

Measuring Perceived User Experience Versus Objective Usability Metrics in Accessible Web Design.

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Abstract-- Although the Web Content Accessibility Guidelines (WCAG) establish a robust technical foundation for digital inclusivity, existing frameworks frequently emphasize functional compliance at the expense of the user's affective and emotional journey. This research interrogates the nexus between objective usability determinants specifically Task Completion Time (TCT), Success Rate (SR), and Error Frequency (EF) and the nuanced dimensions of perceived User Experience (UX), namely Comfort, Trust, and Satisfaction. Employing a concurrent mixed-methods triangulation design. We evaluated 40 participants with diverse visual and motor impairments as they engaged with both "compliance-oriented" and "user-centric" accessible interfaces. Empirical findings reveal a pronounced "Accessibility Gap": high levels of objective task success frequently failed to predict commensurate levels of user trust or psychological comfort. These results suggest that technical adherence alone is an insufficient proxy for true inclusivity. Consequently, this study advocates for a paradigm shift in accessible web development, proposing an integrated emotional-performance model that harmonizes rigorous technical standards with the qualitative human experience.

Keywords-- Web Accessibility, User Experience (UX), Human-Computer Interaction, Objective Metrics, Affective Computing, WCAG.

I. INTRODUCTION

The contemporary digital landscape is undergoing a fundamental transformation, where inclusivity is no longer a peripheral consideration but a core architectural mandate. Nevertheless, conventional approaches to accessible web design remain largely reductive, frequently treating accessibility as a binary checklist of technical specifications rather than a multifaceted, holistic user experience (Dritsas et al., 2025). While contemporary automated auditing tools are proficient at validating deterministic elements such as ARIA landmarks, color contrast ratios, and syntactical compliance, they possess an inherent inability to capture the qualitative nuances of the human journey. Such tools cannot quantify the cumulative cognitive friction experienced when navigating redundant architectures, nor can they gauge the erosion of user trust that occurs when screen readers encounter syntactically valid but semantically incoherent data structures.

Consequently, a critical scholarly tension has emerged between **objective usability** the quantifiable efficiency of user actions and **perceived experience** the subjective emotional state of the user. Despite the proliferation of accessibility standards, there remains a dearth of empirical research exploring the correlation (or lack thereof) between performance-based success and the psychological dimensions of comfort and trust. This paper seeks to address this significant research gap by deploying a robust mixed-methods evaluation. By triangulating performance-based metrics with affective user feedback, this study provides critical insights into how the implementation of accessibility protocols influences not only the functional efficiency of the interface but also the profound emotional equilibrium of the user.

II. RELATED WORK

2.1 The Compliance-Usability Paradox

Traditional accessibility research has been anchored in the validation of the Web Content Accessibility Guidelines (WCAG). Studies by Azofeifa et al. (2022) emphasize that while technical adherence significantly improves the crawlability of websites by Assistive Technologies (AT), it does not inherently guarantee a streamlined user experience. The compliance-usability paradox suggests that a site can be 100% accessible according to automated scanners while remaining functionally unusable for a human agent due to poor information architecture.

2.2 Objective Metrics in Assistive Interaction

The evaluation of accessible interfaces has historically relied on deterministic metrics. Jagnade et al. (2023) demonstrated that Task Completion Time (TCT) and Error Frequency (EF) are vital for benchmarking the efficiency of multimodal inputs, such as voice and eye-tracking. However, these metrics often treat the user as a rational actor, ignoring the cognitive and emotional noise generated by complex interfaces. Research in multimodal surveying highlights that while performance can be optimized through algorithmic fusion, the user's perception of the system's intelligence is often detached from their actual speed of task execution (Dritsas et al., 2025).

2.3 The Affective Dimension of Accessibility

Recent shifts in HCI have begun to acknowledge the emotional tax of disability. Coutray et al. (2025) explored how hybrid interfaces (e.g., EEG and eye-tracking) affect hands-free interaction, noting that user Trust and Comfort are highly sensitive to system latency and unpredictable feedback. Despite this, the literature remains fragmented; studies either focus on high-level emotional satisfaction (UX) or low-level performance data (Usability), but rarely do they synthesize the two into a single evaluative framework.

III. THE RESEARCH GAP

Despite the maturation of web accessibility standards, a critical **Affective-Performance Gap** persists in current HCI literature:

1. *Metric Siloing*: Current research tends to bifurcate objective usability (TCT, EF) and perceived UX (Trust, Satisfaction). There is a lack of empirical data explaining the mathematical relationship between these two domains in the context of accessibility.
2. *Neglect of Trust as a Metric*: While ‘Success Rate’ is a standard metric, ‘Trust’ is rarely measured as a core accessibility outcome. Current models fail to address how a technically successful task can still result in a loss of user trust due to confusing semantic structures.
3. *The Contextual Weight of Comfort*: There is insufficient evidence on how **Comfort** acts as a mediator between accessibility and long-term user retention. Most studies provide point-in-time evaluations rather than understanding the cumulative fatigue (cognitive load) of navigating compliant but complex designs.
4. *Absence of Mixed-Method Synthesis*: Most journals focus on either large-scale quantitative data or small-scale qualitative interviews. There is a specific gap for a **triangulated approach** that uses qualitative insights to explain the **why** behind anomalous performance data in accessible web design.

IV. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

4.1 Objective Usability in Accessibility

Objective usability is traditionally defined by efficiency and effectiveness. Metrics such as Task Completion Time (TCT) and Error Frequency (EF) are the standard for evaluating assistive technology (AT) compatibility (Azofeifa et al., 2022).

Research suggests that while WCAG compliance reduces EF, it does not inherently optimize TCT, often leading to compliant but cumbersome interfaces (Jagnade et al., 2023).

4.2 Perceived User Experience (UX)

Perceived UX moves beyond the functional to the phenomenological. In the context of accessibility, Comfort relates to the lack of physical or cognitive strain, Trust refers to the user’s confidence that the system will behave predictably and Satisfaction is the overarching emotional response to the interaction (Coutray et al., 2025).

V. METHODOLOGY

5.1 Research Design

This study utilizes a **mixed-methods concurrent triangulation design**. Quantitative data provides the what (performance), while qualitative data provides the why (emotional context).

5.2 Participants

A cohort of 50 participants was recruited, divided into two groups:

1. *Group A*: Users with visual impairments (primary screen-reader users).
2. *Group B*: Users with motor impairments (primary switch or voice-control users).

5.3 Evaluation Metrics

Table 1.0: Showing metrics and tools

Category	Metric	Tool/Instrument
Objective	Task Completion Time (TCT)	Logged via Screen Recording
	Success Rate (SR)	Binary (Pass/Fail)
	Error Frequency (EF)	Count of Wrong-way clicks/commands
Perceived	Comfort & Satisfaction	System Usability Scale (SUS)
	Trust	Trust in Automated Systems Scale (modified)
Qualitative	Emotional Insights	Semi-structured Interviews

VI. RESULTS AND DISCUSSION

6.1 The Correlation Paradox

Preliminary data analysis reveals a moderate correlation ($r = 0.52$) between Success Rate and Satisfaction. However, a significant divergence was noted in Task Completion Time and Trust. Users often completed tasks successfully but reported low trust and high discomfort due to the cognitive noise created by excessive navigational elements.

The site is technically correct, but it feels like walking through a maze where every wall is labeled. I'm successful, but I'm exhausted. *Participant 12 (Screen-reader user).*

6.2 Accessibility As An Emotional Driver

The findings suggest that accessibility features act as Hygiene Factors. Their absence causes immediate dissatisfaction and distrust, but their presence if implemented purely for compliance does not linearly increase comfort. True satisfaction is only achieved when the interface minimizes the tax on the user's working memory (Dritsas et al., 2025).

6.3 Analysis Of Objective Performance Vs. Perceived Experience

Table 2.0: Physical Metrics & Emotional Responses Divergence

Modality/ Interface Type	Task Completi on Time (TCT)	Error Frequen cy (EF)	Perceived Comfort (1-10)	User Trust (1-10)	Satisfac tion (SUS Score)
Standard (Compliance- focused)	142.5s	1.2	4.2	5.1	62.5
Optimized (UX- focused)	98.2s	0.8	8.7	9.0	88.4
Variance/ Significance	-31%	-33%	+107%	+76%	+41%

The table above illustrates the divergence between physical metrics and emotional responses. Data is aggregated from the Precision Navigation task, comparing a Standard Accessible Interface (strictly WCAG compliant) with an Optimized Experience Interface (user-centric design).

Key Insights from the Data

- *The Efficiency-Comfort Disconnect:* While the Optimized interface reduced TCT by 31%, it more than doubled the **Perceived Comfort** score. This suggests that even minor technical optimizations in accessibility (e.g., reducing tab-trap navigation) have a disproportionately large impact on the user's emotional well-being compared to their actual speed.
- *The Trust Threshold:* Trust scores in the Standard interface remained low (5.1/10) despite a relatively low Error Frequency (1.2). Participants noted that while they *could* complete the task, the lack of clear landmarks made them constantly double-check if they were on the right page, leading to high cognitive anxiety (Dritsas et al., 2025).
- *Satisfaction vs. Success:* A high Success Rate (95% across both groups) did not translate to high Satisfaction in the Standard group. This confirms that for users with disabilities, success is often equated with "survival" in a difficult digital environment, whereas satisfaction requires an interface that respects the user's time and effort (Azofeifa et al., 2022).

Statistical Correlation Analysis

A Pearson correlation (r) was calculated to determine the strength of the relationship between TCT and Satisfaction:

- *Standard Interface:* $r = -0.34$ (Weak correlation). Speed did not make the experience much better.
- *Optimized Interface:* $r = -0.82$ (Strong correlation). In a well-designed system, speed is a direct proxy for a "seamless" and "trustworthy" experience.

Discussion of the Cognitive Tax

The qualitative feedback suggests that participants using the Standard interface experienced a **Cognitive Tax** is a mental exhaustion caused by deciphering technical accessibility features that were not intuitive. As noted by Jagnade et al. (2023), when a system provides too much redundant auditory feedback (e.g., announcing every div or container), the user's **Trust** diminishes because the system feels "noisy" and "unrefined."

In contrast, the Optimized interface utilized Contextual Silence and Semantic Prioritization, leading to the observed 76% increase in Trust. Users felt the system was "aware" of their needs rather than just following a rulebook.

VII. DESIGN RECOMMENDATIONS FOR EMOTIONAL ACCESSIBILITY

To move beyond technical compliance and toward a high-trust, low-strain user experience, the following evidence-based design patterns are recommended:

7.1 Prioritize Semantic Hierarchies Over Technical Coverage

Technical compliance often leads to over-tagging, where every element is described, creating a high cognitive load for screen-reader users.

- *Recommendation:* Implement Semantic Prioritization. Instead of labeling every container, use ARIA landmarks to define High-Value Zones (e.g., search, checkout, and primary navigation).
- *Impact:* Reduces Cognitive Tax and increases Perceived Comfort by allowing users to skip redundant information (Jagnade et al., 2023).

7.2 Implement Contextual Silence

Constant auditory or haptic feedback can lead to sensory overload, which negatively impacts Trust and Satisfaction.

- *Recommendation:* Apply the principle of Contextual Silence. Non-interactive elements or decorative graphics should remain truly silent unless they provide critical context for the task.
- *Impact:* Improves Trust scores, as the system appears more intelligent and less noisy (Dritsas et al., 2025).

7.3 Design for Predictive Consistency

The discrepancy between a 95% Success Rate and low Trust often stems from unpredictable interface behavior.

- *Recommendation:* Ensure Modal Consistency. If a voice command works for a Submit button on one page, it must function identically across all pages. Unexpected changes in interaction logic are the primary drivers of user anxiety.
- *Impact:* Directly correlates with higher User Trust (1-10) ratings and reduces the need for users to double-check their actions (Azofeifa et al., 2022).

VIII. SUMMARY OF CONTRIBUTIONS

This study contributes a novel Integrated Evaluation Framework for accessible web design, as summarized in the comparison below:

Table 3.0: Comparison between Traditional Approach & Proposed Emotional-Performance Model

Traditional Approach	Proposed Emotional-Performance Model
Focus: Technical Compliance (WCAG)	Focus: User Trust and Comfort
Success Metric: Binary Pass/Fail	Success Metric: Satisfaction + Effort Score
Testing: Automated Scanners	Testing: Mixed-Method Human Evaluation
Outcome: Functional Accessibility	Outcome: Empowering User Experience

IX. CONCLUSION AND IMPLICATIONS

The future of Human-Computer Interaction lies in interfaces that are not only usable but lovable. By measuring Perceived User Experience alongside Objective Metrics, designers can create digital spaces that do not just accommodate disabilities but actively foster a sense of autonomy and dignity for all users.

This study demonstrates that objective metrics alone are insufficient for validating accessible design. A website can be 100% WCAG compliant while remaining an emotional burden to the user.

Research Strengths: By bringing in a mixed-method approach, this work provides a framework for Emotional Accessibility. We propose that developers must measure the Cost of Interaction a hybrid metric combining TCT with a Perceived Effort Score to truly understand the user's journey.

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