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1. Introducing the Concept of Shared Belief

The importance of the notion of shared belief has been emphasized by philosophers, economists, sociologists, and psychologists at least since the 1960's (the earlier contributors include Schelling 1960, Scheff 1967, Lewis 1969, and Schiffer 1972). This article deals with the strongest kind of shared belief to be called *mutual belief*. While a belief can be shared in the trivial sense of two or more people having the same belief, mutual belief requires the kind of strong sharing which requires at least the participants' awareness (belief) of their similar belief. Mutual belief is one central kind of collective attitude, examples of others being collective intentions, wants, hopes and fears. Understandably, collective attitudes are central explanatory notions in the social sciences, as one of the tasks of these sciences is to study collective phenomena, including various forms of collective thinking and acting (see below for illustrations).

There is some special, additional interest in the notion of shared belief as mutual belief. First, mutual beliefs serve to characterize social or intersubjective existence in a sense that does not rely on the participants' making agreements or contracts. Thus, many social relations, properties, and events arguably involve mutual beliefs (cf. Lewis1969, Ruben 1985, Lagerspetz 1995, Tuomela 1995). As a simple example, think of the practice of two persons, A and B, shaking hands. It presupposes that A believes that B and A are shaking hands and that A also believes that B believes similarly; and B must believe analogously. Similarly, communication has been argued by many philosophers, especially Grice, to involve mutual belief (cf. Schiffer 1972, Grice 1989). Secondly, characterizations of many other collective attitudes in fact depend on the notion of mutual belief (cf. Balzer and Tuomela, 1997).

In social psychology and sociology theoreticians often speak about *consensus* instead of mutual belief. The notion of consensus - with the core meaning mutual belief - has been regarded as relevant to such topics as public opinion, values, mass action, norms, roles, communication, socialization, and group cohesion. It can also be mentioned that fads, fashions, crazes, religious movements, and many other related phenomena have been analyzed partly in terms of shared beliefs, consensus, shared consensus, mutual belief or some similar notions. As pointed out by the sociologist Scheff (1967), such analyses have often gone wrong because they have treated consensus merely as shared first-order belief. Thus, as Scheff argues, consensus as mere first-order agreement does not properly account for "pluralistic ignorance" (where people agree but do not realize it) and "false consensus" (where people mistakenly think that they agree). Scheff proposes an analysis in terms of levels of agreement corresponding to a hierarchy of so-called loop beliefs (e.g., in the case of two persons A and B, A believes that B believes that A believes that something p). As is easily seen, pluralistic ignorance and false consensus are second-level phenomena. The third level will have to be brought in when speaking about people's awareness of these phenomena. Other well known social psychological notions requiring more than shared belief are Mead's concept of "taking the role of the generalized other", Dewey's "interpenetration of perspectives", and Laing's metaperspectives (see, e.g., Scheff 1967).

There are two different conceptual-logical approaches to understanding the notion of mutual (or, to use an equivalent term, common) belief: 1) the *iterative* account and 2) the *reflexive* or *fixed point* account. According to the iterative account, mutual belief is assumed to mean iteratable beliefs or dispositions to believe (cf. Lewis, 1969, Chapter II, and, for the weaker account in terms of dispositions to come to believe, Tuomela 1995, Chapter 1). In the two-person case, mutual belief amounts to this according to the iterative account: A and B believe that p, A believes that B believes that p (and similarly for B), A believes that B believes that A believes that p (and similarly for B); and the iteration can continue as far as the situation demands. In the case of loop beliefs there is accordingly mutual awareness only in a somewhat rudimentary sense. As will be seen, in many cases one needs only two iterations for functionally adequate mutual belief: A and B believe that p and they also believe that they believe that p. However, there are other cases in which it may be needed to go higher up in the hierarchy.

The fixed point notion of mutual belief can be stated as follows: A and B mutually believe that p if and only if they believe that p and also believe that it is mutually believed by them that p. No iteration of beliefs is at least explicitly involved here. Correspondingly, a clear distinction can be made between the iterative or the level-account and the fixed point account (to be briefly commented on in Section 4.).

One can speak of the individual (or personal) mode and the group mode of having an attitude such as belief or intention. This article deals with the general notion of mutual belief, be it in the individual mode or in the group mode. Some remarks on the present distinction are anyhow appropriate here. The group mode sense, expressible by "We, as a group, believe that p", requires that the group in question is collectively committed to upholding its mutual belief or at least to keeping the members informed about whether it is or can be upheld. This contrast with mutual belief in an aggregative individual mode involving only personal commitments to the belief in question. When believing in the group mode sense group members are accordingly committed to a certain shared view of a topic and to group mode thoughts such as "We, as a group, believe that p". Group mode beliefs are central in the analysis of the kinds of beliefs that structured social groups such as organizations and states have. According to the "positional" account defended by Tuomela (1995) the group members authorized for belief or view formation collectively accept the views, which will qualify as the beliefs the group has. These views are group mode views accepted for the group and are strictly speaking acceptances of something as the group's views rather than beliefs in the strict sense.

2. Mutual Beliefs More Precisely Characterized

This section will be concerned with what mutual beliefs involve over and above plain shared beliefs, and the following section takes up the problem of how many layers of hierarchical beliefs are conceptually or psychologically needed. (The discussion below draws on the treatment in Tuomela 1984 and 1995.)

Consider now the iterative account starting with the case of two persons, A and B. Recall from Section 1 that according to the standard iterative account A and B mutually believe that p if and only if A believes that p, B believes that p, A believes that B believes that p (and similarly for B), A believes that B believes that A believes that p (and similarly for B), and so on, in principle *ad infinitum*. In the general case the account defines that it is mutually believed in a group, say G, that p if and only if a) everyone in G believes that p, b) everyone believes that everyone believes that p, c) everyone believes that everyone believes that everyone believes that p, and so on *ad infinitum.* The word "everyone" can of course be qualified if needed and made dependent on some special characteristics; e.g., it can be restricted to concern only every full-fledged, adequately informed, and suitably rational member of the group.

A major problem with the iterative account is that it seems in some cases it is psychologically realistic. It loads the people's minds with iterated beliefs which people, after all, do not experientially have and possibly, because of lack of rationality and memory, cannot have. Thus, the account

must be improved to make it better correspond to psychological reality. One way to go is to operate partly in terms of lack of disbelief. A person's lack of disbelief that p is defined as that it is not the case the person believes the negation of p. One can try to define mutual belief schematically by saying that it is mutually believed in G that p if and only if everyone believes that p, iterated n times, and from level n+1 on everyone lacks the disbelief that p. With n=2, viz. two levels actually present, this definition says that mutual belief amounts to everyone's believing that p and everyone's believing that everyone believes that p and that everyone lacks the disbelief that p from the second level on.

The basic reason for using this amended iterative approach is that no more levels of positive belief than people actually have should be required. Provided that the value of n can be established, the present account satisfies this. It must be assumed here that the agents in question are to some degree intelligent and rational as well as free from emotional and other disturbances so that they, for instance, do not lack a higher order belief when they really ought to have one in order to function optimally.

While the iterative account amended with the use of the notion of lack of disbelief seems viable for some purposes, an alternative analysis is worth mentioning. This analysis amends the original iterative account in that it requires iterative beliefs up to some level n and from that level on requires only the disposition to acquire higher order beliefs in appropriate conditions. These appropriate conditions, serving to determine the value of n, include both background conditions and more specific conditions needed for acquiring the belief in question. First, the agents in G must be assumed to be adequately informed and share both general cultural and group-specific information; especially they must have same standards of reasoning so that they are able to "work out the same conclusions" (see Lewis, 1969, Chapter II, and Heal, 1978). Secondly, they must be sufficiently intelligent and rational, and they must be free from cognitive and emotional disturbances to a sufficient degree (so that there are no psychological obstacles for adding the n+1'st order belief when a genuine mutual belief is involved and for not adding it, or indeed for adding its negation, when a genuine mutual belief is not involved). A typical releasing condition for the disposition to acquire a higher order belief would be simply that the agents are asked about higher order beliefs (or are presented with other analogous problems concerning them).

There is not much to choose between the two amended accounts, and the matter will not be discussed further here. With the conceptual machinery at hand, one can deal with, for instance, the mentioned phenomena of pluralistic ignorance and false consensus. An account of pluralistic ignorance, concerning something p, must obviously include the idea that everyone believes that p. Secondly, it must say that the agents do not have the belief that they agree. Compatibly with this, it can

still be required that that they do not disbelieve that they believe that p. As to false consensus, it must be required that not everyone believes that p and that, nevertheless, it is believed by everyone that everyone believes that p.

3. Mutual Beliefs and the Level Problem

Let us next discuss the level problem. Given the iterative account, the problem is how many iterative levels of belief are conceptually, epistemically, or psychologically needed for success in various cases. The criterion here is functionality and success. For instance, how many levels of belief does successful joint action require? The level question is difficult to answer in general terms. However, it can be conjectured that in certain cases at least two levels (viz. n = 2), relative to the base level, are needed for mutual belief, but no more. In some other cases this is not enough. Generally speaking, there are very seldom epistemic or psychological reasons for going beyond the fourth level. For many agents level n=4 probably is psychologically impossible or at least very difficult to handle in one's reasoning.

The base level is the level zero at which the sentence or proposition p is located, and p will concern or be about an agent's or agents' actions, dispositions to act, intentions, beliefs (or something related); or, alternatively, p can be (or concern) a belief content. In the analysis below analysis it is accepted that the beliefs—at least those going beyond the level n=2 -- need not be proper occurrent or standing beliefs or even subconscious ones but only dispositions to form the belief in question. (See Audi, 1994, for the relevant notion of a disposition to form a belief.)

The claim that n=2 is not only necessary but also sufficient in many typical cases is allowed to involve social loop beliefs where the content of mutual belief could be, for instance, that A believes that B believes that A will act in a certain way or believes that such and such is the case. What the base level will be is relative to the topic at hand. That at least two levels are needed can be regarded as a conceptual truth (related to the notion "social existence"); that in many typical cases no more is needed or that in some other cases four layers are needed can be regarded as general psychological theses concerning the actual contents of people's minds in those situations.

The present view allows that a need may arise to add layers indefinitely. Here is a recursive argument to show that such a situation is possible in principle. Given an analysis of mutual belief in terms of iteration of beliefs such as ours, then at each level under consideration one may start asking questions about people's realizing (or believing) such and such, where "such and such" refers to the level at hand. This game obviously can go on indefinitely as far as the involved agents' reasoning capacities (or whatever relevant capacities) permit. This is an inductive argument (in the mathe-

matical sense—the first step is obvious) for the open and infinite character of the hierarchy of nested beliefs.

To discuss the level problem in more concrete terms, let us consider mutual belief in the case of two agents, A and B. First we let our base level sentences be related to the agents' performances of their parts as follows:

1) A will do his part of X (in symbols, p(A));

2) B will do his part of X (p(B)).

Next, let us assume:

i) A believes that 1) and 2);

ii) B believes that 1) and 2).

This is a social or mutual recognition of the agents' part-performances in the context of joint action.

The sentence p in 1) and 2) may alternatively concern other things than action. Thus it may represent a belief content, e.g. p = The earth if flat, and we will consider this case below.

Considering joint action, it can be argued that n = 2 is both necessary and sufficient for successful performance. In this example, A will obviously have to believe that B will do her part. This gives her some social motivation to perform her own part. Concentrating on our reference point individual A and genuine joint action X (in which the agents' performances of their parts are interdependent), A must also believe (or be disposed to believe, at any rate, viz., come to form the belief if asked about the matter) that B believes that A will do her part. For otherwise A could not believe with good reason that B will do her part, for B would - if she does not so believe - lack the social motivation springing from her belief that A will do her part. However, if she did lack that motivation, A could not on this kind of ground defensibly form the belief that B will perform her part. This argument shows that it must be required that the agents have a loop belief or at least a disposition to have a loop belief:

iii) A believes that i) and ii);

iv) B believes that i) and ii).

For instance, iii) gives the loop "A believes that B believes that p(A)", and this means that in the present kind of case n=2 is necessary and normally also sufficient (relative to the chosen base level).

An analogous claim can be defended in the case of belief. Here the defense can be given in terms of the recognition by the agents that they share a belief. Suppose that each member of the Flat Earth Society not only believes that the earth is flat, but – because of being organized into a belief group—the members all share this information. This second-order belief indicates the first level at which social and mutual belief can be spoken of in an interesting sense, for at this level people recognize that the others in the group believe similarly, and this establishes a doxastic social connection; at level one that recognition is, however, missing. This is a typical case of a social property, and again n=2 is both necessary and normally sufficient for acting in matters related to the shape of the earth *qua* a member of the society.

Suppose next the members of the Flat Earth Society now begin to reflect upon this second order belief of theirs and come to form the belief that indeed it does exist. (Perhaps a sociologist has just discovered that they share the second order belief and told them about it.) They might wonder how strong this second order awareness is, and so on. All this entails that on some occasions third order beliefs may be needed, although the standard case clearly would be second order beliefs accompanied by a disposition to fo higher up, if the need arises. Analogously, in the case of joint action in some very special cases, e.g., double loop beliefs may be needed for rational action.

The reader should be reminded that not all social notions depend on mutual belief. For instance, latent social influence and power do not require it, nor does a unilateral love-relation between two persons.

4. Mutual Belief as Shared We-belief

What has been called "we-attitudes" are central for an account of social life (see Tuomela, 1995, Chapter 1, Tuomela and Balzer, 1998). A we-attitude is a person's attitude (say belief, want, fear, etc.) concerning something p (a proposition, or sentence) such that a) this person has the attitude in question and believes that b) everyone in the group has the attitude and also believes that there is a mutual belief to the effect that b) in the group. Of these, the somewhat idealized clause a) is required because there cannot of course be a truly shared attitude without all the members participating in that attitude. Clause b) gives a social reason for adopting and having the attitude A, and c) strengthens the reason by making it intersubjective. (A shared we-attitude can be either in the group mode or in the individual mode; cf. Section 1.)

A shared we-belief is a we-belief (be it in the individual or in the group mode) which (ideally) all the group members have. To take an example, a shared we-belief that the earth is flat entails that

the group members believe that the earth is flat, that the group members believe that the earth is flat, and also that it is a mutual belief in the group that the group members believe that the earth is flat.

Shared we-beliefs can be related to the reflexive or fixed-point account of mutual belief. According to the simplest fixed point account mutual belief is defined as follows: It is a mutual belief in a group that p if and only if everyone in the group believes that p and also that it is mutually believed in the group that p. It can thus be seen that the account of mutual belief given by the fixed-point theory is equivalent to the definiens in the definition of a shared we-belief. In the *fixed point* approach the syntactical infinity involved in the iterative approach is cut short by a finite fixed point formula, that is, an impredicative construct in which the joint notion to be "defined" already occurs in the definiens. Under certain rationality assumptions about the notion of belief it can be proved that the iterative approach which continues iterations *ad infinitum* gives the fixed point property as a theorem (see Halpern and Moses, 1992 and, for a more general account, Balzer and Tuomela, 1997).

The fixed-point account is in some context psychologically more realistic, as people are not required to keep iterative hierarchies in their minds. Note, however, that it depends on context whether the iterative approach or the fixed-point approach is more appropriate. Thus, in the case of successful joint action, at least loop beliefs must be required.

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(Abstract)

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The importance of the notion of shared belief has been emphasized by philosophers, economists, sociologists, and psychologists at least since the 1960's. This paper concentrates on the strongest kind of shared belief to be called *mutual belief*. While a belief can be shared in the trivial sense of two or more people having the same belief, mutual belief requires the kind of strong sharing which requires at least the participants' awareness (belief) of their similar belief. Mutual belief is one central kind of collective attitude, examples of others being collective intentions, wants, hopes and fears. Understandably, collective attitudes are central explanatory notions for the social sciences, as one of their tasks is to study collective phenomena, including various forms of collective thinking and acting. As to mutual beliefs, they serve to characterize social or intersubjective existence in a sense not relying on the making of agreements or contracts. Thus many social relations, properties, and events -- including intentional communication -- arguably involve mutual beliefs. Furthermore, characterizations of many other collective attitudes depend on the notion of mutual belief.

This paper discusses various kinds of shared belief and the problem of whether and when several iterated beliefs are needed. While the emphasis is on individual mode beliefs, it is pointed out that in full-blown group contexts special group-mode (or “we-mode”) beliefs will be required of the group members.