class includes Aesthetic Manipulation - design choices to distract or persuade to take specific actions (e.g., putting a lot of information and UI elements in ADs versus a small close button). Four subclasses divide this subclass: Toying with Emotions - appeals to UI elements that affect user's emotions to manipulate their actions (e.g., presents offers with countdowns and catchphrases); False Hierarchy - one option prevails over others intentionally (e.g., gives two actions to the user but the one that benefits the system is more eye-catching); Disguised Ad - ADs that are not different from the application or try not to be (e.g., AD with interactive game); Trick Question - includes unclear and confusing sentences on purpose (e.g., double negative options).

Forced Action defines when the user is required to complete an action to continue their current task. It includes two subclasses: Privacy Zuchering - convince the user to share more information about themselves than they would like (e.g., the user needs to share their data to create an account); Social Pyramid - convince the user to invite more users (e.g., the user needs to recruit a new user to access a feature).

In the Nagging and Forced Action macro classes, there were cases of DPs that fit more directly with the macro class itself. For this reason, Di Geronimo used them as macro classes that functioned as unique subclasses within themselves. In addition to Di Geronimo's expansion of Gray's taxonomy, we also based our research on Hidaka's findings on a new macro class related to linguistic factors [Hidaka et al. 2023].

Linguistic Dead-Ends appears as a linguistic choice to discourage the user from understanding relevant information. This macro class expands into two more subclasses: Untranslation - using another language in a specific part of the application that is interesting to the user; Alphabet Soup - switching characters (i.e., letters, numbers, and/or symbols) from different syllabaries to prevent the user from understanding them.

Both studies seek increasingly comprehensive ways to identify DPs in their contexts based on previous findings [Brignull et al. 2010, Conti e Sobiesk 2010, Gray et al. 2018]. Our study aims to move in the same direction, using prior knowledge of DPs to identify them in our context and contribute to this line of research.

3. Related Work

This section explores works related to the prevalence of DPs embedded in applications and websites and their effectiveness. It also presents alternative approaches in Brazilian research on DPs.

3.1. Investigation of Prevalence and Effectiveness of Deceptive Patterns

Mathur et al. propose an automated approach to identify the presence of DPs in e-commerce websites [Mathur et al. 2019]. They document, classify, and measure the prevalence of these patterns in shopping websites. They also developed a web crawler that followed a determined procedure along all sites, storing screen captures and HTML data to be categorized and further analyzed. With approximately 11,000 websites, they analyzed over 53,000 product pages and identified 1,818 instances of DPs, distributed across 15 types and 7 general categories.

Mathur's approach is an important advancement in the automated identification of DPs. However, their intrinsic relation with e-commerce websites leaves space for analyses in broader scopes and, as highlighted by them, this approach had several limitations due to the nature of some DPs and their appearances being presented in a "gray area", in which the automated recognition of DPs would require human pondering whether that instance is deceptive or misleading. Beyond that, they also point out that their software only recognizes text-based DPs, therefore overlooking visual DPs (e.g., small close button on ads). Our work could complement their findings by providing a human analysis of different contexts in which DPs may be present, mainly by including different categories besides shopping.

On the other hand, Luguri and Strahilevitz have endeavored to understand how effective DPs can be [Luguri e Strahilevitz 2021]. They conducted two large-scale studies to comprehend how American consumers identify DPs and how they influence their decisions. Their study presents that aggressive DPs do not encourage users to make decisions outside of their preferences as much as mild DPs. They also found that less educated Americans are significantly more vulnerable than more educated users, especially to mild DPs.

Di Geronimo et al.'s study aims to identify the prominence of DPs by analyzing their appearance in 240 popular and free mobile applications [Di Geronimo et al. 2020]. They also contributed to the research on DP Blindness by conducting an online experiment with 589 participants from different backgrounds to understand whether users are aware of or can recognize DPs. Categorizing the presence of DPs in interfaces can be ambiguous; as a result, the study provides an extension of Gray's taxonomy with specific cases that ensure consistency of this and future analysis.

Hidaka et al.'s study intended to replicate Di Geronimo's work, following their methodology but inserted in a Japanese apps context [Hidaka et al. 2023]. They composed their corpus with 200 apps and then followed Di Geronimo's procedure, but contributed with the addition of a new class of DP to Gray et al.'s taxonomy, Linguistic Dead-Ends, a DP class that encompasses designs that prevent users from understanding key aspects of the interface when manipulating the language of the interface and/or its elements.

With similar intentions, our study is performed based on Di Geronimo's methodology in its first scope and Hidaka's contributions, analyzing the presence of DPs in mobile applications, but inserted in the Brazilian context.

Even though all these studies seek to contribute to the understanding of DP occurrence in large sets of applications in different contexts and platforms, their research focuses on the context of the WEIRD and EIRD countries, and the conclusions of the research may vary in other contexts, such as Brazil. This work demonstrates that DPs manifest themselves in different ways in our scenario.

3.2. Brazilian Approaches to Investigate DPs

Miranda et al. propose a novel definition of design pattern that encourages game designers to use alternatives to the standard DPs found in games, the "Radiant Game Design Patterns" [Miranda et al. 2022]. Based on the Self-determination Theory (SDT) [Gagné e Deci 2005], they aim to create a list of design patterns that are a positive counterpart of deceptive game patterns, encouraging game designers to create games that provide a healthier and more motivating experience to players. To demonstrate the applicability of their definition, they selected three non-healthy game mechanics [Zagal et al. 2012] and transformed them into mechanics that would still be profitable and meet market necessities while being healthier for the player's experience.

Santos Filho et al. argue that, although Radiant Patterns (RPs) [Miranda et al. 2022] represent a promising theoretical framework for positive design, their practical applicability and operational clarity remain limited [Santos Filho e Darin 2025]. To address this, they propose a refined definition of RPs grounded in SDT [Gagné e Deci 2005], emphasizing that these patterns should avoid frustrating players' basic psychological needs, rather than aiming to satisfy them directly. They also present a practical template to identify and validate RPs based on this refined understanding, demonstrating its use in an illustrative analysis.

Santos Filho et al. developed a serious game based on SDT to raise awareness on the impact of DPs in the design process. Their game immerse the players into the process of creating a game, where they take the place of the developer and need to choose mechanics that fulfill the in-game metrics [Santos Filho et al. 2024]. After performing playtests, they found that the serious game can make the players connect their own gameplay to the in-game choices, creating in-depth knowledge about DPs in games. Their work utilized a game-based approach to empower users to better understand DPs impact and consequences on both game design and the user well-being.

Valença et al. perform a structured analysis between the legal software requirements for children's privacy and protection online [Polito et al. 2022] and the DPs of Brignull's taxonomy [Brignull et al. 2010] based on a data collection analysis of the DP findings in the Computer Science literature [Valença et al. 2024]. Alongside this, they create a description of this interplay and describe in detail how these patterns affect the rights of young users. The results indicate that each DP affects 10 requirements on average. In their research, Valença et al. also prototype possible ways to avoid DPs on interfaces and ensure the well-being of young users.

The studies of Baroni et al. present DPs seen as a sociotechnical phenomenon [Baroni et al. 2021, Baroni e Pereira 2024]. They identify a gap where most DP studies

focus only on understanding these patterns in isolated situations. To fill this gap, they analyze and dissect a DP using the Semiotic Framework, alongside offering a catalog of DPs and resources that help users to recognize, understand, and protect themselves from DPs.

While these are examples of valuable Brazilian research on DPs, our study offers a distinct contribution through its specific focus and methodology. Unlike Miranda et al.'s and Santos Filho et al.'s work proposing definitions of an alternative "Radiant Game Design Patterns" for designers [Miranda et al. 2022, Santos Filho e Darin 2025] or Santos et al.'s serious game aimed at raising awareness of DP impacts [Santos Filho et al. 2024], our research empirically analyzes popular Brazilian app interfaces to quantify the prevalence and frequency of existing DPs in this specific context. Furthermore, differing from Valença et al.'s theoretical comparison between DP taxonomies and children's legal rights [Valença et al. 2024] and Baroni's sociotechnical and semiotic approach to build a conceptual catalog for user identification [Baroni et al. 2021, Baroni e Pereira 2024], our work employs a quantitative methodology to create a database detailing the actual presence and frequency of DPs in trending Brazilian applications [Coelho et al. 2025], exploring this context for potentially new DP findings and enriching concerns about DP impacts with feasible, frequent cases.

4. Methodology

The objective of this methodology was to replicate the protocol documented by Di Geronimo et al., focusing on Brazilian apps to identify the presence, frequency, and distribution of DPs in those applications and also find similarities and differences with studies performed in different contexts [Di Geronimo et al. 2020, Hidaka et al. 2023]. This research database is available in our dataset [Coelho et al. 2025].

First, we generated the corpus of applications. We divided the researchers into two pairs and conducted a test for the recording and analysis phases using 18 apps. Each pair recorded nine apps and analyzed the other nine apps recorded by the other pair. We proceeded to the next phase, where half of the app corpus was recorded for a pair of researchers while the other pair analyzed and classified those recordings to minimize the potential DP blindness. After finishing half of the analysis, the pairs of researchers changed roles, so those analyzing passed to the recording phase, and the ones recording passed to analysis. Each part of the procedure is detailed in its respective section.

It is crucial to clarify that we choose to use the term "trending" in this study to refer to those apps that are in the top placements in the Google Play Store ranks, being in general ones or the categories, because this classification includes multiple factors that can make an app popular, and also embraces new and recently published apps. Google itself reports that apps are ranked based on a combination of ratings, reviews, downloads, and other factors. The details of these weights and values are a proprietary part of the Google search algorithm, so we don't have access to how they calculate this[2]. The trending is a volatile context since it can change with the tendencies every day, but it's the closest to users' daily lives, encompassing all the variables used to rank apps in the Google Play Store. Its use also keeps the consistency between the scope of free and trending apps adopted by our study and the previous ones [Di Geronimo et al. 2020,

[2]https://support.google.com/googleplay/android-developer#topic=3450769

Hidaka et al. 2023]. The ranks were extracted on unique dates each to maintain a solid corpus that would not change during future phases and to maintain consistency with the corpus generation of previous studies[Di Geronimo et al. 2020, Hidaka et al. 2023].

4.1. Adaptations from the Original Protocol to Our Context

We adapted the original protocol by Di Geronimo et al. due to budget, device, and time limitations, but also to incorporate emerging findings from our study [Di Geronimo et al. 2020]. Despite these deviations, our work offers an initial classification of DPs in trending Brazilian apps, contributing new app categories, identifying new DP cases, and stimulating further DP research within the Brazilian context.

Corpus Generation. We expanded the corpus categories to nine by adding 'Tools', reflecting its significant presence in an initial list of popular Brazilian apps compared to the eight in Di Geronimo's study. Time and team limitations reduced our sample to 100 apps, fewer than Di Geronimo's 240.

Recordings and Classification. We added an initial testing phase that determined our recording method and identified necessary protocol changes. Two pairs of researchers participated: one pair recorded app usage on personal Android smartphones, and the other used an emulator. Each pair analyzed videos recorded using the alternate method, following Di Geronimo's protocols [Di Geronimo et al. 2020]. We selected the emulator approach for practicality and comparability, as budget limitations prevented providing identical smartphones to each researcher, unlike Di Geronimo. The test confirmed that DPs were identifiable in emulator recordings as much as in smartphone recordings. Based on this test, we also added the task "checking the terms of service and privacy policy" to the recording protocol for more consistent cataloging of related DPs. This initial testing phase ensured consistency of analysis between our two researcher pairs (using a rotation method, unlike Di Geronimo's single pair) and helped identify potential new DPs relevant to the Brazilian scenario beyond Di Geronimo's findings. Apps used during testing were retained but re-recorded by different researchers to avoid bias.

New Usage Contexts. Although Di Geronimo's expansion of Gray's taxonomy performed well for our study, we identified and considered new DP cases. In parallel, Hidaka's findings led to discussions about identifying DPs in non-native English-speaking countries. For this reason, we added the Unstranslation subclass and its respective macro class (Linguistic Dead-Ends) in the taxonomy, including instances of DP use cases identified in our context.

We noticed the presence of the subclass Untranslation in our test phase when the application was in Portuguese but had Terms of Service and Privacy Policy in another language (predominantly in English). That is pertinent information for the users, and they need to be aware of what they are agreeing to. Because of that, we added the "Terms/Policy in Another Language" as a new DP case. Alongside, we identified more specific contexts of DP on those applications that were not reported by Di Geronimo, resulting in the addition of six DP cases:

(1) "Terms/Policy in Another Language" as an Untranslation case describes when crucial information for the user is in another language, even if the app is in the user's native language. This creates a barrier between the user and the information.

(2) "Terms/Policy Out Of Bounds" as an Obstruction case redirects the user to an external page to view terms - typically a web page, increasing unnecessary stress and reducing the likelihood of reading. [Other cases related to app terms ("Terms of service is small and/or greyed out" and "Privacy policy is small and/or greyed out") existed in the scope, but they didn't contemplate the new case scenario]

(3) "Ads with Layers" as an Obstruction case specifies Ads that chain multiple time-delayed sub-ads to extend user exposure within the same AD content. Typically, they have timeouts between each other. That is, the first one plays N with X seconds. Then N2 plays with an additional X seconds, and N3 with another X seconds. This way, they make three "attention calls" within the same 15-second space. We classify DPs related to ADs because we consider apps responsible for the format in which the ADs are presented.

(4) "Task-based Rewards" as a Forced Action case describes cases in which the application presents a task that goes beyond the main flow of the application (e.g., spinning a roulette wheel in a shopping app to earn a coupon), which upon completion the user will receive some aspect of the application's service, generally rewards, coins used within the application or power-ups. Di Geronimo reported similar cases (e.g., "Daily/weekly rewards" and "Login to obtain some rewards/bonus"); however, those cases do not cover all the ways to receive rewards in the apps.

(5) "Ad-locked Rewards" as a Forced Action case indicates when the application forces the user to watch an advertisement to receive a reward (e.g., virtual coins, time accelerators, or bonuses within the application system). Di Geronimo reported the "Watching AD to unlock feature", which is very similar, although some cases lead to different outcomes.

(6) "Evoke Emotions to Take Action" as a Toying with Emotions case specifies when there is any use of language or other appealing visual elements to persuade the user into an action. The previous Toying with Emotions cases ("Countdown offer" and "Shame user for not doing something") were very specific, and we identified the need to add a case that could cover general contexts (e.g., emotional appealing rate popup options).

The "Terms/Policy Out Of Bounds" and "Ads with Layers" DP cases were reported as Obstruction cases because they fit more directly with the macro class itself. Because of that, along with Nagging and Forced Action, Obstruction will function as a unique subclass within itself.

4.2. Step 1: Corpus Generation

Our first step in generating the corpus for the study was to identify the top 100 trending general apps in the Brazilian Google Play Store [3] on January 19th, 2025. We looked for the apps' uses, suspicious reviews, and what categories most appeared among the 100 most popular apps and tried to fit them in the eight categories reported by Di Geronimo (Communication, Entertainment, Family, Music & Audio, News & Magazines, Photography, Shopping, and Social). In this form, we could build an overview of the most used apps in the country, their categories, and their uses.

In this first overview, we realized that Brazil presents two significant categories

[3]https://play.google.com/store

that aren't present in the scope of the original study, being then: the Finance and the Tools categories, where in those 100 general trending apps, Finance and Tools constituted 32% of applications, each one presented 16% (16 apps) of the general top 100. given their presence in Brazilians' daily lives and trending apps, we decided to bring the Tools and Finance category into the research.

Our next step was to gather 154 apps stratified into the eight categories presented by Di Geronimo, plus the Tools and Financial categories. Each category had its respective top 15 apps, besides Communication, which had 16 apps, and Tools, which had 18 apps. We aimed to approve 12 apps for each category, plus three backup apps. The Communication and Tools categories had more disapproved apps than the others, which is why they held more apps. During forward steps in the recording phase, we discovered that the Finance category doesn't work on emulators, only on real smartphones, so we didn't use the category in the upcoming phases. The selection was made using the Sensor Tower [4] on January 22nd, 2025, following four criteria:

1. It must be available to Android devices.
2. It must be free to download.
3. It must be trending in Brazil.
4. It must be trending in its category.

Some apps were reproved for the recording and analyses based on six criteria:

1. Not available for download.
2. Not available in Brazil.
3. Already appeared in other categories.
4. "Launcher" Apps.
5. The main function of the application can only be used by logging in as a paying member.
6. Apps that are tied to the citizen's ID and used to access governmental services.

Ultimately, we aimed to analyze 108 apps in total, so we approved 12 trending apps from each category for the analysis. Some of them presented malfunctions when used in the emulator, which resulted in 100 apps in total for the analysis phase divided between the categories in the following form: 12 in Family; 12 in Music & Audio; 12 in News & Magazines; 12 in Photography; 12 in Social; 11 in Shopping; 11 in Tools; 9 in Communication; 9 in Entertainment.

4.3. Step 2: Interaction Recording

We consolidated our record method using BlueStacks 5[5] emulating Samsung Galaxy S22 Ultra. We bought a SIM card and plugged it into a smartphone to validate its use in applications that required a phone number. Each researcher also created a new Gmail account for the study. We recorded the screen with a native tool on desktops powered by Windows and split the applications to be recorded among the researchers. We record the total number of 100 apps following a shared script.

The usage was recorded in the first 10 minutes following a protocol with eight tasks (when available): (1) creating an account and log out; (2) closing and reopening the

[4]https://sensortower.com
[5]https://www.bluestacks.com/pt-br/bluestacks-5.html

app; (3) visiting the market page; (4) going to the settings page; (5) checking the terms of service and privacy policy; (6) continuing shopping until checkout; (7) trying to select product names in e-shopping; (8) using the app for its intended use.

Although each researcher followed these tasks to guarantee consistency in the recording, some tasks may be hidden or unreachable in the first 10 minutes of usage. Furthermore, we did not purchase any products or services in the apps. We only went to the checkout page and then canceled it, even though some DPs could appear after those phases. We subscribed for free when the intended use of the app was paid (e.g., free trial).

4.4. Step 3: DPs Classification

We made the recording and classification phase in a function rotation method that switched the positions of two pairs. While a pair was recording their apps, the other was already analyzing them. Then, when the first half of the apps were already analyzed, the pairs switched positions. In this way, every researcher could experience the whole process. The researchers analyzed the videos individually first, and then they discussed them together to mitigate DP Blindness. This method contributed to the study of how perceptive DPs can be. While some DPs could be identified for both, others could only be identified by one of the researchers. The agreement score was calculated with Weighted Cohen's Kappa ($\kappa = 0.64$) and indicated a good agreement rate. We solved disagreements in the classification with the opinion of a third researcher.

To classify the DPs, we used the same basis taxonomy as Di Geronimo's study [Brignull et al. 2010, Gray et al. 2018], in addition to Hidaka's later findings related to linguistic DPs in non-native English-speaking countries. Identifying DPs based on application descriptions can lead to varied interpretations, especially when multiple researchers conduct the analysis. Hence, we followed a guide with specific DP case descriptions to promote consistent identification. These descriptions are available in our dataset [Coelho et al. 2025].

The same UI element can present different DPs at the same time. For example, a popup appears and interrupts the current task, an option is already preselected, and there are more options, but the one most beneficial to the app is more prominent. In this case, we identify Nagging, Preselection, and False Hierarchy in the same UI element. Additionally, we did not count re-occurrences of DP that already appeared early in the application to guarantee that the usage of the application would not interfere with the count of DPs. We considered the same DP if the same UI appeared in a similar context (e.g., the Terms of Service are greyed out in every login step).

In conclusion, the taxonomy used is defined by: (1) Nagging; (2) Obstruction including three subclasses (Intermediate Currency, Price Comparison Prevention, and Roach Motel); (3) Sneaking including four subclasses (Bait and Switch, Hidden Information, Preselection and Sneak into Basket); (4) Interface Interferences including five subclasses (Disguised Ad, Aesthetic Manipulation, Toying with Emotions, False Hierarchy and Trick Question); (5) Forced Action including two subclasses (Privacy Zuchering and Social Pyramid); (6) Linguistic Dead-Ends including the subclass Untranslation. Totaling six macro classes, 18 subclasses, and 40 DP cases, considering Nagging, Forced Action, and Obstruction as macro classes that also function as unique subclasses within themselves.

5. Results

After analyzing our corpus, we performed several comparisons to understand the characteristics of the problem in the Brazilian context. Furthermore, we compared to the situation reported in the Japanese and American contexts [Hidaka et al. 2023, Di Geronimo et al. 2020].

5.1. Frequency and Prevalence of DPs (RQ1)

Considering the existence of Single and Multiple DP cases, being Single the DPs that can only appear one time per app and Multiple DPs that could occur several times on the same application, we used the Di Geronimo's classification [Di Geronimo et al. 2020], with the addition of Untranslation, that was counted within the Linguistic Dead-Ends macro class, proposed by Hidaka et al. [Hidaka et al. 2023], and 6 new DP cases that were found in the initial test as possibly relevant to our context.

Between the 100 apps analyzed, we found that 96% (N=96) of them contained at least one DP. A total of 751 DPs were found in the corpus, averaging 7.51 DPs per application (std.dev.:4.7). Besides that, most apps contained at least 7 DP´s (N=46), followed by 3 to 6 appearances (N=41) and the least being between 0 to 2 appearances (N=13).

The distribution between the six macro classes shows a pattern that most interfaces will try to obstruct or force the user interaction. The most common macro classes are Nagging, appearing in 78% (N=78) of the apps, Interface Interference with 76% (N=76) and Forced Action with 68% (N=68). The macro classes appear in an average of 3.7 (std.dev.: 1.5) per app.

The subclasses average 4.4 per app with the most commons being Nagging present in 78% (N=78) of the apps, Forced Action with 54% (N=54) and Obstruction with 50% (N=50). For Obstruction we defined two new DP use cases - "Ads With Layers" and "Terms/Policy Out of Bounds" - which allowed us to use it as a functional subclass. The same occurs with Nagging and Forced Action, but their DP use cases were proposed in Di Geronimo's expansion of Gray's taxonomy [Di Geronimo et al. 2020]. In addition to that, in terms of total occurrences, the subclasses that most appeared in our corpus were Nagging (N=201), Forced Action (N=115) and Disguised Ad (N=75), as total appearances we considered the multiple times that a subclass occurred in an app.

5.2. Types of DP on the Brazilian apps (RQ2)

Considering our findings in the DPs subclasses, we performed a Kruskal-Wallis test (χ^2 = 520, p = <0.001), since the assumption of homogeneity failed, and found that exists a statistically significant difference in the distribution of the DPs subclasses. And by performing a Dwass-Steel-Critchlow-Fligner pairwise comparison, we found that the Nagging subclass is significantly bigger than all the DP subclasses (p <0.001) except when compared to Forced Action (W = -5.6466; p = 0.008).

Furthermore, by analyzing the Obstruction, as a functional subclass, we found that 60% (N=42) of the cases were "Ads With Layers" and the other 40% (N=28) were "Terms/Policy Out Of Bounds", being those two of the new cases we added to the taxonomy. In addition to that, the cases "Task-based Rewards" and "Ad-locked

Rewards" represented 17% (N=20) and 12% (N=14) of the occurrences in the Forced Action subclass.

Finally, as shown in Figure 1, the fourth most common DP occurrence was Untranslation, appearing in 83% (N=10) of the apps from the "Family" category and 63% (N=7) of the apps in the "Utilities" category. The number of appearances of this kind of DP, especially in those categories, raises concerns about how the user's data and privacy are being treated, a topic that's going to be discussed further in the Discussions section. Furthermore, our Untranslation occurrence it's considerably higher than what was found in Hidaka's research (Ours: 45%, Hidaka's: 15%) [Hidaka et al. 2023].

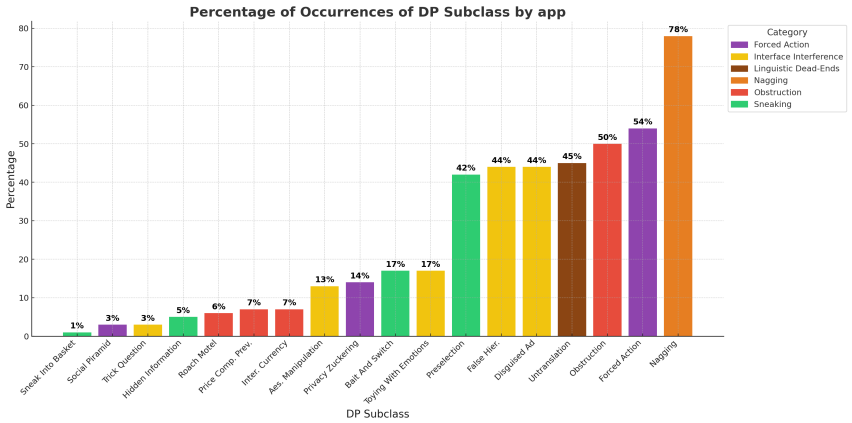

Figure 1. Percentage of Occurrences of DP Subclass by app. Bar chart showing the percentage of appearance of DP subclasses in Brazil. The most frequent subclass is Nagging (78%). The least common are Sneak Into Basket (1%).

5.3. Sub/Class relationship with the Categories (RQ3)

First, we tried to find if there was any significant statistical difference between any of the app categories. By running a Kruskal-Wallis test (χ^2 = 15.4, p = 0.051), after our data failed the homogeneity assumption, we did not find any significant difference between the categories. However, the p-value is borderline and may suggest a possible trend that will not reach the conventional significance threshold for this sample, suggesting further investigation in a larger corpus.

After analyzing the descriptive statistics of each category, we found that the three with the highest average DPs number were "Utilities" (avg.: 10.1, std.dev.:18.3) "Photography" (avg.: 9.83, std.dev.:3.27) and "Entertainment" (avg.: 8.78, std.dev.:6.89). Beside this, we found the category with the most DPs in one app was "News and Magazine" with 25 occurrences. Three other categories, including "News and Magazine", had apps with 0 occurrences, being "Entertainment" and "Social".

By generating a Kernel Density Estimate plot (KDE), as shown in Figure 2, it's possible to see that almost all categories are concentrated around it's own means, being the most narrow the "Music and Audio". In contrast, "News and Magazines" and "Entertainment" had broader curves, suggesting a more diverse number of DP occurrences within it's apps.

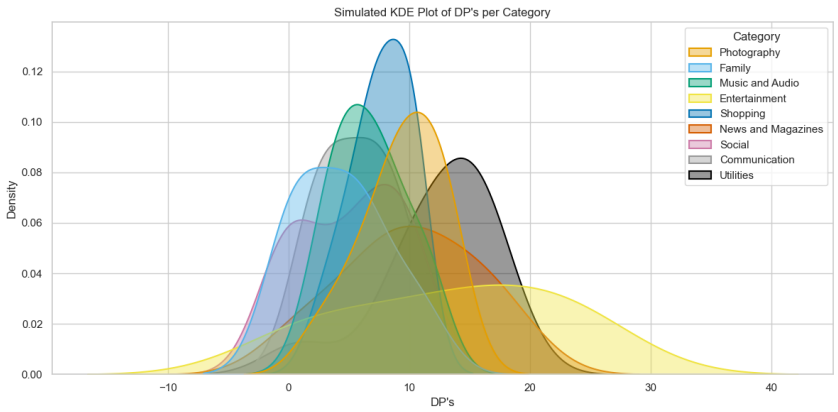

Figure 2. KDE Plot of Density of DPs by Categories. KDE plot showing the distribution of DPs across 9 app categories. The Utilities and Photography categories show peaks at higher DP counts, while Family and Social have lower density peaks. The x-axis represents the number of DPs, and the y-axis represents density.

5.4. Comparison with the International Situation (RQ4)

When comparing with Di Geronimo et al.'s findings [Di Geronimo et al. 2020], as shown in Fig. 3, we used only the same DPs categories as they did, as a result of that the Linguist Dead-Ends and Obstruction, as a functional subclass, were disregarded as their findings don't use both. Given this context, we directly compared the percentage results in Di Geronimo's report and calculated the difference between both. The positive region of the graphic shows the increase in the rate of occurrences of DPs subclasses per app in our study. As a result, we found that the most increased subclasses are Toying With Emotions, followed by Forced Action and Nagging, reinforcing the idea that most apps on the Brazilian context try to force the user to do something that they wouldn't normally do. Building on our Kruskal-Wallis test (χ^2 = 15.4, p = 0.051), a similar outcome was reported in Di Geronimo's findings. The consistent lack of difference between categories might suggest a pervasive characteristic to DPs.

Furthermore, our corpus had a higher percentage of apps with at least one DP - 96% against 95% in Di Geronimo's findings. We almost found an equivalence in the average number of DPs when compared with Di Geronimo's - 7,5 against 7,4. However, our analyses showed a difference when compared to the Japanese context. First, our corpus had more apps with at least one DP - 96% versus 93.5% - and our apps averaged almost double the average found in the Hidaka corpus - 7.5 against 3.9 [Hidaka et al. 2023]. Moreover, we had a near number of overall DPs across the apps (Ours: 751; Hidaka's: 775), even though they had twice the apps in their corpus (N=200).

Additionally, we analyzed the reoccurrence of apps in our dataset and Di Geronimo's [Di Geronimo et al. 2020], and identified 11 apps that appear in both, with most apps appearing in the categories of Social (N=4) and Communication (N=4). By performing a Chi-Square Test of Independence, testing the difference between the sum of occurrences by subclass, we did not find any statistical difference in the recurrent apps. Unfortunately, the Hidakas' [Hidaka et al. 2023] data set is anonymized, and this analysis can not be performed.

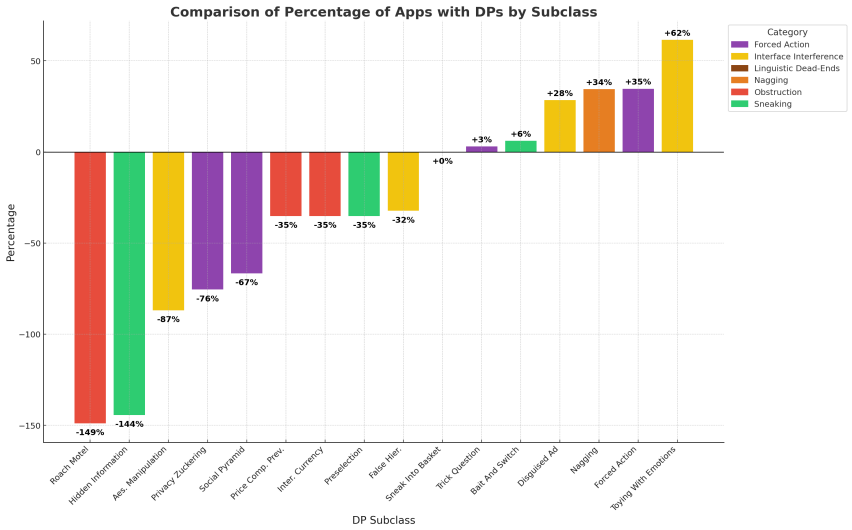

Figure 3. Comparison of Percentage of Apps with DPs by Subclass. Bar chart comparing subclass occurrences in US and Brazil. 9 out of 16 subclasses are more common in the US. "Toying with Emotions" is the most frequent in Brazil. Positive bars indicate higher occurrence in Brazil when compared to the US subclass ocurrences.

6. Discussions

In this section we are going to explore questions that appeared in the previous sections in a more profound approach, better understanding each dilemma, such as the Brazilian perspective as a country outside the WEIRD classification, the comparison with the International scenario and the need of new researches on the theme.

6.1. How DPs are affecting Brazil?

Determining whether Brazil fits a WEIRD classification is complex due to its continental proportions and internal disparities, potentially misrepresenting the context. While Mueller culturally referenced Brazil as WEIRD [Mueller 2020] and its overall HDI is High [UNDP 2023], further analyses reveal significant variations: multiple states show indicators similar to underdeveloped countries [AtlasBR 2021, WPR 2025], and the "Synthesis of Social Indicators 2024" [IBGE 2024] confirms major regional gaps in education and wealth, particularly between the North/Northeast and South/Southeast. This complex structure, with different regions presenting unique issues, makes a single WEIRD framework unsuitable and likely impacts ICT use [IBGE 2022] and how DPs affect society. Our analysis of trending apps provided an overview reflecting this complexity, but does not capture all regional nuances. Therefore, studies contemplating these variations—regional, rural/urban [IBGE 2022], specific local contexts [Ribeiro et al. 2023], and isolated communities like indigenous lands [Baggio et al. 2023]—are necessary to build a deeper understanding of DPs across diverse contexts.

Whether Brazil is WEIRD or non-WEIRD, 27% of the population, approximately 59 million people, are still below the poverty line [Gov 2024b]. On that matter, Haushofer conducted a study that related the state of poverty to higher levels of stress

and negative affective states, which may lead to short-sighted and risk-averse decision-making [Haushofer e Fehr 2014]. Both of the effects pointed out by Haushofer seem to be exploited in DPs present in the Brazilian context.

The comparison between our results and Di Geronimo's [Di Geronimo et al. 2020] Fig. 3, reinforces the idea that most apps in the Brazilian context try to force the user to do something they wouldn't normally do. Besides that, the results also imply how it does it: possibly by shaming, persuading, or creating a sense of scarcity in the user. Considering the subclass Toying With Emotions, 56% (N=14) of its appearances were in the "Shopping" category. This subclass of DP may be exploiting persons in situation of poverty by using elements in the interface to shame the user for not doing something or creating a sense of scarcity by creating a countdown offer, exploiting the situation pointed out by Haushofer. To reinforce this assumption, a study performed by Woon Chee Koh showed that there exists an increase in the selection of products that were sold with DPs based on scarcity-based messages, such as low-stock and limited-time messages - countdown timers, and messages based on the user's recent activity [Koh e Seah 2023]. The combination of those factors could be a cause for the increase in the rate of debt of the population [CNC 2025], since 55% of the Brazilian people shop online at least once a month [Lucio 2024].

Furthermore, by analyzing the Nagging macro class, the highest appearing among the 6 considered in this work, the idea that the interfaces are designedly trying to force the user to take actions that they wouldn't normally do or that benefit the developers is deepened. Rhomberg found that the users feel annoyed and fear having to keep refusing requests to use the app [Rhomberg 2024]. The cognitive pressure, caused by the annoyance and the fear, combined with strategies of the use of phrases such as "Maybe Later" and "Not Now", creates the feeling of commitment, enhancing the possibility that the user will perform the action the app is asking. Thus, that kind of DP and the situation it implies increase the chance of the user spending more time on the app or enabling notifications, which could lead the user to return to the app when doing another activity. In the Brazilian context, this situation creates concern since a study showed that 56% of the population cannot stay one hour disconnected [lehibou 2022] and measures such as banning cell phones in schools were taken due to high use by kids and teenagers [cetic.br 2023].

Therefore, as the DPs situation seems to be affecting the Brazilian society in many layers, besides focusing on how those techniques affect the user, studies should investigate how DPs affect the economics, education, and overall life quality of the population.

6.2. The presence of new app categories, class, subclass and DP cases

The top 100 general trending apps in Brazil have a significant presence in two categories not discussed in previous studies [Di Geronimo et al. 2020, Hidaka et al. 2023], the Finance and Tools categories, each making up 16% (16 apps) of the top 100 apps in the Google Play Store, together they are 32% of that top. But why are they so significant in the Brazilian context? Firstly, Brazil has seen a rising of digital banks, which have become part of Brazilians' daily lives and have impacted the Brazilian banking system [Ribeiro et al. 2022, Martins et al. 2025]. This tendency of digital banking also fostered the use of those banks' apps. We did not analyze the Finance category, as we used

the emulator to record the applications, and this category is only functional on real smartphones for security bank configuration. We encourage other studies to investigate the situation of DPs in this category.

We believe that the Tools categories have that prevalence because even though 96.7% of Brazilian homes have access to a smartphone [6], some lack basic functionalities such as PDF readers and screen recorders. A specific type of app exists in the Tools category, being the governmental apps (apps used to access governmental services and digital documents and tied to the citizens' personal ID) that were not possible to include in our study because we need to record the first 10 minutes of use, including creating an account. These applications only allow one account per person, and all researchers already have an account. Also, it is not possible to delete the account. The presence of DPs in governmental apps remains undocumented, DP studies with these kinds of apps can bring new findings to the Brazilian context.

Another relevant finding was apps with essential information in foreign languages (e.g., user terms and private policy), especially English. As discussed by Hidaka, this finding consists of a DP of the Linguist Dead-Ends macro class (DPs where the use of language prevents or makes it very difficult for the user to understand crucial functionality or information) with an Untranslation subclass (DPs where part or all of the application is in a language unfamiliar to the user) [Hidaka et al. 2023]. We added this class and subclass to our scope, and 45% (n=45) of the 100 apps analyzed presented this DP. This presence in Brazilian applications reveals a serious problem since English is not an official Brazilian language. Brazil is in the 81st position among 116 countries in the 2024 EF English Proficiency Index [7], which means that a significant portion of users are prevented from accessing crucial information such as Terms of Service and Privacy Policy.

Finally, Brazilian apps revealed new DP cases undocumented in previous studies and not presented in the original protocol. We added six new DP cases, which together have 158 occurrences in the final classification, representing around 21% of the 751 DPs found. Their stratified occurrence is: Terms/Policy in Another Language (occurrence = 45); Terms/Policy Out Of Bounds (occurrence = 26); Ads with Layers (occurrence = 42); Task-based Rewards (occurrence = 20); Ad-locked Rewards (occurrence = 14); Evoke Emotions to Take Action (occurrence = 11). Those additions contribute to a list of DP cases closest to the Brazilian context. And also cover the changes that may have happened in apps since Di Geronimo's study, like what happened with DP related to receiving rewards or features where the scope has already three DPs about that situation ("Daily/weekly rewards", "Login to obtain some rewards/bonus" and "Watching ad to unlock feature") yet many apps have adopted a system of internal coins and rewards with multiple ways of getting them, those three existing cases didn't cover all those new ways, so we added the "Task-based Rewards" and "Ad-locked Rewards" cases to have a more complete, specifically and consistent way to classify all these forms of getting rewards.

[6] https://educa.ibge.gov.br/jovens/materias-especiais/21581-informacoes-atualizadas-sobre-tecnologias-da-informacao-e-comunicacao.html

[7] https://www.ef.com.br/epi/regions/latin-america/brazil/

6.3. How Does DPs Brazilian Scenario Compares to USA and Japan?

Our results, compared to Di Geronimo's findings, on average (Ours: 7.5; Di Geronimo's: 7.4) and in prevalence (Ours: 96%; Di Geronimo's: 95%) are very similar. Even with a significant difference between the corpus sizes, this similarity in the results suggests that the appearances of DPs in Brazil are aligned with those found in apps in the United States. However, the values begin to distinguish when compared with the distribution of these results between the subclasses of DPs. As shown in Fig. 3, our findings present an increase, when compared to Di Geronimo, in the subclasses Toying with Emotions (61.5%), Forced Action (34.7%), and Nagging (34.5%). Those subclasses lead and manipulate the user by encouraging them persuasively to perform an action (e.g., using a countdown on offers, forcing the user to watch the AD for a few seconds, popups constantly interrupting the flow). On the other hand, there was a decrease in the subclasses Roach Motel (-148.9%), Hidden Information (-148%), and Aesthetic Manipulation (-86.9%). The two least prevalent subclasses, compared to Di Geronimo, belong, respectively, to the macro classes Obstruction and Sneaking.

This fact raises the hypothesis that DPs in the United States are more related to user manipulation, tricking them or making their task difficult, in contrast to the Brazilian scenario, which manipulates the user by persuading them to do or complete an action. This hypothesis is validated when analyzed along with the study by Luguri and Strahilevitz on the effectiveness of DPs in the decisions of an American consumer user [Luguri e Strahilevitz 2021]. Their research reveals that the most effective strategies are Hidden Information, Obstruction, Trick Questions, and Social Proof. They raise the question of whether companies did not already know this before and use these patterns on purpose. What about in Brazil, are the most common patterns the ones that most affect Brazilians? Are they strategically positioned to do so?

Regarding the study conducted in Japan[Hidaka et al. 2023], our findings were higher in two of the matters analyzed (average number of DPs per app and apps with at least one DP) when compared with Hidaka's. We averaged almost the double DPs per app (7.5 against 3.9) and had more apps with at least one DP (Ours: 96%, Hidakas's: 93.5%).

That difference might suggest a more significative difference in the density of DPs in the Brazilian and Japanese contexts. A factor that might influence this situation is the more advanced legal approach to the situation in Japan. The Japan Fair Trade Commission, made a report where they found the 10 most prevalent DPs in websites and calculated a annual damage of ¥1.7 trillion [Shimbun 2025]. While Japan advances in the comprehension of the DPs problem to the country, in the Brazilian contexts it stills being discussed profoundly only by researchers but with little progress by legal bodies such as the Brazilian National Authority of Data Protection [Pereira 2025]. Furthermore, this difference could be due to cultural differences, market maturity and methodological differences, such as the corpus size.

6.4. Brazilian Context Requires In-Depth DPs Research

Our findings bring a foundational understanding of the Brazilian DP situation. Although our results demonstrate general trends, they also indicate particular aspects that require additional exploration outside the scope of the present analysis. Therefore, we outline research themes decurrent directly from our results.

The "Untranslation" subclass presented by Hidaka had a notable presence in our research results (45%) [Hidaka et al. 2023]. Registered as the fourth most common subclass, it was most identified in the Family (83%) and Utilities (63%) categories. Therefore, it becomes relevant to include research that investigates the specific impact of "Untranslation" on the understanding of terms of service, privacy policies, and critical features, especially among populations with lower English proficiency or lower digital literacy. Furthermore, study how the presentation of crucial information in a foreign language or in an obfuscated way affects user trust and their ability to make informed decisions about their data and privacy. In addition, explore whether the prevalence of "Linguistic Dead-Ends" is higher in applications targeted at users perceived as less able to identify or challenge these practices.

The new DP case we identified in the Brazilian context, "Ads with layers" occurs 42 times and constitutes 60% of Obstruction DP, as a functional subclass, showing that it's necessary to understand how and why it is present in the Brazilian context. This DP is deeply related to publicity, so future works could explore this to investigate the prevalence and specific tactics used in this DP case. Who are the actors that use this practice the most? Ad networks? App developers? Or other ones? Future work can also analyze the impact of these layered ads on the user experience (UX), time spent, and potential exposure to unwanted or malicious content for different audiences across app categories.

The social, cultural, economic, and educational disparities in Brazil render the traditional WEIRD categorizations inadequate to understand DPs in this context. While an in-depth exploration of this complexity would go beyond the scope of our current research, it highlights an essential imperative: DP research needs to consciously move beyond Global North norms and take on a decolonized perspective.

This highlights the need for regionally focused and socioeconomically relevant research within Brazil. We advocate for comparative studies examining the leading apps across different regions of the country. It is essential to analyze whether socioeconomic factors such as wealth, literacy, and access to technology influence exposure to DPs. Yet another pressing issue is to investigate how DPs may adapt their characteristics to exploit specific vulnerabilities among rural, peripheral, and Indigenous populations, taking into account their unique perspectives, contexts and interactions with technology.

We argue that pursuing this strand of research develops the locally-situated, detailed knowledge that is lacking. Although contextualized in games research, the creator-consumer divide could serve as a lens to move passed the DPs research bias. Darin proposes a perspective where the context of "creator-consumer divide" builds a structural schism where the developers are deliberately exploiting the lack of consumer protection and power imbalances or indifferently automating systems to different cultures [Darin 2025]. It leads to the exploitation of the asymmetry of social, educational, or economic parameters of the Global South when compared with WEIRD societies. Our results agree with Darin's (2025) perspective that building partnerships and co-creating research agendas with other communities from the Global South is a path to help promote a decolonial approach to DP research. We call for the HCI community to prioritize such context-specific work, not just in Brazil, but across the Global South, to form a truly representative and fair conception of deceptive design's impact.

7. Limitations

Our study analyzed trending free apps from Brazil's Google Play Store only. We recorded the first 10 minutes of app use, which might not capture DPs appearing only in longer interactions. Scripts ensured data collection consistency, though minor variations reflecting natural user behavior could occur. Two groups analyzed the data; consistency checks minimized subjective interpretations and potential DP blindness.

Time and budget constraints limited our sample to 100 apps, a smaller size than Di Geronimo's study. We observed similarities in overall DP prevalence compared to their findings. This sample size could potentially limit the generalizability of our results regarding the distribution of specific DP types prevalent in less popular applications, introducing a risk of sampling bias.

Using an emulator might slightly modify app UI elements and some interactions, potentially affecting DP presentation compared to a real smartphone. Some apps were excluded due to emulator malfunctions or security rejections (e.g., financial apps), with substitutions made when possible.

Google Play's undisclosed criteria for trending apps, combined with time constraints, made long-term tracking for a precise Brazilian context database challenging. Nevertheless, Android's widespread use and Google Play's dominance in Brazil suggest its trending list is reasonably representative[8].

8. Conclusion

A sample of 100 trending mobile apps in Brazil revealed a widespread presence of DPs with a 96% prevalence rate and an average of 7.51 DPs per app observed. The most frequent category of DP was Nagging (78%), based on the adapted taxonomy for Brazil. The results indicate an urgent need to investigate further the influences of DPs in the country.

Future studies will address the link between DP interactions and economic welfare by population segments, particularly considering the power dynamics and fundamental character of Finance and Government apps excluded at this time due to methodological constraints. Similarly, the unique DP ecosystems in popularly played mobile games, often categorized under Family, call for a thorough examination of their impact on Brazilian players' perceptions of fairness, satisfaction, and buying behaviors.

The high incidence of DPs in Brazilian apps demands intervention. Effective DP education tailored to different Brazilian consumers, analysis of existing legal frameworks such as the Consumer Protection Code, and development of detection tools tailored to local trends are critical follow-ups. Studies on DPs in Brazil provide necessary evidence, generally lacking in research conducted mainly in the Global North or WEIRD settings. Understanding how these patterns arise and influence users across different socioeconomic and cultural settings, as are found across Brazil, is essential for a truly comprehensive grasp of this worldwide trend. We urge the HCI community to broaden its scope, thinking about and actively addressing the adverse effects of DPs within the wide range of users globally.

[8]https://gs.statcounter.com/os-market-share/all/brazil

9. Ethical Aspects

This study did not involve human participants, the collection of personal data, or the use of animals in experiments. All information used is publicly available or derived from theoretical and/or experimental analyses conducted without ethical risk. Therefore, submission to an Ethics Committee was not required. Nevertheless, the research was conducted in accordance with academic integrity and good research practices.

10. Acknowledgments

This paper is a partial result of the project *"Digital Well-Being"*, supported by the Brazilian agency National Council for Scientific and Technological Development (CNPq/MCTI, Call No. 10/2023 – Universal), under grant number 404559/2023-9.

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