Affective Motivational Collaboration Theory

by

Mahni Shayganfar - mshayganfar@wpi.edu

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Approved

Professor Charles Rich, Thesis Advisor

Professor Candace L. Sidner, Thesis Co-Advisor

Professor John E. Laird, Thesis Committee Member

Professor Stacy Marsella, Thesis Committee Member

ABSTRACT

Abstract Here!

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CHAPTER 1

INTRODUCTION

1.1 Motivation

1.2 Thesis Statement and Scope

In this thesis, we develop and validate a framework based on *Affective Motivational Collaboration Theory* which can improve the effectiveness of collaboration between agents/robots and humans. This thesis is established based on the reciprocal influence of collaboration structure and the appraisal processes in a dyadic collaboration. We focus only on two-participant collaboration; teamwork collaboration is out of our scope. Furthermore, this work focuses on a) the influence of emotion-regulated processes on the collaboration structure, and b) prediction of the observable behaviors of the other during a collaborative interaction.

We describe the cognitive processes involved in a collaboration in the context of a cognitive architecture. There are several well-developed cognitive architectures, e.g., Soar [4] and ACT-R [3], each with different approaches to defining the basic cognitive and perceptual operations. There have also been efforts to integrate affect into these architectures [1, 5]. In general, however, these cognitive architectures do not focus on processes to specifically produce emotion-regulated goal-driven collaborative behaviors. At the same time, existing collaboration theories, e.g., SharedPlans [2] theory, focus on describing the structure of a collaboration in terms of fundamental mental states, e.g., mutual beliefs or joint intentions. However, they do not describe

the associated processes, their relationships, and influences on each other. *Affective Motivational Collaboration Theory* deals with some of the major affect-driven processes having an impact on the collaboration structure. This theory is informed by research in psychology and artificial intelligence which is reviewed in Chapter 2. Our contribution, generally speaking, is to synthesize prior work on appraisal and collaboration, and motivation thus to provide a new theory which describes some of the prominent emotion-regulated goal-driven phenomena in a dyadic collaboration.

1.3 Contributions

Throughout this work we aim to show how a robot can leverage emotion-driven processes using appraisal algorithms to improve collaboration with humans. As such, in this thesis work, we introduce a novel framework, called Affective Motivational Collaboration (AMC) framework, which allows a robotic agent to collaborate with humans incooperating the underlying emotion-driven processes and the expressed emotion of human collaborator. Such a framework is built based on computational models of collaboration and appraisal allowing for task-driven interaction with robots or other agents. The theoretical foundation, computational models and algorithms as well as the overall framework, and the end-to-end evaluation of the framwork make the following contributions:

1. **Introducing *Affective Motivational Collaboration Theory*:**

   (Chapter 3) As mentioned earlier, since the theoretical foundation of AMC framework is built on the combination of SharedPlans theory of collaboration [2] and cognitive appraisal theory of emotions [cite], one of the contributions of our work is to introduce theoretical concepts incorporating key notions of both theories in a dyadic collaboration context. Applying cognitive appraisal theory in the collaboration context is novel. Other models of the appraisal theory have not paid attention to the dynamics of the collaboration.

2. **Developing new computational models and algorithms for *Affective Motivational Collaboration Framework*:**

   (Chapter 4) Another contributions of our work is to create computational models and algorithms to compute the value of appraisal variables in a dyadic collaboration. We have also developed a new algorithm for the emotion-driven goal management in the context of collaboration. Goal management is one of the important functions of emotions during collaboration. Existing models and implementations of emotions focus only on how emotions regulate and control internal processes and sometimes behaviors. This part of our work shows how appraisal components of the self and the human collaborator contributes to the goal management as an emotion function.

3. **Developing a computational framework based on *Affective Motivational Collaboration Theory*:**

   (Chapter 5) In order to evaluate our computational models and algorithms within an interaction with human collaborators, we have developed a computational framework based on our theoretical foundations in Affective Motivational Collaboration Theory. Our computational framework implements the key concepts related to *Affective Motivational Collaboration Theory* as well as minimal implementation of other processes which are required for validation of the model but are not part of this thesis contributions. The emphasis of the model is on underlying cognitive processes embracing collaboration and appraisal concepts, rather than the Perception and the Action mechanisms.

4. **Validating *Affective Motivational Collaboration Theory:***

   (Chapters 4 and 6) We have conducted two user studies a) to validate our appraisal algorithms before further development of our frmaework, and b) to investigate the overall functionality of our framework within an end-to-end system evaluation with human subjects and a robot. The second user study

was also conducted to evaluate the benefit of using our computational framework in human-robot collaboration. In the first user study, we crowd sourced our questionnaires to test our hypothesis that humans and our algorithms will provide similar answers to questions related to different factors within our appraisal algorithms. In the second user study, we investigated the importance of emotional awareness in human-robot collaboration, and the overall functionality of the AMC framework with the participants in our study environment.

CHAPTER 2

BACKGROUND AND RELATED WORK

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4.5 Results and Evaluation

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CHAPTER 6

IMPROVING HUMAN-ROBOT COLLABORATION LATEX ERROR: THERE'S NO LINE HERE TO ENDSEE THE LATEX MANUAL OR LATEX COMPANION FOR EXPLANATION.YOUR COMMAND WAS IGNORED.TYPE I ¡COMMAND¿ ¡RETURN¿ TO REPLACE IT WITH ANOTHER COMMAND,OR ¡RETURN¿ TO CONTINUE WITHOUT IT.

= *

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APPENDIX A