Social Actions and Influences: An extended abstract

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1 INTRODUCTION

We strive to engineer agent-based systems with a high level of independence for agents yet allow indirect control over agents by manipulating social influences. Social actions such as a call for help or a delegation action produce social influences. Social factors are inter-related and an initial social influence due to a social action often produces secondary influences. We are designing agents whose actions are guided by social values and norms as well as a set of relationships among the agent's social parameters. Elsewhere, we have discussed social influences over autonomy and this work generalizes that to other social influences [1, 2, 3, 4, 5].

Social action might be an action by one agent toward another, a mutual action of two agents, or a bilateral action by two agents. For simplicity, we limit our attention to the actions that commonly cause the influence as actions over the following notions: Help, Permission, Delegation, Service, and Resources. Help is an action performed to aid someone in her task and it might be provided, withheld, requested, or rejected. Common actions over Permission are to request, to grant, to deny, and to withdraw. Delegation might be issued, accepted, or rejected. Service is an action but unlike help that is pro-active, it is usually passive. Service should be requested. It might be given or denied. Resources might be requested, offered, rejected, taken away, or prevented.

Let's refer to the set of social actions as A. Social influences can be in several dimensions including the following: dependence, autonomy, control, power, and obligation. Let's refer to the set of influences as I. We define function f that maps the agent's current beliefs B, a set of currently active values V, a set N of currently active norms, and a set of social actions A to a set of influences I:

$$f: B \times V \times N \times A \rightarrow I.$$

An example is delegation of homework by a teacher to a student, which following norms of teacher-student relationships produce the influence of student obligation to carry out the homework.

We said that social influences might be in the context of norms and values. An agent might have several levels of such values and norms at any one time. Obligations to uphold the ultimate group intent are derived from corresponding values and norms at the global level. These obligations may compete against an agent's social influences at lower levels. Let's differentiate values and norms for an agent into n levels with level 1 being the highest (i.e., ultimate) and levels n being the lowest. Values and norms will be labeled with their level as values V_i and norms N_i. Let's redefine function f with f^i that maps an agent's set of beliefs B, a set of values V_i, a set of norms N_i, and a set of social actions A to a set of influences I^i:

$$f^i: B \times V_i \times N_i \times A \rightarrow I^i.$$

As designers of agent systems we can design mechanisms for encoding the desired ontological level to match the agent's responsibility level. This design-time responsibility encoding is a method that can be used to assure predictable agent behavior. If we design obligation categories (i.e., responsibilities within ontological levels for the agent), an agent might be directed to adopt specific obligations about certain tasks to perform on behalf of a chosen agent or the human user in case the agent interacts with a human. This will affect the agent's autonomy and control with respect to the agent (or the user). For example if the project is safety-critical, overall project goals (and corresponding values and norms) are given a higher ontological status in the agent.

Agents might experience simultaneous social actions that have influences at different value/norm levels. These influences will also have different magnitudes. At times there might be conflicts among these influences. The conflict might be within an agent or between agents. A simplistic conflict resolution for an agent is "if an influence at the highest level is conflicted with a lower level and the magnitudes of differences are sufficiently large, then choose the highest level." I.e., higher ones suppress the lower influences. When agents share ontological levels of values and norms, it is easy to see that they have a greater chance of harmony. Conflicts among such agents can also be resolved using our resolution rule. In this case, one agent might sacrifice its highest social influence for another's even higher social influence.

Overall missions can be guaranteed among agents who share the values pertaining to that mission if we specify certain social influence tolerances in agents. First, we can specify how much tolerance we allow for adverse social influences before reacting to them. Next, we can specify the threshold of deviation from other social influences for suppression of lower level social influences.[1] We can use this method to other levels of norms and values and

[1] Agents who share mission level values and norms might not share norms and values at lower levels.

produce similar guarantees at those levels. The notion of guarantee we introduce here differs from validation and verification.

In the second section of this abstract we outline the general relationships among social influences in an agent. In section 3 we suggest approaches to control agents and with it provide a sense of control over agent's actions. We then offer some concluding remarks.

2 SOCIAL INFLUNCES: THE BIG PICTURE

Agents that work together must reciprocate in order to reach equilibrium levels of sociality. This means agents must adjust their own social attitudes in order to experience a sense of fair exchange. Here we will briefly outline a few of the attitudes about relationships that help establish equilibrium. For each social attitude such as Autonomy we will introduce notations that help us refer to a quantity of (or degree of) that attitude. Since our statements apply to all social notions, instead of repeating, we will label the social attitude as ν, which is a member of the set of social notions {Autonomy, Control, Power, Obligation, Delegation, Dependence}. In this section we will introduce notations and state a number of useful definitions and conditions without any discussion.

Notation:

The maximum amount of ν the agent allows itself to tolerate is denoted by ν_{max}.

The minimum amount of ν the agent allows itself to experience is denoted by ν_{min}.

The amount of ν the agent actually experiencing is denoted by $\nu_{experiences}$.

The amount of ν the agent wishes to exert is denoted by ν_{exerts}.

The actual amount of ν the agent affects is denoted by $\nu_{accomplishes}$.

Condition 1: Upper and lower ranges of Autonomy and Control for any agent a are complimentary, $Autonomy_{max\text{-}a} = 1 - Control_{max\text{-}a}$ and $Autonomy_{min\text{-}a} = 1 - Control_{min\text{-}a}$

Condition 2: Autonomy and Control are complimentary, $Autonomy_{experiences} = 1 - Control_{experiences}$ and $Autonomy_{exerts} = 1 - Control_{exerts}$, and $Autonomy_{accomplishes}$

Condition 3: If agent a assumes an obligation (i.e., responsibility) for some action to agent b, then agent b has dependence on agent a for that action, $Obligation_{ab} \rightarrow Dependence_{ba}$ regarding an action.

Condition 4: If agent a delegates an action to agent b, then agent b has obligation (i.e., responsibility) to agent a for that action, $Delegation_{ab} \rightarrow Obligation_{ba}$ regarding an action.

Condition 5: If an agent b depends on an agent a or b delegates an action to a, then agent b's autonomy is diminished, $Dependence_{ba}$ or $Delegation_{ba} \rightarrow \Delta\text{-}Autonomy_{b}$.

Condition 6: If agent a depends on agent b for some action or a delegates an action to b, then agent b has power over agent a by that amount for that action, $Dependence_{ab}$ or $Delegation_{ab} \leftrightarrow \Delta{+}Power_{ba}$ regarding an action.

Condition 5: If an agent b depends on an agent a or b delegates an action to a, then agent b's autonomy is diminished. $Dependence_{ba}$ or $Delegation_{ba} \rightarrow \Delta\text{-}Autonomy_{b}$

Condition 6: If agent a depends on agent b for some action or a delegates an action to b, then agent b has power over agent a by that amount for that action, $Dependence_{ab}$ or $Delegation_{ab} \rightarrow \Delta{+}Power_{ba}$ regarding an action.

Condition 7: Changes in either Power or Control influence the other proportionately, $\Delta Power_{ab} \leftrightarrow \Delta Control_{ab}$.

Condition 8: Changes in either Delegation or Control influence the other proportionately and complimentarily. $\Delta Delegation_{ab} \leftrightarrow \Delta Control_{ba}$.

3 CONTROLLING AGENTS

It is conceivable to control agents indirectly by controlling only the social influences that are accessible. Here we sketch a few suggestions. Consider we have access to control. Imagine a sphere of social control between two agents in which one agent sets goals and monitors the other agent. Control can be designed to be in various levels, e.g., master-slave, supervisory, recommender levels. The tighter we set the control the more we can rely on the subordinate agent's behavior. The controlling agent is responsible for the behavior of the other agent. For a second suggestion, consider access to power. If two agents have a differential power relationship, they can affect one another's behavior. Command and control authority relationships are one example of establishing power relationships. By setting agent a in charge of agent b, a directly controls the actions of b. Setting obligations (i.e., responsibilities) for the agent is another alternative. An agent might be given specific obligations about certain tasks to perform on behalf of a chosen agent (or the human user in case the agent interacts with a human) and that affects its autonomy and control with respect to the agent (or the user). Value and norm adjustment is our fourth idea. Although this is the least direct method of controlling behavior, it can be used to design an agent who will uphold certain general principles, e.g., Azimov's three laws of robotics.

4 CONCLUSION

We suggest that social actions generate social influences and presented a few salient interdependencies among social influences. We sketched agents that can be designed to favor social influences that pertain to their highest level of norms and values. If agents shared norms and values, we can design agents that guarantee guarding against adverse social influences and suppression of social influences due to lower level norms and values. This gives us a practical methodology for implementing social responsibility.

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