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## 1 Research interests

My research interest lies in the realm of **social interactive agents**, specifically in the development of **social agents for positively influencing human psychological states**. This interdisciplinary field merges elements of artificial intelligence, psychology, and human-computer interaction. My work integrates psychological theories with dialogue system technologies, including rule-based systems and large language models (LLMs). The core aim of my work is to leverage these systems to promote mental well-being and enhance user experiences in various contexts.

### 1.1 Social agent for psychological well-being

A significant focus of this research was designing dialogue systems that interact with users in ways that support their psychological well-being. In my master's thesis, I developed a social interactive robot aimed at reducing student anxiety during oral tests (Baihaqi, 2023). This study involved comparing different types of agent interactions that promote a positive psychological state by delivering certain dialogue such as small talk against a control group where the agent exhibited flat, robotic behavior. The triggers for delivering such dialogue were based on the similarity score of the student's answer to the answer key. In addition, I measured the students' anxiety levels during oral tests with a human examiner to provide a comprehensive comparison.

This study evaluated anxiety levels using subjective reports, behavioral observations, and physiological measures. Subjective reports were collected through structured questionnaires, behavioral observations were made by annotating recorded videos, and physiological states were assessed using self-designed measurement devices.

I have also undertaken several efforts in this field, including proposing a robot demonstration method to introduce social robotics to university students (Baihaqi and Xu, 2024), conducting a literature review on the practical applications of small robots as social robots and fuzzy techniques (Baihaqi and Xu, 2022a,c), explor-

ing the emotion classification technique (Baihaqi et al., 2023), and designing customer service robot interactions in shopping malls using the seven stages of action (Baihaqi and Xu, 2022b).

### 1.2 Human-agent rapport

Currently, my doctoral research focuses on human-agent rapport, specifically exploring rapport-building dialogue strategies for multimodal dialogue agents (Baihaqi et al., 2024). Rapport refers to a warm and effortless connection marked by mutual comprehension, acknowledgment, and sympathetic harmony among individuals (VandenBos, 2007). It ensures team members' sustained interest, involvement, and contentment, which eventually improves work results. Existing research highlights the vital role of rapport in enhancing task outcomes across various applications, such as healthcare (Johanson et al., 2020), tutoring (Sinha and Cassell, 2015), food services (Lee et al., 2012), and clinical interviews (Gratch et al., 2014).

Our research introduced a rapport-building dialogue strategy by integrating rapport-building utterances into the small talk with a virtual agent which was gathered from various successful existing studies of human-human rapport-building such as storytelling and praise expression. By integrating these curated utterances, our aim was to leverage the benefits of each utterance to diversify and enrich the agent's responses, ultimately enhancing the rapport between humans and agents.

The rapport-building dialogue strategy was embedded into the agent with two distinct strategies, free-form and predefined dialogue strategies. In the free-form strategy, the virtual agent gained the advantage of fostering a more natural and dynamic conversation, allowing users to express themselves authentically. This approach offered flexibility and adaptability, enhancing user engagement by responding to unique cues. However, drawbacks included potential inconsistency and missed opportunities for strategic rapport-building across many sessions. On the other hand, predefined elicitation ensured consistency and goal alignment but led to a more rigid and less personalized dialogue.

The effectiveness of these strategies was assessed through questionnaires examining rapport scores and user experiences. Additionally, we are examining confounding factors such as total turn count and utterance length to understand their impact on rapport.

## 2 Spoken dialogue system (SDS) research

For the future of SDS research, I agree with the statements by Mattar et al. (2012). While the research on task-oriented SDS is well-developed, limiting SDS to task-oriented interactions is not sufficient and can negatively affect user experiences. Enhancing non-task-oriented dialogue systems is essential, as these systems engage users in trivial conversations, increasing engagement and satisfaction before crucial or main conversations. Remembering the importance of it, in the future, non-task-oriented dialogue system research is expected to become a trend.

In line with the growing importance of non-task-oriented dialogue, leveraging psychological theories will become a common strategy to achieve meaningful interactions. By incorporating these theories, SDS can exhibit more favorable behaviors, resulting in natural and relatable dialogue. However, implementing some theories will require a deep understanding of human utterances and non-verbal cues to discern implicit meanings, thereby increasing the demand for recognition techniques. For instance, recognizing when a human is not actively engaged in the conversation allows the agent to provide appropriate backchanneling behaviors. Instead of simply instructing the participant to pay attention, these behaviors may include employing psychological theories such as clarification, followed by reflective and active listening strategies. This approach may enhance the user experience, fostering connection between users and dialogue systems.

Last, unlike task-oriented dialogue that can be evaluated through computable metrics, non-task-oriented dialogue systems typically require human participants to evaluate performance. However, there is a growing discussion on utilizing LLMs to evaluate SDS. This method can possibly accelerate development through continuous feedback, reduce human evaluator biases, and save cost and time. It helps establish benchmarks and standards in SDS development. I believe this type of research will be a trend for the next five years.

## 3 Suggested topics for discussion

- **Implementing psychological theory to SDS:** Implementing psychological theory into SDS has primarily relied on rule-based methods and prompting LLMs. An alternative approach involves conducting human-human dialogue experiments and using the resulting dialogue corpus to train the language

model. This enables the agent to adopt desired behaviors based on psychological principles. However, it requires a high cost and time to experiment and annotate. Is there a possible novel method to further integrate psychological theory with a language model?

- **Assessing human-agent rapport without human evaluation:** Currently, assessing rapport between humans and agents primarily relies on human evaluations through questionnaires. Some research has moved beyond questionnaires by observing specific behavioral patterns of participants. However, human evaluation is often questioned by reviewers for its subjectivity, generalization, and reliability. Is it possible to evaluate an SDS's ability to cultivate rapport using computable metrics, without relying on human evaluation?
- **Conducting SDS evaluation using other SDSs:** Evaluating SDS, especially for non-task-oriented SDS typically involves human interaction and feedback, which can be time-consuming and costly. Nowadays, there is a growing discussion about using other SDSs for evaluation purposes. As a result, there is also a growing debate about how closely the agent can replicate the human responses. Is it possible to build SDSs that can accurately represent human responses by incorporating diverse human personas?

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## Biographical sketch



**Muhammad Yeza Baihaqi** earned his B.Eng. degree from President University in 2020, where he was recognized as the top graduate in Electrical Engineering. Subsequently, he completed his M.Sc. degree in the Graduate Institute of Automation and Control at the National Taiwan University of Science and Technology in 2023, receiving accolades as an Outstanding Student in the College of Engineering. Currently, he is pursuing his Ph.D. in Information Sciences at the Nara Institute of Science and Technology. His research interests include social interactive agents and dialogue systems for psychological well-being.