



My Eyes Don't Consent! Exploring Visual Attention in Cookie Consent Interfaces

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ABSTRACT

Each cookie consent interface has a different design variant, featuring various levels of information details, which makes the interaction highly challenging. This study aimed to explore how users' visual attention differs across different variants of cookie consent interfaces. To conduct the study, we designed an experiment testing three cookie consent variants, representing good, suboptimal, and bad design practices. Study results showed that none of the participants read the text on the interfaces. Most participants admitted skipping over the text about the cookie notice and did not carefully consider the options related to cookie consent. Notably, the bad design variant proved to be statistically significantly the most challenging for participants to make decisions, as evidenced by the highest total duration of fixation and number of fixations. However, participants spent a longer average fixation duration when the interface included both poor and decent design practices. Study results highlight the impact of interface design, banner location, content, and options presented on visual attention, indicating the necessity of establishing design guidelines to facilitate users in navigating cookie consent interfaces easily.

CCS CONCEPTS

• **Human-centered computing**; • **Interaction design**; • **Empirical studies in interaction design**;

KEYWORDS

Cookie consent, Visual attention, GDPR, CCPA, Eye-tracking, Deceptive pattern, Usability

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1 INTRODUCTION

Cookies are simple text files on websites that aim to store information to identify the user's options decided by the user. Regarding the purpose they serve, there are four types of cookies, namely strictly necessary cookies, statistics cookies, preferences cookies, and marketing cookies [Koch, 2023]. According to the European Union's General Data Protection Regulation (GDPR), which came into force in May 2018, websites must inform users about data processing methods to obtain their personal data and get their consent. Personal data refers to "any information about an identified or identifiable person," such as name, address, income, cultural profile, and Internet Protocol address [GDPR, 2022].

However, the majority of evaluated cookie consent interfaces violate established laws and regulations [Santos et al., 2021]. They can potentially threaten users' privacy as many of them are not helpful for users to understand what they are asked to select [Bouma-Sims et al., 2023; Lapin and Volungevičiūtė, 2022] and start tracking users even before they choose what to accept [Papadogiannakis et al., 2021]. Technical terms and jargon affect users' comfort levels, creating confusion before deciding their preferences [Tang et al., 2021]. Previous research has consistently shown that cookie consent interfaces include deceptive patterns and privacy and security violations [Lapin and Volungevičiūtė, 2022; Mejtoft et al., 2021; Rakovic and Inal, 2023; Soe et al., 2020]. Information hiding, pre-selection [Gray et al., 2021], misdirection, sneaking into a basket [Mejtoft et al., 2021], interface interference, and obstruction [Soe et al., 2020] are commonly detected deceptive patterns. Poor design features, including deceptive patterns, lead to nudging users toward options that are less protective of privacy, resulting in them agreeing to consent unintentionally [Habib et al., 2022].

As regulations mandate, websites use cookie consent interfaces to get users' permission so that users can state their preferences regarding the options they want to accept or decline. However, each interface has different design variants [Utz et al., 2019], which might generate usability issues and demand more cognitive effort for users to understand and consent [Lapin and Volungevičiūtė, 2022]. Design parameters such as interface prominence, location of cookie category definitions, and initial set of cookie options displayed in the cookie interface have an effect on users' consent

decisions [Bouma-Sims et al., 2023]. For instance, users are more likely to accept all cookies when the interface includes a cookie preferences option [Habib et al., 2022]. However, when the cookie consent interface includes a nudging bar, they tend to change the opt-in default settings provided by the interface [Fernandez et al., 2021]. Different nudging types, such as color highlighting, social cues, and timers, have the potential to influence users' consent decisions [Gerber et al., 2023]. Cookie consent interfaces that focus on the functional risks of denying cookies by emphasizing the disadvantages of choosing the lower-utility options are more effective at nudging users' decisions [Ma and Birrell, 2022]. Users prefer a cookie consent interface that is "easy to use, less time-consuming, customizable and concise" [Singh et al., 2022, p. 35]. A cookie consent interface can comply with most design requirements by including best design practices, such as a fully-blocking banner with inline cookie options and a persistent button to allow users to update their consent preferences later [Habib et al., 2022]. However, there is a lack of universally established standards or guidelines for designing a usable cookie consent interface [Bouma-Sims et al., 2023]. Users can decide which cookies they wish to share with the website. Yet, when operating the cookie consent process, the interaction becomes highly challenging for them due to different design variants with various information details present in each interface.

Exploring visual attention is, therefore, critical to understanding which design variant is most helpful for users when sharing their personal data. Eye tracking comes into play when the focus is on visual attention, as eye tracking data is effective in understanding what users pay attention to and avoid. Fixations and saccades are two common metrics to investigate visual attention. During fixations, the eyes remain stationary, while gaze points are maintained in a single location for a specific duration, whereas saccades are continuous eye movements between fixations, reflecting voluntary shifts from one part of the visual field to another [Mishra and Inal, 2023]. Cognitive processes such as attention and decision-making influence users' gaze points, duration of fixations, and eye movements [Carter and Luke, 2020]. In this study, we carried out experimental research to explore the variations in visual attention across cookie consent interfaces with different design variants, representing good, suboptimal, and bad design practices on shopping websites. We looked into how users perceive different cookie consent variants based on two parameters: eye-tracking metrics and experience with cookie consent interfaces presented in the study.

2 METHODS

This study consists of experimental research that tries to answer the research question: *How does users' visual attention differ in cookie consent interfaces with different design variants on shopping websites?* A total of 20 participants contributed to the study, 12 of whom were females and eight males. Thirteen participants were in the age group of 20 to 25, four between 26 and 30, and three above 30 years old. Most participants (n=8) reported shopping online once a month, followed by those with a few times a month (n=5), a few times a week (n=4), and once a year (n=3).

2.1 Study Design

A within-subjects design was used, meaning that the participants were exposed to all levels of independent variable(s) [Bordens and Abbott, 2011]. The independent variables were three different cookie consent variants, and the dependent variables were eye-movement metrics, including the total duration of fixation, the average duration of fixation, and the number of fixations. The total duration of fixation is the duration between the first and last gaze points on the presented cookie consent variants. The average fixation duration calculates the mean fixation time for each cookie consent variant, and the fixation count measures how often the participants look at each specific cookie consent variant. Eye-movement metrics were collected using a Tobii screen-based eye-tracker (Pro Fusion 120 Hz). Additionally, we developed a questionnaire that consisted of two parts containing 12 questions. The first part asked about the participant's demographic information. The second part delved into participants' experiences with the cookie consent variants presented in the experiment, such as the options they remembered selecting, how carefully they considered different options, and the types of cookie consent variants they could remember on the presented websites. Further, we asked about what a cookie was, what strictly necessary cookies were, and how easy they considered the cookie consent variants to understand.

2.2 Selected Cookie Consent Interfaces

Three different cookie consent variants were chosen for the experiment. All of them were based on the findings from Habib et al.'s [2022] study on usability and cookie consent interfaces. As our primary purpose was to explore how different variants of the cookie consent interface affect the users' visual attention, we used three websites that used different cookie consent variants, representing good, suboptimal, and bad design practices.

Figure 1 shows the evaluated cookie consent variants in the study. The good design variant provided the most privacy-protective options and included all necessary information in the same interface, presenting them in a user-friendly manner for more convenient access. It contained "a fully-blocking consent interface with in-line cookie options accompanied by a persistent button enabling users to later change their consent decision best meets several design objectives" [Habib et al., 2022]. The design variant also avoided loss aversion framed text that might affect users' decision-making.

The cookie consent interface categorized as "bad" was considered the least privacy-protective due to factors such as the paragraph text layout, the absence of cookie settings options, and the presence of a single generic button nudging users in only one direction. Additionally, it incorporated a deceptive pattern, namely bad defaults, where a single option was pre-selected, highlighting the "I accept" button. This design variant lacked sufficient information to guide users on cookie options, making it challenging for them to understand what to accept or decline. Clicking the "I accept" button meant users had to consent to all cookies, as they were not given the freedom to select options aligned with their best interests, leading to a lower awareness of their privacy decision. The suboptimal design variant offered effective techniques, including privacy statements and cookie options, enabling users to manage their consent settings. However, the variant also included poor

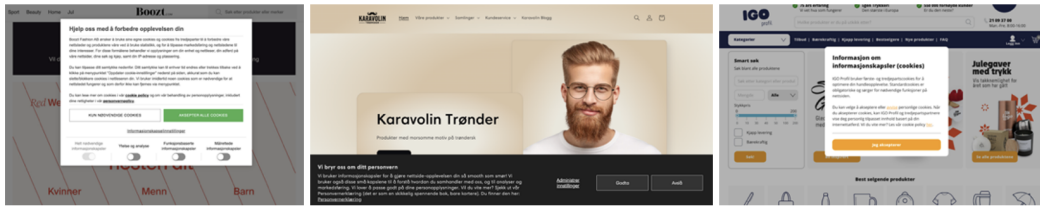


Figure 1: Good (left), suboptimal (middle), and bad (right) design variants of cookie consent interfaces

design practices, such as a non-blocking interface, paragraph text layout, and generic accept and decline buttons that were equal in color and placement.

2.3 Procedure

Before the experiment, the participants were informed about the purpose of the study. Next, they were introduced to three online shopping websites and assigned to complete a shopping task. The participants were divided into three groups, with the websites displayed in randomized orders. This random assignment aimed to eliminate biases and ensure that each design variant was adequately tested. The participants were then given a specific shopping task: selecting and adding an item to the shopping cart. They were free to select any item on the websites. The task was designed to simulate a real-world online shopping experience. While engaged in the shopping task, the participants encountered each design variant and proceeded to complete the shopping task on the websites. After each session, we reset the cookie consent settings for the next participant. Following task completion, the participants were given a questionnaire, which included demographics and their experiences with the cookie consent variants presented in the experiment. No personal data was collected during the study to ensure participants' anonymity.

3 RESULTS

3.1 Experience with the Cookie Consent Interfaces

The participants were divided into groups based on their self-reporting in the questionnaire. Almost all participants ($n=18$) expressed knowledge of what a cookie is, defining it as a small piece of data stored on a computer to keep track of information, such as logins or websites the user has visited previously. More than half of the participants ($n=11$) said that strictly necessary cookies are necessary for the proper functioning of the website, seven mentioned that these cookies are required for collecting certain metrics, and two participants were unsure. None of the participants reported reading the text in the cookie consent interfaces. The majority ($n=13$) admitted to skipping over the cookie notice, while seven reported skimming it. Regarding the challenges of understanding what to accept in cookie consent interfaces, half of the participants found the presented cookie consent variants easy to comprehend. Study results showed that 12 participants admitted to not carefully considering the options given in the cookie consent interfaces on the presented websites, while eight reported doing so moderately. Further, nine participants chose the “all cookies”

option, and the remaining participants preferred “some cookies,” including options such as “only allow strictly necessary cookies” and “allow functional cookies.”

3.2 Visual Attention in the Cookie Consent Interfaces

Table 1 displays participants' visual attention at each cookie consent interface. On average, the total duration of fixations was the highest for the bad design variant (6076 ms), followed by the good (3907 ms) and suboptimal (2115 ms) design variants. The participants spent the most time on the bad design variant, as it included poor design practices that might have made it more difficult for them to make a choice. Furthermore, the total duration of fixations for the good design variant was longer than the suboptimal design variant, suggesting that more options provided and the location of the cookie banner led to longer fixation times. The standard deviation was generally rather large, indicating significant individual differences, but it remained quite consistent across different experimental conditions.

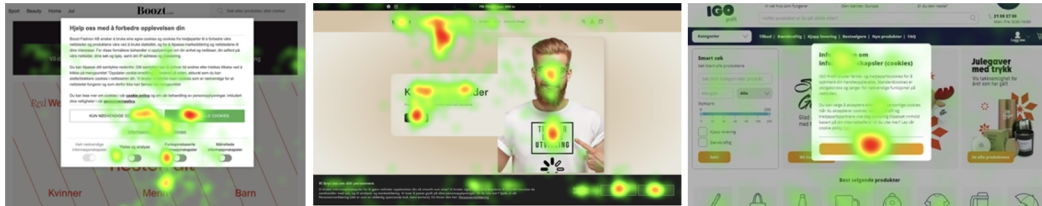
A series of one-way repeated measure ANOVAs were conducted on all participants' eye movement data across the cookie consent variants. The test results showed that the total duration of fixations differed statistically significantly ($F(2,38)=7.132$, $p=0.002$, Wilks' $\lambda=0.519$, partial $\eta^2=0.48$). A post hoc pairwise comparison using the Bonferroni correction showed an increased total duration of fixations score from good to bad and a decreased total duration of fixations score from good to suboptimal design variants, but these were not statistically significant ($p=0.298$ and $p=0.109$, respectively). However, the decrease in the total duration of fixations score did reach significance when comparing bad and suboptimal design variants ($p=0.004$).

The average duration of fixations exhibited the opposite pattern. The participants needed to spend more time operating the cookie consent process as the design became more challenging with the suboptimal design variant, which included both poor and decent design practices. They scored the highest on average for the suboptimal design variant (289 ms), while the good design variant (243 ms) received the least average duration of fixations. Although there was no statistically significant main effect for the outcome ($p=0.377$), post hoc pairwise comparison using the Bonferroni correction showed increased average duration of fixations from good to bad to suboptimal design variants.

The suboptimal design variant had an average of 7.5 fixations, indicating a likely lower number of elements in the consent interface that attracted participants' attention. In contrast, the bad

Table 1: Visual attention metrics for each cookie consent variant - Mean (SD)

Visual Attention Metrics	Good	Suboptimal	Bad
Total Duration of Fixations (ms)	3907 (2829.6)	2115 (1285.7)	6076 (4676.2)
Average Duration of Fixations (ms)	243 (64.0)	289 (157.7)	264 (54.8)
Number of Fixations (n)	16.6 (11.2)	7.5 (4.9)	23.3 (17.9)

**Figure 2: Heatmap data on evaluated cookie consent variants**

design variant recorded an average of 23.3 fixations, while the good design variant had 16.6. The number of fixations showed a statistically significant difference among the cookie consent variants ($F(2,38)=7.616$, $p=0.002$, Wilks' $\lambda=0.478$, partial $\eta^2=0.52$). Bonferroni's test for multiple comparisons revealed a statistically significant difference in the number of fixations between the good and suboptimal ($p=0.021$) and bad and suboptimal ($p=0.004$) design variants. We observe a rather high standard deviation indicating significant individual variability among the participants.

Figure 2 displays heatmap data concerning the evaluated cookie consent variants in the study. The participants predominantly directed their attention to cookie consent options and buttons in the good design variant, while the bad design variant exhibited different fixation patterns. Specifically, participants focused mainly on the button labeled "I accept" since the design variant lacked details about cookie consent. Please note that the suboptimal design, positioned at the bottom of the page with a non-blocking banner option, meant participants weren't required to decide on cookie consent to proceed with their website activities. As depicted in the figure, the participants concentrated primarily on website-related design elements such as images, titles, texts, logos, etc., rather than the cookie consent interface. They barely looked at the cookie consent details provided by the interface, which was crucial to pay enough attention to decide what to accept or decline. Their gaze was mostly fixated on the buttons offering accept or decline options on the cookie consent interface.

3.3 Effect of Experience with the Cookie Consent Interfaces on Visual Attention

The study results indicated that the bad design variant posed the greatest challenge. Participants who opted to allow all cookies spent the most time on the bad design variant, but their average duration of fixations was highest for the suboptimal design variant. The bad design variant failed to offer adequate options aligned with users' best interests. Participants from both groups (those permitting all cookies and those allowing some cookies) exhibited

very similar total and average fixation durations for the suboptimal design variant. Moderately careful participants had the shortest total duration of fixations for the suboptimal design variant but spent the longest average duration of fixations across all cookie consent variants (see Table 2).

The participants who perceived the presented cookie consent variants as easy to understand spent less time on them compared to those who found them challenging, for both the good and bad design variants. Interestingly, the most significant disparities were observed in the context of the good design variant, where the participants, who considered the cookie consent variants challenging, spent, on average, 1714 ms more on the total duration of fixations than those who deemed them easy to understand. For the bad design variant, the difference was 162 ms, and for the suboptimal design variant, the difference was 1417 ms. Similarly, concerning the average duration of fixations, the participants who found the interfaces challenging spent an average of 259 ms, while those who rated them easy to use spent an average of 228 ms per fixation for the good design variant.

Table 3 displays the fixations recorded during the experiment. Irrespective of the participants' demographics provided in the table, all participants showed the highest number of fixations in the bad design variant, followed by the good and suboptimal design variants, respectively. This suggests that participants faced more challenges in decision-making within the cookie consent variant with poor design practices. The participants who permitted all cookies had fewer fixations for the good and suboptimal design variants than those who allowed only some cookies. However, the pattern was reversed for the bad design variant. Moderately careful participants had more fixations only for the good design variant, whereas participants who reported not being careful had more fixations for the bad and suboptimal design variants. Additionally, on average, participants who rated the presented cookie consent variants as hard to understand had a higher number of fixations for the good and bad design variants than those who found the same cookie consent variants easy to understand.

Table 2: Participants' experience with cookie consent variants and their total and average duration of fixations - Mean (SD)

Participants who ...	Total Duration of Fixations			Average Duration of Fixations		
	Good	Suboptimal	Bad	Good	Suboptimal	Bad
allowed all cookies (n=9)	3435 (2285.7)	2038 (999.6)	7662 (5412.1)	239 (60.5)	301 (168.8)	256 (42.7)
allowed some cookies (n=11)	4293 (3266.3)	2177 (1527.1)	4778 (3741.2)	246 (69.5)	279 (155.6)	269 (64.5)
were moderately careful (n=8)	4735 (3554.7)	2076 (1641.4)	5767 (3947.9)	269 (68.2)	307 (175.6)	286 (62.4)
were not careful (n=12)	3355 (2226.7)	2140 (1067.3)	6282 (5266.4)	226 (57.6)	276 (151.4)	249 (46.0)
found cookies easy to understand (n=10)	3050 (1636.5)	2823 (1126.6)	5995 (4859.3)	228 (50.2)	336 (145.9)	264 (54.5)
found cookies hard to understand (n=10)	4764 (3548.5)	1406 (1051.6)	6157 (4747.2)	259 (74.8)	241 (162.0)	263 (58.0)

Table 3: Participants' experience with cookie consent variants and their number of fixations - Mean (SD)

Participants who ...	Number of Fixations		
	Good	Suboptimal	Bad
allowed all cookies (n=9)	15.4 (11.3)	6.8 (3.7)	29.7 (19.7)
allowed some cookies (n=11)	17.5 (11.5)	8.0 (5.8)	18.1 (15.1)
were moderately careful (n=8)	17.9 (12.1)	6.6 (5.3)	21.5 (16.6)
were not careful (n=12)	15.7 (10.9)	8.0 (4.7)	24.5 (19.3)
found cookies easy to understand (n=10)	13.8 (7.3)	9.7 (4.9)	22.5 (18.8)
found cookies hard to understand (n=10)	19.3 (13.9)	5.2 (3.9)	24.1 (17.9)

4 DISCUSSION

This study explored how users' visual attention differs across different variants of cookie consent interfaces, representing good, suboptimal, and bad design practices on shopping websites. The study results showed that participants had a high level of knowledge about the definition of a cookie. However, they did not read the text in the presented cookie consent interfaces; most skipped over the text regarding the cookie notice, and the rest just skimmed it. This might be because half of the participants found the presented cookie consent variants easy to understand. Previous research indicates that most users prefer to customize their cookie preferences instead of allowing all cookies [Bouma-Sims et al., 2023]. In line with this argument, more than half of the participants in the present study chose some cookie options to accept, such as strictly necessary cookies and functional cookies, although they reported not carefully considering the options concerning cookie consent variants. To increase the probability of users changing the default cookie settings, some nudging elements might be utilized on cookie consent interfaces [Fernandez et al., 2021]. The evaluated cookie consent interfaces in the present study did not provide such techniques and had the same features regarding the consent responses.

Participants' visual attention statistically significantly differed in the cookie consent interfaces. They exhibited a higher total duration of fixations in the bad design variant than in the good and suboptimal design variants, indicating that the more challenging the cookie consent interface, the longer their fixation. An intriguing finding from the data is that the good design variant has the lowest numbers for the average duration of fixations. This may indicate that the user interface is easier to process than the other interfaces of the cookie consent variants. Moreover, the number of fixations

in the good design variant was lower than in the bad design variant, suggesting that users exerted less effort in understanding the cookie policies, even though the interface provided detailed information about cookie consent. However, the good design variant received a higher total duration of fixations and a greater number of fixations than the suboptimal design variant.

Users prefer a cookie interface design that is usable, contains enough information to understand, and takes less time to operate [Singh et al., 2022]. The bad design variant, representing several poor design practices, emerged as the most challenging interface for decision-making, evidenced by the highest total duration and number of fixations. It is important to note that this variant was positioned at the center of the page with a fully-blocking banner, providing minimal information about cookie consent. The text in the cookie interface about gains and losses has the potential to influence users' decisions [Ma and Birrell, 2022]. Technical terms should be avoided, as users might misunderstand them, creating challenges to user privacy and security [Tang et al., 2021]. The bad design variant in the study did not provide clear and sufficient information in this regard. It also incorporated a deceptive pattern, which could impact the design's usability, making it difficult for users to select the right options [Lapin and Volungevičiūtė, 2022]. This likely resulted in the longest fixation duration for the bad design variant in the present study, as participants may have needed more time to navigate the poor design and choose options aligned with their best interests.

Furthermore, the participants spent a higher average duration of fixations when the cookie consent interface included both poor and decent design practices, referred to as the suboptimal design variant. This suggests that more time is required to comprehend the

options provided by the interface as the design becomes more challenging. For instance, the suboptimal design variant received the highest average duration of fixations but the lowest number of fixations. Banner location has been shown to impact visual attention [Guner and Inal, 2015] and users' consent behavior [Bouma-Sims et al., 2023]. This observation aligns with the argument that longer fixation durations with lower fixation counts might be related to confusion and difficulty completing tasks [Mishra and Inal, 2023]. In the present study, the reject button of the suboptimal design variant did not include an indication of its functionality. Providing a close button without showing functionality is discouraged in cookie consent interfaces; the ideal design solution would be "Close without accepting optional cookies" [Bouma-Sims et al., 2023]. Otherwise, users may find it challenging to understand the consequences of accepting or declining when clicking a button without indicating its functionality.

We collected participants' experiences with the presented cookie consent variants during the experiment. Notably, the bad design variant received the highest total duration of fixations and the number of fixations, regardless of participants' experiences. The good and suboptimal design variants followed, respectively. However, participants' visual attention metrics differed across design variants based on their experiences with the presented interfaces. When the participants were specifically searching for a choice in the cookie consent variant and spent more time per fixation, they exhibited a higher total duration of fixations. Additionally, their average duration of fixations increased when they needed to comprehend the options provided by the cookie consent interface. The participants who were careful about the presented options had the longest average duration of fixations in all cookie consent variants. This suggests that they might have read the text more thoroughly or examined the user interface, resulting in an increased time per fixation.

4.1 Limitations and Future Work

This experimental research has some validity threats due to the relatively small sample size, which should be considered. Data were collected from young adults with high technical competency and skills, and the results might differ with older participants or those with different computer literacy backgrounds. Future studies must address these limitations by focusing on various user groups to gain more insight into how users' visual attention differs across different cookie consent interfaces. Regarding construct validity, certain potential threats should be taken into account. In the experiment, we utilized three websites providing different cookie consent variants, naming each variant based on previous research. However, there are many other ways to design cookie consent interfaces with different locations, content, and options for users, which should be explored. Evaluating additional design variants can capture the impact of design on users' visual attention and provide useful solutions, enabling them to select options aligned with their best interests. Even though the experiment involved a shopping task after the cookie decision process, we do not know if the motivation for making the decisions would be different in a real-world setting. There is a chance that under different conditions, where the mental focus is more clearly on the task following the cookie consent form,

people might behave differently. Despite these limitations, the study offers insights into designing effective, useful, and efficient cookie consent interfaces on websites.

5 CONCLUSION

Overall, the bad design variant proved to be the most challenging, as evidenced by the highest total duration and number of fixations. The suboptimal design, incorporating both poor and decent design practices, exhibited the highest average fixation duration with lower fixation counts, indicating confusion and difficulty in understanding the information provided by the interface, as participants required more time to decide what to accept or decline. Study results underscore the impact of interface design, banner location, content, and options presented on visual attention. We conclude that establishing design guidelines is necessary to facilitate users in navigating cookie consent interfaces easily. This would guide websites in providing a more effective consent mechanism without compromising users' privacy and security.

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