Timing Matters: Comparing the Effects of Immediate, Delayed, and No Feedback on User Trust in Interactive Systems

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Abstract. *This study examines the impact of feedback timing on user trust and perceived reliability in interactive systems. Three scenarios were tested: no feedback, immediate feedback, and delayed feedback. Thirty participants interacted with these scenarios and completed trust-based questionnaires. Results show that immediate feedback significantly enhances user trust and perceived reliability, followed by delayed feedback, while the absence of feedback undermines these factors. The study aligns with human-computer interaction theories and extends recent research on user experiences. Findings emphasize the importance of implementing timely feedback in interactive system design, particularly immediate feedback when feasible. This research provides insights for improving user experience across various domains, including critical areas like healthcare technology. Future studies should address limitations in sample size and task diversity and explore different feedback modalities and user characteristics.*

Keywords:*Immediate Feedback, User Experience (UX), Trust in Systems, Interactive Interfaces, Human-Computer Interaction (HCI).*

1. Introduction

In Human-Computer Interaction (HCI), feedback is essential for shaping user experience, and responding to user actions that communicate the results of those actions. Immediate feedback ensures that users receive prompt confirmation, guidance, or correction, which can range from visual or auditory cues to more complex messages indicating success, failure, or needed adjustments [Nielsen 1993]. This feedback is crucial not only for confirming actions but also for minimizing uncertainty, improving control, and enhancing user trust, system usability, and efficiency [Shneiderman et al. 2010]. The lack of timely feedback can disrupt interaction, causing frustration, increasing cognitive load, and reducing user engagement [Norman 2013].

With technological advancements, digital platforms increasingly incorporate immediate feedback to enhance user experience. Applications in various domains, such as e-learning, performance monitoring, and real-time collaboration, rely on swift responses to maintain user engagement and optimize task performance [Solis 2010]. In these environments, feedback not only accelerates learning and decision-making but also supports user confidence in automated and interactive systems.

Despite its recognized advantages, research on feedback timing often focuses on cognitive models rather than empirical evaluations of how different feedback strategies affect user trust and usability [Ryan and Deci 2017]. Recent literature has posited that varying feedback timing—whether concurrent (real-time) or terminal (summary after completion)—significantly affects learners' performance and engagement levels. For instance, one study indicates that immediate feedback can enhance accuracy and fluency in learning settings, particularly during interactive tasks, providing empirical support for the timing of feedback as a crucial factor in educational contexts [Mashhura 2024]. Moreover, a comprehensive analysis delineates the importance of feedback presentation modes and timing in rehabilitation settings, reinforcing that feedback can be more effective when delivered in the right context [Brennan et al. 2019]. However, the practical implications of immediate versus delayed feedback remain underexplored, particularly in modern interactive interfaces where responsiveness is a key factor.

This study aims to address this gap by assessing the impact of immediate feedback on user experience in interactive systems. By empirically analyzing how different feedback timings influence trust and usability perceptions, this research offers valuable perspectives for designing more intuitive and user-centred systems. To guide this investigation, the following research questions were formulated:

- **RQ1:** How does immediate feedback influence user trust compared to no feedback and delayed feedback?
- **RQ2:** How do different feedback timings (immediate, delayed, and absent) affect users' preference and perceived reliability of the system?

[Carroll 2003] emphasizes that the core objective of HCI research is to ensure that interactive technologies are not only functional but also intuitive and reliable. This study aligns with this perspective by investigating how feedback mechanisms influence user trust and perceived system reliability.

2. Related Work

This section highlights key studies (2010-2024) on feedback in interactive systems, focusing on user trust and engagement.

[Solis 2010] demonstrated immediate feedback increases engagement, while [Hartson and Pyla 2012] found consistent feedback enhances trust. [Vassileva 2012] emphasized feedback's role in community-building, and [Ryan and Deci 2017] linked timely feedback to increased user motivation. In contrast, [Cecchinato et al. 2019] identified gaps in optimizing feedback across contexts, suggesting a more nuanced implementation approach.

Recent studies by [Yilmaz et al. 2022] revealed immediate feedback's importance in educational outcomes and trust-building. Similarly, [Rainey et al. 2024] showed how AI feedback affects trust in clinical settings.

While these studies provide valuable insights, most examine feedback within specific domains. Our research uniquely compares three distinct feedback conditions (immediate, delayed, absent) in a controlled experiment, isolating feedback timing as the primary variable to measure its specific effects on user trust and perceived reliability.

3. Methodology

This study employed a structured methodology to address the research questions, covering participants, materials, procedures, manipulations, surveys, generative AI, ethical considerations, and statistical analysis, each detailed in the following subsections.

3.1. Participants

Participants for the study were recruited from the university campus, primarily consisting of undergraduate and graduate students, all with basic knowledge of interactive systems and digital interfaces. They were personally invited while passing near the study room, conducted in a controlled environment. Informed consent was obtained from all participants prior to the study.

3.2. Materials

Recycling has gained importance as a vital practice for environmental preservation, with responsible waste disposal essential for a sustainable future. To address this, the Reclique system was created to simplify and optimize the recycling process, fostering environmental awareness and sustainable habits. Although Reclique does not exist as a functional system, this study utilized an interactive prototype developed in Figma to address its feasibility, simulate user interactions, and examine how different types of feedback influence user trust and satisfaction.

The Reclique system was conceptualized to include the following core features:

- **Collection Point Map:** Locates nearby recycling points.
- **Recycling Guide:** Provides disposal guidelines.
- **Partnerships:** Promotes sustainability collaborations.
- **Reports:** Helps users track their recycling impact over time.
- **Rewards:** Incentives eco-friendly actions.

The Reclique *prototype*, developed in Figma, simulates user interactions to explore real-time feedback in digital recycling apps. The prototype included:

- **Login Screen:** Allows users to create an account or log in.
- **Main Dashboard:** Displays the user's points, activities and navigation.
- **Collection Point Locator:** Enables users to find recycling stations.
- **Recycling Education Section:** Guides material sorting.
- **Points Redemption System:** Exchange accumulated points for mobile credit.
- **Transaction History:** Records activities and redemptions.
- **Settings:** Allows customization of notifications and account preferences.

Figma was chosen for developing the Reclique prototype due to its ease of use, interactivity, and collaboration features, allowing for quick creation of interactive prototypes without extensive coding. It enabled the simulation of feedback mechanisms and streamlined teamwork in design refinement.

These interface elements were created to assess usability, trust, and engagement through interactive feedback. The Reclique prototype was central to the study, enabling participants to experience recycling gamification and evaluate the impact of feedback timing on system confidence. Figure 1 illustrates key screens of the Reclique prototype.

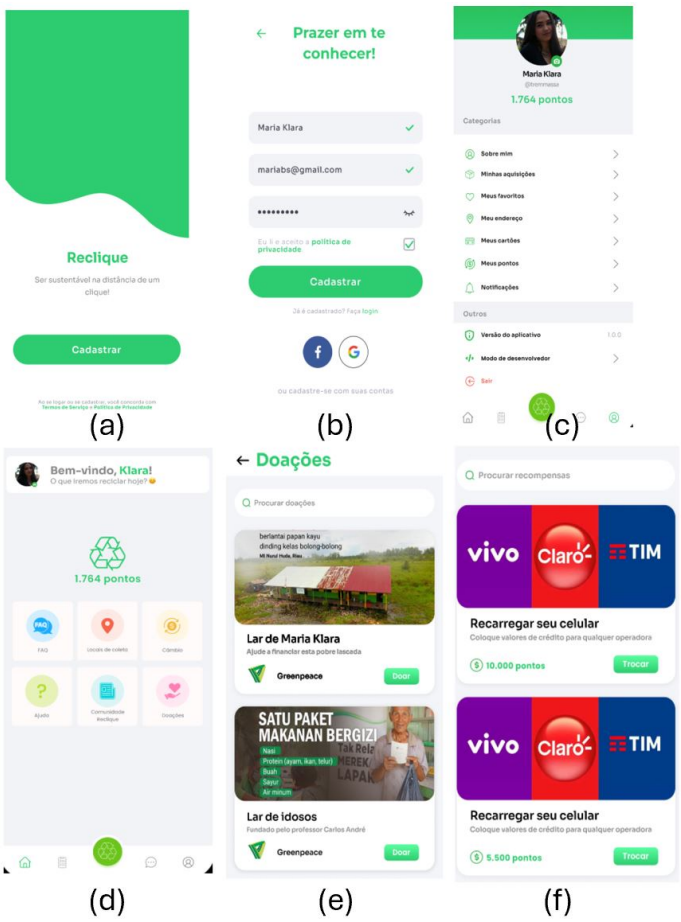


Figure 1. Key screens of the Reclique prototype. (a) Home screen. (b) Login screen. (c) Menu with functionalities. (d) Main dashboard. (e) Donation screen. (f) Mobile recharge screen.

3.3. Procedures

The study was conducted in a dedicated room within the university to ensure a controlled environment. Participants interacted with the prototype using desktop computers with standard monitors, mice, and keyboards to ensure consistency in the interaction experience. The procedure was divided into the following steps:

1. **Participant Recruitment and Initial Briefing:** Participants were invited in person and received an overview of the study's purpose, emphasizing voluntary participation and anonymity.
2. **Informed Consent:** Participants read and signed a consent form detailing the study's goals, risks, and their right to withdraw.
3. **Tutorial and Warm-up Session:** Before starting the main study, participants received a brief tutorial o interacting with the prototype, ensuring familiarity with the system.
4. **Experimental Task Execution:** Participants interacted with three versions of the Reclique prototype (No Feedback, Immediate Feedback, and Delayed Feedback) in a counterbalanced order.
5. **Survey Completion:** After each task, participants answered a questionnaire on

user trust, satisfaction, and system responsiveness, using Likert-scale questions (1 = Strongly Disagree to 5 = Strongly Agree).

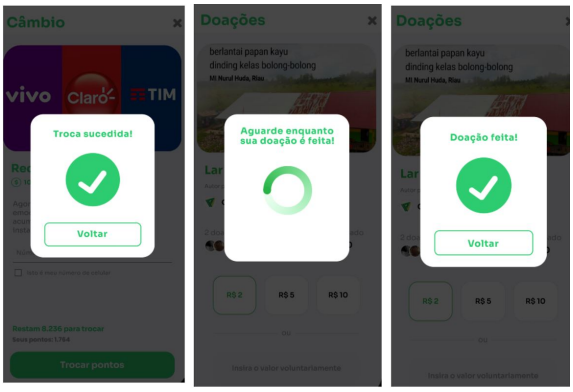
6. **Final Feedback and Debriefing:** After testing all versions, participants provided qualitative and suggestions for improvement.
7. **Data Collection and Organization:** Responses were securely stored for analysis, with no personally identifiable recorded.

3.4. Manipulation

To explore the effects of feedback timing on user experience, three distinct conditions were tested in the interactive prototypes:

- **No Feedback Condition**: In this scenario, participants performed tasks without receiving any confirmations, animations, or notifications. This served as a baseline to assess the effects of feedback absence.
- **Immediate Feedback Condition**: Here, users received instant responses after each action, such as confirmation messages and visual animations, allowing an evaluation of real-time feedback benefits on user trust and satisfaction.
- **Delayed Feedback Condition**: In this setup, feedback was purposefully delayed by approximately 3 seconds after each action, simulating common system delays often experienced in applications with heavy processing requirements or network latency issues.

Figure 2 shows how the feedbacks were presented to the participants.



(a) (b) (c)

Figure 2. (a) Immediate feedback condition. (b) Delayed feedback condition informing the user about the process. (c) Feedback after the processing signal.

Aside from the feedback timing, all other aspects of the interface, including layout, wording, and functionality, were kept consistent across conditions to ensure that any observed differences in user experience could be attributed to the feedback mechanisms.

3.5. Survey

After agreeing to participate in the study and providing informed consent, participants first completed a demographic questionnaire. The questions asked were:

- **Gender:** Male, Female, Non-binary, Gender Fluid, Transgender, Queer, Prefer not to say.

- **Age:** Participants provided their age.
- **Education level:** Elementary, High School, Incomplete High School, Complete Higher Education (undergraduate, bachelor's), Incomplete Higher Education (undergraduate, bachelor's), Complete Master's, Incomplete Master's, Complete Doctorate, Incomplete Doctorate, Prefer not to say.

After interacting with each prototype version, participants completed a survey measuring trust and satisfaction. Adapted from established questionnaires, it included trust items from the Trust of Automated Systems Test (TOAST) [Wojton et al. 2020] to assess reliability, predictability, and dependability. Example questions included:

- "I understand what the system is supposed to do."
- "The system helped me achieve my goals."
- "I understand the limitations of the system."
- "I understand the capabilities of the system."
- "The system operates consistently."
- "The system operates the way it is supposed to."
- "I feel comfortable relying on the information provided by the system."
- "I understand how the system performs its tasks."
- "I am rarely surprised by how the system responds."

At the end of the study, a post-survey was administered to gather additional quantitative feedback. The questions asked were:

- "What did you think of using the system with immediate feedback (Scenario 2) after performing an action?"
- "Do you think the system becomes more reliable to use when it contains immediate feedback? Why? (Optional)"
- "Which system did you like using the most?"
- "What did you think of using the system without feedback (Scenario 1) after performing an action?"
- "What did you think of using the system with delayed feedback (Scenario 3) after performing an action?"
- "Do you think the system becomes more reliable to use when it does not contain feedback?"
- "Do you think the system becomes more reliable to use when it contains delayed feedback?"

Participants provided their responses on a Likert scale, with options such as:

- "Yes, I feel more confident in the system."
- "No, I do not feel more confident in the system."
- "It makes no difference to me whether the system has feedback."

Survey responses were collected using Google Forms immediately after participants completed tasks with each version of the prototype version, ensuring feedback was based on their most recent interaction for accurate data.

3.6. Generative Artificial Intelligence (AI)

Generative AI tools were utilized to assist in the writing and structuring of this research paper. The AI contributed to drafting some sections, refining content for clarity, ensuring consistency in terminology and style, and assisting with accurate formatting and inclusion of references and citations. The use of AI was limited to enhancing the writing process and did not influence the experimental design, data collection, or analysis.

3.7. Ethical Considerations

The study was conducted in accordance with ethical guidelines for research involving human participants. Informed consent was obtained from all participants, and they were assured of their right to withdraw from the study at any time. Participant anonymity and data confidentiality were maintained throughout the study.

3.8. Statistical Analysis

To analyze the impact of feedback timing on user trust and satisfaction, data from the questionnaires were processed using SPSS 19, with non-parametric tests applied due to the potential violations of normality assumptions. Descriptive statistics summarized the data, calculating median values for trust and satisfaction across the three feedback conditions: No Feedback, Immediate Feedback, and Delayed Feedback. The Kruskal-Wallis H test was used to assess significant differences between these conditions.

Pairwise comparisons were performed using the Mann-Whitney U test with Bonferroni correction to identify which feedback conditions most impacted trust and satisfaction. Additionally, Spearman's rank correlation assessed the relationship between trust and satisfaction levels. These statistical methods provided a comprehensive evaluation, offering an understanding of how feedback timing influences user experience.

4. Results

This section presents a detailed analysis of the results from the questionnaires.

4.1. Participants

A total of 30 participants took part in the study. The gender distribution was 70% male and 30% female. Participants' ages ranged from 17 to 45 years, with 26.7% aged 17-19 years, 50% aged 20-22 years, 13.3% aged 23-30 years, and 10% aged 31-45 years. Regarding education level, 16.7% had completed high school, 63.3% had incomplete higher education (undergraduate, bachelor's), and 20% had completed higher education (undergraduate, bachelor's).

4.2. RQ1: Impact of Immediate Feedback on User Trust

The analysis aimed to assess the impact of feedback timing on user trust, comparing three conditions: No Feedback (C1), Immediate Feedback (C2), and Delayed Feedback (C3). Trust scores were calculated as the mean of responses to nine trust-related questions for each participant and analyzed using the Friedman Test, followed by post-hoc comparisons with the Wilcoxon Signed Ranks Test.

The Friedman Test revealed a significant difference in trust scores across the three conditions ($\chi^2 = 23.804$, $df = 2$, $p < .001$). The mean ranks were: Trust_Score_C1: 1.32; Trust_Score_C2: 2.20; Trust_Score_C3: 2.48. Post-hoc analyses using the Wilcoxon Signed Ranks Test revealed significant increases in trust scores for both C2 and C3 compared to C1. However, no significant difference was found between C2 and C3 conditions (Table 1).

Table 1. Wilcoxon Signed Ranks Test Comparisons

	Z	Asymp. Sig. (2-tailed)	Mean Rank (Positive - Negative)
Trust_Score_C2 - Trust_Score_C1	-4.158	$< .001$*	$16.06 - 5.13$
Trust_Score_C3 - Trust_Score_C1	-4.165	$< .001$*	$16.40 - 6.25$
Trust_Score_C3 - Trust_Score_C2	$-.829$	$.407$	$12.24 - 15.89$

* indicates $p < .05$

4.3. RQ2: Impact of Feedback Timings on Users' Preference and Perceived Reliability of the System

The analysis aimed to determine how different feedback timings affect users' preference and perceived reliability of the system. The post-questionnaire responses were analyzed using the Friedman Test to compare perceived reliability scores across the three conditions. The Friedman Test revealed a significant difference in perceived reliability scores across the three conditions ($\chi^2 = 20.819$, $df = 2$, $p < .001$). The mean ranks for each condition were as follows:

- **Immediate Feedback Condition (C2):** What did you think about using the system with immediate feedback after performing an action? 2.48
- **No Feedback Condition (C1):** What did you think about using the system without feedback after performing an action? 1.40
- **Delayed Feedback Condition (C3):** What did you think about using the system with delayed feedback after performing an action? 2.12

Pairwise comparisons were conducted using the Wilcoxon Signed Ranks Test to further explore the differences between conditions, as summarized in Table 2.

Table 2. Wilcoxon Signed Ranks Test Comparisons for Perceived Reliability

	Z	Asymp. Sig. (2-tailed)	Mean Rank (Positive - Negative)
No Feedback (C1) - Immediate Feedback (C2)	-4.185	$< .001$*	$14.46 - 8.25$
Delayed Feedback (C3) - Immediate Feedback (C2)	-1.668	$.095$	$11.42 - 8.79$
Delayed Feedback (C3) - No Feedback (C1)	-2.957	$.003$*	$16.81 - 10.25$

* indicates $p < .05$

The Friedman Test showed significant differences in perceived reliability scores across the three feedback conditions. Post-hoc analyses with the Wilcoxon Signed Ranks Test (Table 2) revealed significant differences between No Feedback and both Immediate and Delayed Feedback conditions. However, no significant difference was found between Immediate Feedback and Delayed Feedback conditions.

4.4. Additional Data

In addition to the main research questions, the post-questionnaire provided insights into the participants' preferences and perceptions regarding the system's feedback. The following tables summarize the most frequent responses for each question.

5. Discussion

RQ1: Our research confirms that immediate feedback significantly enhances user trust compared to delayed feedback or no feedback, aligning with established HCI principles [Nielsen 1993, Shneiderman et al. 2010, Norman 2013]. The study reveals that while immediate feedback is preferred, delayed feedback is nearly as effective, both significantly outperforming the absence of feedback in terms of trust.

Table 3. Summary of Most Frequent Responses from the Post-Questionnaire

Question	Most Frequent Response	Frequency	Percent
I rarely get surprised by how the system responds.	5 (Strongly Agree)	13	43.3%
Do you think the system becomes more reliable to use when it contains immediate feedback?	Yes, I feel more confident in the system	28	93.3%
Which system did you like the most?	Scenario 2 (Immediate Feedback)	17	56.7%
Do you think the system becomes more reliable to use when it does not contain feedback?	No, I don't feel more confident in the system	23	76.7%
Do you think the system becomes more reliable to use when it contains delayed feedback?	Yes, I feel more confident in the system	20	66.7%

The empirical data supports the notion that the presence of feedback, regardless of timing, is crucial for improving user trust. This finding has practical implications for systems where real-time feedback is not always feasible, suggesting that delayed feedback is a valuable fallback [Shneiderman et al. 2010].

RQ2: The analysis underscores significant differences in perceived reliability across feedback conditions, with immediate feedback being rated highest, followed by delayed feedback, and no feedback being the least reliable. This aligns with prior research indicating that timely feedback enhances user trust and satisfaction [Ryan and Deci 2017, Følstad and Brandtzaeg 2020]. The preference for immediate feedback due to instant confirmation aligns with Carroll's feedback loop theory [Carroll 2003], while delayed feedback still offers a sense of control compared to no feedback [Solis 2010].

Additional Data: The post-questionnaire responses show a strong preference for immediate feedback, with 93.3% of participants expressing increased trust, and 56.7% preferring immediate feedback over delayed. The absence of feedback was notably detrimental, with 76.7% reporting decreased confidence [Nielsen 1993].

Implications for Design: Immediate feedback is critical for enhancing trust and usability in interactive systems. Delayed feedback is a suitable alternative when immediate responses are not possible. Effective feedback mechanisms are essential in critical domains such as healthcare [Borsci et al. 2019]. Designers must ensure consistent feedback to maintain system reliability and user trust.

6. Conclusion

This study demonstrates the significant impact of feedback timing on user trust and perceived reliability, with immediate feedback being most effective, followed by delayed feedback, and no feedback being least effective. These findings underscore the value of incorporating feedback in interactive system design.

The study's limitations include a small, primarily student-based sample size, which may introduce bias and limit generalizability. Additionally, using a Figma prototype may not fully capture the variability of real-world feedback timing. Future research should diversify participant demographics and test with fully functional systems under various conditions to further validate these findings.

Understanding feedback timing's role is essential as AI and machine learning continue to evolve, influencing technology adoption and user experience in interactive systems. This research calls for further exploration into different feedback types and their effects on diverse user groups.

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