

## **AN EXPANDED REPRESENTATION OF BELIEF STRUCTURES IN GROUPS**

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### **ABSTRACT**

In this paper we propose an expanded representation of group belief structures. Three key aspects of belief structures are identified – validity, irrelevance, and uncertainty. Validity arises from the amount of valid beliefs that comprise a group’s belief structure, and the amount of invalid (not corresponding to reality) beliefs in the belief structure. Irrelevance represents the represents the reliance of a group on beliefs that, while valid, do not significantly influence the group’s decision making ability. Finally, uncertainty represents the extent to which a group has confidence in its beliefs, or whether it simultaneously adheres to contradictory beliefs. The three characteristics of a group’s belief structure are show to significantly impact group short and long run performance.

Beliefs held by groups are important constituents of their mental models (Shope, 1983; Smith, Benson, & Curley, 1991). They are also constituent elements of group schemas (Rousseau, 1985). Consequently, group beliefs are likely to shape the group’s approach to solving critical problems and determine the quality of their decisions.

Beliefs are closely tied to knowledge – Researchers have pointed out that knowledge is comprised of ‘true justified beliefs’ (Nonaka & Takeuchi, 1995; Polanyi, 1958) where beliefs are considered to be true justified if they correspond with reality and if they have been formed through valid observation or through reasoned logic (Smith et al., 1991).

For the most part, organizational researchers have focused on the true justified beliefs while ignoring other beliefs that may be held by the group. In reality however, groups also work with unjustified beliefs (for instance a marketing team may believe that their customers are insensitive to price while in reality they are not) or irrelevant beliefs (for instance, a product development team may decide on design criteria, which while having valid content, are unlikely to impact product performance or demand). A group will likely take action on the basis of their beliefs – whether those beliefs are valid, invalid, or irrelevant. Consequently an understanding the group decision making process requires us to consider all three types of beliefs simultaneously.

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In this paper we propose an expanded representation of a group’s belief structures. We discuss how groups may differ with respect to the nature of their belief structures, and the implications of different belief structures for performance.

## 1 INDIVIDUAL BELIEFS

In this section, we briefly describe individual beliefs and then move on to explore belief structures at group levels.

### Individual Beliefs

When attempting to represent an individual’s mental and cognitive states, psychologists have described two key states: a) Qualia which are qualitative states corresponding to feelings and emotions, and b) Propositional attitudes that represent ‘meaning or content that can be true or false (Smith, Benson, and Curley, 1991: p 292).’ While we can mentally form numerous propositions in our mind, when we gain confidence that a given proposition accurately represents reality, then that proposition represents our belief (Shope, 1983). Note that our perception that the proposition represents reality may or may not be true.

Beliefs are inseparably intertwined with human knowledge. Polanyi (1966) describes knowledge as being composed of individuals’ justified true beliefs. Shope (1983) points out that the ‘true’ aspect of a belief implies that it corresponds with reality, while the ‘justified’ part implies that the belief has been derived from valid evidence, and/or by strong reasoned argument. (Thus a true belief that is held by fluke is not considered knowledge).

In addition to justified true belief, individuals also act on the basis of other beliefs that are incorrect. Thus a marketing manager may strongly hold a belief that price reductions are strongly related to increased sales, but this may just be a wrong belief. Such a belief is a deviation from reality, but is important because it shapes the actions taken by the individual. Such beliefs are a neglected but important aspect on individual belief structures.

In addition to knowledge and distortion, individuals may also possess irrelevant beliefs. These are beliefs that are true as far as their content goes, but are not essential for perform the task. For instance, old-timers in paper manufacturing mills believe that the ‘formation’ of the paper is an important determinant of the quality of paper. That is true, but with the emergence of advanced finishing and printing machines, formation was not an important determining characteristic for customer choice. Consequently, an individual selecting a new manufacturing technology while possessing the irrelevant belief may spend more time and actually make a sub-optimal choice.

While the preceding discussion provides a clean differentiation between propositions and beliefs, and between justified, distorted, and irrelevant beliefs, the actual reality involves additional nuances relating to the confidence with which individuals hold beliefs. Individuals can hold different confidence levels about how well a given proposition represents reality. Thus, it becomes important to focus on the strengths of individual beliefs – a strong belief is one where the individual is fairly confident of its correspondence with reality. In the case of a weaker belief, an individual may believe that his or her belief probably corresponds with reality but is a lot less sure.

Further complicating the above situation is the fact that individuals can simultaneously hold contradictory propositions (Goldman, 1986). For instance a marketing manager may simultaneously assign a positive and negative relationship between the price of a product and its consumer demand. When individuals hold competing propositions that are assigned similar probabilities they experience uncertainty. When the need arises to resolve such uncertainty, the individual may try to gain confidence about one of the two competing propositions through introspection, experimentation, or information seeking.

The preceding discussion suggests that an individual’s belief structure may be categorized along the following three parameters: a) Whether the belief is justified, distorted, or irrelevant, b) the level of confidence with which beliefs are held, and c) the proportion of beliefs that compete with other contradictory beliefs. These three characteristics are also relevant and underlie important characteristics of a group’s belief structure as described below.

## 2 THE STRUCTURE AND CHARACTERISTICS OF GROUP BELIEFS

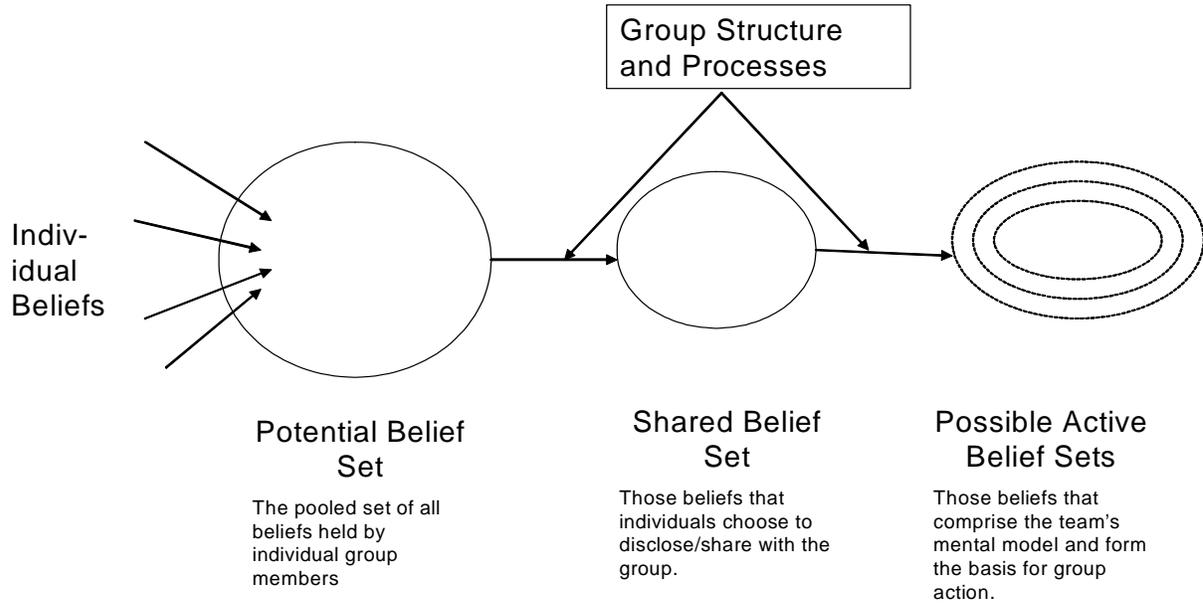
Individual group members bring their belief structures into a group. Groups then go through a dynamic process where individual knowledge and beliefs are shared, debated, and typically yield a group mental model. For instance, Gibson (2001) suggested that decision-making groups typically undergo a process comprising four stages: a) Accumulation: Where they acquire needed information about the task, b) Interaction: Where group members retrieve information and beliefs held by each other, c) Examination: where group members examine each others beliefs, engage in interpretive discussions, and try to resolve inconsistencies and contradictions among each other’s beliefs, and d) Accomodation: where group members integrate diverse knowledge of individual group members and develop a common team mental model.

In a group when individuals interact with each other, the group begins to form a shared mental model and the group’s belief system emerges (Gibson, 2001; Levesque, Wilson, & Wholey, 2001; Mohammed & Dumville, 2001). During this process it is necessary to distinguish between three sets of group beliefs. The first set, that can be termed a “potential belief set”, comprises a simple pooling of all the beliefs that are held by group members (Anand, Fugate, & Manz, 2000). However, research in group information sharing has shown that decision-making groups are not likely to share all personal knowledge held by members and further, they are unlikely to use all of the knowledge that they do share (Anand, Glick, & Manz, 2002; Anand, Manz, & Glick, 1998; Stasser & Stewart, 1991; Stasser & Titus, 1985). Thus, at least two sub-sets of the potential belief sets are identified : The shared belief set, which comprises those beliefs that members have chosen to share with other group members, and an ‘active belief set’ which represents those beliefs that form the basis of a group’s actions.

The relationship between the three group sets is shown graphically in Figure 1 below. The potential belief set is an artifact that is constructed by pooling together all beliefs that are held by group members. Individual members choose to share a portion of their beliefs with the group – their choices determine the nature and amount of information available in the shared belief set. The group’s active belief set, on the other hand, is a group level phenomenon and comprises those beliefs from the shared set that the group has

incorporated in its active memory or in its mental model (Anand et al., 2000; Mohammed et al., 2001).

Figure 1: From Individual Beliefs to Group Beliefs

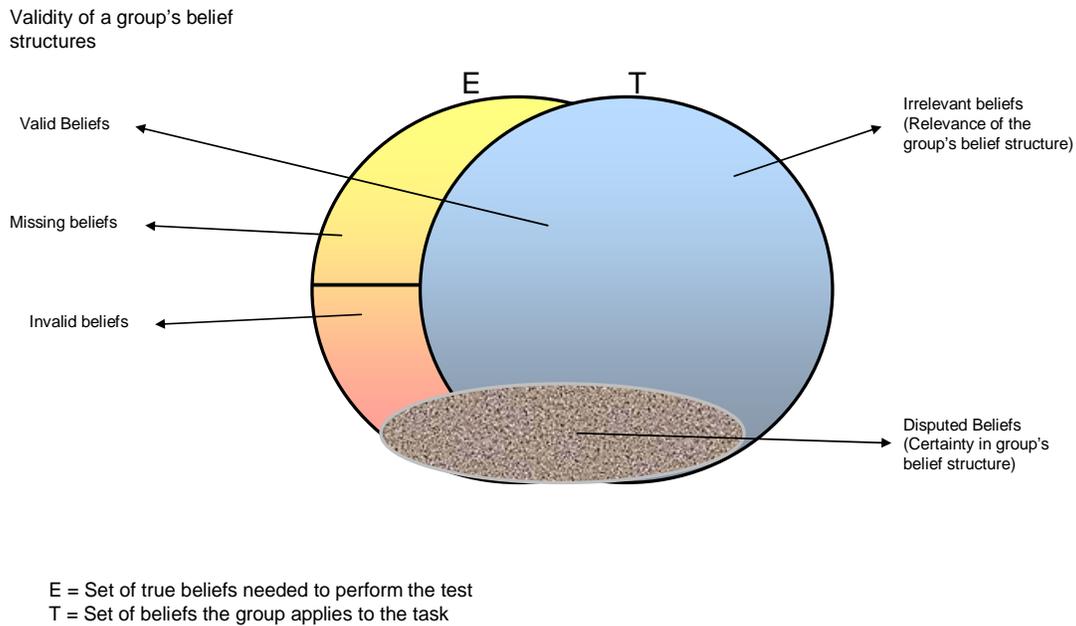


Past research has shown that the relationship between the potential belief set and the shared belief sets is likely to be moderated by group characteristics such as group diversity, amount of shared knowledge and so on. (Larson, Sargis, & Bauman, 2004; Larson, Foster-Fishman, & Keys, 1994; Stasser, Stewart, & Wittenbaum, 1995; Tesluk & Mathieu, 1999). Similarly, the relationship between the shared and active belief sets is likely to be moderated by the group characteristics and the process used by the group during discussions (Stasser, Vaughan, & Stewart, 2000; Stewart & Stasser, 1995). The active belief set is not necessarily a smaller sub-set of the shared belief set. The sharing of beliefs often yields new insights and may lead to the generation of specific beliefs that were not contained in the pooled or shared belief sets (Weick, 1995).

While the relationships between pooled, shared, and active belief sets are important in themselves, they are beyond the scope of this paper. Rather, we begin with the assumption that groups have an active set of beliefs that guide their actions. The active set of beliefs can be viewed as a component part of a team’s mental model which is defined as the team members’ shared, organized understanding and mental representation of knowledge about key elements of the team’s task environment .

The beliefs held in a group’s active belief set are similar to those held by individuals in that they comprise propositions that the group believes correspond to reality (to a greater or lesser extent). A representation of group belief structures is shown in Figure 2 below.

Figure 2: A Representation of a Group's Belief Structure



In Figure 2, set T represents all beliefs that group members hold about the focal task, and the set E is an idealized set containing all possible true beliefs required to perform the group’s task. The intersection of sets T and E represents the group’s true knowledge – those of its beliefs that are relevant to the task at hand and are justified. The intersection of T’ and E ( $T' \cap E$ ) represents a set of justified true beliefs that are needed to perform the task properly, but are not possessed by the group. Thus,  $T' \cap E$  represents the missing beliefs of the group. The intersection of E’ and T ( $E' \cap T$ ), represents the group’s set of irrelevant or unjustified beliefs. These beliefs represent propositions that are inconsistent with reality or those assumptions that are irrelevant to the task at hand but used by the group while making decisions.

At the bottom of the set T is a shaded area that represents the group’s disputed beliefs. The beliefs may be disputed because: a) the group as a whole assigns similar levels of confidence to two competing propositions, or b) one sub-group subscribes to one belief, while another sub-group believes a competing belief represents reality. In this case, the first situation may represent uncertainty in the group, while the second condition may represent a conflicted group.

Figure 1 provides us a basis to develop the properties of a group’s active belief set. We identify the three properties on which group’s may differ with respect to their group structures: a) Validity of a group’s active belief structure, b) The relevance levels in a group’s active belief structure, c) The uncertainty inherent in the group’s belief structure. Each of these factors is described below.

### Validity

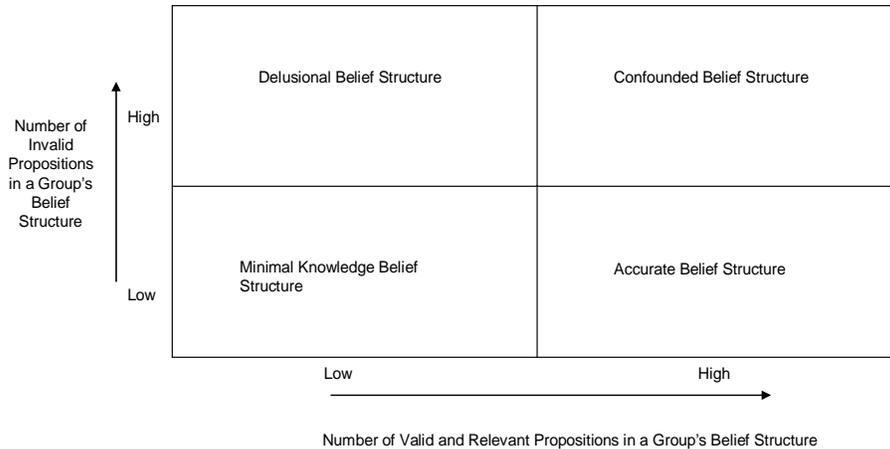
One direct measure of the validity of a group’s belief structure is the proportion of the propositions in a group’s belief structure that are both valid and relevant for the task at hand. In Figure 2, this can be defined as the ratio of beliefs in the set  $T \cap E$  to the beliefs in the set  $T$ . At a basic level, group’s that have high validity in their belief structures are groups that are knowledgeable about their tasks.

However, there are a couple of subtle nuances to the validity of a group’s belief structure. The set,  $T' \cap E$  (shaded yellow and pink in Figure 2) represents the beliefs that a group ought to have but are absent. Absent beliefs may be of two types: a) those propositions that are needed but are not present in any form in the group’s belief structure – these are the group’s missing beliefs, and b) those propositions that are present but incorrect representations of reality (Pink shaded portion of Figure 2). In effect these are beliefs that do not correspond with reality. For instance, while the reality may be that price increases in a product do not decrease demand, group members may subscribe to the opposite view. Missing and invalid beliefs represent two ends of a continuum. As the number of missing beliefs increases, the number of invalid beliefs declines by definition. For the sake of simplicity, henceforth, we describe a group’s belief structure validity in terms of a high or low proportion of invalid beliefs without referring to missing beliefs. The proportion of invalid beliefs represents a second measure of the validity of the group’s belief structure. Variations along the two measures give us four types of belief configurations as shown in Figure 3 below.

When the amount of valid knowledge is low, we see two types of groups that may exist, the Minimal Belief structure, whose members lack key knowledge about their tasks. While such groups are rarely expected to perform very well, in certain environments, such groups may be the only kinds of groups available. For instance, a group planning to commercialize a novel technology is likely to be unsure about what to expect in developing the commercialization plan. In such circumstances, the low presence of valid beliefs will inhibit performance initially – both in terms of quality of decisions and the timeliness of decisions. However, the absence of pre-existing beliefs, allows a team to learn and develop a more accurate belief structure relatively quickly. This can often lead to superior performance in the long run, especially compared to the Delusional team described below.

The delusional team is one with a very low proportion of accurate beliefs, but a high level of inaccurate beliefs. Such teams may exist in conditions very similar to the one described above – for instance a team, attempting to develop a commercialization plan for a new innovation, but erroneously believing that their experience in commercializing a former product is very relevant. Additional examples include strategy teams that have tried to implement a successful business plan from one country to another, erroneously believing that what worked in the first country will also work in the new country.

Figure 3  
Validity of a Group's Belief Structure



Compared to the Minimal belief structure teams, such delusional teams will exhibit poor quality of decision making because they are acting on poor knowledge that leads them to make inappropriate decisions. However, the illusion that such a team has of knowing what needs to be done, will probably allow it to make faster decisions. In the long run, the quality of its decisions is likely to improve at a slower rate because feedback received from the environment is likely to be initially ignored, or the group's are likely to make inadequate adjustments to their erroneous beliefs.

An accurate belief structure is one which, at least in the short run, provides an outstanding quality of decision making. However, the positive feedback is likely to entrench group beliefs. Consequently, group's operating in a fast changing environment will find it more difficulty to alter their beliefs to match the changed environment. Consequently there is a possibility that performance will decline in the long run. ON the other hand, a confounded belief structure is one that will exhibit poorer performance in the short or long term.

**Relevance**

The relevance of a group's belief structure represents the proportion of irrelevant beliefs present in the group's active belief set. A group is likely to have high levels of irrelevance in their beliefs when they over-complicate a decision situation. For instance, a group which uses multiple criteria to evaluate the acceptability of alternatives when a fewer number of criteria needed to be used. As the irrelevance in a group's belief structure increases, it is likely to slow down the quality of decisions and the time taken to formulate them. A great example is provided by Lou Gerstner (Former CEO of IBM) as he reflected on how IBM engineers in the early 1990s used so many criteria while developing products that the whole product development process was significantly slowed (Gerstner, 2002):

*‘The pursuit of excellence over time became an obsession with perfection. It resulted in a stultifying culture and a spider’s web of checks, approvals, and validation that slowed decision making to a crawl. When I arrived at IBM, new mainframes were announced every four to five years. Today they are launched, on average, every eighteen months (with excellent quality, I might add). I can understand the joke that was going around IBM in early 1990s; “Products aren’t launched at IBM. They escape”. Gerstner, 2002 (PP 185-186)’*

**Uncertainty:** The third key aspect of a group’s belief structure is the presence of uncertainty. Uncertainty in a group’s belief structure arises from two key sources: a) Strength of beliefs, and b) the presence of disputed beliefs. The strength of beliefs, as described earlier, refers to the conviction that group members have that a given proposition that they believe corresponds to reality. When group members uniformly have greater faith in their beliefs their belief structures exhibit lower uncertainty. As their confidence declines a large level of uncertainty is experienced by the group. The uncertainty is further enhanced when the group collectively, or through rival factions, subscribes to contradictory propositions.

Uncertainty in a group’s belief structure has several consequences on a group’s decision making ability. As the uncertainty in its belief structures increases, a group is likely to seek more information prior to making key decisions. Additionally, it is more likely to engage in discussion to determine and understand the decision situation more clearly – in both instances, the quality of the group’s decision is likely to improve, while the speediness is likely to decline. However, extreme uncertainty, may reverse any of the above benefits. In the face of a lack of confidence, a group may start making risk averse decisions, or believing that the situation is not easily understood, eschew any attempts to seek additional information. Thus the effect of uncertainty on short term group performance is likely to be of a curvilinear nature.

A similar pattern of relationships is likely to be seen with respect to long term performance, though for different reasons. Extremely high levels of certainty in a group’s belief structures are likely to be associated with lower willingness to change in the group. Even if the group’s decision quality is poor and the feedback from initial decisions is negative, the group may make relatively smaller amounts of adjustments to existing beliefs, or attribute the poor performance to external factors. Thus, the group is likely to experience lower motivation levels to improve the accuracy of their beliefs.

As the uncertainty in the group’s belief structure increases, the group is far more likely to reexamine existing beliefs in the face of negative performance. The group is thus much more likely to modify their belief structures and this will be especially beneficial in changing environments. On the other hand if the uncertainty is extreme to begin with, in the face of poor performance, the group may believe itself incapable of handling the existing tasks and use more extreme measures such as breaking the group or reconstituting it with members perceived to be more suited to the task at hand.

### 3 CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

We have presented a model of representing group belief structures. This model offers an expanded way of looking at how knowledge may be structured in group mental models. Key arguments here include the fact that its not just the knowledge of a group, but their ignorance (missing beliefs), irrelevance, and the nature of their invalid beliefs that in totality determine both short and long term performance. Further, the uncertainty inherent in a group’s belief structure plays a key role in group performance. The uncertainty arises either as a function of how strongly group members ascribe to their beliefs, or as a function of whether there exist competing propositions in the group’s belief structure.

Looking at this expanded representation of group belief structures is important because it provides unique insights into how best to form and manage decision making groups in organizations. Group composition is important because, for instance, a group composed of veterans with prior success is likely to possess lower uncertainty in their belief structures. This has implications for short run and long run group performance. In the short run the group may make decisions faster (because the group members have large amounts of propositions about which they feel confident), but such a group may be slower to change its beliefs in the face of changing environments, and slower to adopt learning routines that could challenge or replace its existing beliefs.

An obvious future direction for research lies in testing the impact of each belief structure component. For instance, it may be possible to modify the amount of irrelevance that groups bring to a task in lab studies. In such studies, variations in training can create groups with multiple belief structures and it may then be possible to monitor their performance over a period of time. Insights from such lab studies can provide strong insights into the group mental model and the group learning literatures.

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