THE COGNITIONS AND EMOTIONS IN HUMAN-AI COLLABORATIONS

STATEMENT OF RESEARCH PROJECT

This proposal seeks to investigate a fundamental research question: How do different forms of AI-generated instructions, verbalized and visualized, affect human cognition, emotion, and task performance in collaborative diagnostic settings, and under what conditions do these effects promote or hinder effective human-AI collaboration?

The objective of this research is threefold. First, it systematically examined the role of verbalized instructions provided by AI systems. We distinguish between inductive (specific, task-focused) and deductive (abstract, exploratory) instructions, theorizing that they influence cognitive load, attention, and diagnostic performance differently. While inductive instructions may simplify complex tasks and reduce uncertainty through step-by-step guidance, deductive instructions may encourage deeper analytical engagement but also increase ambiguity and confusion among users. By exploring this distinction, we intend to identify the conditions under which each type of instruction facilitates more effective human–AI collaboration.

Second, this project investigates how visual illustrations in augmented reality (AR) environments shape human responses to AI instructions. Building on instructional design and dual-coding theory, we differentiate between schematic illustrations (simplified representations highlighting key task components) and structural illustrations (detailed depictions of visible and hidden elements). We posit that schematic illustrations, when paired with inductive instructions, enhance comprehension and efficiency by fostering heuristic, task-focused processing. In contrast, structural illustrations combined with deductive instructions may encourage more analytic processing, improving problem-solving depth at the cost of efficiency. We aim to identify how visual-verbal consistency supports or disrupts collaboration between humans and AI.

Third, the research explores the cognitive and emotional mechanisms underlying human–AI collaboration. Specifically, we focus on cognitive effort (the attentional resources required to process AI instructions) and confused emotions (affective responses to ambiguity or inconsistency in instructions). Using both behavioral data (task completion rates, efficiency, and effectiveness) and physiological measures (eye-tracking, facial expression analysis, and galvanic skin response), we sought to uncover how these mechanisms mediate the relationship between AI instruction types and human performance. By incorporating emotional and metacognitive dimensions, this project moves beyond performance outcomes to explain why certain human-AI collaborations succeed or fail.

In sum, this research addresses several interrelated questions:

1. How do inductive and deductive AI-generated instructions shape human cognitive processing, emotions, and diagnostic outcomes?
2. How do schematic and structural visualizations in AR environments moderate the effects of different types of instruction?
3. What cognitive and emotional mechanisms explain the impact of instruction-visualization combinations on collaboration effectiveness?
4. How do variations in AI verbalization styles (e.g., robotic vs. humanoid voices) further shape human responses to AI instructions?

By addressing these questions, this project will generate actionable insights into the design of AI systems that foster productive, trustworthy, and emotionally sustainable collaborations. The findings will contribute theoretically to the literature on instructional design, human-AI interaction, and information systems, while offering practical guidance for organizations adopting AI to enhance learning, diagnosis, and decision-making in a digital environment.

SCOPE OF WORK FOR SELECTED PHD STUDENT

The PhD student will play a central role in investigating the cognitive and emotional dynamics of human-AI collaboration, focusing on instructional design and augmented reality (AR) applications. The scope of the work is structured as a four-year program, ensuring steady progress from theoretical grounding to empirical studies and finally to scholarly dissemination.

<u>Year 1: Theoretical Foundations and Research Design</u>
In the first year, the student will focus on building a strong foundation in relevant literature, including instructional design, dual-coding theory, cognitive psychology, and human-AI collaboration. This phase will involve conducting a comprehensive literature review and refining the conceptual framework that integrates verbalized instruction, visual illustrations, and synthetic verbalization styles. The student will also develop detailed research questions and hypotheses aligned with the project's objectives.

<u>Year 2: Execution of Experiment 1</u>
During the second year, the student will conduct Experiment 1, a 2 (verbalized instructions: inductive vs. deductive) × 2 (visual illustrations: schematic vs. structural) factorial design. They will be responsible for recruiting participants, conducting pilot sessions, administering the main study, and collecting data on diagnostic task completion. Particular emphasis will be placed on refining manipulation checks and ensuring the robustness of an AR-based experimental environment. The student will analyze the results, interpreting the findings in light of dual-coding and instructional design theories. The outcomes of Experiment 1 are expected to yield at least one conference paper submission, providing an early opportunity to present and receive feedback from the academic community on the proposed model.

<u>Year 3: Execution of Experiment 2 and Mechanism Testing</u>
In the third year, the student will expand the research by implementing Experiment 2, which introduces synthetic verbalization styles (robotic vs. humanoid) and incorporates physiological and cognitive measures, such as eye-tracking, galvanic skin response (GSR), and facial expression analysis. The student will oversee the integration of these methods to capture cognitive effort and confused emotions as mediating variables in human-AI collaboration. Data analysis will involve advanced modeling techniques, including mediation and moderation analyses, to uncover the mechanisms linking instruction-visualization combinations to performance outcomes. This year will also focus on producing draft journal articles targeting leading outlets such as Information Systems Research and MIS Quarterly.

<u>Year 4: Integration, Writing, and Dissemination</u>
The final year will focus on synthesizing the findings from both experiments to form a cohesive dissertation. The student will write dissertation chapters highlighting theoretical contributions to information systems, instructional design, and human-AI collaboration research. Multiple journal submissions will be finalized, with at least one article under review at a premier journal. The student will also present the findings at top international conferences (e.g., ICIS, PACIS, HICSS) to strengthen academic visibility. Additionally,

efforts will be made to produce practitioner-oriented summaries that disseminate actionable insights to organizations adopting AI-enabled collaboration tools. By the end of this year, the student will have built a strong academic portfolio, positioning them for a competitive career in academia.