

Shared Scoreboards and Common Information

Anton Benz

Institut for Fogsprog, Kommunikation og Informationsvidenskab
Syddansk Universitet (Kolding)
benz@sitkom.sdu.dk

Abstract

Using a picture by Lewis, we call information structures that explicitly represent the dialogue participant's shared information '*scoreboards*'. The central claim is that we have to keep the aspect of common ground as a shared scoreboard that determines interpretations of dialogue contributions distinct from its aspect as mutually available information. We look at the following two conditions: If the shared scoreboard were a representation for common information, then (1) every dialogue participant would be licensed to add any proposition as soon as he/she has a proof that it is shared information. On the other side, (2) an interlocutor is not allowed to add a proposition as long as he/she does not know that it is also shared. We give arguments that both conditions can be violated.

1 Shared Information

David Lewis (1979) introduced the picture of a *scoreboard* to illustrate the role of the common ground in conversation. We can think of it as a shared board where all public activities and utterances are written down and thereby become *shared* facts about the dialogue. It provides the background against which to interpret new sentences, and forms the basis for expectations about behaviour of conversational partners.

Of course, a public scoreboard does not exist, and the common ground is generally identified with the proposition that represents the totality of information shared by dialogue participants. We distinguish two ways in which this information can be *shared*: As an explicit information structure or as the implicit common information. Depending on how we represent information, we may think of the common ground as a set of sentences or a set of possible worlds¹, where the first way is more in line with the scoreboard picture, and the second with the view of the common ground as implicit common information.

Both aspects play a different role in interaction: If you and I read a newspaper article about Nicole Kidman, and one of us refers to her with the description '*the actress*,' then we both have to *know* about each other what we have read in order to be sure that we both interpret the description in the same way. This is different from cases where coordination works without explicit representation of knowledge of others: The fact that all drivers drive on the right side of the street guarantees that no crashes occur. They have common information that they succeed in this aim but they don't need to have explicit *knowledge* about this, or about each other.

A need for an explicit representation of shared information is obvious for implemented dialogue systems. The standard definition for common knowledge reads as follows: a proposition φ is *common knowledge* for two interlocutors A and B

¹(Fagin et al., 1995; Meyer & v. d. Hoek, 1995; Hintikka, 1962)

iff φ is true, if A and B know that φ is true, if A and B know that A and B know that φ is true, if A and B know that A and B know that A and B know that φ is true, etc... If we read here *know that* as *has information that*, then we arrive at the intended definition of *common information*.

2 Coordination of Interpretation

The differences between explicit and implicit representations are mainly discussed in the literature with respect to *fine grainedness* and the problem of *logical omniscience*². We concentrate here on their different roles in coordinating interpretation. One of the central tasks of dialogue participants is to make sure that they both interpret dialogue contributions in the same way, or else misunderstandings will arise. The aspect of coordination becomes especially prominent in a dialogue theory as that of H.H. Clark (1996). He analysed dialogue predominantly in terms of joint projects, i.e. every contribution of the speaker is seen as part of an activity where he and the addressee must work together towards a joint goal. If interlocutors want to be sure that they have success, then they need common information that they coordinate their activities in the right way; but they don't need necessarily explicit representations of this information.

If the interpretations of utterances and updates of the common ground depend in a non-trivial way on private information, then the interlocutors may end up with different interpretations, and hence fail in their coordination task. This motivates a strong restriction on interpretations:

- (SP) The interpretation $[\varphi]$ of a phrase φ is totally determined by the phrase itself and the common scoreboards.

We call this the *scoreboard principle*. If we see scoreboards as representations for common information, then the following two principles should hold:

- (1) If an interlocutor knows that it is common information that a sentence φ is true, then he has to add φ to his scoreboard.

- (2) No dialogue participant is allowed to add a sentence φ at time t to his scoreboard unless there is common information that every participant knows that φ at time t .

We discuss a number of examples that show that the scoreboard principle (SP) can get into conflict with (1) and (2). The Muddy Children³ example shows that there are situations where (1) together with (SP) leads to miscommunication; i.e. there is a context in this example where there exists a sentence φ such that even if a participant can prove that it is common information that φ is true, he is not allowed to add φ to his scoreboard. This shows that the participants scoreboards may be *less* informative than common information. We discuss the Time Imprecision Problem⁴ in order to show that the participants scoreboards may also contain *more* information; i.e. there is a sentence φ that a dialogue participant has to add to his scoreboard at a time t although it is not common knowledge that φ at t . This violates principle (2).

Together these examples show that the content of shared scoreboards cannot be defined as a representation for common information. As all interlocutors have to maintain the same representations in order to coordinate their language use, the maintenance of identical scoreboards becomes itself a coordination task.

References

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²See (Fagin et al., 1995, Ch. 7) and (Meyer & v. d. Hoek, 1995, Ch. 2) for a discussion of various notions of knowledge and belief in modal approaches and the problem of logical omniscience.

³See e.g. (Fagin et al., 1995, p. 4).

⁴See (Fagin et al., 1995), Chapter 11, Section 11.2, and (Fagin et al., 1999).