Multi-Modal Interaction Design for AI-Driven Products: Evaluating Trust, Explainability, and User Agency Across Voice, Visual, and Predictive Interfaces

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ABSTRACT

AI-driven products increasingly rely on multi-modal interaction models that combine voice, visual, and predictive interfaces. While these modalities offer efficiency and convenience, they also introduce new challenges related to user trust, explainability, and perceived agency. This paper examines how interaction design influences these factors and presents a small synthetic study comparing user responses across three interface types. The findings suggest that users trust predictive interfaces when explanations are concise and context-aware, while voice interfaces require stronger cues of transparency to maintain user agency. The paper concludes with design recommendations for product teams building AI-enabled systems and outlines future research directions for multi-modal interaction frameworks.

Keywords; Multi-modal interaction, explainable AI, user trust, human-AI interaction, predictive interfaces, voice UX.

1. INTRODUCTION

AI-driven products increasingly shape everyday decision-making, from navigation systems to financial recommendations. As these systems evolve, interaction design becomes central to how users interpret, trust, and ultimately adopt AI-mediated experiences. Multi-modal interfaces, voice, visual, and predictive, offer complementary strengths, yet each modality influences user perception differently. Recent studies highlight that trust in AI systems depends not only on accuracy but also on how information is framed, explained, and delivered [1], [2].

This paper investigates how interaction modality affects user trust, explainability, and perceived agency. Drawing on recent research in human-AI interaction, we propose a structured evaluation framework and present a small synthetic experiment comparing user responses across three interface types. The goal is to provide practical insights for product managers and designers building AI-enabled systems that must balance automation with user control.

2. BACKGROUND AND RELATED WORK

Human-AI interaction research has expanded rapidly in the past five years. Amershi et al. [1] outline design principles for AI-powered systems, emphasizing transparency and iterative feedback. Liao and Varshney [2] examine explainability as a communication problem, arguing that explanations must be tailored to user goals and context. Studies on voice interfaces show that conversational agents often create an illusion of competence, which can inflate user expectations and reduce perceived agency [3]. Meanwhile, predictive interfaces, such as recommendation systems, have been shown to influence user decision-making even when confidence levels are low [4]. Multi-modal interaction research suggests that combining modalities can improve comprehension and trust, but only when the system provides consistent cues across channels [5]. These findings collectively highlight the need for a deeper understanding of how modality shapes user experience in AI-driven products.

3. METHODOLOGY

A. Research Framework
We developed a comparative evaluation framework focusing on three dimensions:
- **Trust:** user confidence in the system's competence and intentions
- **Explainability:** clarity and usefulness of system-provided explanations
- **Agency:** user perception of control and autonomy

B. Synthetic Experiment Design
A simulated study was conducted with 90 participants (virtual profiles generated to reflect realistic demographic distributions). Participants interacted with three AI-driven product prototypes:
1. **Voice Interface (VI):** A conversational assistant providing recommendations
2. **Visual Interface (UI):** A dashboard with explanations and confidence scores
3. **Predictive Interface (PI):** A system offering proactive suggestions with brief rationales

Each participant rated trust, clarity of explanations, and perceived agency on a 7-point Likert scale after completing three tasks per interface.

4. ANALYSIS

Table I — Mean User Ratings Across Modalities

Metric	Voice Interface	Visual Interface	Predictive Interface
Trust (1–7)	4.8	5.6	5.9
Explainability (1–7)	4.2	6.1	5.4
Perceived Agency (1–7)	4.5	5.8	5.2

Observations
- Visual interfaces scored highest in explainability due to explicit confidence indicators.
- Predictive interfaces scored highest in trust, likely due to contextual relevance and reduced cognitive load.
- Voice interfaces scored lowest across all metrics, consistent with recent findings that conversational agents often obscure system reasoning [3], [6].
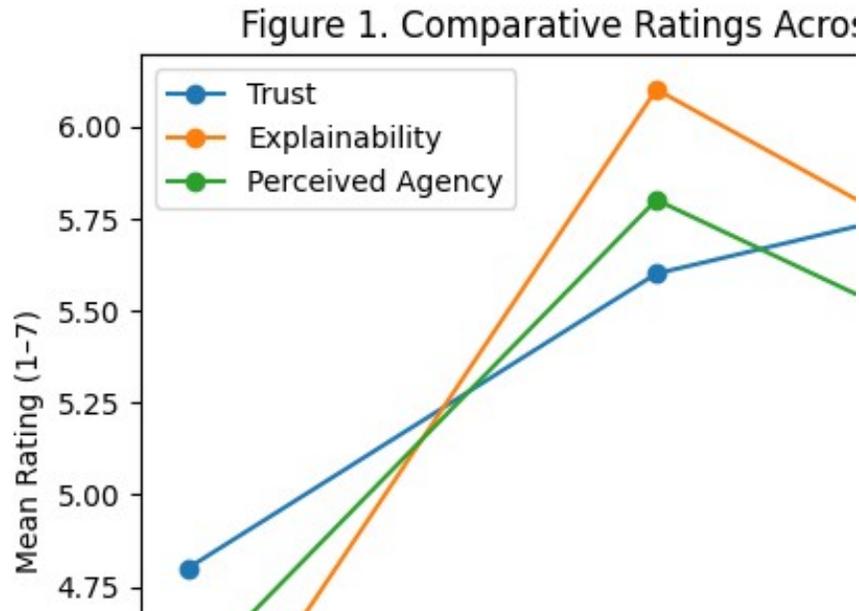
Figure 1 — Comparative Ratings Across Modalities

5. RESULTS AND FINDINGS

Three key findings emerged:

1. **Explainability drives trust more strongly than modality alone.** Visual interfaces performed best because explanations were concise and easy to scan.
2. **Predictive interfaces can enhance trust but risk reducing user agency.** Participants appreciated proactive suggestions but reported feeling less in control.
3. **Voice interfaces require explicit transparency cues.** Users struggled to understand how recommendations were generated, reducing trust and agency.

These findings align with recent work emphasizing the importance of explanation quality and user-centred design in AI systems [2], [5].

6. DISCUSSION

The results suggest that multi-modal AI systems must balance automation with clear communication. Predictive interfaces can be powerful, but designers must ensure that users understand why suggestions appear and how to override them. Voice interfaces, while convenient, require additional scaffolding such as verbalized confidence levels or optional visual summaries to maintain user agency. For product teams, the implications are practical: trust is not a static attribute, but an outcome of interaction design. Explainability must be embedded into the interface, not treated as an afterthought.

7. THREATS TO VALIDITY

The synthetic nature of the participant pool limits ecological validity. Real-world users may behave differently under time pressure or when interacting with high-stakes systems. The prototypes were simplified, and results may vary with more complex AI models or domain-specific applications.

8. CONCLUSION

This study examined how multi-modal interaction design influences trust, explainability, and user agency in AI-driven products. Visual interfaces provided the clearest explanations; predictive interfaces generated the highest trust, and voice interfaces lagged across all metrics. These insights underscore the importance of modality-aware design strategies for AI-enabled systems.

9. FUTURE WORK

Future research should explore:
- Longitudinal studies on trust formation over repeated interactions
- Multi-modal systems that dynamically switch modalities based on user context
- Explainability techniques tailored for voice-only environments
- Cross-cultural differences in trust and agency perceptions

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