

Modelling Conflict Dynamics in Dyadic Interactions

Extended Abstract

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ABSTRACT

Change is at the core of conflict resolution. Conflicts provoke changes in other people's behaviours, beliefs or goals, and changes influence the state of conflict between the parties, making it a dynamic process over time. In this paper, we present a model of conflict based on aspiration dynamics and a satisfying heuristic, which incorporates the agent's sensitivity to conflict. As such, agents are able to detect conflict and have a choice to act pro-socially.

KEYWORDS

Conflict Dynamics; Socially Intelligent Agents; Conflict Detection

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1 INTRODUCTION AND RELATED WORK

Many theories of conflict establish the *incompatibility of goals* as the fundamental premise behind observations of conflict between dyads [8]. Whether conflicts are about divergences/incompatibilities in needs, desires, intentions, plans, norms, duties or orders, conflicts are about (interdependence of) *Goals* [4, 6]. Yet, two interdependent people (or agents) are not in conflict just by having opposed goals. Tomasello [21], argues that people naturally cooperate to reduce competition and harmonise goals with their interaction partner. Thus, to conflict be observed, some breakdown in cooperation must occur. Some *change* in the world, such as communication with other agent, one's actions or inactions, transforms one's perception of the situation. When a party's choice (either cooperative or competitive) causes some sort of *deprivation*, of valuable outcomes, on the counterpart, conflict has potential to *emerge* and *be experienced*. Such view of conflict shapes it as an idiosyncratic dynamic process that is fueled by how one appraises a situation [3].

In AI, in the context of rich social simulations, representing conflict realistically is important. To create prototypes of conflict episodes, researchers have modelled conflict as specific blocks in the system along with a set of guidelines to generate and manage conflict [3, 10, 13, 19]. Others modelled the relationship between the agents in a story driven game, by varying the levels of cooperation based on a set of fixed variables [23]. Also, in the work of Ware and Young [22] conflict is defined as a threat or an interference to the agent's plan and they attempt to represent a wide range of

conflicts, both intra and interpersonal. In contrast, in our work, we explore a more general mechanism to model conflict from the inside out, i.e., based on the internal state of the agent, to be generalized across dynamic scenarios. We take a stance that the process of *change* and *movement*, characterized by choices, is central to *conflict dynamics*, such that *conflict potential* influences change, which in turn, influences conflict outcomes [12].

2 A MODEL OF CONFLICT DYNAMICS

We approach the challenge of complexity of conflict modelling by incorporating in the agent decision-making process three notions: *goals*, *aspiration dynamics* and *potential for conflict*. *Goals* work as a driving system that motivate the agent to act and are a principled way of representing a person's preferences [1], ordered by the goals' *value* [5]. We use the schematics of the TKI framework [20] – an influential taxonomy – to represent a *goal's value* (see Fig. 1) in a 2-D space (*Other*, *Self*), describing how much one cares about the interacting party (*Other*) and how much one cares about itself (*Self*), in varying degrees.

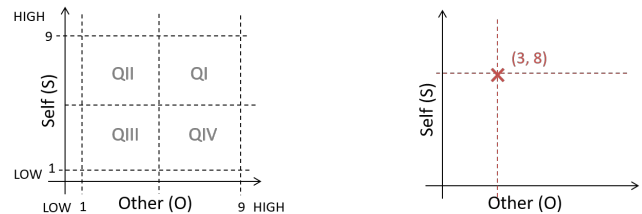


Figure 1: A goal's value in terms of preferences for *Other*(O) and *Self*(S). A goal's value given by (3,8) means that for a goal g_i the agent values more itself than the interacting party. According to TKI, QI, QII, QIII, QIV map to inclinations to collaborate, compete, neglect and accommodate, respectively.

When an interaction between two agents starts, the exchange of cooperative and competitive moves may create/increase/decrease what we call **Conflict Potential** (CP). We characterize CP as a dependent function (see Eq. 1 and Fig. 2) on *exploitation* and *deprivation* throughout an interaction, that is, it depends on cooperation level ($CoopL \in \mathbb{R}$). In this modulation we consider that $CP \in]0, 1[$ and it is defined by the piece-wise function¹ in Eq. 1.

Note that individuals vary in terms of how they experience conflict and may have different views on how an action impacts

¹The rationale behind the choice of the function $\cosh^2(x)$ is due to $\lim_{CoopL \rightarrow \infty} \cosh^2(x) = 0$, encapsulating the meaning that *Conflict Potential* approaches its minimum when *Cooperation Level* increases. Also the function $f(\beta)$ normalizes the values of β to $[0, 1]$ and the function $g(\beta)$ applies a transformation to create more distinct curves as in Fig. 2.

the *CP* in an interaction. β in Eq. 1 simulates that **sensitivity to conflict**. β is a *goal's value* in one of the dimensions (*Self* or *Other*), because we consider that *CP* can be experienced in two directions: **a)** CP_{Self} , when one feels exploited and **b)** CP_{Other} , when one feels he is exploiting the other.

$$CP = \begin{cases} \frac{f(\beta)}{\cosh^2(g(\beta) \times CoopL)} & , CoopL > 0 \\ f(\beta) & , CoopL \leq 0 \end{cases} \quad (1)$$

At each timestep the agent evaluates the *Conflict Potential* of a situation, which may affect the agent's motivation to change its strategy and the magnitude of that change. Take two agents, A and B, who are interdependent and with one incompatible goal, G_1 (each agent has an *initial aspiration level* toward that goal). The *value* of G_1 for A and B is (S_A, O_A) and (S_B, O_B) , respectively. Anecdotal evidence suggests that agent A's willingness to change its aspirations about G_1 will depend on how it feels about agent B, i.e., on how much *CP* agents A and B are injecting in the interaction. According to Marcus' terminology [12] we establish that:

Motivation to Change (or *Driving Force*) is a stochastic process given CP_{Other} . CP_{Other} depends on $\beta (= O)$ and the one's own *CoopL*. That is, the higher agent A's estimate of CP_{Other} the higher the probability of updating its aspirations.

Retreat Function (or *Restraining Force*) is a deterministic function that applies a downward adaptation on the agent's current aspiration level based on how much *CP* one is experiencing (CP_{Self}). CP_{Self} depends on $\beta (= S)$ and the other's *CoopL*.

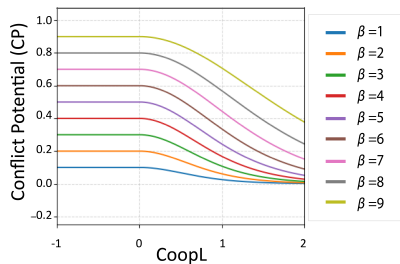


Figure 2: Marginal distribution that gives an expectation of *conflict potential* (*CP*) given the *CoopL* in a interaction. β represents the sensitivity of the agent toward *CoopL*.

Agent A's aspiration level at time t (α_t) is adapted with probability $P(X < CP_{Other})$ and suffers no change ($\alpha_t = \alpha_{t-1}$) when $P(X \geq CP_{Other})$, for some random variable $X \in [0, 1]$. The process unfolds as described in Eq. 2. The factor that drives adaptation is $\lambda (= CP_{Self})$. The higher the λ in Eq. 2 the lower the retreat force (downward adaptation). This implies that the more an agent feels exploited (high CP_{Self}) the less the agent is willing to change/adapt. Note that both computations of *CP* depend on assessments of levels of cooperation. When computing CP_{Other} agent A is more certain of its own *CoopL*. In cases, of incomplete information agent A can only estimate the other's cooperation level. *CoopL* estimation is *context dependent* and uncertain. The aspiration adaptation process unfolds until the agent is satisfied or one of them decides to

stop interacting. At each time step the agent selects the action that matches its current *aspiration level*.

$$\alpha_t(X) = \begin{cases} \lambda \alpha_{t-1} + (1 - \lambda) \pi_{t-1} & P(X < CP_{Other}) \\ \alpha_{t-1} & P(X \geq CP_{Other}) \end{cases} \quad (2)$$

Aspiration adaptation in Eq. 2 describes a process where individuals search for satisfying solutions. Strong evidence that people make decisions based on this search for *good enough* solutions was presented by Rosenfeld and Kraus [16]. They claim that using this perspective of bounded rationality can help to create more realistic agents that can simulate humans' behaviour. *Aspiration Adaptation Theory* (AAT) attempts to model this search process. AAT [17, 18] assumes that people rarely adhere to fully rational behaviour and are not always able to find the optimal solution to a problem. Later, Karandikar et al. [11] propose the incorporation of exogenous variables (or social processes) in the aspiration adaptation process, which is given by: $\alpha_t = \lambda \alpha_{t-1} + (1 - \lambda) \pi_{t-1}$.

3 CONFLICT DETECTION

In this model, conflict does not occur in a specific point in time, nor is an overt manifestation that something is wrong. Instead, we say that **conflict potential** is continuously monitored, by assessing CP_{Other} (this is inspired from findings in [2]). At the same time, the agent may also experience some deprivation or exploitation reflected in CP_{Self} . These two estimates are a benchmark of tolerance or dissatisfaction felt by the agents. The tolerance or dissatisfaction level is mediated by β , which encapsulates personal characteristics of the interacting agents themselves and their relationship. Thus, throughout an interaction, action choice is dependent on the **conflict level** in the interaction. The dynamic aspiration adaptation (in Eq. 2) works as a non-strategic conflict management mechanism that makes the agents cooperate² and eventually converge to a solution [7, 9, 14, 15]. A preliminary evaluation showed that dyadic interactions between different initializations of the model generate distinct behaviours that map to the behaviours described in conflict management literature.

4 CONCLUSION

We described a mechanism to model conflict dynamics as a value-sensitive decision-making. The agents combine an interpersonal perspective based on the TKI-model to anticipate conflict potential, which is influenced by one's own gains and the other's gains. However, contrarily to the static models that represent an orientation to solve conflicts, we consider that the agent's preferences are dynamic, based on its sensitivity to detect conflicts. The model for conflict dynamics incorporates reactivity and anticipation in a satisfying heuristic. The mechanism relies on self-evaluation only, and does not require any additional information about the surrounding environment (strategy and pay-off structure of the partners). This allow us to address conflict as an intrapersonal phenomenon that may have interpersonal effects. Furthermore, it creates a mechanism to analyse situations myopically accepting the fact that people do not always make utility-maximizing decisions [1].

²Although this aspiration adaptation mechanism makes the aspiration level decrease monotonically, the agents actions may not seem cooperative.

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