



UMEÅ UNIVERSITET

# Breakdown Situations in Dialogues Between Humans and Socially Intelligent Agents

**Maitreyee Tewari**

## Akademisk avhandling

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Fakultetsopponent: Professor Olov Engwall,  
Institutionen för intelligenta system, avd. Tal, musik och  
hörsel vid Kungliga Tekniska Högskolan, Stockholm,  
Sweden.

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**Author**  
Maitreyee Tewari

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### **Abstract**

Dialogues between humans are complex due to the challenges in predicting how they will unfold as people may want to achieve different purposes. For instance, to act together, they co-create a common goal; to learn, they co-create knowledge; to build relationships, they share emotions and beliefs. Apart from different purposes, people may want to achieve multiple purposes in a dialogue, introducing a movement between goals. Such actions cause problems in understanding and conflicts among the participants. Activity Theory denotes such situations as breakdown situations, which also occur when people have dialogues with software agents driven by Artificial Intelligence (AI). This thesis falls within the domain of human-centred AI, focusing on software agents able to collaborate and support people to achieve their goals. We call these software agents socially intelligent agents.

This thesis has two aims: (1) to develop an increased understanding of breakdown situations in dialogues between humans and socially intelligent agents and (2) to develop computational frameworks based on the developed understanding to manage breakdown situations, which could be embedded in an agent's cognitive architecture.

The main contributions addressing the first aim were theory-driven analysis and empirical findings that provided increased knowledge of breakdown situations, resulting in design implications and future agendas guiding the subsequent research. The results informed the three strategies to manage breakdown situations by aligning, partially aligning or not aligning with human's intentions. To address the second aim, two novel computational frameworks were provided. Based on linguistics and social sciences theories the frameworks allowed an agent to interpret the dialogue's syntax, semantics, and social aspects, facilitating a deeper understanding of dialogues. Finally, a novel computational framework was developed to reason about conflicts and be able to plan by adopting the strategy of aligning with the human's intentions. We conceptualised a cognitive architecture based on our research findings. The cognitive architecture embeds mechanisms for socially intelligent agents to manage breakdown situations in dialogues with humans.

### **Keywords**

Dialogues, Breakdown Situations, Focus Shift, Human-Centric Artificial Intelligence, Engeström's Activity Triangle, We-Intention, Argumentation-Based Dialogues, Grice's Cooperative Principle, Communicative Functions, Wizard-of-Oz, User Studies, Thematic Analysis, Sequence Organisation.

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