UNIVERSITY OF CAMBRIDGE
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CONSTRUCTION ENGINEERING MASTERS DISSERTATION ABSTRACT

Using biofeedback to identify and capture client experiences during the early design evaluation stage

Communication is at the core of the architectural work and effective communication between designer and client during the early design stage is critical for project success. Failure in communicating, or misunderstandings, often result in schedule delays, cost overruns and quality issues and can negatively impact customer satisfaction. In an attempt to support effective communication, designers utilise a variety of visualisation methods including 2D drawings, physical models, 3D digital models and extended reality (XR). While these methods enrich designers' ability to communicate complex spatial ideas, client feedback is still based on subjective verbal communication, which relies on the stakeholder articulation skills and inherently introduces semantics gaps. The use of multimodal biofeedback to transform the implicit client experience to an explicit output was explored in this research to overcome the limitation of the current communication process, reduce ambiguity and gain objective insight into the client experience and preferences.

The research deployed a mixed-methods experimental design with quantitative experiment as the primary component and semi-structured interviews as supplemental qualitative data. Participants went through a 3D virtual reality experience of an office space, with six design variations for the office windows as the only design change. A set of synchronised non-invasive biometric sensors continuously monitored participant brain activity and eye movements while they were experiencing the virtual environment. Following the session, participants rated the design alternatives from most to least preferred and provided information about their experience in a contextual semi-structured interview. The synchronised output was used to identify a correlation between participant brainwaves activity and preferences while the eye-tracking provided the visual context. Analysis of the results showed that brainwaves patterns help identify meaningful experiences as well as indicate user preferences concerning design alternatives. A significant difference in brainwaves activity was measured while participants experienced the most-preferred and least-preferred designs compared to the other design variations. Additionally, a faster brain response was measured when subjects experienced their least-preferred compared to their most-preferred design. The qualitative analysis results were integrated into the findings and provided insight into the triggers for participants' brainwaves activity.

The results suggest that the use of biofeedback can provide insight into client experience, reduce the dependency on verbal feedback and inform designers about stakeholders' preferences by transforming implicit experiences to an explicit output. This dissertation introduces an objective, quantitative method to support designer client communication and design decisions. Additionally, this research lays the foundation for the use of a neuroarchitecture approach and enables an experience-driven design process.

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