A Multi-issue Negotiation Model of Trust Formation through Concern Alignment in Conversations

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1 Introduction

'Concern Alignment in Conversations' project aims to investigate the relationship between rational agreement seeking and affective trust management through conversations. The project conducts both empirical analyses of real-life conversation data that involve both agreement and trust, e.g., various types of consultation conversations, including medical domain dialogues, and computational modeling of the processes connecting agreement seeking and trust management taking place behind those conversational exchanges.

Our guiding idea in the project is the notion of *'concern alignment'*, that aims to schematically capture conversational processes from the perspective of consensus-building and trust formation (Katagiri et al., 2011; Katagiri et al., 2012).

2 Trust through conversation

Dialogue provides a central mechanism with which to negotiate a consensus among ourselves in daily interactions. Consensus can be conceived as a formation of shared commitment on certain choice of future joint actions by a group of people (Clark, 1996). These actions are often mutually conditional on each other for their successes, and hence, consensus-building has invariably involve some form of management of affective trust relationships between conversational participants. We identify 'trust' as a type of mental states that enables us to form, even lacking sufficient support, presumptive expectations on other agents' choice of actions, and to choose our own actions based on those presumptions.

3 Concern alignment

We conceptualize dialogue consensus decision-making processes as consisting of two functional parts, concern alignment and joint plan construction, as shown in Figure 1. When a group of people engage in a conversation to find a joint course of actions among themselves on certain objectives (*issues*), they start by expressing what they deem relevant on the properties and criteria on the actions to be settled on (*concerns*). When they find that sufficient level of alignment of their concerns is attained, they proceed to propose and negotiate on concrete choice of actions (*proposals*) to form a joint action plan.

We have been iteratively developing a set of dialogue acts (Allen and Core, 1997; Bunt, 2006) for concern alignment through annotating real-life consultation conversations and refining the dialogue act set.

4 Analysis of concern alignment

Figure 2 shows an annotation example of a part of a medical obesity counseling dialogue session. The analysis captures the process of concern alignment in which the nurse A tries to identify all the possible concerns related to the smoking behavior the patient B by both her own concern introduc-
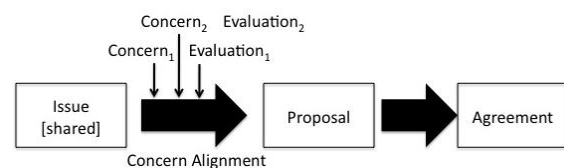

Figure 1: A schematic diagram of the concern alignment process in consensus-building dialogues.

A-B:	C-solicit:	(what makes you want to smoke)		
A-B:	C-introduce:	(when offered)	$\Rightarrow$	C-eval/negative:(do not smoke even when offered)
A-B:	C-introduce:	(with somebody smoking)	$\Rightarrow$	C-eval/positive: (sometimes I will)
A-B:	C-introduce:	(feel impatient)	$\Rightarrow$	C-eval/positive: (I do smoke when I feel impatient)
A-B:	C-introduce:	(with tea or coffee)		
B-A:	C-introduce:	(when drinking)		

$\Downarrow$

A-B:	P-solicit:	(when with somebody smoking?)
B-A:	P-introduce:	(will leave the place)
A-B:	P-solicit:	(when you feel impatient?)
B-A:	P-introduce:	(can manage if I have something in my mouth)
A-B:	P-elaborate:	(how about e-cigar?)
B-A:	P-reject:	(tried but failed)
A-B:	P-introduce:	(how about stop-smoking pipe?)
B-A:	P-accept:	(I've wanted to try)
A-B:	P-solicit:	(when drinking?)
B-A:	P-introduce:	(the same [stop-smoking pipe])

Figure 2: An example analysis of sequential organization of concern/proposal exchanges.

Participant A					Participant B			
issue	weight	estimate	align		align	estimate	issue	weight
$Concern_1$	u_1^A						$Concern_1$	u_1^B
$Concern_2$	u_2^A						$Concern_2$	u_2^B
$\vdots$	$\vdots$	$\hat{u_i^B}$	w_i^A	$\Longleftrightarrow$	w_i^B	$\hat{u_i^A}$	$\vdots$	$\vdots$
$Concern_i$	u_i^A						$Concern_i$	u_i^B
$\vdots$	$\vdots$						$\vdots$	$\vdots$
$Concern_n$	u_n^A						$Concern_n$	u_n^B

Figure 3: Concern alignment as multi-issue negotiation

tion and elicitation from the patient. A then tries to draw out proposals from B to refrain from smoking for each and all of the concerns raised.

5   Trust through multi-issue negotiation

Multi-issue negotiation: We have been exploring several models to capture and describe the conversational processes of concern alignment in computational terms, including the one based on the idea of multi-issue negotiation (Traum et al., 2008). Assuming that conversational participants A, B have their own utility u_i^A, u_i^B for each of the issues $Concern_i$ (Figure 3). The process of concern exchange in concern alignment for a participant A can be modeled by the process of estimating the utility structure on multiple issues $\hat{u_i^B}$ of your interlocutor B through the exchange of information on their own utility structures u_i^A and u_i^B.

Joint utility maximization: In the phase of negotiation on joint action proposals, participants have to weigh the utility structure of their interlocutors by the weight w_i against their own utilities. Participants then propose a joint action which maximizes the combined utilities. Alignment in this phase can be captured as the adjustment of

alignment weight w_i.

Trust as parameters for joint utility: Under this concern alignment as multi-issue negotiation picture, trust can be conceived to correspond to parameters for joint utility computations. Once the process of concern alignment succeeds in obtaining a mutually satisfactory consensus, parameters such as interlocutor utility structure estimate $\hat{u_i}$ and alignment weight w_i can be utilized in later consensus-building negotiations. This accumulation of parameter values through a successful concern alignment history constitutes one's trust in others in the sense that it provides the basis in forming reasonable expectations on the interlocutor behavior choices in succeeding interaction sessions.

Acknowledgments

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