The Revision of Intentions

José Martín Castro-Manzano

Instituto de Investigaciones Filosóficas
Universidad Nacional Autónoma de México
Circuito Mario de la Cueva s/n Ciudad Universitaria, 04510 Coyoacán, México
jmcmanzano@hotmail.com
http://www.filosoficas.unam.mx

Abstract. The change of beliefs on the basis of new information has been widely studied; however, the change of other mental states has received less attention, and particularly, intentions. Despite there are philosophical and formal theories about intentions, few of them consider the revision of intentions. We suggest introductory guidelines to define a research program for the revision of intentions regarding that: (i) intentions are intimately related to the beliefs and desires of agents immersed in a dynamic world; (ii) intentions are directly related to planning; and (iii) a reconsideration function is needed.

Key words: Intention, reconsideration, BDI, agents.

1   Introduction

Belief revision is a paradigmatic research program: it is a relatively new area of research that joins two disciplines: computer science and philosophy. Since programmers dealt with databases they faced the problem of updating their information. On the other hand, certain philosophers dealt with the change of information within epistemic structures. So, we can identify, respectively, two important moments in the history of this research program: one in [6]; and the other in [9] and in [12]. A general theory can be found in [1]. This last approach constitutes the core for any program of belief revision.

Thus, although the change of beliefs on the basis of new information has been widely studied with success during the last 25 years, the dynamic process of other mental states has received less attention, and particularly, intentions [10]. Certainly, there are philosophical and formal theories of intention [2], [3], [4], [5], [11], [13] but few of them, if any, consider the possibility of the revision of intentions [10].

We suggest some general and introductory guidelines in order to define a program for intention revision. We think this topic is important because *(i)* intentions are intimately related to the beliefs and desires of the agents immersed in a dynamic world; *(ii)* intentions are related directly with planning; and *(iii)* a function of reconsideration is needed.

The general background of this work assumes the theories of intention as represented by [2], [3], [4]; and the belief revision program as represented by [1].

2   Intention Revision

Intention revision should occur when a new piece of information that is inconsistent with the database of the agent is added to the system in such a way that the resulting system is inconsistent. But this change is not the only one that may occur, because depending on how intentions are represented and what intentions are accepted, different intentional changes are possible. We can distinguish four intentional changes, three of them similar to belief changes: expansion, revision, contraction and reconsideration. These processes are possible since intentions are pro-active, posses inertia and provide a filter of admissibility: intentions require a notion of commitment (given the principle of pro-activity), a notion of consistency (given the principle of admissibility) and a notion of retractability (given the notion of inertia). But moreover, since intentions are related to other mental states, such as beliefs and desires, and since no formal approach can solve the problems of revision by itself, we face some well defined methodological problems: the problem of representation (e.g., what language should we use to represent our data and is this language adequate to relate the BDI components within a context of revision?), the problem of the logical consequences (e.g., what is the relation between the facts of the agent's database and the elements that are infered?); and finally, there is the problem of the function of selection (e.g., what are the reasons that dictate which intentions have to be retracted?).

In previous works we have presented a logic to specify and verify properties of agents programmed in the agent oriented programming language *AgentSpeak(L)* [8], and we have related results about intentional learning with commitment and policy-based reconsideration [7]. We now suggest a research program for intention revision taking into acount such results. So, our methodological approach is based on three corners: the theoretical one is based on the BDI model of rational agency together with philosophical concepts from practical reasoning; the formal one is based on our previous research about specification and verification of properties together with the formal theories of revision and update; the third and final one is approached by way of an implementation of our theoretical and formal results in order to enrich our intentional theories. The idea is to create a loop between the theory and the implementation, in such a way that the theory will allow us to investigate the implementation and the implementation, in turn, will allow us to increase the explanatory power of our theory.

3   Preliminary results

So far we have proposed that agents can retract their intentions when such intentions present problems; and we have suggested that if an agent reconsiders an intention, such intention is abandoned or continued. Thus, we have shown that if an agent reconsiders, such agent is closer to rationality by following the intention-belief incompletness property and by avoiding the intention-belief inconsistency [2].

We have also proposed a basic set of postulates for reconsideration. The first postulate declares closure:

Postulate 1 *For any formula ϕ and any intentional set Σ, $\Sigma \otimes \phi$ is a intentional set.*

The second postulate guarantees success:

Postulate 2 $\phi \in \Sigma \otimes \phi$.

Reconsideration leads to revision [2] and contraction:

Postulate 3 $\Sigma \otimes \phi \subseteq \Sigma \odot \phi$.

Postulate 4 $\Sigma \otimes \phi \subseteq \Sigma \ominus \phi$.

The purpose of a reconsideration is to produce a new consistent intentional set:

Postulate 5 $\Sigma \otimes \phi = K_\perp$ *if and only if* $\vdash \neg \phi$.

We also require equivalence:

Postulate 6 *If* $\vdash \phi \Leftrightarrow \psi$, *then* $\Sigma \otimes \phi = \Sigma \otimes \psi$.

And we have found that:

Proposition 1 *The following statements hold:*

- *1. If an intention is reconsidered, then such intention is abandoned or continued.*
- *2. Inconsistency of reconsideration results from the inconsistency of intentions.*
- *3. Reconsidering a consistent set of intentions with the current intention does not remove any intention.*
- *4. Reconsideration implies expansion.*
- *5. Successful reconsideration produces an intentional set.*
- *6. Reconsideration is successful.*
- *7. Reconsideration implies intention-belief incompletness.*
- *8. Reconsideration avoids intention-belief inconsistency.*

4   Conclusions and Future Work

We are currently researching the formal properties of intention revision and, in doing this, we have considered intentions in an isolated way. This is indeed a problem, but is a necessary step nonetheless, since intentions are irreducible components of the BDI architecture [2]; however, such step is not sufficient: we have to relate the functions to other mental states through bridge rules between the BDI components [13] in order to specify the change of states given certain beliefs and intentions defined as plans. Finally, we have started to explore different approaches to design a set of $AgentSpeak(L)$ instructions capable of modelling our proposal.

4

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