



Formalizing the Interpretation of Actions Within a Logical Framework

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The interpretation of an action is a complex (psychological) process that nevertheless complies to some logical dynamics. To get a glimpse of them, just consider these two real-life examples. Assume that you see somebody drawing a ball from an urn containing black balls and white balls. If you believe there is no particular distribution in the urn then you would expect with equal probability that he draws a white ball or a black ball; but if you believe there are more black than white balls in the urn then you would expect with a higher probability that he draws a black ball rather than a white ball. We see in this example that your beliefs of the situation contribute actively to interpret the action: they determine the probability with which you would expect (or would have expected) the action to happen. But this expectation, determined by your beliefs of the situation, can often be balanced consciously or unconsciously by what you actually obtain by the pure observation of the action. For example, assume that you listen to a message of one of your colleagues on your answering machine which says that he will come to your office on Tuesday afternoon, but you cannot distinguish precisely due to some noise whether he said Tuesday or Thursday. From your beliefs about his schedule on Tuesday and Thursday, you would have expected him to say that he would come on Tuesday (if you believe he is busy on Thursday) or on Thursday (if you believe he is busy on Tuesday). But this expectation has to be balanced by what you actually perceive and distinguish from the message on the answering machine: you might also have a preference between having heard Tuesday or Thursday, which is independent of this expectation. Thus we see in these examples that in the process of interpreting an action, there is an interplay between two main informational components: your expectation of the action to happen and your pure perception of the action happening.

We provide a general logical framework extending Baltag et col's logic of update ([BMS04]) which allows to represent these patterns of real-life reasoning. In parallel we propose a formalism based on hyperreal numbers to accurately represent an agent's epistemic state. Infinitesimals are used to express what would surprise the agents (and by how much) by contradicting their beliefs. We also use a subjective probability to represent the notion of belief (whose revision satisfies the AGM postulates).

References

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