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Transparent app design reduces excessive usage time and increases willingness to pay compared to common behavioral design - A framed field experiment

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a framed field experiment**

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Abstract

Transparent app design reduces excessive usage time and increases willingness to pay compared to common behavioral design—a framed field experiment *

Smartphone app designers often use behavioral design to influence users, increase sales, and boost advertising revenue. Behavioral design relies on elements ranging from app appearance to black-box algorithms and personalization. It commonly exploits behavioral biases, such as the lack of self-control. Consumers are seldom aware of such design and usually have no control over it. Aiming to protect consumers, the recently enacted European Digital Services Act requires app design to be more transparent and adjustable.

In a framed field experiment, we document that behavioral design increases app usage time, especially in the case of vulnerable users. An app version that adds transparency and offers protection features helps to overcome temptation. The higher willingness to pay for the transparent version shows that the positive effects of app transparency and increased consumer protection might not only materialize on the demand side but may also challenge current practices on the supply side.

Keywords: smartphone app, filtering algorithm, transparency, consumer protection, field experiment.

JEL classification: C93, O33, D83, L86, M38, D18

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1. INTRODUCTION

Mobile apps are swiftly growing in importance. There were 3.5 million apps available for download on the Google Play Store and 2.2 million on the Apple App Store in 2022.¹ On average, users have 80 apps installed on their smartphones and spend 4.8 hours per day using mobile apps.² Most app business models rely on behavioral design aiming to achieve high conversion rates and viral growth (Lambrecht et al. 2014). Behavioral design elements can take various forms, including app appearance, rewards, social features, black-box algorithms, and personalization.

Given that app providers seek to boost profits and face intense competition on the app market, app designers have developed tools to influence consumption decisions, nudge users to reveal personal data, or manipulate them into taking certain actions (Luguri & Strahilevitz, 2021). Designs, termed sludge, deceptive design, or dark patterns, deliberately disregard user preferences. Dark patterns, such as confirmshaming—shaming the user for declining an option and pressuring them to confirm—exploit cognitive biases and harm vulnerable users. Misleading and aggressively deceptive design has been shown to quadruple the likelihood of changing user behavior in the desired direction, while even a milder version still doubles the success rate (Luguri & Strahilevitz, 2021). Since users are not able to consent to such practices, these practices are increasingly being addressed by new legislation that strengthens consumer protection, including the newly enacted Digital Services Act (DSA) by the European Parliament (European Commission, 2022; Gray et al., 2018; Mathur et al., 2019; Sunstein, 2019; Thaler, 2018).

With emerging restrictions on deceptive design, the market will evolve to replace dark patterns with other versions of behavioral design. For this reason, the DSA intends to cover

¹ <https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/>, viewed on 19.08.2022.

² <https://mindsea.com/app-stats/>, viewed on 06.11.2022.

possible future design “replacements” and requires app design to ensure more transparency and user-adjustability. Thus, the behavioral design studied in this work is concerned with (a) the potential risks of “mild” behavioral design, which does not fall under the legal notion of dark patterns as defined by the DSA, but still exploits behavioral biases and (b) the effectiveness of newly recommended transparent protection features. If it is effective and valued by consumers, a transparent design can open the way to standardize responsible design and certify ethical apps, thus creating a new competitive advantage for responsible app providers on the market. The holistic effects of behavioral design and consumer protection measures in digital media and apps have not yet been studied causally in the academic literature—a gap that is closed by this work.

In a framed field experiment, using an experimental news app designed specifically for this study, we investigate (a) how app usage time is affected by behavioral design; (b) how it is affected by app transparency and protection measures, and (c) whether a more transparent alternative to typical behavioral design in apps is valued by users. Over a two-week period, participants interacted with a news app that had one of three app versions: a baseline version, with minimal functional design and no protection features (*Baseline Design*), a version with typical behavioral design but no protection features (*Behavioral Design*), or a transparent version with both behavioral design and protection features (*Transparent Design*). The behavioral design implemented in the app incorporated elements known to influence user behavior by creating echo chambers based on past preferences, offering mental rewards, attracting user attention, and triggering user action, all intended to extend usage time. Protection features consisted of (a) explanations of the design mechanisms and their risks in form of an in-app consent to behavioral design and (b) features that enabled participants to adjust design settings.

We found that, in the *Behavioral Design* group, participants used the app twice as long as in the *Baseline Design* group, on average. This was mostly driven by a proportion of participants with excessive usage patterns. In the *Transparent Design* group, usage times were between that of the other two treatment groups. While, at the beginning, the usage times in the *Transparent Design* group were more similar to those in the *Behavioral Design* group, later on, they more resembled those in the *Baseline Design* group. More than two thirds of the participants in the *Transparent Design* group made active use of adjustable protection features. In addition, the awareness of the behavioral design was the highest in this group, as indicated in the poststudy survey. The willingness to pay was lowest in the *Behavioral Design* group, whereas it was highest in the *Transparent Design* group.

The findings suggest that users with excessive usage patterns in the *Behavioral Design* group are not able to resist temptation to spend more time on the app. Since, compared to others in their group, they are highly aware of the behavioral design elements aiming at increasing their usage time and are willing to pay less for the app than users in the *Transparent Design* group, they probably face psychological costs of self-control. The educative and adjustable protection measures offered in the *Transparent Design* group help users to better exert self-control. The reduction in usage time over the course of the study indicates that users in the *Transparent Design* group learned over time and that the locally adjustable protection features were responsible for this effect. In contrast, the lack of a pronounced effect of the in-app consent regarding behavioral design elements suggests that pure information plays a lesser role.

Essentially, we find evidence that there is a need for in-app consumer protection measures. When consumers are exposed to behavioral design without any protection measures, they are less likely to realize how their behavior is being influenced and spend much more time with the app—

at least a nonnegligible proportion of the users. They are not able to resist temptation, they behave as the app designers induce them to behave, and they are fully exposed to the underlying behavioral mechanisms. They thus become an instrumentalized and dulled ‘object’ of behavioral design (Cohen, 2017). On the other hand, if consumers are offered protection measures, despite being exposed to behavioral design, they become empowered and reduce the time spent on the app. They are aware of the potentially abusive design and make use of in-app protection features. They also value those features and are willing to pay more for a transparent version of the app. Thus, the results show potential for business models that do not solely rely on monetizing usage time and taking advantage of impulsive spending or habitual and addictive dependence. Alternative business models, such as subscriptions, relying on trustworthy and responsible design, may win satisfied and loyal consumers, and thus be both socially and economically sustainable.

2. RELATED WORK

Behavioral design is a design framework for programming (i.e., intentionally and systematically changing) human behavior by modifying the physical and digital environment (Combs & Brown, 2018). Such design is deliberately applied on a daily basis by digital applications that influence billions of users (Alter, 2017; Oinas-Kukkonen & Harjumaa, 2008). It exploits various behavioral biases of individuals like attentional bias, confirmation bias, or the mere exposure effect (see, for example, Barberis & Thaler, 2003) for business, political, or other purposes. Individuals might suffer from cognitive limitations when it comes to privacy data self-management (Solove, 2013).

Other risks for consumers in digital media involve, for example, unconscious social contagion, such that traditional metrics may overestimate consumer utility of social media apps

because of digital addiction (Allcott et al., 2020). Media content studies find that the attributes of news articles (such as images, novelty, sentiment, title, polarity) strongly affect user attention and loyalty (Brady et al., 2017; Kramer et al., 2014). Furthermore, these studies find that news content personalization reduces knowledge (Beam, 2014) and contributes to the creation of echo chambers (Bail et al., 2018). Persuasive technologies can be more effective if they are personalized (Kaptein et al., 2015) and a literature review by Hamari et al. (2014) concludes that gamification affects certain users in specific contexts more than others. Finally, the systematic review by Seaborn & Fels (2015) calls for more empirical evidence on specific gamification elements. While most studies investigate the effects of different design elements, none has actually built an authentic study app and tested its holistic effects on behavior and its overall valuation in the field, as the present work did.

The reasons for applying behavioral design include the option to personalize content and advertising to sell products (Boerman et al., 2017) and make price discrimination possible (Acquisti et al., 2016), to assist decision making (Kleinberg et al., 2018), to nudge and influence users (Dellarocas, 2006), to bind their attention and loyalty (Claussen et al., 2013), and to create complex, much-tested tools with specific business purposes (Montag et al., 2019). As a side effect of only putting the user but not the user interests at the heart of design, behavioral design can induce risk-prone or addictive behavior (Mosquera et al., 2020) and induce users to share more data than they actually would be willing to do (Acquisti et al., 2015). Moreover, if such design is used carelessly or with poor awareness it can bring about inherent manipulation and algorithmic discrimination (Lambrecht & Tucker, 2019; Obermeyer et al., 2019; Weidmann et al., 2016).

Given the use of the habit-forming techniques in the digital context, users are not able to exert enough self-control on their own, which means there is a need for external help like

commitment devices (Hoong, 2021; Acland & Chow, 2018). However, research has established that individuals underestimate their need for such devices (Acland & Levy, 2015), which points to a need for alternative solutions. Toussaert (2018) concludes that welfare benefits from policies restricting the availability of tempting options could be larger than predicted. Other potential avenues to help users to resist might include education. When surveyed, consumers exhibit demand for such education (Cemiloglu et al., 2023) and education has been shown to work in the context of fake news (Berger et al., 2022). Fogg (2002) pioneered a discussion on requirements for responsible behavioral design. The requirements can be summarized as: (1) Designers and app providers shall be aware of the consequences, the potential for backfire, and risks of the applied behavioral design elements and have tested their effects thoroughly. At the same time, (2) consumers shall get informed and educated about the applied behavioral design as well as its risks, such as losing money, privacy, or freedom, and (3) they shall get the chance to interactively make necessary adjustments to protect themselves from unwanted behavioral design.

Led by the state-of-the-art literature, our study app offers a unique opportunity to conduct a real-world assessment of behavioral design risks and the feasibility of built-in consumer protection measures and to provide practical recommendations both for app providers and regulators. Moreover, the study closes an important gap in the literature since, to our knowledge, none of the studies has implemented and experimentally assessed the effectiveness of explaining behavioral design and offering innovative in-app protection features.

3. EXPERIMENTAL DESIGN

In order to determine how participants interact with different versions of the study app and what the economic implications are for app providers and their businesses, we ask the following

research questions: (1) How does behavioral design affect usage time? (2) How do app transparency and adjustable protection features impact usage time? (3) Do users value app transparency and adjustable protection features, that is, are they willing to pay more for such a version of the app?

For the purpose of the study, we decided to develop a news app, because news feeds are an easy way to fill a study app with rich real-world and up-to-date content, and readers worldwide predominantly obtain their news content online (Flaxman et al., 2016). The app was built by a professional app developer based on our design. During the design process, we consulted interdisciplinary research partners to incorporate expertise from the fields of law, digital ethics, technology assessment, and computer science; this complemented our own expertise in behavioral economics.

Prior to the field experiment, we conducted an independent online survey in order to understand news reading behavior and consumer needs regarding the news app design. The design of the app draws upon insights from this survey (for more details, see Appendix B). The survey also confirmed that participants consider a news apps to be serious and they do not want manipulative elements in that kind of app. Therefore, we considered a news app to be a good and neutral candidate for the purpose of the study. Moreover, the baseline version reflects stated preferences for fair and uninfluenced news consumption. However, the modern business models of news providers include advertising as the major source of revenue, and thus rely on maximizing the time that users spend on the app. For this reason, news apps rely on elements such as content personalization and content manipulation, which capture users' attention in order to monetize it. Instead of manipulating news content and providing ads, we applied news filtering, used push

notifications to encourage more reading, and added gamification elements—all common in popular apps, the latter less so in news apps.

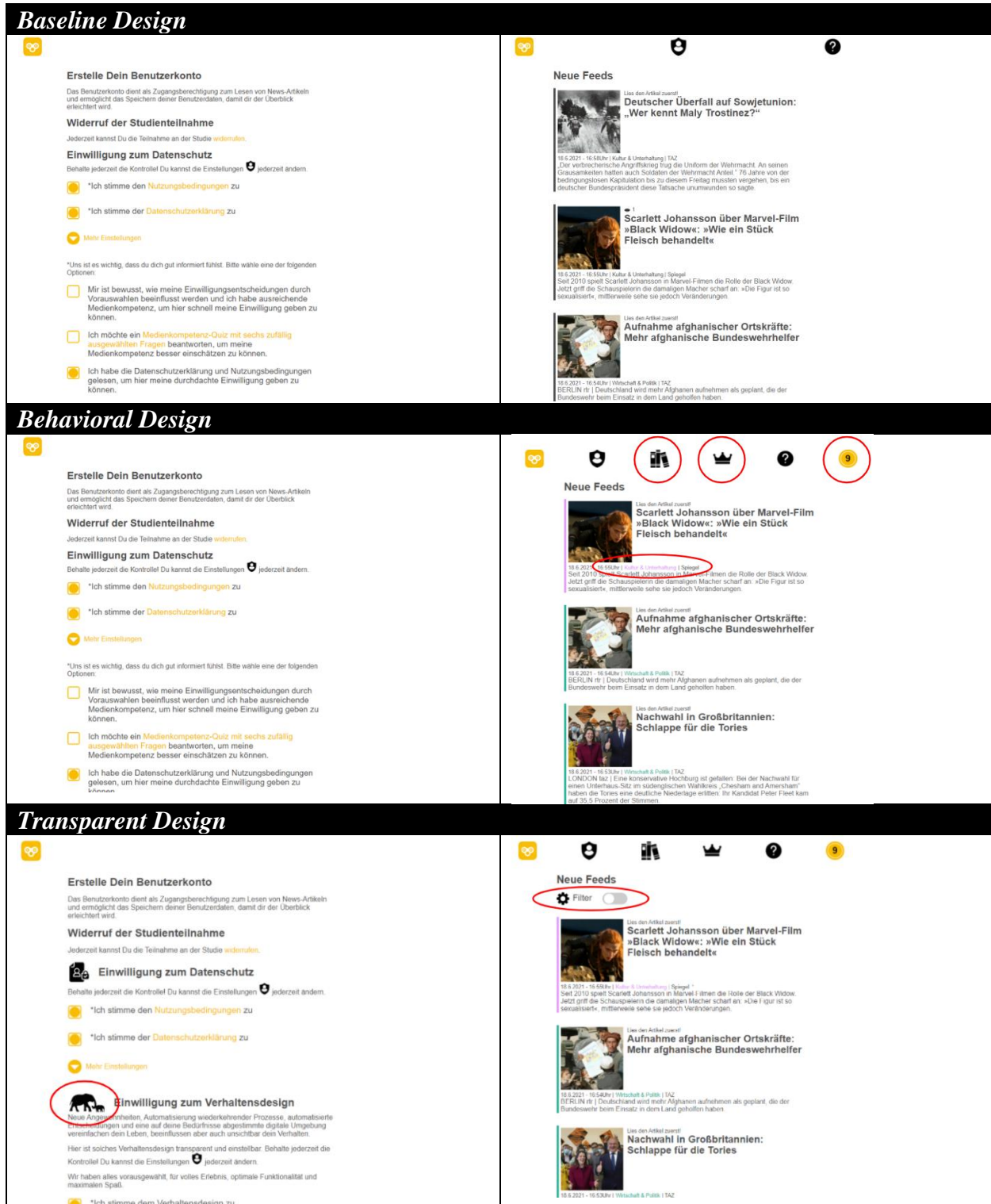
Three app versions were designed, one for each treatment group: (1) The *Baseline Design* group used a baseline version of the app with a minimal functional behavioral design, but no additional behavioral design aiming to bind user attention and no protection features. (2) The *Behavioral Design* group used a version with behavioral design elements intending to prolong usage time but no protection features. (3) The *Transparent Design* group used a version with the same behavioral design elements as those in the *Behavioral Design* version but included information on pros and cons of behavioral design and offered adjustable protection features.

The app versions in the *Behavioral Design* and *Transparent Design* groups contained behavioral design elements typically found in similar real apps. These elements included algorithmic filtering of news based on user preference profiling, choice architecture (e.g. different coloring of news categories and highlighted news), gamified elements (e.g. rankings and achievement badges for the most active readers), tailored push notifications, and user-friendly front-end elements to make the app more engaging. The *Transparent Design* version additionally contained novel consumer protection measures, which included in-app consent to behavioral design and adjustable behavioral design settings. The upfront information read as follows: “*New habits, automation of recurring processes, automated decisions and a digital environment tailored to your needs simplify your life, but also invisibly influence your behavior. Here, such behavioral design is transparent and adjustable. Keep control at all times! You can change the settings at any time. We have pre-selected everything for full experience, optimal functionality, and maximum fun.*” The adjustable settings not only allowed participants to tailor the functionalities of their app and to deactivate certain behavioral design elements, but also provided short explanations of the

mechanisms at hand. For an overview of the three app versions see Figure 1. For a detailed showcasing of the three app versions, the behavioral design elements applied in the app, and its protection features, see Table C1 in Appendix C. For details on the media competency quiz, which was contained in each of the three app versions, see Table A5 in Appendix A.

News came from 15 different German language sources, comprising the major news providers, with some requiring license fees and others generously supporting the study with their content. Our app did not contain any advertising; thus, there was no actual monetization of users' time. To unify the design, we only included one image per article. News items were assigned to one of four predefined categories in the feed. The categories were (1) economy and politics, (2) sport, (3) culture and entertainment, and (4) gaming and technology. The category names and the highlighting were grey in the *Baseline Design* version and had distinct colors in the other two groups. The content in each participant's news feed was automatically updated several times each day. Additionally, participants in the *Behavioral Design* and *Transparent Design* groups could update their news feed through the widely used "pull-to-refresh" design element, which allows users to load new content by "pulling down" the screen with one finger. In the main news feed, all app versions displayed the average article rating and the number of people who read an article. The option to rate an article was also available in all app versions at the end of each article on a voluntary basis. This minimal behavioral design in the *Baseline Design* group aimed to make the app somewhat realistic and allowed for meaningful responses in the post-study survey.

Figure 1: Design versions



Note: Left panel—in-app consent containing privacy policy and terms of usage and, additionally in the *Transparent Design* group, agreement to behavioral design; Right panel—example of a news feed; the red ovals mark the differences between treatments.

3.1. Outcome variables

In our study design, we set usage time as the main outcome variable. This would help us to address the first two research questions on the effects of behavioral design and consumer protection measures. App usage time reflects user attention. For real-world apps, business models are often based on displaying as many advertisements as possible; thus, they rely on maximizing usage time (Kerkhof, 2020). Additionally, in a post-study survey, we asked questions pertaining to willingness to pay for the app, awareness of behavioral design, and need for protection. These measures complement our understanding of the extent to which participants are captivated by the study app and their self-reflection about this situation.

Regarding the willingness to pay for the app, we asked each participant to state the amount of money they would be willing to pay for a comparable market-ready app in four most common business models that rely on direct payments: individual (i.e. not shared) monthly subscription, monthly subscription shared with family and friends, donation (pay-as-you-want), and paying per article (pay-as-you-use). Then, we assessed participants' awareness of behavioral design by asking: *"Have you noticed that we applied behavioral design elements in the app, which aimed to increase your usage time?"* In the question, we intentionally put the focus on our main outcome variable. In order to assess the need for protection, we asked several questions including: *"Would you like to be able to set yourself which behavior-influencing elements are allowed to be active in the apps that you use?"* In addition, we also assessed the need for protection related to the algorithmic filtering of news, the push notifications, and data protection.

3.2. Participants

We recruited 141 participants for the 14-days of online study from a German public university's laboratory for economic research. For more details on participant demographics and balancing, see Table 1. The study was conducted anonymously. Participants were informed that the aim of the study was to learn about their user experience with the app. All participants signed an informed consent declaration.³ We randomly assigned the participants to three treatment groups, stratifying on gender. However, two participants never opened the app. Since the treatment assignment was only visible after opening the app, we exclude those two non-participants from further analysis, so that there were 45 participants in the *Baseline Design* group and 47 participants in each of the other two groups. Two participants from the *Behavioral Design* group did not take part in the post-study survey and one participant from the *Transparent Design* group did not finish the post-study survey. Consequently, the post-study survey was filled in completely by 136 participants, with 45–46 participants in each group.

Participants who completed all parts of the study received 50 euros. The fee was divided into 6 euros for downloading the app, 1 euro for each day participating in the study, without any requirement to actively use the app, and 30 euros for filling in the post-study survey, in order to reduce any attrition. The actual app usage time was not incentivized as this is our main outcome variable. Beyond the direct financial incentives, the app offered free access to daily news content that is either not available without subscription or only in limited quantities. We communicated with participants via the lab and on every fourth day sent reminder emails to those who had not

³ While our university had no ethics committee that could deal with an ethical approval, we were pointed to the precedential decision on ethical approvals by the German Association for Experimental Economic Research (GfEW) which states that by German federal law and by the ethics code of the German National Science Foundation (Deutsche Forschungsgemeinschaft DFG), human subject experiments are exempt from the IRB review as long as standard experimental protocols are used.

opened the app for the previous three days.⁴ The reminders told “*You have not used the news app since several days. During the study duration you may freely use the functions of the app and read and rate the content as you like.*” With the reminder emails we tried to avoid complete inactivity, while having the least impact on app usage time. Nevertheless, using control questions in the informed consent declaration, participants were aware that they could stay inactive during the whole study. Although withdrawal was always possible with a proportional payment until the day of withdrawal, there were no active withdrawals.

3.3. Hypotheses

We hypothesize that compared to the *Baseline Design* group, the usage time will be higher in the *Behavioral* and *Transparent Design* groups, as in those groups we employ behavioral design elements that aim at influencing participants to engage with the app for longer. We expect that the protection features in the *Transparent Design* group will raise awareness of the effects of behavioral design, and thus usage time in that group will fall between the usage time values of the other two groups. Therefore, our first hypothesis is:

Hypothesis 1 - Usage time: Baseline Design < Transparent Design < Behavioral Design

Since participants in the *Transparent Design* group were educated about behavioral design, participants’ awareness of applied behavioral design should be highest in that group, followed by the *Behavioral Design* group, since this treatment employed many behavioral design elements without educating individuals about them. Given the minimal behavioral design in the *Baseline*

⁴ In total, we sent 57 reminders to 39 participants. The numbers were 28 and 18 in the *Baseline Design*, 15 and 10 in the *Behavioral Design*, and 14 and 11 in the *Transparent Design*.

Design group, we expect the awareness of such to be lowest in that group. This leads us to the second hypothesis:

Hypothesis 2 - Awareness of behavioral design: Baseline Design < Behavioral Design < Transparent Design

Finally, although the participants are expected to spend more time with the app in the *Behavioral Design* version, when coupled with the awareness of the behavioral design and its habit-forming aspects, we expect that, as a result, the valuation for the app will be lower in the *Behavioral Design* group than in the *Transparent Design* group. We have no ex ante expectations for the valuation of the *Baseline Design* group, which leads us to the following hypothesis:

Hypothesis 3 - Willingness to pay: Behavioral Design < Transparent Design

4. RESULTS

4.1. Descriptive findings

Over the 14 days, 7,839 articles were available, of which 2,301 (29%) were read by at least one participant. We classified an article as read if the participant opened the article for at least five seconds. The average app usage time was 6.6 minutes per day. This compares to eleven minutes spent daily by a representative German person on reading print newspapers and to three minutes spent daily on reading newspaper content online in 2021, the same year as our study took place (Media Activity Guide, 2021). Rating of articles was popular, with 88% (2,029) of the articles that were classified as read being rated on a scale from one to five stars. On average, the articles were rated 3.57 out of five stars. Until the second last day of the study, the participants in the *Behavioral*

and *Transparent Design* groups received, on average, almost six push notifications. On the very last day, all groups received a push notification inviting them to participate in the post-study survey, next to any other notifications in the *Behavioral* and *Transparent Design* groups.

When asked about the preferred business model, most participants indicated that they would be willing to choose some kind of freemium model that would entail trading their data, which is still a very common business model in this and many other real-world contexts. In addition, 6% were willing to pay a regular subscription, 10% a shared monthly subscription, 3% to pay per article, and 15% to donate (see Table A4 in the Appendix). Those numbers are close to the number of individuals paying for online news in Germany—9% in 2020 and 14% in 2021 (Newman et al., 2022).

Overall, this shows that our app was popular with the participants and that their behavior matched well with the behavior in the population, on average, providing a very realistic setting for our study.

Table 1: Balancing table

	<i>Baseline Design (A)</i>	<i>Behavioral Design (B)</i>	<i>Transparent Design (C)</i>	Test of proportions p-value		
	Share			A=B	A=C	B=C
Female	0.511	0.533	0.500	0.833	0.916	0.75
Native speaker	0.956	1.000	0.978	0.153	0.544	0.32
With no reading problems (impaired vision, reading difficulties)	0.622	0.578	0.457	0.667	0.113	0.247
Aged 18–25	0.556	0.511	0.500	0.673	0.596	0.916
With a BA degree	0.356	0.378	0.500	0.827	0.164	0.24
With a MA degree	0.244	0.244	0.130	1.000	0.163	0.163
Computers science major	0.133	0.111	0.109	0.748	0.718	0.971
N	45	45	46			

Before proceeding with the hypothesis tests, we analyze whether our randomization achieved a good balance between treatment groups. Table 1 shows a number of available characteristics and simple t-test p-values in all group comparisons; none of the 18 p-values is significant at conventional levels thus confirming a good balance.

4.2. App usage time

Regarding usage time, we calculate both the total usage time and the time spent solely on reading articles during the 14 days of the study. The total app usage time is recorded as the time when the app is open and in the foreground on the smartphone screen. The total reading time is measured as the time spent reading the full text of the articles. In order to draw a comprehensive picture, we complement the measures of usage time by other measures of usage patterns. First, we count the number of articles the participants screened, read, and rated. Second, we also look at how frequently the app was opened and the proportion of participants who opened the app on each day. Table 2 shows the averages for those outcome variables.

The average total usage time was 67 minutes in the *Baseline Design* group over the two-week period, which is somewhat below five minutes per day. In the *Behavioral Design* group, the average usage time was 132 minutes, which is almost ten minutes per day. In the *Transparent Design* group, it was 88 minutes, which is over six minutes per day. The time spent on reading articles was 39, 86, and 54 minutes in the respective treatments, which is between close to three minutes per day in the *Baseline Design* group to more than six minutes per day in the *Behavioral Design* group. This pattern confirms our hypothesis 1, all differences being statistically significant at $p < 0.05$ or $p < 0.1$,⁵ see bottom of Table 2.

⁵ As per our ex ante directional hypotheses, we use a one-tailed test. The power calculation protocol can be found in Table A1 in the Appendix A.

The average total numbers of articles screened (counted if the user opened the article independent of how long they spent on reading it), read (open for 5 seconds or longer), and rated were 28, 23, and 18 in the *Baseline Design* group, and they were 119, 97, and 90 in the *Behavioral Design* group. In the *Transparent Design* group, the numbers were 68, 53, and 42. Finally, regarding app usage frequency, we observed the total number of sessions in the *Baseline Design* group to be, on average, 26. Each day, 71% of the participants in this group opened the app. Those numbers were 38 and 81% in the *Behavioral Design* and 40 and 80% in the *Transparent Design* groups.

Table 2: App usage, aggregated data

			Total time in minutes	Total reading time	Number of articles screened	Number of articles read	Number of articles rated	Number of sessions	Share using the app per day
	N								
<i>Baseline Design</i>	45	Mean	66.784	39.709	28.133	23.311	18.444	26.200	0.708
		Std. error	8.855	5.546	2.715	2.503	2.504	2.141	0.033
<i>Behavioral Design</i>	45	Mean	132.009	85.677	118.533	96.756	89.956	38.067	0.806
		Std. error	30.308	20.638	32.259	25.409	31.162	3.211	0.026
<i>Transparent Design</i>	46	Mean	87.526	54.472	67.891	52.500	42.261	39.870	0.799
		Std. error	9.553	6.637	9.926	7.199	8.370	3.661	0.029
<i>Baseline<Transparent</i>		t-test	0.058	0.046					
<i>Transparent<Behavioral</i>		p-	0.081	0.075					
<i>Baseline<Behavioral</i>		value*	0.021	0.017					

Notes: *As per our ex ante directional hypothesis, we use a one-tailed test.

Since the averages may mask the dynamics of the usage, we next turn to usage patterns over time. In Figure 2, we present selected outcome variables by treatment group and over time. The graphs for additional variables can be found in Figure A1 in the Appendix A. The first graph in Figure 2 shows the development of the article reading time over the study period for the three

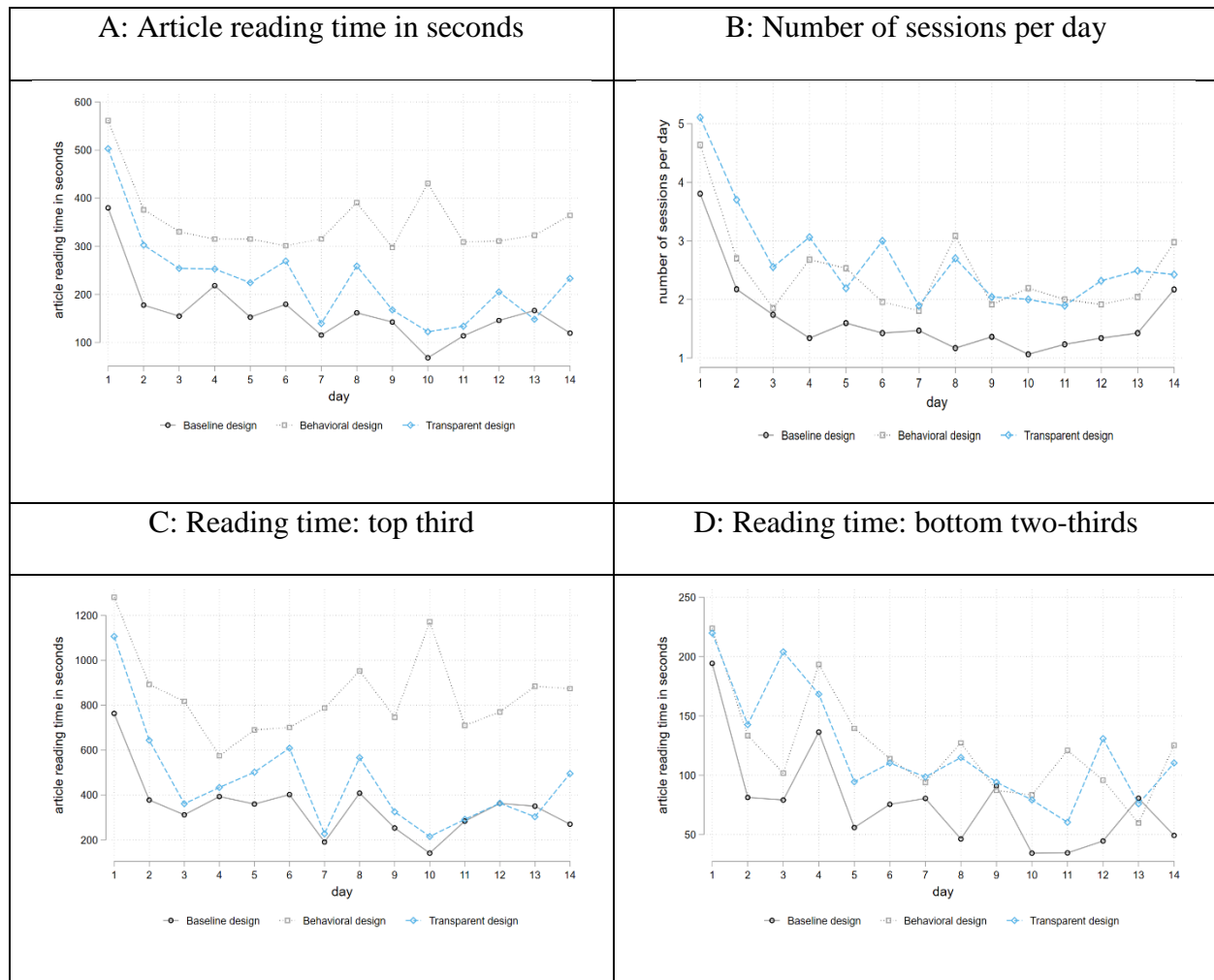
groups separately. We see that, at the beginning of the study, the reading time per day in the *Transparent Design* group was more similar to the *Behavioral Design* group than to the *Baseline Design* group and from day seven on it was the other way around. When looking at the number of sessions per day (right panel), we see that it was higher in the *Transparent Design* group than in the *Behavioral Design* group in the first four days and very similar afterwards. Overall, we observe a more negative trend in usage over time in the *Transparent Design* group than in the two other groups. Those differences may have arisen because participants in the *Transparent Design* treatment are more aware of the pitfalls of the behavioral design due to the information that they received upfront. Note, however, that at the beginning, the reading time is more similar to the *Behavioral Design* group. This rather speaks against the information presented upfront being able to explain the difference. The other reason for the difference could be that the adjustable protective measures at hand help the participants to better exert self-control. The more negative trend in reading time dynamics suggests a learning effect.

In addition to looking at behavior over time, we need to zoom in on particular user types. The higher average time spent with the app in the *Behavioral Design* group can be explained by excessive usage behavior by at most a third of users, while the remaining participants show similar behavior in all treatments, see Figure A2 in the Appendix A for the numbers of article reads by the highest ranked individuals in each group. An obvious reason for this observation could be the stimulation of competition through gamification and social comparison in this treatment group. Note that such design elements are also present in the *Transparent Design* group. Given our experimental design, we can only speculate that there is a positive interaction effect of the gamification elements and the algorithmic personalization because the suggested articles match the users' interest such that competition is more easily stimulated. In Figure 2, Panels C and D, we

present the over-time dynamics separately for the top third most active users and the remaining participants per treatment group. We see that the overall treatment differences are purely driven by the top third most active users, while the remaining participants express very similar behavior independent of the treatment. It seems that there is a group of individuals who are especially susceptible to becoming overly engaged but who might be, however, helped with protection measures. Such protection measures might be valuable for consumers if they help them to resist temptation—temptation that they would prefer to avoid (Toussaert, 2018). Without protection measures, avoiding temptation implies costs for the individuals, and it seems that the costs are high in our context, at least for some of the participants.

Who are these individuals who find it difficult to avoid temptation? We run a simple linear probability estimation of being among the top third of users according to the number of articles read per treatment group and present the results in Table A2 in the Appendix A. We see that the most active users are less likely to be aged 18–25 (they are older) and less likely to study computer science, both if we look at the whole sample or restrict it only to participants in the *Behavioral Design* group. This is in line with the literature that has documented higher digital literacy among younger individuals (Guess et al., 2019; Munger et al., 2021) and this can also be expected from computer science students.

Figure 2: Dynamics of average usage time and sessions started per study day and by treatment groups



4.3. Awareness of behavioral design and need for protection

Not surprisingly, most of the participants (70%) in the *Transparent Design* group are aware of being subject to behavioral design, followed by half of the participants (51%) in the *Behavioral Design* group and almost quarter of the participants (22%) in the *Baseline Design* group, see Table

3. These differences are all significant at $p < 0.05$ and less, therefore, our results support Hypothesis 2, the awareness of behavioral design increases with its salience, and thus the *Transparent Design* group shows the highest awareness compared to the other groups.

Interestingly, the most active users in the *Behavioral Design* group were much more likely to have noticed behavioral design elements in the app that aimed to increase their usage time than the remaining participants in that group, namely 67% compared to 44%, see Table 3, Column II and III.

Table 3: Awareness of behavioral design

	all		Top third		Bottom two thirds	
	N	share	N	share	N	share
<i>Baseline Design</i>	45	0.222	15	0.200	30	0.233
<i>Behavioral Design</i>	45	0.533	15	0.667	30	0.467
<i>Transparent Design</i>	46	0.717	15	0.867	31	0.645
<i>Baseline < Behavioral</i>	test of	0.001				
<i>Behavioral < Transparent</i>	probabi	0.035				
<i>Baseline < Transparent</i>	lity p-value*	0.000				

Notes: share of participants who responded positively to the question whether they realized behavioral design aiming at increasing usage time; *As per our ex ante directional hypothesis, we use a one-tailed test.

In the post-study survey, we asked participants for their need for protection measures in any app. Nearly all participants in all treatment groups require protection measures and wish for the option to adjust them. See Table A3 in the Appendix A for the average responses. Since there are not many differences in those subjective responses by treatment, we only present the overall mean. In order to get a richer picture, we asked in more detail whether participants would have used an option to correct algorithmic filtering results to influence the news content shown to them in the app if that option was available. The majority (70%) stated that they would use such an

option. Moreover, we also asked whether they would adjust the settings of their push notifications if that option was available. More than every second participant would use such an option. In sum, the participants expressed a high need for protection features.

Next, we look at the actual usage of protection measures in the *Transparent Design* group, which was the only treatment group with such measures. We note that the majority of the participants (66%) changed the offered filtering settings including the adjustment of the personalization algorithm's outcome: 30% did so once and 36% did so multiple times. Overall, the participants adjusted filtering options throughout the study, including on the last day. While 26% of the participants accepted the default protection settings as part of the in-app agreement to behavioral design, which contained the usage of algorithmic filtering and receiving 1–2 push notifications each day, 30% made at least one change to the default push notification settings. 15% of the participants adjusted local protection settings directly placed within the push notifications. 87% of the participants accepted the strongest default suggestions for eyesight protection, which was the only protection measure in the study that pertained to physical risks of app usage. Altogether, 74% of the participants adjusted at least one of the default protection settings. The high usage rate of protection features, when offered so, confirms their value for users. In addition, we observe that the usage of protection measures was higher for the top third of users in this group indicating a higher need for protection measures among more active users—potentially the ones prone to addiction without such measures. Figure A3 in the Appendix A shows the usage of filters by study day and user ranking in the *Transparent Design* group.

Participants' responses to post-study questions regarding the usefulness and risks of apps can shed some light on the actual popularity of the usage of protection measures (see Table A3 in the Appendix). Whereas behavioral design in apps in general is rated medium on usefulness, its

risk is rated high. More specifically, for example, usefulness of gamification features in apps is rated low but their risk is rated high, which mirrors that the most active participants in the study were also tempted by competitive gamification elements, which technically could not be deactivated or adjusted by any of the offered protection features. When asked how participants feel not having any control over the behavioral design, they indicate to have an unpleasant feeling—a feeling that they can potentially eliminate if offered adjustable protection features.

4.4. Willingness to pay

We asked the participants for their willingness to pay for an individual monthly subscription, shared subscription, the amount they would be willing to donate, or how much they would be willing to pay per article. Table 4 below shows the averages of the respective outcome variables. Panel A presents the results for all participants, while panel B restricts the sample to the top third users per treatment group only. In the *Transparent Design* group, participants are, on average, willing to pay a monthly subscription of €4.79, a shared monthly subscription of €9.55, a one-time donation of €6.05, and pay per article €0.84. The respective numbers in the *Behavioral Design* group are €3.81, €7.23, €4.48, and €0.33. The results indicate that the participants in the *Transparent Design* group are willing to pay more than those in the *Behavioral Design* group, all differences but for the donation value being statistically significant, thus confirming our Hypothesis 3. In panel B, we also zoom in on the top third most active users and obtain even more pronounced differences with the exception for per article willingness to pay in line with a higher number of articles read. This is important, since the pronounced differences in the usage time come mainly from the *Behavioral Design* group, which could suggest that users in this group derive higher utility from the app—this is clearly contradicted by the reverse pattern in willingness to

pay. The results of this section suggest that the consumer utility in the *Behavioral Design* group is actually lower than the usage time would suggest it to be.

Table 4: Willingness to pay

	N		monthly subscription	monthly shared subscription	donation	per article
Panel A: all participants						
<i>Behavioral Design</i>	45	Mean	3.811	7.233	4.478	0.328
		Std. error	0.480	0.898	0.853	0.075
<i>Transparent Design</i>	46	Mean	4.793	9.554	6.054	0.835
		Std. error	0.462	1.029	0.981	0.339
<i>Behavioral < Transparent</i>		t-test p-value*	0.072	0.047	0.115	0.076
Panel B: top third most active users per treatment group						
<i>Behavioral Design</i>	15	Mean	3.167	5.067	2.933	0.211
		Std. error	0.523	0.967	0.621	0.075
<i>Transparent Design</i>	15	Mean	5.933	11.567	5.067	0.211
		Std. error	0.849	1.759	0.732	0.043

Notes: *As per our ex ante directional hypothesis, we use a one-tailed test.

5. DISCUSSION

We built a study app and tested its holistic effects on behavior and its valuation in the field, which allows to draw causal conclusions while relying on a real-world setting. We have documented that behavioral design elements in an app, including filtering algorithms and personalization, double usage time compared to the baseline. Moreover, behavioral design induces (at least some) individuals to use the app excessively. This has economic significance because user attention and usage time often translate into monetizable advertising or data collection on the supply side. However, on the demand side, consumers increasingly become vulnerable. They face risks like app addiction and giving up privacy. They are seduced to take actions, some even with

monetary consequences, that they would otherwise prefer not to take. It should be clear that, in such an environment, the usage time cannot be used as an indicator of consumer valuation of the product—independent of whether the app in question is a news app or not. With regard to news apps, these hold additional risks, such as polarization through echo chambers and personalization. Moreover, readers prefer to get informed quickly and efficiently, not getting distracted by ads and gamification. In our *Behavioral Design* version of the app, where we intentionally distracted user focus and self-control, we see that the willingness to pay is lower than for the other versions, and the difference is even larger for the top (and most vulnerable) users.

We have also shown that educating users and offering innovative protection features helps them to overcome temptation. Participants in our *Transparent Design* version reduce their screen time but not their frequency of app usage. They also value the app more highly—the top third most active users are willing to pay 47–87% more for a monthly subscription or donate more. *Transparent Design* participants become immune to dulling approaches thanks to the increased awareness and the interactive protection features. Being transparent and offering explanations regarding the applied behavioral design empowers consumers to make better informed and more responsible decisions. Study participants value this empowerment, as is evident from their usage of protective features and as stated in the post-study survey.

On the other hand, our finding that the vast majority of the participants prefer freemium models willing to pay with their data is consistent with the findings by Grossklags and Acquisti (2007) and other studies discussed therein, which documented the dichotomy between consumers' stated preferences about privacy and their actual behavior—in real-world situations consumers often trade privacy for short-term benefits. This suggests that consumers suffer from bounded

rationality and self-control problems, such that without regulations, they can be (intentionally or not) manipulated and instrumentalized by app providers.

Our proposed consumer protection measures complement European regulations according to the EU's Digital Strategy. Those protection measures are in line with the current intentions of law to lift up consumers to be on a par with businesses, service providers, and appliers of behavioral design, in order to have the same opportunities and equal chances (European Commission, 2022). Above all, designing transparent apps and algorithms seems to be a good way to make market outcomes fair. Following good practice not only adds costs to the provider and value for consumers, but may increase profitability and performance of the provider (European Commission, 2022; McMurrian & Matulich, 2016). In our study, participants' positive willingness to pay offers new incentives to create alternative business models based on responsible behavioral design and consumer satisfaction and loyalty.

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APPENDIX A: ADDITIONAL ANALYSIS

Table A1: Power calculation protocol

t tests - Means: Difference between two independent means (two groups)

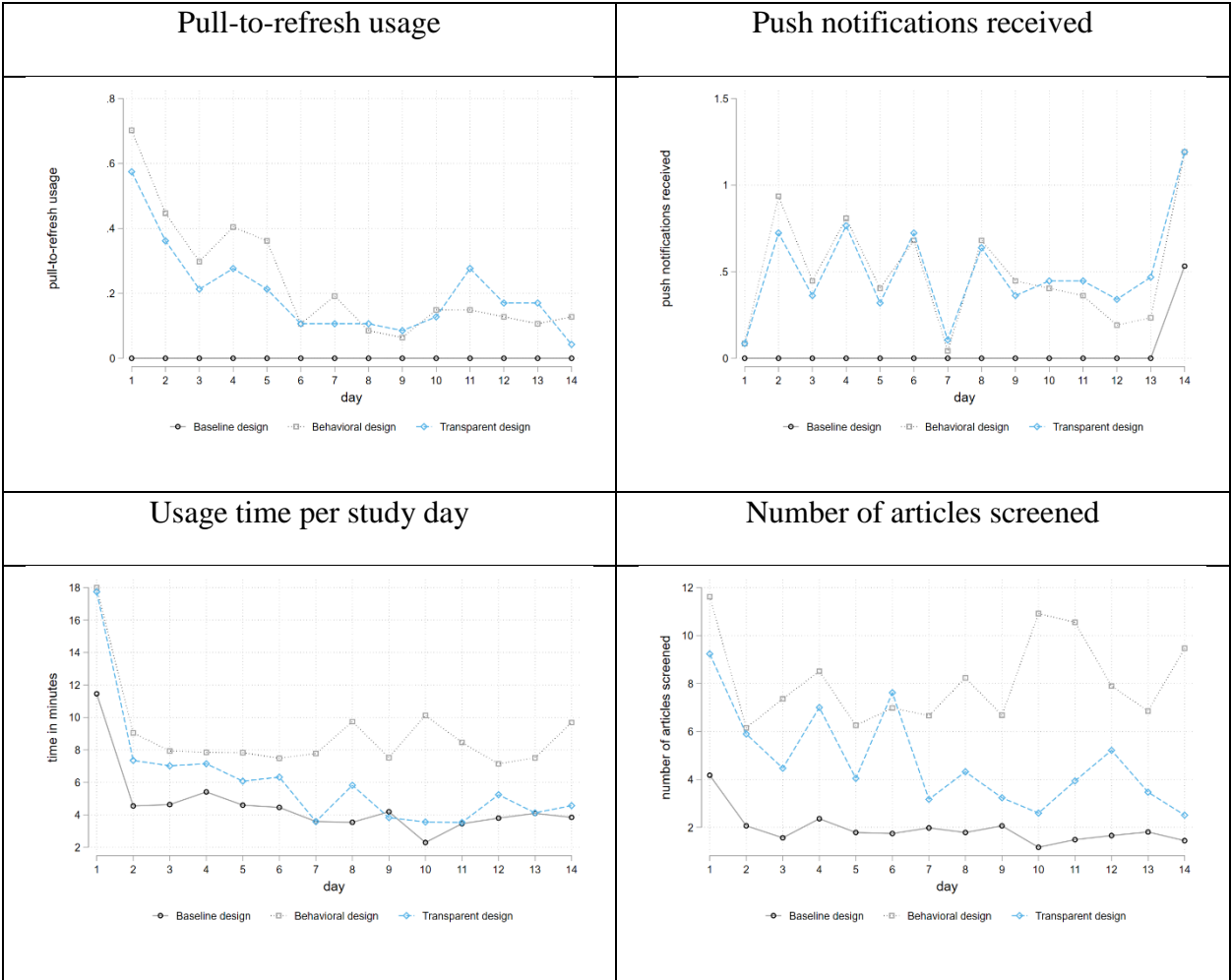
Analysis:	A priori: Compute required sample size	
Input:	Tail(s)	= One
	Effect size d	= 0.53
	α err prob	= 0.05
	Power (1- β err prob)	= 0.8
	Allocation ratio N2/N1	= 1
Output:	Noncentrality parameter δ	= 2.5140107
	Critical t	= 1.6623540
	Df	= 88
	Sample size group 1	= 45
	Sample size group 2	= 45

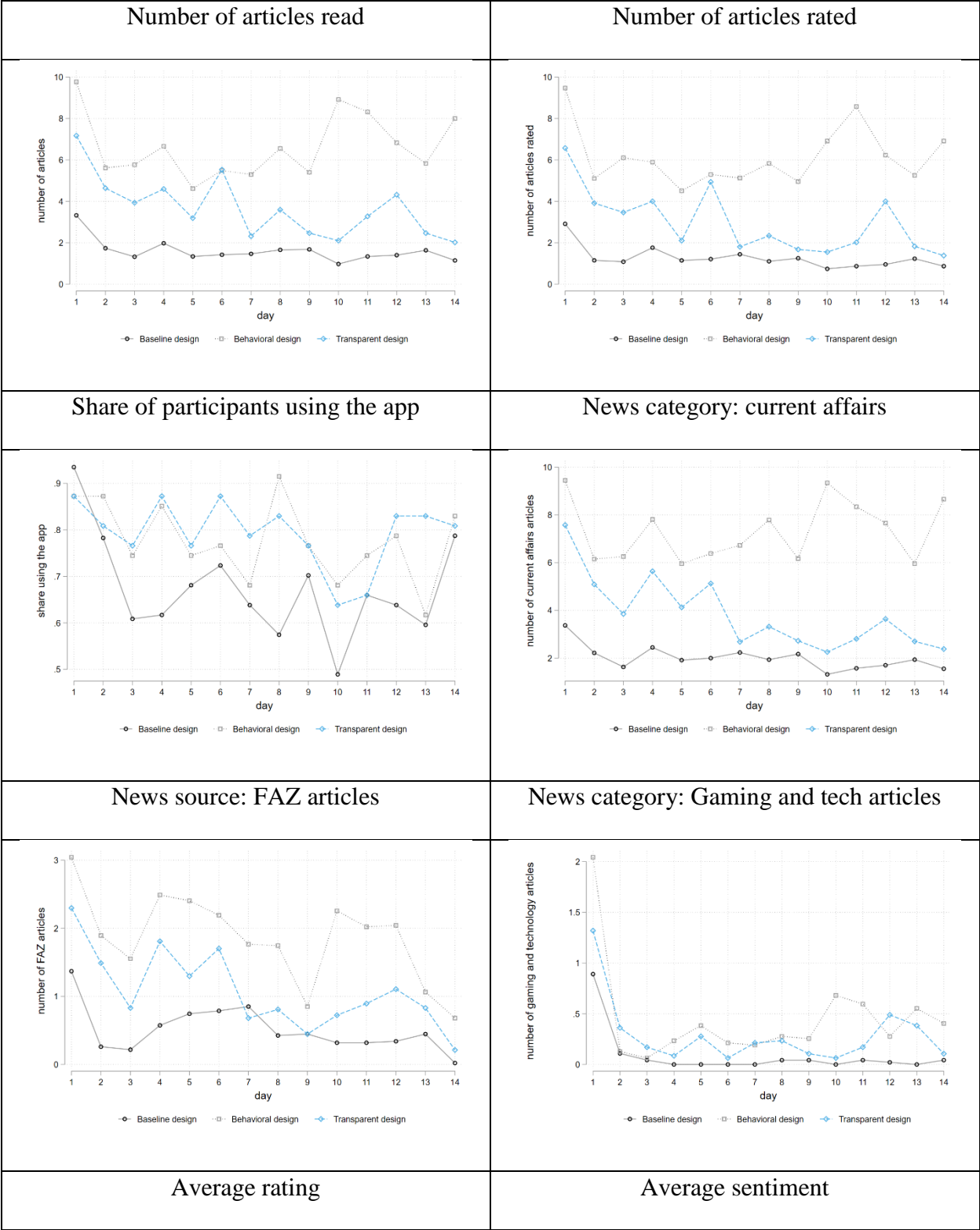
t tests - Means: Difference between two independent means (two groups)

Analysis:	A priori: Compute required sample size	
Input:	Tail(s)	= One
	Effect size d	= 0.45
	α err prob	= 0.1
	Power (1- β err prob)	= 0.8
	Allocation ratio N2/N1	= 1
Output:	Noncentrality parameter δ	= 2.1345374
	Critical t	= 1.2912459
	Df	= 88
	Sample size group 1	= 45
	Sample size group 2	= 45

Notes: Power calculation was computed using G*Power (Faul et al., 2007), version 3.1.9.7.

Figure A1: Usage of and exposure to behavioral elements by treatment groups and over time





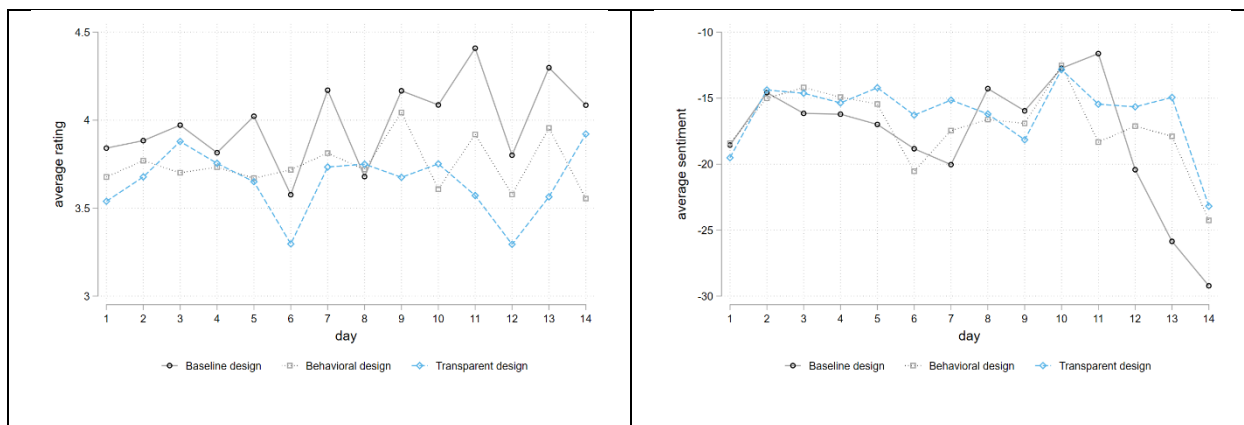
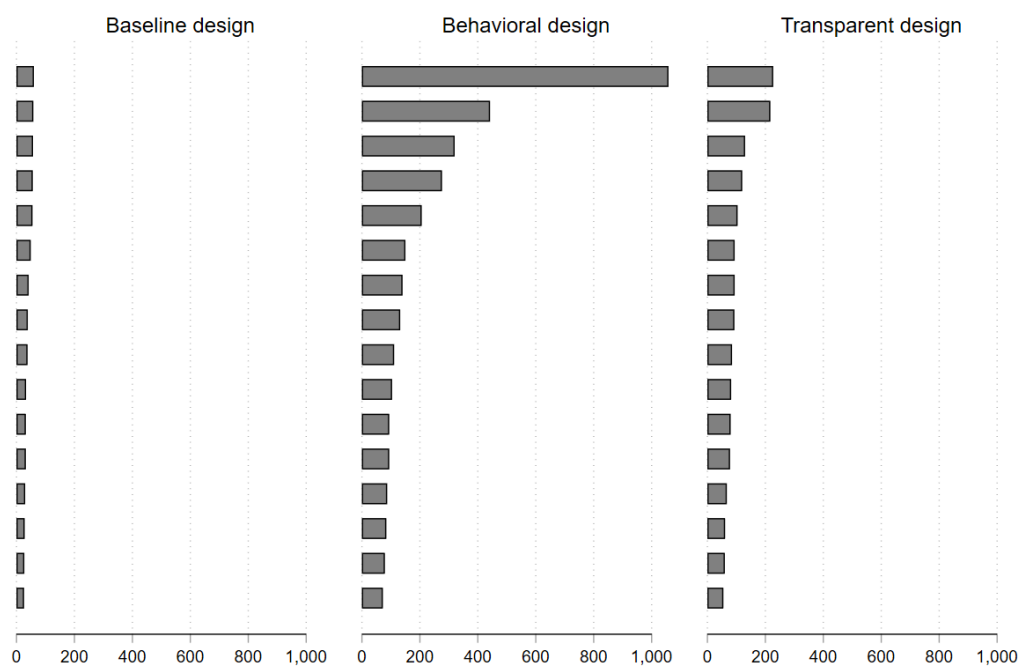


Figure A2: Number of article reads by most active users per treatment group



Notes: For each participant, the articles that were counted as read were added up. The 15 participants who read the most articles in their respective treatment group were ranked from highest to lowest number of articles read.

Table A2: Probability of being a top third most active user per treatment group

	All participants	Only <i>Behavioral Design group</i>
Native German speaker	0.062 (0.295)	-
Reading restrictions	0.201*** (0.075)	0.127 (0.157)
Age group: 18 to 25	-0.280*** (0.079)	-0.315** (0.155)
Bachelor degree	-0.198** (0.084)	-0.162 (0.180)
Master degree	-0.120 (0.110)	-0.134 (0.191)
Female	0.179** (0.077)	0.080 (0.148)
Share computers science major economics	-0.214*** (0.079) 0.103 (0.086)	-0.357** (0.137) 0.080 (0.153)
Constant	0.311 (0.321)	0.483** (0.199)
Observations	136	45
R^2	0.198	0.200

Notes: Robust errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Subjective need for protection measures, shares

	Share (N=136)
Behavioral design in general	
“In general, what do you think of behavior-influencing elements in apps in terms...	
“Was halten Sie generell von verhaltensbeeinflussenden Elementen in Apps hinsichtlich...	
... of usefulness?: I find it useful.”	0.42
... der Nützlichkeit?: Finde ich nützlich.”	
... of risk?: I find it problematic.”	0.75
... der Risiken?: Finde ich problematisch.”	
Behavioral algorithms	
“What do you think of behavior-influencing algorithms in apps in terms...	
“Was halten Sie am ehesten von verhaltensbeeinflussenden Algorithmen in Apps hinsichtlich...	
... of usefulness?: I find it useful.”	0.50
... der Nützlichkeit?: Finde ich nützlich.”	
... of risk?: I find it problematic.”	0.74

... der Risiken?: Finde ich problematisch."	
Push notifications	
"What do you think most about push notifications in apps in terms...	
"Was halten Sie am ehesten von Push-Nachrichten in Apps hinsichtlich...	
... of usefulness?: I find it useful."	0.54
... der Nützlichkeit?: Finde ich nützlich."	
... of risk?: I find it problematic."	0.40
... der Risiken?: Finde ich problematisch."	
Gamification features	
"What do you think most about gamification features in apps in terms of...	
"Was halten Sie am ehesten von Spielfunktionen in Apps hinsichtlich...	
... of usefulness?: I find it useful."	0.27
... der Nützlichkeit?: Finde ich nützlich."	
... of risk?: I find it problematic."	0.54
... der Risiken?: Finde ich problematisch."	
Design elements that influence behavior	
"What do you think of behavior-influencing design elements in apps in terms ...	
"Was halten Sie am ehesten von verhaltensbeeinflussenden Design-Elementen in Apps hinsichtlich ...	
... of usefulness?: I find it useful."	0.62
... der Nützlichkeit?: Finde ich nützlich."	
... of risk?: I find it problematic."	0.24
... der Risiken?: Finde ich problematisch."	
No control over behavioral design: feel bad	
"How do you feel about algorithms and behavior-influencing elements making decisions about settings, push notifications, profiling, and filtering content without your control as a user?: I feel uncomfortable with this."	0.69
"Wie fühlen Sie sich damit, wenn Algorithmen und verhaltensbeeinflussende Elemente ohne ihre Kontrolle als Nutzer_in Entscheidungen über Einstellungen, Push-Nachrichten, Profilerstellung und Filtern des Inhalts treffen?: Ich fühle mich unwohl damit."	
Control over behavioral design elements: yes	
"Would you like to be able to set yourself which behavior-influencing elements are allowed to be active in the apps that you use?"	0.99
"Möchten Sie gern selbst einstellen können, welche verhaltensbeeinflussenden Elemente in von Ihnen genutzten Apps aktiv sein dürfen?"	
Regulation of behavioral design elements: yes	
"Do you think there should be legislation regulating what behavior-influencing elements can be included in apps?"	0.78
"Sollte Ihrer Ansicht nach gesetzlich geregelt werden, welche verhaltensbeeinflussenden Elemente in Apps eingebaut werden dürfen?"	
Certificates: yes	
"Do you think there should be certificates that make it transparent to users what behavior-influencing elements are built into apps?"	0.90
"Sollte es Ihrer Ansicht nach Zertifikate geben, die den Nutzer_innen transparent machen, welche verhaltensbeeinflussende Elemente in Apps eingebaut sind?"	
Easy control over data collection and use: yes	

“The collection and processing of data by companies that offer apps can be done in a variety of ways. To what extent do you agree with the following: I think that I should be given easy ways to control what data is being collected about me by companies and how it is used.” 0.76

“Die Erfassung und Verarbeitung von Daten durch Unternehmen, die Apps anbieten, kann auf unterschiedliche Weise erfolgen. Inwieweit stimmen Sie den folgenden Möglichkeiten zu: Ich finde, dass ich einfache Kontrollmöglichkeiten erhalten sollte, welche Daten von Unternehmen über mich erhoben werden und wie sie verwendet werden.”

Sell data: yes

“From my perspective, companies could be allowed to resell the data to other companies.” 0.49
“Aus meiner Sicht dürften Unternehmen die Daten an andere Unternehmen weiterverkaufen.”

Share anonymized data with third parties: yes

“I think it would be fine if companies were to pass on data collected for the purpose of market research to third parties in anonymized form.” 0.23

“Ich fände es in Ordnung, wenn Unternehmen erfasste Daten zu Zwecken der Marktforschung in anonymisierter Form an Dritte weitergeben würden.”

State laws on data use: yes

“I would like to see the state regulate and enforce by law which data may be used.” 0.38
“Ich wünsche mir, dass der Staat gesetzlich regelt und durchsetzt, welche Daten genutzt werden dürfen.”

Like filters: yes

“Some participants had the possibility to influence the order of the displayed articles: they had the choice to turn on and off several automated filters including automated filtering based on their preferences for the topics and mood of the articles.: Do you think it is good to have such a setting option in an app?” 0.77

“Einige Teilnehmer_innen hatten die Möglichkeit, die Reihenfolge der angezeigten Artikel zu beeinflussen: sie hatten die Wahl, mehrere automatische Filter an- und auszuschalten, darunter auch eine automatisierte Filterung aufgrund ihrer Präferenzen bezüglich der Themen und der Stimmung der Artikel.: Finden Sie es gut, in einer App so eine Einstellmöglichkeit zu haben?”

Use filters: yes

“Did you or would you have used this option in the study to influence the content that is displayed?” 0.70
“Haben oder hätten Sie diese Möglichkeit in der Studie genutzt, um den Inhalt zu beeinflussen, der angezeigt wird?”

Like push notification settings: yes

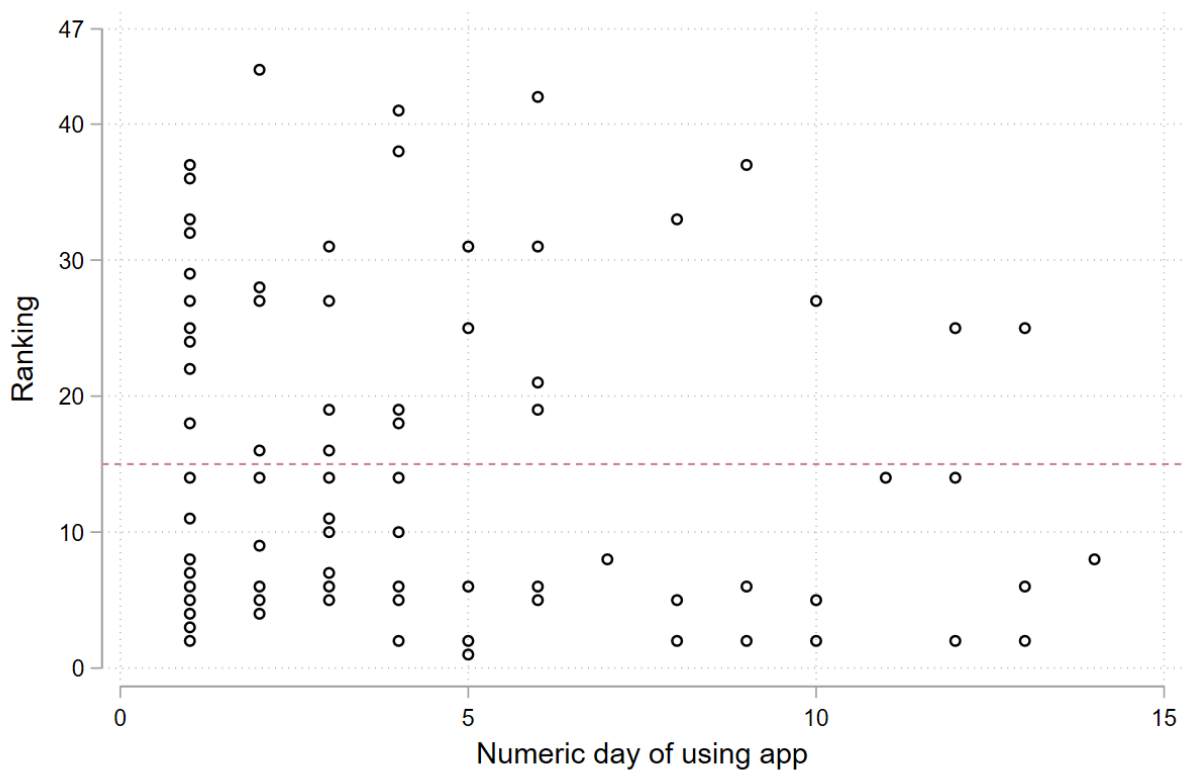
“Some participants were given the opportunity to set when they would receive push notifications and why they are triggered. Do you think it is good to have such a setting option in an app?” 0.67

“Einige Teilnehmer_innen hatten die Möglichkeit, selbst einzustellen, wann sie Push-Nachrichten bekommen und warum diese ausgelöst werden.: Finden Sie es gut, in einer App so eine Einstellmöglichkeit zu haben?”

Use push notification settings: yes

“Did you or would you have used this option in the study to influence the content that is displayed?” 0.56
“Haben oder hätten Sie diese Möglichkeit in der Studie genutzt, um den Inhalt zu beeinflussen, der angezeigt wird?”

Figure A3: Usage of filters by study day and user ranking in the *Transparent Design* group



Notes: User ranking according to the total time spent using the app

Table A4: Business models preferred by participants, shares

	Share (N=136)
Business model: monthly subscription	
“Which usage model would you prefer for a comparable market-ready newsfeed reader app?: I would be willing to pay a regular monthly subscription.”	0.06
“ Welches Nutzungsmodell würden Sie für eine vergleichbare marktreife Newsfeed-Reader App bevorzugen: Ich wäre bereit, regelmäßig ein monatliches Abo zu zahlen. ”	
Business model: shared monthly subscription	
“I would be willing to pay a regular monthly subscription that I could share with family and friends. and friends.”	0.10
“Ich wäre bereit, regelmäßig ein monatliches Abo zu zahlen, das ich mit Familie und Freunden teilen kann.”	

Business model: per article	
<i>"I would be willing to pay per article read."</i>	0.03
<i>"Ich wäre bereit, pro gelesenen Artikel zu bezahlen."</i>	
Business model: donation	
<i>"I would be willing to make a donation to the provider of the otherwise free app from time to time."</i>	0.15
<i>"Ich wäre bereit, dem Anbieter der sonst kostenlosen App ab und zu eine Spende zukommen zu lassen."</i>	
Business model: sell data to third parties	
<i>"I would use the app free of charge and in exchange I would agree that my usage data can be sold to third parties."</i>	0.19
<i>"Ich würde die App kostenlos nutzen und im Gegenzug wäre ich damit einverstanden, dass meine Nutzungsdaten an Dritte verkauft werden können."</i>	
Business model: use data for market research	
<i>"I would use the app free of charge and in return I would be willing to occasionally participate in market research and behavioral studies within a regulated framework."</i>	0.56
<i>"Ich würde die App kostenlos nutzen und im Gegenzug wäre ich bereit, ab und zu - im geregelten Rahmen - an Marktforschungs- und Verhaltensstudien teilzunehmen."</i>	
Business model: use data by private companies	
<i>"I would use the app free of charge and in return I would be willing to occasionally allow for my usage data to be send to private companies within a controlled framework."</i>	0.13
<i>"Ich würde die App kostenlos nutzen und im Gegenzug wäre ich bereit, ab und zu - im kontrollierten Rahmen - meine Nutzungsdaten an private Unternehmen zu senden."</i>	
Business model: use data for non-profit research	
<i>"I would use the app for free and in return I would be willing to donate my usage data to universities for research purposes."</i>	0.63
<i>"Ich würde die App kostenlos nutzen und im Gegenzug wäre ich bereit, meine Nutzungsdaten zu Forschungszwecken an Universitäten zu spenden."</i>	
Business model: no compensation	
<i>"I would use the app for free and for no compensation."</i>	0.64
<i>"Ich würde die App kostenlos und ohne Gegenleistung nutzen."</i>	
Business model: not use app	
<i>"I would not use the app under any circumstances."</i>	0.04
<i>"Ich würde die App unter keinen Umständen nutzen."</i>	
Business model: other	
<i>"I would use the app on terms other than the above."</i>	0.09
<i>"Ich würde die App zu anderen als den obigen Konditionen nutzen."</i>	

Table A5: Media competency quiz

Description
<p>Each of the three app versions contained a media competency quiz. This quiz was placed saliently into the user account and in-app consent settings, which were the first settings participants had to make before starting to use the app. The in-app consent settings included privacy policy, terms of usage, and for the <i>Transparent Design</i> group agreement to behavioral design. Later, during the whole study, the quiz was available under the settings menu. Filling in the quiz was not obligatory. However, participants had to choose whether they gave their in-app consent with or without completing the quiz.</p>
Aim of the quiz
<p>We explained to participants that the quiz could be done to measure one's media competency and upon that to decide whether one can make the decision to agree to the in-app consent (1) quickly, flying over the text, or (2) carefully, reading the text line-by-line. In the <i>Baseline Design</i> and <i>Behavioral Design</i> groups the quiz contained only questions related to privacy and data protection. In the <i>Transparent Design</i> group, it additionally contained questions related to behavioral design. The reason for building in the quiz was to see if there's a need to fetch different kinds of users offering them distinguished ways to make their in-app consent. With this, we aimed to make the in-app consent more inclusive. Users might differ in their knowledge and experiences with privacy and data protection and protection from the influence of behavioral design, or they might have time constraints, or varying motivations. When presenting settings and explanations, we tried to consider how much time and what kind of context participants need for making their protection decisions. Participants thus had the option</p>

to quickly read through the explanations and orient with the help of icons and a clear structure of the presented information, or they could go into details of explanations in simple language by opening accordion folds.

Results


45% of the participants agreed to the in-app consent quickly, flying over the text and 55% carefully, reading the text line-by-line. Although the media competency quiz was started and finished by only 28% of the participants, 81% of all participants who filled in the post-study survey found it to be useful.


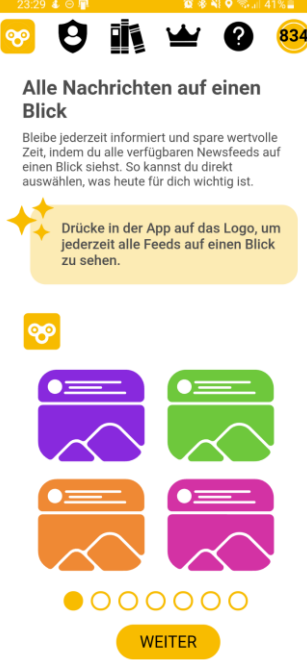
APPENDIX B: DETAILS OF PRE-STUDY SURVEY

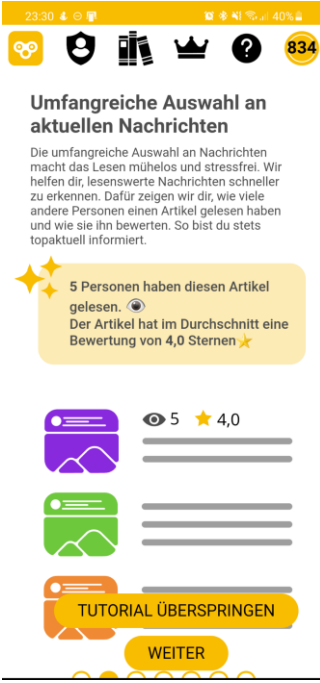

Prior to the field experiment, we conducted an independent online study survey among 77 students, employees, and professors at a German public university. We asked participants about their reading behavior and needs, if reading takes place using a news app. Unsurprisingly, participants turned out to be a demanding and conscious audience that reads several times a day and many times in between. We found that an app design that motivates readers to read more frequently, while not sending more than 1-2 push notifications a day, has good chances to increase reading frequency and by that the total reading time. Social aspects, such as comparing reading performance with other readers or peer rating of news, manifold and transparent options to filter news, and self-selection of news content are all features that are welcomed by the participants of the pre-study. Distracting components, such as gamification, ads, tabloid journalism, and filter bubbles should be avoided, according to the participants. These insights entered into the design of the protection measures, e.g. in the form of raising awareness about gamification and allowing adjustments to filtering outcomes.


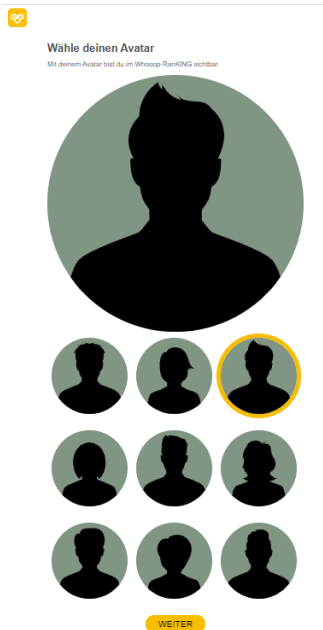
APPENDIX C: SHOWCASING DESIGN SYSTEMATICS

Table C1: Complete list of the applied behavioral design elements and protection measures

Behavioral design elements & protection measures		
Element	In the app	Explanation
Onboarding		
Appearance		The appearance of the app (e.g. visual cues and color convention) is designed to be coherent, neat, recognizable, and appealing in order to catch attention. The name of the app, Whoop with three strongly pronounced 'o'-s, reminds of a sudden exclamation calling for attention or expressing amazement. The logo symbolizes the wondering face of a stylized sloth forming an 'o'. It appears also in the lettering in a playful manner. The sloth was chosen as a symbol for the 'dull user', who deliberately chose to be entertained. The emphasis is on the sloth's choice and its ability to adapt to its designed environment. The choice should be deliberate, rather than invisibly governed by behavioral design. With this logo we aim to raise awareness even beyond the study, throughout the publication and dissemination work.
Similarity Fogg 2002 Durantini et al. 2007 Oinas-Kukkonen & Harjumaa 2008 Dolan et al. 2012		Similarity is applied by reminding the amazed reader of herself and the feeling accompanying the discovery of interesting news. Thus users feel more connected to the app and are more open to being influenced by it when they recognize something similar to their own character or (social) environment.
Surface Credibility Oinas-Kukkonen & Harjumaa 2008		Surface Credibility means that the app looks and feels serious and competent by its neat appearance and accurate language. This element can lower the barrier for users to download and use the app.
Present in:		
Baseline Design Behavioral Design Transparent Design		

<h2>Launch screen</h2>		<p>The Launch screen is onboarding participants. The first sentence says “Successful people spend an above-average amount of time reading news”. Such and similar statements form a Narrative about the usefulness of reading news. This framing narrative is continued in the tutorial by emphasizing benefits of the app rather than simply introducing features. The narrative in turn contributes to Priming participants to make them eager to read as much as possible. Additionally, it marks the beginning of the tutorial process that follows a Tunnelling approach, ensuring that participants understand all relevant functions and set up their account properly (see following screens). Curiosity is instilled by giving a first insight of Whooop’s functions without revealing everything at once.</p> <p>Present in:</p> <p>Baseline Design Behavioral Design Transparent Design</p>
<h2>Tutorial 1</h2>		<p>The first Tutorial screen gives more details on the core function of the app, the news feed, and continues the Tunneling process and the approach of keeping up Curiosity. Priming is strengthened by the message “Stay up to date and save valuable time by seeing all relevant news at a glance”. The Progress Bar at the bottom of the screen provides orientation along the tutorial process, keeping participants motivated to complete the tutorial.</p> <p>Present in:</p> <p>Baseline Design Behavioral Design Transparent Design</p>
<h2>Tutorial 2</h2>		

<p>Social Facilitation Guerin 1993 Oinas-Kukkonen & Harjumaa 2008</p> <p>Curiosity Loewenstein 1994 Toxboe 2007 Jirout 2020</p> <p>Tunneling Fogg 2002 Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Priming Lashley 1951 Toxboe 2007 Mirsch et al. 2017</p> <p>Progress Bars Toxboe 2007 Chou 2019</p>		<p>The second Tutorial screen introduces the views and rating functions. Here, Social Facilitation is added by displaying the behavior of other participants (reading and rating articles), making it easier for the individual to adopt the behavior.</p> <p>(For the other elements see the screen before.)</p> <p>Present in:</p> <p>Baseline Design Behavioral Design Transparent Design</p>
<p>Tutorial 3</p> <p>Social Facilitation Guerin 1993 Oinas-Kukkonen & Harjumaa 2008</p> <p>Peer Rating Toxboe 2007</p> <p>Curiosity Loewenstein 1994 Toxboe 2007 Jirout 2020</p> <p>Tunneling Fogg 2002 Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Priming Lashley 1951 Toxboe 2007 Mirsch et al. 2017</p> <p>Progress Bars Toxboe 2007 Chou 2019</p>		<p>Here, in combination with other elements, Priming focuses on making users contribute to another element: Peer Rating, which increases trust and perceived connection with other users.</p> <p>(For the other elements see the screens before.)</p> <p>Present in:</p> <p>Baseline Design Behavioral Design Transparent Design</p>

<div>Tutorial 4</div> <div>Status Points</div> <div>Schell 2008</div> <div>Chou 2019</div> <div>Reward Oinas-Kukkonen & Harjuma 2008</div> <div>Schell 2008</div> <div>Michie et al. 2013</div> <div>Curiosity</div> <div>Loewenstein 1994</div> <div>Toxboe 2007</div> <div>Jirout 2020</div> <div>Tunneling</div> <div>Fogg 2002</div> <div>Toxboe 2007</div> <div>Oinas-Kukkonen & Harjuma 2008</div> <div>Priming</div> <div>Lashley 1951</div> <div>Toxboe 2007</div> <div>Mirsch et al. 2017</div> <div>Progress Bars</div> <div>Toxboe 2007</div> <div>Chou 2019</div>		<p>For each article that a participant has read, he or she is awarded three points as a Reward. This kind of Status Points allows participants to track their progress and can motivate them to consistently perform the rewarded action (in this case reading news on a regular basis).</p> <p>(For the other elements see the screens before.)</p> <div>Present in:</div> <div>Behavioral Design</div> <div>Transparent Design</div>
<div>Avatar</div> <div>Anonymity</div> <div>Personalization</div> <div>Oinas-Kukkonen & Harjuma 2008</div> <div>Schell 2008</div> <div>Need for Closure</div> <div>Barlow 1981</div> <div>Toxboe 2007</div> <div>Schell 2008</div> <div>Tunneling</div> <div>Fogg 2002</div> <div>Toxboe 2007</div> <div>Oinas-Kukkonen & Harjuma 2008</div>		<p>Users who finished the tutorial stage and are then prompted to complete the onboarding process might feel a Need for Closure, motivating them to stay inside the app until the process of setting up and personalizing the app is finished. Choosing an avatar allows for Personalization without forcing the user to give up their Anonymity, keeping the barrier for using the app as low as possible. (Besides this effect of Anonymity, it was a standard procedure for all study participants to preserve their anonymity within the lab's framework.) In turn, having made a step towards a personalized experience can increase the willingness to complete the following steps of accepting terms and conditions as well as allowing the app to use any personal and behavioral data.</p> <div>Present in:</div> <div>Behavioral Design</div> <div>Transparent Design</div>

Protection measures during onboarding & later globally accessible

In-app consent

Reduction

Fogg 2002
Toxboe 2007
Oinas-Kukkonen & Harjumaa 2008

Tunneling

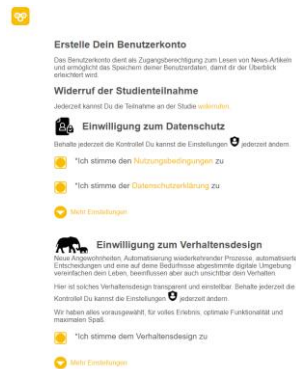
Fogg 2002
Toxboe 2007
Oinas-Kukkonen & Harjumaa 2008

Serial Positioning

Ebbinghaus 1913
Toxboe 2007

Defaults

Cronqvist & Thaler 2004
Toxboe 2007



Elements for the in-app consent are placed in a certain order by applying **Serial Positioning**, making necessary consents for data protection the first priority by presenting them first. More complex and optional information and adjustments are presented at the bottom of the screen. **Reduction** makes it easy to complete the process quickly without having to open the fold-down menu if the participant is not interested in details. **Defaults** additionally save time and effort.

A special novelty as part of the in-app consent is the **“Consent to Behavioral Design”** in the *Transparent Design* version. (The other app versions have only a “Consent to Data Protection”.) As an educational protection measure, this measure aims at raising awareness of mechanisms of behavioral design.

Present in:

Baseline Design
Behavioral Design
Transparent Design (*has extended version*)

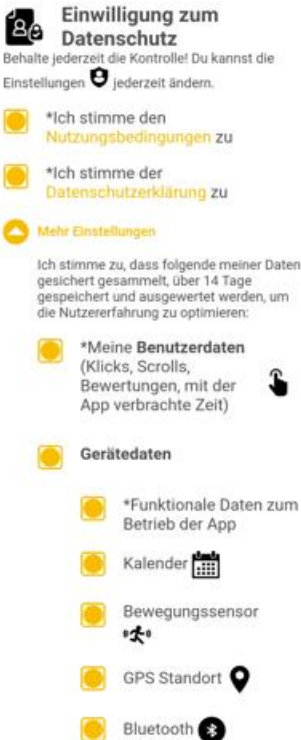

Fold-down menu of in-app consent


Trustworthiness

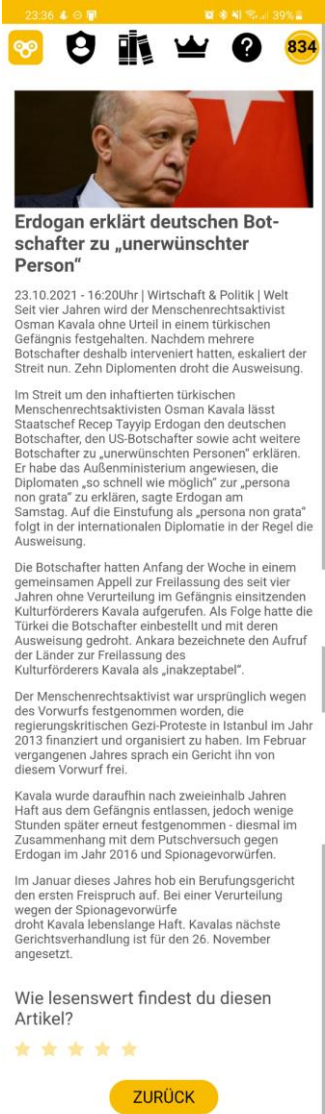
Oinas-Kukkonen & Harjumaa 2008

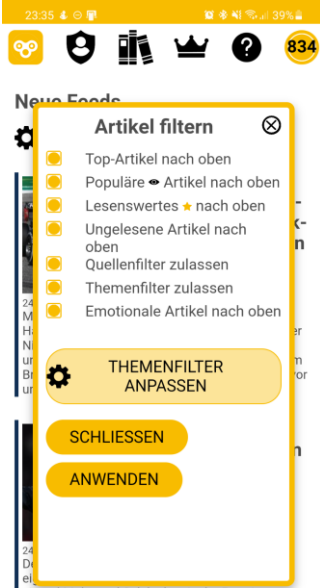

If the participant opens the fold-down menu (**Reduction**, see previous row), further options are visible that are turned on via **Defaults**. If participants are interested, they can switch those on or off, allowing them to control their settings and establishing **Trustworthiness**.


Present in:



<p>Reduction Fogg 2002 Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Tunneling Fogg 2002 Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Serial Positioning Ebbinghaus 1913 Toxboe 2007</p> <p>Defaults Cronqvist & Thaler 2004 Toxboe 2007</p>		<p>Baseline Design Behavioral Design Transparent Design (<i>has extended version</i>)</p>
<p>Media competency quiz</p> <p>Trustworthiness Oinas-Kukkonen & Harjumaa 2008</p> <p>Halo Effect Thorndike 1920 Kahneman 2011</p>		<p>During the in-app consent, participants get the option to do a quiz that helps them assess their media competency, providing guidance when deciding if they would like to skim the content and give their consent quickly or if they should read it more carefully. This can support Trustworthiness and, in combination with other protection measures, possibly contribute to a kind of Halo Effect, making the app appear especially trustworthy and concerned with the participants' data sovereignty (and awareness of and protection from behavioral design in the <i>Transparent Design</i> version) throughout the whole user experience.</p> <p>Present in:</p> <p>Baseline Design Behavioral Design Transparent Design (<i>has extended version</i>)</p>
<p>Core function</p>		
<p>News feed</p>		<p>Similar to the algorithms that big companies like Facebook apply in their apps' news feeds (although</p>


<p>Trustworthiness Oinas-Kukkonen & Harjumaa 2008</p> <p>Tailoring Fogg 2002 Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Personalization Oinas-Kukkonen & Harjumaa 2008 Schell 2008</p> <p>Pull-to-Refresh Toxboe 2007 Harris 2016</p> <p>Infinite Scroll Toxboe 2007 Harris 2016</p> <p>Defaults Cronqvist & Thaler 2004 Toxboe 2007</p>		<p>much simpler), Tailoring is used to make the news feed adapt to participants' interests, showing them more articles that are similar to their preferred reading choices, which can in turn motivate them to read even more articles. The option to filter news by certain attributes (e.g. top news, see yellow article in the screenshot), is a form of Personalization, making the participant feel in control. Pull-to-Refresh is applied as a mechanism for loading new content into the news feed, contributing to the development of a potential habit - if new content appears, which works as a kind of reward for performing the gesture. Infinite Scroll is aimed at keeping participants engaged with the app while scrolling through a seemingly endless stream of news. Presenting the (reliable) sources of the news contributes to Trustworthiness. By Default, the option is active, inviting the participant to use it and see what is behind.</p> <p>Present in:</p> <p>Baseline Design (<i>has simplest version with 'Trustworthiness' and 'Infinite Scroll'</i>) Behavioral Design Transparent Design (<i>has extended version</i>)</p>
<p>Article</p> <p>Social Facilitation Guerin 1993 Fogg 2002 Oinas-Kukkonen & Harjumaa 2008</p> <p>Trustworthiness Oinas-Kukkonen & Harjumaa 2008</p> <p>Peer Rating</p>		<p>When the participant opens an article and scrolls down, the Peer Rating function becomes visible. If other participants have already rated the article, the average rating will be displayed here, providing Social Facilitation. Trustworthiness is created again by providing the source of the article. The Isolation Effect makes it easy to find the "Back" button at the end of the page when reading is finished, bringing the participant back to the news feed where more articles are waiting.</p> <p>Present in:</p>

<p>Toxboe 2007</p> <p>Isolation Effect Von Restorff 1933 Toxboe 2007 Chou 2019</p>		<p>Baseline Design Behavioral Design Transparent Design</p>
Protection measures for the core function		
<p>Filter option</p> <p>Isolation Effect Von Restorff 1933 Toxboe 2007 Chou 2019</p> <p>Personalization Oinas-Kukkonen & Harjumaa 2008 Schell 2008</p>		<p>In the <i>Transparent Design</i> version, the filter can be turned off locally using a toggle switch. The toggle switch is an outstanding element with an Isolation Effect guiding the user towards the protection measure. Moreover, the filtering options can be adjusted using local settings, like a kind of Personalization Defaults show how filtering works and invite the participant to explore the different possibilities.</p> <p>Present in:</p>

<p>Defaults Cronqvist & Thaler 2004 Toxboe 2007</p>		<p>Transparent Design</p>
<p>Correction of algorithmic results</p> <p>Self-Monitoring Oinas-Kukkonen & Harjumaa 2008 Michie et al. 2013</p>		<p>In the <i>Transparent Design</i> version, the result of algorithmic filtering is shown transparently, so that Self-Monitoring and self-administered adjustments become possible.</p> <p>Present in:</p> <p>Transparent Design</p>
<p>Rewards & losses</p>		
<p>Achievements</p> <p>Achievements Toxboe 2007 Chou 2019</p>		<p>Different Achievements can be unlocked by consistently reading articles (e.g. the “Beginner” achievement, a Reward for reading the first article). This Collection Set motivates participants to set increasingly demanding goals and spend more time reading articles in order to collect as many achievements as possible.</p>

<p>Reward Oinas-Kukkonen & Harjumaa 2008 Schell 2008 Michie et al. 2013</p> <p>Collection Sets Chou 2019</p>	 <p>Ruhmesregal</p> <p>Je mehr du die Whooop-App verwendest, desto mehr Erfolge schaltest du frei. Hier findest du eine Übersicht über deine bisherigen Erfolge. Versuche, alle zu erreichen und werde ganz nebenher zum News-Experte! Du kannst regelmäßig vorbeischaun und sehen, wie sich deine Sammlung vergrößert.</p> <ul style="list-style-type: none"> Einsteiger Lies einen Artikel! Zehn runter! Lies zehn Artikel! Centuria! Lies 100 Artikel! Tausend Sterne! Lies 1000 Artikel! Nur noch 722! Düsenantrieb Lies 20 Artikel an einem Tag! Nur noch 20! Raketen-Experte Lies 40 Artikel an einem Tag! Nur noch 40! Galaktisch Lies 60 Artikel an einem Tag! Nur noch 60! Regelmäßig Lies Artikel an 3 Tagen hintereinander! Nur noch 2! Routiniert Lies Artikel an 7 Tagen hintereinander! Nur noch 6! Meisterhaft Lies Artikel an 14 Tagen hintereinander! Nur noch 13! <p>ZURÜCK</p>	<p>Present in:</p> <p>Behavioral Design Transparent Design</p>
<p>Achievement message</p> <p>Beginner's Luck Chou 2019</p> <p>Achievements Toxboe 2007 Chou 2019</p> <p>Praise Toxboe 2007 Oinas-Kukkonen &</p>		<p>Participants are informed about having unlocked an Achievement through an in-app message, stating in this case "Whooop, you read an article!" for the "Beginner" achievement. This achievement is unlocked at the very beginning of the user experience as an instance of Beginner's Luck, making the participant feeling successful from the beginning. Generally, the messages aim at encouraging participants to read more in order to unlock more achievements by relying on the element Praise. Again, this works as a Reward for performing the desired action of reading articles and spending more time with the app.</p>

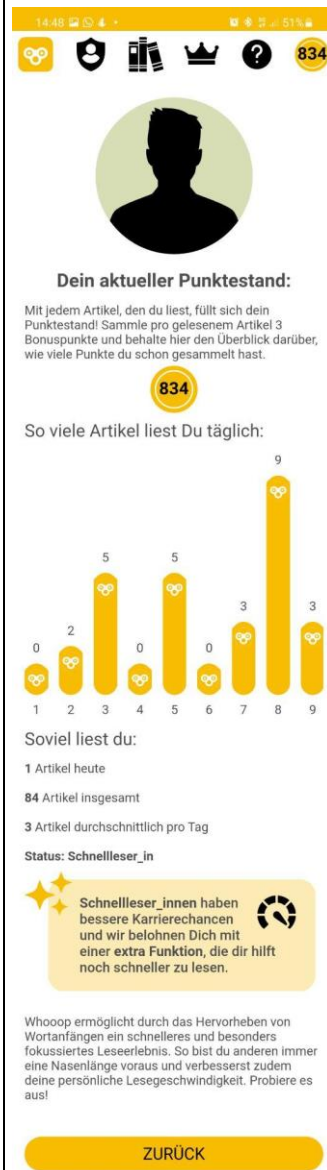
<p>Harjumaa 2008 Schell 2008</p> <p>Reward Oinas-Kukkonen & Harjumaa 2008 Schell 2008 Michie et al. 2013</p>		<p>Present in:</p> <p>Behavioral Design Transparent Design</p>
Social interaction		
<p>Reader RankING</p> <p>Social Facilitation Guerin 1993 Fogg 2002 Oinas-Kukkonen & Harjumaa 2008</p> <p>Conformity Anchor Chou 2019</p> <p>Social Comparison Oinas-Kukkonen & Harjumaa 2008 Michie et al. 2013</p> <p>Leaderboards Toxboe 2007 Chou 2019</p> <p>Recognition Oinas-Kukkonen & Harjumaa 2008</p>		<p>Participants can compare their bonus points for the day (daily ranking) and in total (overall ranking) with the points that others achieved so far in a Leaderboard. On the one hand, this contributes to a general Social Facilitation, on the other hand, the dynamics of Social Comparison (motivation through comparing the own performance to others') and Conformity Anchor (wish to make the own behavior fit into social norms, in this case reading much) push participants to read more if others do so, too. Dividing rankings into an overall and a daily ranking gives all users the opportunity to rank high and receive Recognition from others.</p> <p>Present in:</p> <p>Behavioral Design Transparent Design</p>
<p>Confetti for best reader</p>		<p>The best reader gets an additional motivational boost in the ranking section in the form of visual Praise.</p>

<p>Praise Toxboe 2007 Schell 2008 Oinas-Kukkonen & Harjumaa 2008</p>		<p>Present in:</p> <p>Behavioral Design Transparent Design</p>
<p>Progress monitoring</p>		
<p>Personal record</p> <p>Elitism Chou 2019</p> <p>Status Points Schell 2008 Chou 2019</p> <p>Easter Eggs/Sudden Rewards</p>		<p>At any time, participants can open their personal record area, Self-Monitoring their progress and reading habits as well as their Status Points. Additionally, for participants belonging to the half of the sample that read more words per minute on average, an extra function supporting fast reading was unlocked after two weeks. This serves as an Easter Egg/Sudden Reward, aiming at increasing interest in the app and instilling a subtle feeling of Elitism for those who now belonged to the group of “Fast Readers”.</p> <p>Present in:</p>

Deci & Ryan 1985
Toxboe 2007
Chou 2019

Self-Monitoring

Snyder 1974
Fogg 2002
Toxboe 2007
Oinas-Kukkonen &
Harjumaa 2008
Michie et al. 2013



Behavioral Design
Transparent Design

Notifications

Push notifications

Curiosity

Loewenstein 1994
Toxboe 2007
Jirout 2020

FOMO

Chou 2019





Visual signaling and vibration triggers a new interaction with the app: opening the new incoming message, relying on both **Curiosity** and **FOMO**, the fear of missing something important. This common type of **Reminders** might lead to a serious checking-habit as a potential risk (Palokangas, 2016).

Present in:

Reminders Toxboe 2007 Oinas-Kukkonen & Harjuma 2008		Behavioral Design Transparent Design
Push notifications - Content	<i>You're falling behind in the daily ranking! Read at least 2 more articles to defend your rank!</i> Today's daily ranking will close in 4 hours.	Several push notifications (Reminders) were integrated into the participants' experience, conveying various messages and relying on different mechanisms. This example utilizes the fact that many people feel stronger motivation to act in order to avoid losing something that they already have (their position in the Leaderboard) than in order to gain something, a phenomenon known as Loss Aversion . The Suggestion of reading 2 more articles serves as a call to action while the Appointment Dynamics of the closing ranking can contribute to a feeling of urgency and support tendencies to increase reading efforts at a certain time of the day. The projection of the outcome if the participant does not take action relies on the Simulation element.
Leaderboards Toxboe 2007 Chou 2019 Appointment Dynamics Toxboe 2007 Chou 2019 Loss Aversion Kahneman & Tversky 1979 Toxboe 2007 Dolan et al. 2012 Mirsch et al. 2017 Reminders Toxboe 2007 Oinas-Kukkonen & Harjuma 2008 Suggestions Oinas-Kukkonen & Harjuma 2008 Simulation Fogg 2002 Fogg 2007 Toxboe 2007 Oinas-Kukkonen & Harjuma 2008		Present in: Behavioral Design Transparent Design
Push notifications - Content	<i>You have almost reached the top 10!</i> Read 2 more articles to make it into the total ranking.	This push notification combines Leaderboards , Suggestions , Reminders and Simulation as well, but in contrast to the previous example aims at the participant's motivation to reach the more prestigious total ranking (Reward), promising Recognition . This can be supported by being framed as an Evanescant Opportunity (if the participant does not take action immediately, the chance to get into the total ranking might vanish).
Leaderboards Toxboe 2007 Chou 2019 Reward Oinas-Kukkonen & Harjuma 2008		Present in:

<p>Schell 2008 Michie et al. 2013</p> <p>Recognition Oinas-Kukkonen & Harjumaa 2008</p> <p>Evanescent Opportunities Chou 2019</p> <p>Suggestions Oinas-Kukkonen & Harjumaa 2008</p> <p>Reminders Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Simulation Fogg 2002 Fogg 2007 Toxboe 2007 Oinas-Kukkonen & Harjumaa, 2008</p>		<p>Behavioral Design Transparent Design</p>
<p>Push notifications - Content</p>	<p><i>Great! You moved up in the ranking!</i> You improved by 5 ranks today. Keep it up!</p>	<p>In this example, the participant is encouraged through Praise and a positive Feedback on Performance, in order to reinforce the active usage of the app.</p>
<p>Leaderboards Toxboe 2007 Chou 2019</p> <p>Praise Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008 Schell 2008</p> <p>Reminders Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Feedback on Performance Michie et al. 2013</p>		<p>Present in:</p> <p>Behavioral Design Transparent Design</p>
<p>Push notifications - Content</p>	<p><i>Keep it up!</i> Read 3 more articles to beat your personal high</p>	<p>Here, the participant's own Status Points are used as a motivation to continue reading.</p>

<p>Status Points Schell 2008 Chou 2019</p> <p>Suggestions Oinas-Kukkonen & Harjumaa 2008</p> <p>Reminders Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Self-Monitoring Oinas-Kukkonen & Harjumaa 2008 Michie et al. 2013</p>	score.	<p>Present in:</p> <p>Behavioral Design Transparent Design</p>
Protection measures for notifications		
<p>Push notification with protection measures</p> <p>Reminders Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Isolation Effect Von Restorff 1933 Toxboe 2007 Chou 2019</p> <p>Personalization Oinas-Kukkonen & Harjumaa 2008 Schell 2008</p> <p>Defaults Cronqvist & Thaler 2004 Toxboe 2007</p>		<p>In the <i>Transparent Design</i> version, push notifications include local toggle switches for turning them off. The toggle switches are part of the Reminder function. At the same time, toggle switches are outstanding thanks to their Isolation Effect, catching attention. The local settings are complemented by global settings under the main menu. Global settings allow turning on push notifications, set a time frame for pausing push notifications, and adjusting Default triggers making use of Personalization for push notifications and persuasion and habit-formation in the broader sense.</p> <p><i>Push notifications</i> have a key role in developing habits.</p> <p><i>Triggers</i> are circumstances under which a push notification is sent.</p> <p>Present in:</p> <p>Transparent Design</p>
Screen time limit		<p>The screen time limit utilizes Personalization and Defaults. Via Reminders with an Isolation Effect a</p>

<p>Reminders Toxboe 2007 Oinas-Kukkonen & Harjumaa 2008</p> <p>Isolation Effect Von Restorff 1933 Toxboe 2007 Chou 2019</p> <p>Personalization Oinas-Kukkonen & Harjumaa 2008 Schell 2008</p> <p>Defaults Cronqvist & Thaler 2004 Toxboe 2007</p>		<p>friction in the app is created, which makes the concern with the screen time limit an important task at the present moment. The Reminder prompts to pause the app usage, it communicates how long the app has been used in the given session and that “It’s time to take a rest for the eyesight.” - putting the focus of motivation on a health aspect.</p> <p>Present in:</p> <p>Transparent Design</p>
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Notes: The table contains the name of the respective element, the citation of the source, an example of how the element was built into the study app, and an explanation of its effects. Note that the table mainly cites publications which systematized the given element in a behavioral design context. Where possible, the first source mentioning the concept is cited, too. The table includes behavioral design elements applied in protection measures.

APPENDIX REFERENCES

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