User Eye Gaze Behavior Study for Healthcare Chatbots

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1 Introduction

2 Background

The purpose of this study is underscored by findings from diverse fields such as psychology, human-computer interaction (HCI), and eye tracking, highlighting the necessity of integrating theories and principles from these interconnected domains to enhance the design and functionality of AI healthcare chatbots. The following section will present a literature review of key findings that contextualize and illuminate the significance and primary objectives of this research.

2.1 Media Richness Theory

Media Richness Theory (MRT) was developed by Daft, Lengel, and Trevino (Daft and Lengel, 1983, 1986; Daft et al., 1987), and it posits that the efficiency of communication is influenced by the suitability of the medium and the nature of the communication task. The theory defines media richness as an objective property characterized by the ability to facilitate shared understanding within a given time frame, as rich (i.e., lean) communication enables this understanding more effectively. The objectivity of richness of the media can be evaluated based on four criteria: (1) capacity for immediate feedback, allowing for quick consensus; (2) ability to transmit multiple cues, including verbal and non-verbal signals; (3) use of natural language, which conveys broader concepts compared to numerical data; and (4) personal focus, which allows for emotional expression and tailoring to the receiver's needs (Daft and Lengel (1983); Daft et al. (1987)). Research by Rohit et al. (2024) applied MRT to human-AI interaction studies, demonstrating nuanced effects of "voicebots" versus chatbots, as well as the roles of product categories and localization levels on user engagement in online retail. It highlights that while voicebots enhance cognitive and affective engagement, particularly with experiential products, chatbots excel in cognitive tasks but slightly lag in emotional connection (Rohit et al. (2024)). The findings emphasize the strategic importance of tailoring virtual assistant

interfaces to align with specific engagement goals and product characteristics to optimize user interactions. While the findings of Rohit et al. (2024) can apply to MRT's (2) criteria (i.e., ability to transmit multiple cues, including verbal and non-verbal signals), research that integrates other aspects of MRT within the field of human-AI interaction—such as the varying communication styles of text-based chatbots, which relate to criteria (3) and (4)— remains nascent.

2.2 Importance of Improving MRT

By establishing a framework to evaluate human-AI interactions with chatbots, we can explore other aspects of established theories that can enhance Media Richness Theory (MRT) and improve the overall communication effectiveness of chatbots. One such theory is Social Presence Theory (SPT), which posits that the degree of presence individuals feel during communication significantly influences their engagement and interaction quality (Short et al. (1976)). Specifically, SPT emphasizes that media conveying emotional warmth and fostering interpersonal connections lead to deeper engagement (Short et al. (1976)), and this has been applied in the field of HCI, with one study demonstrating that matching the synthesized voice personality to user personality positively affects feelings of social presence, particularly among extroverted users (Lee and Nass (2003)). This study's findings indicated that users experience a stronger sense of social presence when the personality of the synthesized voice aligns with the personality of the textual content. Past studies have even applied it to the field of human-AI interaction, revealing that text-based chatbots with human-like characteristics significantly enhance customer trust, purchase intention, word-of-mouth, and overall satisfaction during interactions (Konya-Baumbach et al. (2023)). Notably, social presence emerged as a key mediating factor in these relationships, underscoring its critical role in fostering effective customer-chatbot engagements, regardless of the shopping context or the sensitivity of the information disclosed (Konya-Baumbach et al. (2023)). Such findings are significant because they can be used to inform the design of chatbots that can effectively convey information to users. Moreover, according to SPT, a higher sense of social presence enhances user engagement, potentially influencing eye gaze patterns. Users may maintain eye contact longer with interfaces that feel more engaging, which could result in extended gaze durations on a chatbot's varied responses, potentially varying based on the communication style employed.

2.3 Connecting Eye Gaze to MRT and SPT

Past research employing eye-tracking methods has shown that chatbots with more anthropomorphic features foster greater user engagement, with one study reporting higher fixation counts and prolonged gaze durations on interfaces exhibiting these characteristics (Jiahao Chen and Ham (2024)). This finding suggests that when chatbots exhibit higher levels of social presence through anthropomorphic design, users not only feel more engaged but also direct their visual focus more intensely on the chatbots, aligning with the principles of Me-

dia Richness Theory (MRT). Additionally, in a study examining how a chatbot impacts the use and effectiveness of electronic health record patient portals, participants in the text-based chatbot condition spent the least amount of time searching for information, while video conditions resulted in significantly longer search times (Yin and Neyens (2024)). The presentation format also influenced total fixations and fixation duration, with fewer fixations and shorter durations in text conditions compared to video (Yin and Neyens (2024)). Eye gaze fixations can be understood through the lens of Engagement Theory (Kearsley and Shneiderman (1998); Shneiderman et al. (1995)), which emphasizes the role of interactive and collaborative environment to foster deep user engagement for learning and interacting with chatbots. According to this framework, users are more likely to immerse themselves in chatbot content when the engagement is rich and interactive (Kearsley and Shneiderman (1998); Shneiderman et al. (1995)). SPT supports this notion by suggesting that environments promoting social presence enhance user immersion. This may manifest in prolonged eye gaze on relevant information, as users allocate their visual attention more intensively during interactions with virtual assistants in highly engaging contexts.

2.4 Designing Human-AI Interactions for Increased Effectiveness in Educational Contexts

When designing chatbots, particularly for educational purposes (i.e., healthcare chatbots), designing them so that they maintain users' attention is essential to increase the chatbot's overall effectiveness. While past research has demonstrated that eye gaze has been used in chatbot research (Jiahao Chen and Ham (2024); Yin and Neyens (2024)), there is still limited understanding of how to design these interactions to enhance varying outcome measures of user experience (e.g., usability, trust, effectiveness, social presence). As chatbots become more prevalent in daily life, it will be increasingly important to investigate how gaze behavior varies with different information presentation styles. Future research could offer valuable insights by applying Flow Theory, or "optimal experience theory," to improve human-chatbot interactions in educational contexts . Flow Theory emphasizes that improving user engagement—through clear goals, appropriate challenges, and minimizing distractions—can help users achieve a state of flow, where they are fully immersed and deeply focused (Csikszentmihalyi (2000)). In chatbot interactions, enhancing engagement by creating an interactive and immersive environment can foster this flow state (Csikszentmihalyi (2000)), leading to better user experience and more meaningful interactions. By integrating principles from Media Richness Theory, Social Presence Theory, and Flow Theory, chatbot design can significantly enhance user engagement, ultimately improving its effectiveness. Combining these theoretical foundations to examine user eye gaze behavior in healthcare chatbots represents a novel approach, which can be leveraged to create more interactive and personalized experiences. This, in turn, can sustain user attention, foster immersion, and ultimately improve learning outcomes in educational chatbot contexts.

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