# Group Disagreement: A Belief Aggregation Perspective

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**Abstract.** The debate on the epistemology of disagreement has so far focused almost exclusively on cases of disagreement between *individual persons*. Yet, many social epistemologists agree that at least certain kinds of *groups* are equally capable of having beliefs that are open to epistemic evaluation. If so, we should expect a comprehensive epistemology of disagreement to accommodate cases of disagreement between group agents, such as juries, governments, companies, and the like. However, this raises a number of fundamental questions concerning what it means for groups to be epistemic peers and to disagree with each other. In this paper, we explore what group peer disagreement amounts to given that we think of group belief in terms of List and Pettit's (2002; 2011) 'belief aggregation model'. We then discuss how the so-called 'equal weight view' of peer disagreement is best accommodated within this framework. The account that seems most promising to us says, roughly, that the parties to a group peer disagreement should adopt the belief that results from applying the most suitable belief aggregation function for the combined group on all members of the combined group. To motivate this view, we test it against various intuitive cases, derive some of its notable implications, and discuss how it relates to the equal weight view of individual peer disagreement.

**Keywords** Group disagreement · Peer disagreement · Equal weight view · Belief aggregation · Judgment aggregation · Collective epistemology

## 1. Introduction

How, if at all, should the parties to a peer disagreement revise their beliefs about the disputed proposition? This question has received a lot of attention in recent social epistemology. However, the debate has so far focused almost exclusively on cases of peer disagreement between *individual persons*. This is somewhat surprising given that many social epistemologists agree that at least certain kinds of *groups* are equally capable of having beliefs that are open to epistemic evaluation.[1] To the extent that this view of group belief is correct, we should expect a comprehensive epistemology of disagreement to accommodate cases of disagreement between group agents, such as juries, governments, companies, and the like.

[1] For proponents of this view, see Gilbert (1987), List and Pettit (2002; 2011), Schmitt (2014), among others. For critical discussions, see Hakli (2006) and Wray (2001; 2007).

There are, however, a number of challenges associated with the attempt to extend theories of individual disagreement to the case of group disagreement. Carter (2014) has recently drawn attention to a set of problems that arise for anyone who aspires to develop a 'conciliatorist' theory of group peer disagreement. Furthermore, as we shall see, there are a number of fundamental conceptual issues concerning what it means for two groups to be epistemic peers and to disagree with each other in the first place. As such, the problem of group peer disagreement is not simply a trivial extension of the problem of individual peer disagreement, but deserves sustained attention in its own right.

The aim of this paper is to clarify various conceptual issues concerning group peer disagreement, explore the question of how the parties to a group peer disagreement should revise their beliefs, and discuss how the problem of group peer disagreement relates to the problem of individual peer disagreement. We will base our investigation on two core assumptions. First, we will assume that a group's belief state can be represented as the output of a *belief aggregation function* that takes the belief states of the individual group members as input. This 'aggregation model' of group belief has been systematically developed by List and Pettit (2002; 2011), and has been used to investigate a variety of topics, ranging from the epistemic merits of co-authorship in science (Bright et al. 2017) to the role of deliberation in democratic societies (Pettit 2001).[2] Second, we will assume that a theory of group peer disagreement should respect the basic intuition behind the *equal weight view* of individual peer disagreement, according to which the parties to an individual peer disagreement should place 'equal weight' on each other's opinions. This view has been prominently defended by Christensen (2007) and Elga (2007) and remains a popular view of individual peer disagreement. That being said, neither of our two core assumptions are uncontroversial, and those who reject either or both assumptions will perhaps find our investigation fundamentally misguided.[3] Nevertheless, we will not defend our basic assumptions here. Our aim is not to derive a theory of group peer disagreement from first principles, but to explore what an equal weight view of group peer disagreement should look like within a belief aggregation framework. Needless to say, the results of our investigation will be no more plausible than the

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[2] See also Goldman (2011) who uses the aggregation model of group belief to investigate the question of what makes a group belief epistemically justified.

[3] For a prominent critic of the equal weight view, see Kelly (2010). For criticism of the aggregation model of group belief, see Magnus (2013) who argues that the aggregation framework cannot adequately represent what the scientific community knows collectively.

assumptions on which our investigation is based. But we hope that many will find the aggregation framework and the equal weight view plausible enough to serve as the basis of a worthwhile investigation. For those who are skeptical about our assumptions, it may still be of interest what they entail with respect to group peer disagreement.

We shall proceed as follows. In §2, we offer a more detailed characterization of what group peer disagreement amounts to within a belief aggregation framework. In §3, we then formulate and evaluate three candidate views of group peer disagreement that one might take to encode the basic idea behind the equal weight view of individual peer disagreement. The view that seems most promising to us says, roughly, that the parties to a group peer disagreement should adopt the belief that results from applying the most suitable belief aggregation function for the combined group on all members of the combined group. To motivate this view, we test it against various intuitive cases, derive some of its notable implications, and discuss how it relates to the equal weight view of individual peer disagreement. In §4, we defend the proposed view against a number of objections. Finally, §5 is a brief summary.

## 2. Characterizing Group Peer Disagreement

The aim of this section is to investigate what group peer disagreement more precisely amounts to within a belief aggregation framework. Let us begin by introducing the framework in a little more detail. The idea is to think of a group's belief state as the result of applying a Belief Aggregation Function (BAF) to the set of individual belief states of the group's members. While any mapping from sets of individual belief states to group belief states may in principle count as a BAF, we will try to illustrate our points using relatively simple and well-known BAFs such as dictatorship, majority voting, unanimity voting, and the like. A fully fledged aggregation model of group belief may well have to impose further constraints on what counts an admissible aggregation function. It might seem odd, for instance, to admit a BAF that results in a group belief that *p* just in case every group member disbelieves *p*. But for present purposes, we need not impose any constraints on which BAFs are admissible.

As is standard in the belief aggregation literature, we will assume that groups as well as individuals have binary 'all-or-nothing' beliefs (rather than graded beliefs), and that each member of any given group either believes or disbelieves any given proposition. Otherwise we will not make any substantive assumptions about the nature of group belief. In particular, we will not assume a 'summativist' version of the aggregation framework, according to which a group's believing a proposition *p* is simply a matter of a sufficient percentage of its members' believing that *p*.[4] On the present picture, a group may in principle believe that *p*, even if only few (or none) of its members believe that *p*, depending on the group's BAF. Also, we will not assume that a group's BAF need be explicitly chosen, or deliberately adhered to, by its members. Rather, a group's BAF may be a tacit convention or otherwise implicit in the group's practice.

What does it mean for two groups to *disagree* on this picture? Trivially, two groups disagree about *p* if and only if the groups have differing beliefs about *p*. So, given that we have a model of group *belief*, we also have a model of group *disagreement*. Nevertheless, one might still wonder whether group disagreement depends in any systematic way on the presence or absence of individual disagreement among the group members. In particular, it might seem natural to think that two groups cannot disagree unless the groups have at least *somewhat* different belief distributions over their members. However, on the present picture, it turns out that differing belief distributions over the members of two groups is neither necessary nor sufficient for the two groups to disagree. A simple illustration is given in Table 1. The groups $G_1$ and $G_2$ disagree, although they have identical belief profiles (in each group, two members believe *p*, and one member disbelieves *p*). Conversely, the groups $G_1$ and $G_3$ agree, although they have different belief profiles (all of $G_3$'s members believe *p*, whereas this is not the case for $G_1$). So the fact that two groups have differing belief profiles is neither necessary nor sufficient for the presence of group disagreement. This is a direct consequence of the fact that a group's belief state is not only a function of the belief states of its members, but also a function of the group's BAF.

It is worth noting that other views of group belief differ from the aggregation model in this respect. Consider, for example, a simple summativist view of group belief, according to which a group believes that *p* just in case a sufficient percentage of its members believe that *p*. On this sort of picture, there is a relatively straightforward connection between group disagreement and member disagreement: two groups disagree just in case there is sufficient disagreement among their members. We do not want to enter a discussion of whether this result is desirable or not. But in any case, it marks a central difference between the aggregation model of group belief and the summativist account.

[4] See Gilbert (1987), Toumela (1992), and Schmitt (1994) for nonsummativist accounts of group belief.

| | $G_1$: Majority voting | $G_2$: Dictatorship (member 3) | $G_3$: Unanimity voting |
|---|---|---|---|
| Member 1 | True | True | True |
| Member 2 | True | True | True |
| Member 3 | False | False | True |
| Group | True | False | True |

**Table 1:** *The groups $G_1$ and $G_2$ disagree, although they have identical belief profiles. Conversely, the groups $G_1$ and $G_3$ agree, although they have differing belief profiles.*

The next question we want to discuss is what it means for two groups to be *epistemic peers* on the present model. In the literature on individual peer disagreement, epistemic peerhood is often understood in terms of two agents being equally competent at judging a shared body of evidence.[5] For example, two weather forecasters might be peers in virtue of having access to the same meteorological data and being equally competent at analyzing and drawing inferences from such data. However, this 'evidentialist' conception of epistemic peerhood does not seem to sit well with the aggregation model of group belief, since this model does not treat a group's belief state as the result of a collective judgment of a body of evidence, which is available to the group as a whole. Rather, it treats a group's belief state as the result of aggregating the set of individual belief states (which may in turn be understood as resulting from individual judgments of different bodies of evidence available to different group members). As such, the evidentialist conception of epistemic peerhood seems ill-suited for the purpose of reasoning about group peerhood.

Instead, we will understand epistemic peerhood in *reliabilist* terms, where 'reliability' is to be understood as a measure of how well an agent's beliefs tend to track the truth. This sort of reliabilist conception of epistemic peerhood has been discussed by Christensen (2016) and Lam (2011) in the context of individual peer disagreement, and has been used by Easwaran et al. (2016) to investigate how individuals should in general revise their credences upon learning the credences of other persons. Furthermore, philosophers who work within an aggregation framework often measure epistemic performance in reliabilist terms.[6] Nevertheless, we should not be taken to say that a reliabilist conception of epistemic peerhood

[5] See, e.g., Christensen (2007), Levinstein (2015), and Rasmussen et al. (2017).

[6] See, e.g., List (2005) and Hartmann and Sprenger (2012).

is always (or even typically) preferable to its evidentialist cousin, nor do we want to enter a broad discussion of the merits and demerits of a reliabilist conception of epistemic peerhood. Instead, we hope to be able to show that a reliabilist conception of epistemic peerhood is at least useful for the purpose of reasoning about group peer disagreement. It is also worth noting that there need not be any deep opposition between reliabilist and evidentialist conceptions of peerhood. After all, it seems clear that an agent's ability to judge the available evidence is in many cases indicative of the agent's reliability, and *vice versa*. If so, there is at least a weak sense in which reliabilist and evidentialist conceptions of epistemic peerhood go hand in hand.

How we should think about an agent's reliability more precisely? In the belief aggregation literature, it is common to distinguish between an agent's *positive reliability*, understood as the likelihood of believing *p* given that *p* is true, and an agent's *negative reliability*, understood as the likelihood of not believing *p* given that *p* is false (see, e.g., List 2005):

**Positive reliability:** $Pr(Bp|p)$

**Negative reliability:** $Pr({\sim}Bp|{\sim}p)$

Note that these two kinds of reliability can come apart: someone can have a high positive reliability but a low negative reliability, and *vice versa*. For example, a highly credulous agent who is willing to believe virtually anything has a high positive reliability, but a low negative reliability. Conversely, a highly incredulous agent who is willing to believe virtually nothing has a low positive reliability, but a high negative reliability.

The fact that an agent's positive and negative reliabilities can come apart raises the question of what it means for two agents to have the same *overall* reliability. A simple proposal would be to understand epistemic peerhood as a matter of having the same positive reliability *and* the same negative reliability. However, this would seem like an overly restrictive requirement. Suppose, for example, that an agent A has a higher positive reliability than an agent B, whereas agent B has a higher negative reliability than agent A. In at least some such cases, it seems reasonable to count A and B as epistemic peers. To allow for such cases, we will instead try to combine an agent's positive and negative reliabilities into a single measure. A familiar way of doing so is given by the likelihood ratio (see, e.g., Goldman 2001):

**Likelihood Ratio:** $\dfrac{Pr(Bp|p)}{1 - Pr({\sim}Bp|{\sim}p)}$

Intuitively, the likelihood ratio indicates how likely an agent is to believe that *p* when *p* is true as compared to how likely the agent is to believe that *p* when *p* is false. Accordingly, the likelihood ratio is positively dependent on both an agent's positive and negative reliability: any increase in an agent's positive or negative reliability will result in an increase in the agent's likelihood ratio.

However, there is reason not to rest content with the likelihood ratio as a measure of an agent's overall reliability. Although the likelihood ratio is positively dependent on both an agent's positive and negative reliability, it nevertheless depends in very different ways on them: while the likelihood ratio is a linear function of the agent's positive reliability, it is a positively accelerating power function of the agent's negative reliability (as illustrated in Figure 1). Intuitively, what this means is that the likelihood ratio tends to give different weight to an agent's positive and negative reliabilities. For example, an agent with a positive reliability of 60 % and a negative reliability of 30 % has a likelihood ratio of .6/(1 - .3) = .86, whereas an agent with a positive reliability of 30 % and a negative reliability of 60 % has a likelihood ratio of only .3/(1 - .6) = .75. In this case, the likelihood ratio gives more weight to the agent's positive reliability than to her negative reliability. In other cases, the opposite is the case. For example, an agent with a positive reliability of 50 % and a negative reliability of 80 % has a likelihood ratio of .5/(1 - .8) = 2.5, whereas an agent with a positive reliability of 80 % and a negative reliability of 50 % has a likelihood ratio of only .8/(1 - .5) = 1.6. Here the likelihood ratio gives more weight to the agent's negative reliability than to her positive reliability.[7]

[7] More generally, if A has positive reliability $x$ and negative reliability $y$, and B has positive reliability $y$ and negative reliability $x$, it is easily verified that A and B have the same likelihood ratio iff $x = y$ or $x + y = 1$.

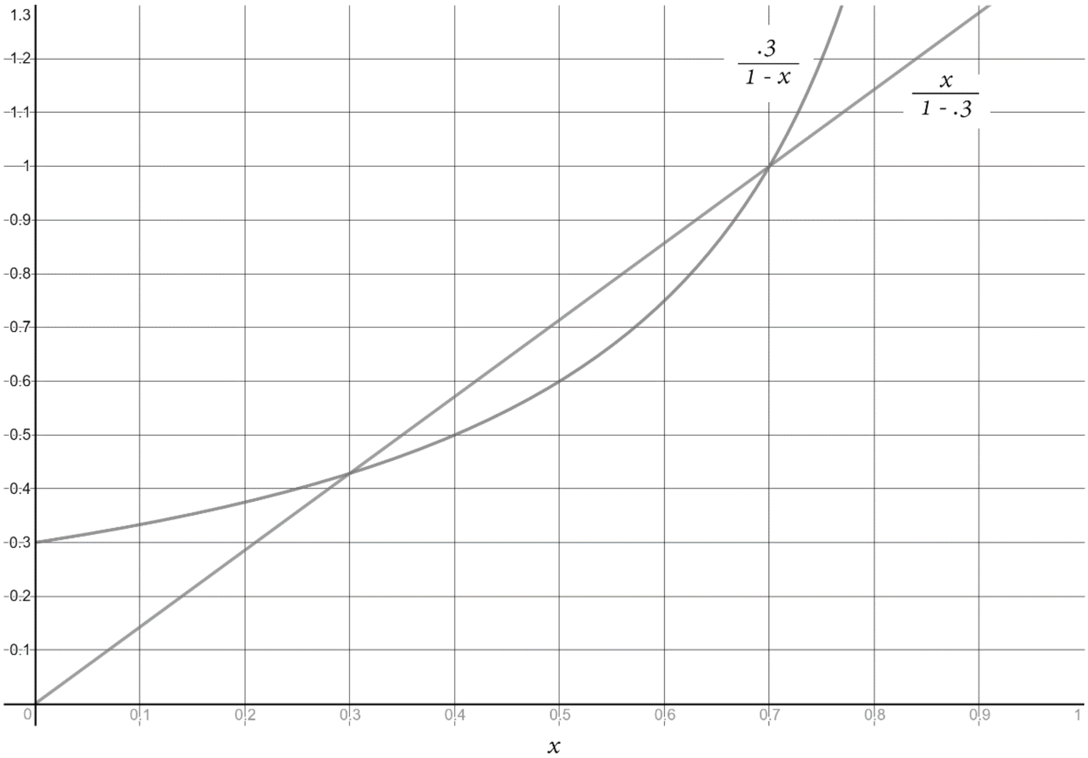


*__Figure 1:__ The straight line represents the likelihood ratio as a function of an agent's positive reliability (setting the agent's negative reliability to 30 % as an illustration). The curved line represents the likelihood ratio as a function of an agent's negative reliability (setting the agent's positive reliability to 30 % as an illustration).*

For present purposes, we find this behavior of the likelihood ratio problematic for a few different reasons. First, it is not clear that an agent's positive and negative reliability should ever be given different weight in determining the agent's overall reliability. From a purely epistemic point of view, it is far from clear that it is more important to believe what is true than to avoid believing what is false, or *vice versa*. Of course, there are those who argue that certain non-epistemic features of an agent's situation may influence the relative value of having true beliefs and avoiding false beliefs (see, e.g., Levi 1962 and Riggs 2008). To the extent that this sort of view is correct, certain pragmatic features of an agent's situation might play a role in determining how an agent's positive and negative reliabilities should be weighed against each other. But in any case, those who want to give different weight to an agent's positive and negative reliabilities will presumably prefer a reliability measure that, unlike the likelihood ratio, allows us to vary the weighting in a flexible manner, depending on relevant features of an agent's situation.

We shall therefore replace the likelihood ratio with a weighted average of an agent's positive and negative reliabilities (where $w_+$ and $w_-$ are the weights of the agent's positive and negative reliabilities respectively):

**Reliability (weighted average):** $$\frac{w_+ \cdot Pr(Bp|p) + w_- \cdot Pr(\sim Bp|\sim p)}{w_+ + w_-}$$

This reliability measure is also positively dependent on both an agent's positive and negative reliability: any increase in an agent's positive or negative reliability will result in an increase in the weighted average (as long as the weights are positive). Since an agent's positive and negative reliabilities both lie in the interval [0,1], the weighted average of those reliabilities also lies in the interval [0,1]. A reliability of 100 % corresponds to always believing that *p* when *p* is true, and never believing that *p* when *p* is false. Conversely, a reliability of 0 % corresponds to never believing that *p* when *p* is true, and always believing that *p* when *p* is false. In between these extremes, we find a spectrum of intermediate levels of reliability that can be reached by different combinations of positive and negative reliabilities. For instance, if we assume that $w_+ = w_-$, an agent with a positive reliability of 80 % and a negative reliability of 30 % will have the same overall reliability as an agent with a positive reliability of 60 % and a negative reliability of 50 %.

To keep matters relatively simple, we shall henceforth assume that $w_+ = w_-$, which means that the weighted average boils down to a simple linear average:

**Reliability (linear average):** $$\frac{Pr(Bp|p) + Pr(\sim Bp|\sim p)}{2}$$

We will use this linear average to represent the overall reliability of individual agents as well as group agents. In doing so, we do not want to suggest that the linear average of an agent's positive and negative reliabilities maps onto any substantive fact about an agent's 'true reliability'. The proposed reliability measure is simply meant as one reasonable way of filling in the details of a reliabilist conception of epistemic peerhood.[8]

[8] We shall sidestep potential issues concerning how the our notion of *reliability* relates to the question of what makes groups beliefs *justified*. In a recent paper, Lackey (2016, §8) has presented an argument, which purports to show that the kind of reliability that can be achieved at the group level as a result of a group's BAF and reliability profile cannot plausibly be regarded as what matters to whether the group's belief state is epistemically justified or not. A detailed discussion of Lackey's argument is beyond the scope of this paper. But even if a group's reliability is not what ultimately determines the justificatory status of the group's beliefs, it seems that a group's

Given this reliability measure, how do we determine the reliability of a group with a given BAF and given distribution of individual reliabilities among its members? Following List (2005), we will make the simplifying assumptions that the group members form their beliefs independently of each other, and that each group member's positive reliability is identical to her negative reliability.[9] These assumptions make it easier to determine a group's reliability as a function of the group's BAF and reliability profile. For example, if a group G uses majority voting and has an odd number $n$ of members with a reliability of $r$, we can determine G's reliability $r_G$ as follows:

$$r_G = \sum_{i=\frac{n+1}{2}}^{n} \frac{n!}{i!(n-i)!} r^i (1-r)^{n-i} \qquad \text{(Majority voting)}$$

By comparison, if G uses unanimity voting or dictatorship instead of majority voting, its reliability is instead given by:

$$r_G = \frac{r^n + 1 - (1-r)^n}{2} \qquad \text{(Unanimity voting)}$$

$$r_G = r \qquad \text{(Dictatorship)}$$

The complexity in determining a group's reliability obviously depends on the complexity of the group's BAF and reliability profile. But as long as the group's BAF and reliability profile are known, it should be possible to determine the group's reliability.

reliability could (a presumably would) still be epistemically relevant and, in particular, relevant for how groups should revise their belief in light of group peer disagreement.

[9] Note that even though each group member's positive reliability is identical to her negative reliability, the group might nevertheless have different positive and negative reliabilities.

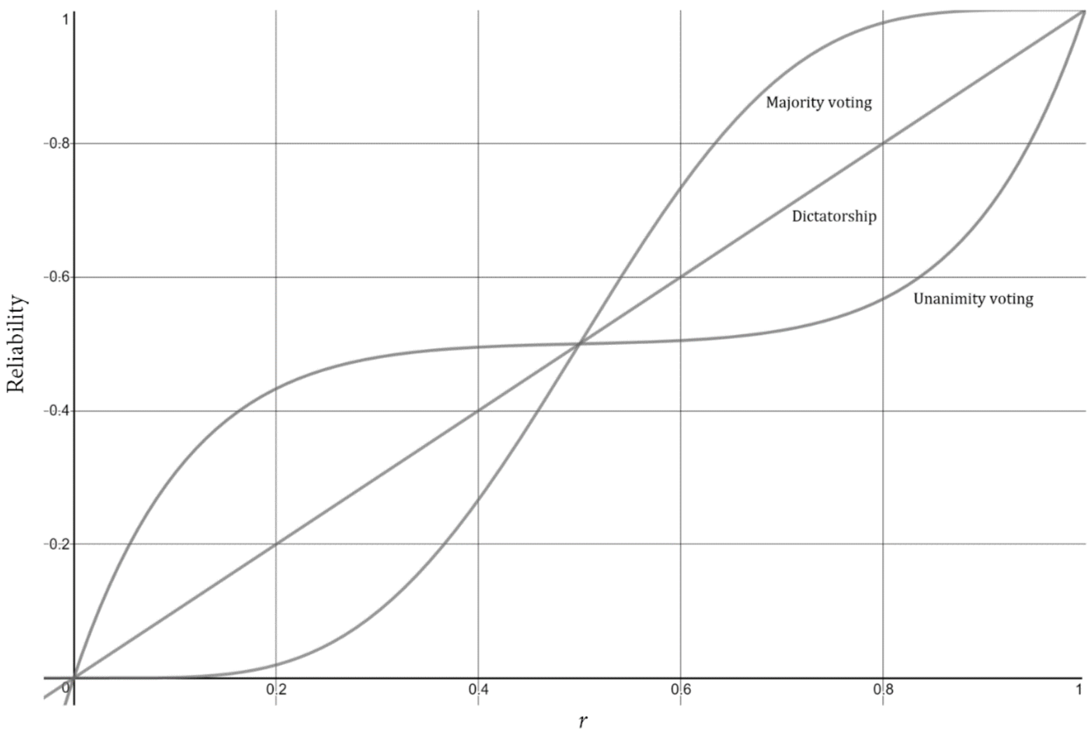


***Figure 2:*** *The graph shows how, relative to different BAFs, the reliability of a group with n equally reliable members depends on the members' shared reliability r (setting n = 9 as an illustration).*

It is worth pausing at this point to compare how well the three BAFs above serve to optimize G's reliability. As illustrated in Figure 2, G's reliability is greater under majority voting than under both unanimity voting and dictatorship given that G's members are more than 50 % reliable. By contrast, unanimity voting outperforms both dictatorship and majority voting given that the members are less than 50 % reliable. This already shows that the same BAF may perform very differently in different groups, depending on the reliability profiles of the groups. Later, in §3, we will say more about how to determine the optimal BAF for a given group, but for now it suffices to note that there is no "one size fits all" answer to the question of which BAF maximizes a group's reliability. Which BAF is optimal for a given group depends on the specifics of the reliability profile of that group.[10]

We are now ready to fill in the details of our reliabilist notion of peerhood: two agents A and B are epistemic peers with respect to a proposition *p* just in case A and B are equally reliable with respect to *p* (that is, just in case the average of A's positive and negative

[10] See also List (2005) who compares different BAFs as they perform with respect to a group's positive and negative reliabilities when taken separately.

reliabilities with respect to *p* is identical to the average of B's positive and negative reliabilities with respect to *p*). We will apply this account of epistemic peerhood to individuals as well as groups.

Given this account of peerhood, one might wonder whether the peerhood status of two groups depends in any systematic way on the peerhood status among individual members of the two groups. In particular, it might seem natural to think that two groups cannot be peers unless at least some of their members are peers. However, on the present picture, it turns out that member peerhood is neither necessary nor sufficient for group peerhood. A simple illustration is given in Table 2. The groups $G_1$ and $G_2$ are peers, although none of their members are peers. Conversely, the groups $G_1$ and $G_3$ are not peers, although all of their members are peers. Both results flow from the fact that a group's reliability is not only a function of the reliabilities of its members, but also of the group's BAF.

| $G_1$: Majority voting | | $G_2$: Dictatorship | | $G_3$: Unanimity voting | |
|---|---|---|---|---|---|
| | *r* | | *r* | | *r* |
| Member 1 | 75 % | Dictator | 84 % | Member 1 | 75 % |
| Member 2 | 75 % | Member 2 | 50 % | Member 2 | 75 % |
| Member 3 | 75 % | Member 3 | 50 % | Member 3 | 75 % |
| Group | 84 % | Group | 84 % | Group | 70 % |

***Table 2:*** *The groups $G_1$ and $G_2$ are peers, although none of their members are peers. Conversely, the groups $G_1$ and $G_3$ are not peers, although all of their members are peers.*

In light of these preliminary remarks on group disagreement and group peerhood, we are now in a position to formulate the kind of generic case of group peer disagreement that will be our focus in the remainder of the paper:

**Group Peer Disagreement**: Let $G_1$ and $G_2$ be two groups such that:

(a) $G_1$ and $G_2$ are epistemic peers with respect to a proposition *p*; and

(b) $G_1$ and $G_2$ disagree about *p*.

The question we are interested in is how, if at all, $G_1$ and $G_2$ should revise their beliefs about *p* in light of their mutual disagreement. To simplify our discussion, we will assume that neither group initially suspends judgment about *p*. Moreover, we will assume that both groups (or whoever makes the revision decision on behalf of the groups) possess the following three pieces of information about each group: (i) the group's BAF, (ii) the group's belief profile (that is, each group member's belief about *p*), and (iii) the group's reliability profile (that is, each group member's reliability with respect to *p*). In §4, we will discuss how one might relax this last assumption to accommodate cases where the groups have less information about each other. But initially, we will focus on the idealized case.

## 3. The Group Equal Weight View

As announced in the introduction, we will assume that a theory of group peer disagreement should satisfy a principle along the following lines:

> **Equal Weight Dictum**: The parties to a peer disagreement should place equal weight on each other's opinions.

This dictum, while intuitive, is obviously quite vague: what, exactly, does it mean to place 'equal weight' on two opinions? There already exist a number of proposals for how to place equal weight on *individual* beliefs. Perhaps the best-known proposal is the 'split the difference' view, according to which the parties to an individual peer disagreement should adopt their average credence in the disputed proposition. In a binary framework, this amounts to saying that the disagreeing parties should suspend judgment about the disputed proposition (assuming, as we do, that neither party initially suspends judgment about the disputed proposition).[11]

The question we are interested in here is, of course, what it means to place equal weight on two *group* beliefs. Since we think of group beliefs as binary (rather than graded) attitudes, an initially plausible interpretation of the Equal Weight Dictum for groups would be:

[11] In previous work, we have defended an alternative to the 'split the difference' interpretation of the Equal Weight Dictum for individuals (Rasmussen et al. 2017). See also Fitelson and Jehle (2009) for a discussion of different interpretations of the Equal Weight Dictum in the case of individual peer disagreement.

> **Uniform Conciliation**: In cases of group peer disagreement, both groups should suspend judgment about the disputed proposition.

This view is *prima facie* plausible, because any other attitude than suspension of judgment would seem to place extra weight on one of the groups' initial beliefs. If so, Uniform Conciliation is the only possible view that does not violate the Equal Weight Dictum.

Despite its initial appeal, however, Uniform Conciliation cannot ultimately be the right interpretation of the Equal Weight Dictum for groups. To see why, consider the following case:

> **Different Majority Sizes**: Two groups $G_1$ and $G_2$ each have a hundred members with individual reliabilities of 55 %. Both groups use majority voting. All of $G_1$'s members believe *p*, which means that $G_1$ believes *p*. Only 49 of $G_2$'s members believe *p*, which means that $G_2$ believes *~p*.

Since $G_1$ and $G_2$ use the same BAF and have the exact same reliability profile, they have the same group reliability, and hence face a mutual peer disagreement. So, according to Uniform Conciliation, the groups should suspend judgment about *p* in light of the disagreement. Yet, this seems like the wrong advice. After all, there is a clear majority in favor of *p* in the combined group (149 out of a total of 200 members in the combined group believe *p*, while only 51 members believe *~p*). Given that both groups know this, it seems unreasonable to suspend judgment about *p* rather than to believe that *p*.

We can motivate this verdict a little further by comparing the probability of *p* given $G_1$'s belief profile with the probability of *~p* given $G_2$'s belief profile. Since $G_1$'s majority in favor of *p* is very large (indeed, as large as it can possibly be), the probability of *p* given $G_1$'s vote is very close to 1 (more precisely, 99.9 %). By contrast, since $G_2$'s majority in favor of *~p* is very small (indeed, as small as it can possibly be), the probability of *p* given $G_2$'s vote is not very close to 0 (more precisely, 40.1 %). So, while $G_1$'s belief profile speaks very strongly in favor of *p*, $G_2$'s belief profile only speaks weakly in favor of *~p*. The reason, then, why Uniform Conciliation delivers the wrong verdict in Different Majority Sizes is that it fails to take into account the fact that $G_1$'s majority in favor of *p* is larger than $G_2$'s majority in favor of *~p*.

Someone might object that the asymmetry between the probability of *p* given $G_1$'s belief profile and the probability of *~p* given $G_2$'s belief profile shows that $G_1$ and $G_2$ were not peers to begin with. After all, how can the groups be peers if $G_1$'s belief profile has a significantly greater impact on the probability of *p* than does $G_2$'s belief profile? We think this worry rests on a mistaken way of thinking about peerhood, but we shall defer a detailed discussion of this worry to §4. For now, we proceed on the assumption that cases like Different Majority Sizes indeed count as cases of group peer disagreement.

Consider, next, the following alternative to Uniform Conciliation:

> **BAF-Dependent Conciliation**: In cases of group peer disagreement, each group should use its own BAF on all members in the combined group.

Contrary to Uniform Conciliation, this view delivers the right verdict in Different Majority Sizes. According to BAF-Dependent Conciliation, $G_1$ and $G_2$ should both use majority voting on the beliefs of all 200 members in the combined group, and since the majority of members in the combined group believe *p*, the groups should end up believing *p*. However, BAF-Dependent Conciliation runs into a different problem. Consider the following case:

> **Different Reliability Profiles**: Two groups $G_1$ and $G_2$ each have a hundred members. $G_1$ uses majority voting, and all of $G_1$'s members have individual reliabilities of 60 %. Only 49 of $G_1$'s members believe *p*, which means that $G_1$ believes *~p*. $G_2$ uses dictatorship, and $G_2$'s dictator has a reliability of 97 %. The rest of $G_2$'s members have individual reliabilities of 50 %. $G_2$'s dictator believes *p*, which means that $G_2$ believes *p*. The rest of $G_2$'s members believe *~p*.

Since $G_1$ uses majority voting and has a uniform reliability profile, we can use the equation from §2 to show that $G_1$ has a group reliability of 97 %. Thus, since $G_2$'s reliability is identical that of its dictator, the groups face a mutual peer disagreement. According to BAF-Dependent Conciliation, $G_1$ should retain its belief that *~p* upon disagreement, since there is a majority in the combined group in favor of *~p* (150 out of a total of 200 members in the combined group believe *~p*, while only 50 members believe *p*). Yet, this seems like the wrong recommendation. After all, *p* is considerably more probable than *~p* given all 200 beliefs in the combined group, since $G_2$'s highly reliable dictator believes that *p* while $G_1$'s majority in favor of *~p* is extremely small. Given that $G_1$ knows this, it seems unreasonable to retain its belief in *~p*.

The reason why BAF-Dependent Conciliation delivers the wrong verdict in Different Reliability Profiles is that $G_1$'s own BAF (i.e. majority voting) is ill-suited for the combined group—it does not do a good job in maximize the reliability of the combined group. This is because majority voting gives equal weight to all members regardless of their reliability they are. Yet, from a purely epistemic point of view, the members in the combined group should *not* be given equal weight, since they have very different reliabilities. In particular, $G_2$'s highly reliable dictator should be given much more weight than the rest of the members in the combined group.

This diagnosis leads to our final proposal:

> **Group Equal Weight View (GEW)**: In cases of group peer disagreement, each group should use the optimal BAF *for* the combined group *on* the combined group.

The key difference between GEW and BAF-Dependent Conciliation is that GEW advises the groups to use the *optimal* BAF for the combined group (i.e. the BAF that maximizes the combined group's reliability) rather than their *initial* BAFs. What motivates this requirement? Part of the motivation stems from the fact that the optimal BAF for the combined group seems like the only non-*ad hoc* alternative to the groups' initial BAFs. If the groups are to adopt new BAFs upon disagreement, it would seem arbitrary, if not unreasonable, to advise them to adopt a BAF that is not somehow well-suited for the combined group. Another part of the motivation stems from GEW's ability to handle cases like Different Majority Sizes and Different Reliability Profiles. However, before we can derive such verdicts from GEW, we need to know how to determine the optimal BAF for a given group.

Generally speaking, there are two features of a BAF that one might modify in order to maximize a group's reliability. First, there is what we will call the BAF's *weight profile*: roughly, a specification of how much weight is being placed on the beliefs of different group members in determining the degree to which the members collectively endorse a given proposition. For example, majority voting and unanimity voting both give equal weight to all members. By contrast, dictatorship gives no weight to all but a single member. To get more precise on the notion of a weight profile, let G be a group with $n$ members, let $r_i$ be the $i$th member's reliability with respect to a proposition $p$, let $b_i$ be the $i$th member's belief about $p$ (where $b_i = 1$ if the $i$th member believes $p$, and $b_i = 0$ if the $i$th member disbelieves $p$), and let $w_i$ be the weight assigned by G's BAF to $b_i$. The degree $c_G$ to which the members of G collectively endorse $p$ is then given by:

**Collective Endorsement:** $c_G = \frac{\sum_{i=1}^{n} w_i \cdot b_i}{\sum_{i=1}^{n} w_i}$

Since the value of $b_i$ (for $1 \leq i \leq n$) is either 0 or 1, the value of $c_G$ lies in the closed interval [0, 1]. If $c_G = 1$, G's members collectively endorse *p* to the highest possible degree: every member with a non-zero weight believes that *p*. Conversely, if $c_G = 0$, G's members collectively endorse *p* to the lowest possible degree: every member with a non-zero weight disbelieves *p*.

The second feature of a BAF that one might modify is what we will call the BAF's *belief threshold*, that is, a number between 0 and 1 representing the degree to which the members of G must collectively endorse *p* in order for G to form a belief that *p*. More precisely, if G's BAF has a belief threshold of *t*, and G's members collectively endorse *p* to degree $c_G$, then G believes *p* just in case $c_G > t$. To illustrate the idea, suppose G uses majority voting and that two out of G's three members believe *p* ($b_1 = b_2 = 1$ and $b_3 = 0$). Since majority voting places equal weight on all members, we get the following weight profile: $w_1 = w_2 = w_3$. Using this weight profile to determine the degree $c_G$ to which G's members collectively endorse *p*, we get: $c_G = .66$. Thus, since majority voting has a belief threshold of $t = .5$, G believes that *p*. By comparison, if G had used unanimity voting instead of majority voting, G would not have believed *p*, since unanimity voting has a belief threshold of $t = 1$.

The question, then, is how we find a combination of a belief threshold *t* and a weight profile $<w_1, \ldots ,w_n>$ that maximizes G's reliability $r_G$ given that G has a reliability profile of $<r_1, \ldots , r_n>$. The answer obviously depends on how we define 'reliability', but if we stick to the linear average of an agent's positive and negative reliability, the task becomes that of maximizing the following quantity:

$$2r_G = Pr(Bp|p) + Pr(\sim Bp|\sim p) = Pr(c_G > t|p) + Pr(c_G \leq t|\sim p)$$

$$= Pr\left(\frac{\sum_{i=1}^{n} w_i \cdot b_i}{\sum_{i=1}^{n} w_i} > t \,\middle|\, p\right) + Pr\left(\frac{\sum_{i=1}^{n} w_i \cdot b_i}{\sum_{i=1}^{n} w_i} \leq t \,\middle|\, \sim p\right).$$

As Nitzan and Paroush (1982) first showed, and Ben-Yashar and Nitzan (1997) later generalized, this optimization problem is solved by a weighted majority rule with a belief threshold of $t = .5$ and a weight profile that satisfies the following relationship:[12]

[12] See also Pettigrew (ms.) for a related discussion of how best to aggregate the credences of different, and potentially disagreeing, experts on some matter.

$$w_i \propto \log\left(\frac{r_i}{1 - r_i}\right).$$

This dependency ensures that agents with a reliability of less than 50 % are given negative weight, whereas agents with a reliability greater than 50 % are given positive weight. Agents with a reliability of precisely 50 % are given no weight at all. Moreover, an agent's weight approaches infinity, when the agent's reliability approaches 100 %. Conversely, an agent's weight approaches minus infinity, when the agent's reliability approaches 0 % (see Figure 3).[13]

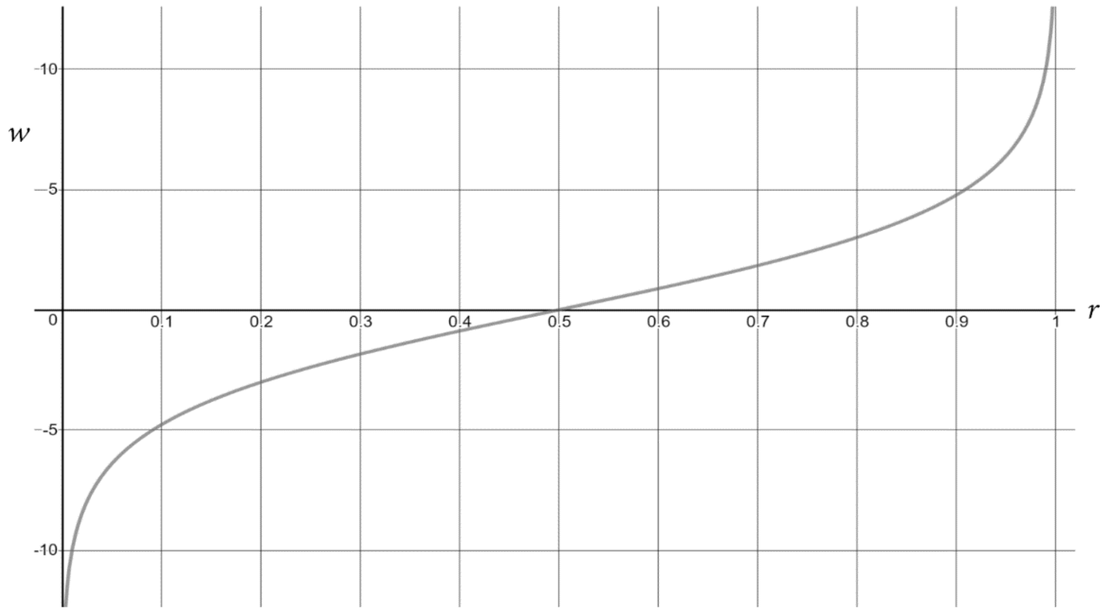


***Figure 3:*** *The graph shows how an agent's weight w depends on the agent's reliability r given that w is proportional to the logarithmic likelihood ratio log(r/(1-r)).*

We can now determine the optimal BAFs for the combined groups in Different Majority Sizes and Different Reliability Profiles. In both cases, the optimal BAF has a belief threshold of $t$ = .5, but the weight profile of the optimal BAF is not the same in both cases (see Table 3). In Different Majority Sizes, the optimal BAF has a uniform weight profile, which is unsurprising since the reliability profile in the combined group is uniform. As such, the optimal BAF for the combined group in Different Majority Sizes amounts to simple majority

[13] Different procedural considerations might, of course, speak against using the epistemically optimal BAF. For example, considerations of fairness might speak against giving uneven weight to members of the electorate in a democracy (see, e.g., List and Goodin 2001). But since our focus here is purely epistemic, we will not enter into a discussion of how to weigh epistemic and procedural considerations against each other.

voting. In Different Reliability Profiles, the optimal BAF has a non-uniform weight profile, which is also unsurprising since the reliability profile in the combined group is non-uniform. More precisely, $G_2$'s highly reliable dictator is given 8.6 times more weight than each of $G_1$'s members, and the remaining 49 members in $G_2$ (all of whom have a reliability of 50 %) are given no weight at all.

| | Reliability profile | Weight profile of optimal BAF |
|---|---|---|
| Different Majority Sizes | $r_1 = \cdots = r_{200} = .55$ | $w_1 = \cdots = w_{200} = 1$ |
| Different Reliability Profiles | $r_1 = \cdots = r_{99} = .50$<br>$r_{100} = \cdots = r_{199} = .6$<br>$r_{200} = .97$ | $w_1 = \cdots = w_{99} = 0$<br>$w_{100} = \cdots = w_{199} = 1$<br>$w_{200} = 8.6$ |

***Table 3**: In Different Majority Sizes, the optimal BAF has a uniform weight profile, because the reliability profile of the combined group is uniform. By contrast, in Different Reliability Profiles, the optimal BAF has non-uniform weight profile, because the reliability profile of the combined group is non-uniform.*

It is worth noting that there is not in general a unique optimal BAF for any given group. Typically there will be a whole set of optimal BAFs, all of which yield the same group reliability. For instance, in Different Reliability Profiles, we can change the value of $w_{200}$ from 8.6 to any other value in the open interval ]8,10[ without thereby changing the reliability of the combined group. The reason for this is that the reliability of the combined group is a step-function of $w_{200}$ (as illustrated in Figure 4).[14] Consequently, the BAF described in Table 3 is just one of a range of optimal BAFs, and GEW does not discriminate among equally well-suited BAFs.

[14] More precisely, the reliability $r_G$ of the combined group in Different Reliability Profiles depends on the weight $w_{200}$ of the dictator in $G_2$ in the following way:

$$r_G = .97\cdot \sum_{i=(101-w_{200})/2}^{100} \frac{100!}{i!(100-i)!}\cdot .6^i\cdot(1-.6)^{100-i} + (1-.97)\cdot \sum_{i=(101+w_{200})/2}^{100} \frac{100!}{i!(100-i)!}\cdot .6^i\cdot(1-.6)^{100-i}.$$

Now that we have determined the (or rather *an*) optimal BAF for the combined groups in Different Majority Sizes and Different Reliability Profiles, we need to calculate the degree to which the members of the combined groups collectively endorse the disputed proposition:

$$c_G = \frac{\sum_{i=1}^{n} w_i \cdot b_i}{\sum_{i=1}^{n} w_i} = \frac{\sum_{i=1}^{200} b_i}{200} = .74 \qquad \text{(Different Majority Sizes)}$$

$$c_G = \frac{\sum_{i=1}^{n} w_i \cdot b_i}{\sum_{i=1}^{n} w_i} = \frac{\sum_{i=100}^{199} b_i + 8.6 \cdot b_{100}}{100 + 8.6} = .53 \qquad \text{(Different Reliability Profiles)}$$

In both cases, the members of the combined group collectively endorse $p$ to a higher degree than the relevant belief threshold of $t = .5$, which means that GEW advises both pairs of groups to believe that $p$ upon disagreement. Thus, unlike Uniform Conciliation and BAF-Dependent Conciliation, GEW delivers the intuitively right verdicts in Different Majority Sizes and Different Reliability Profiles.

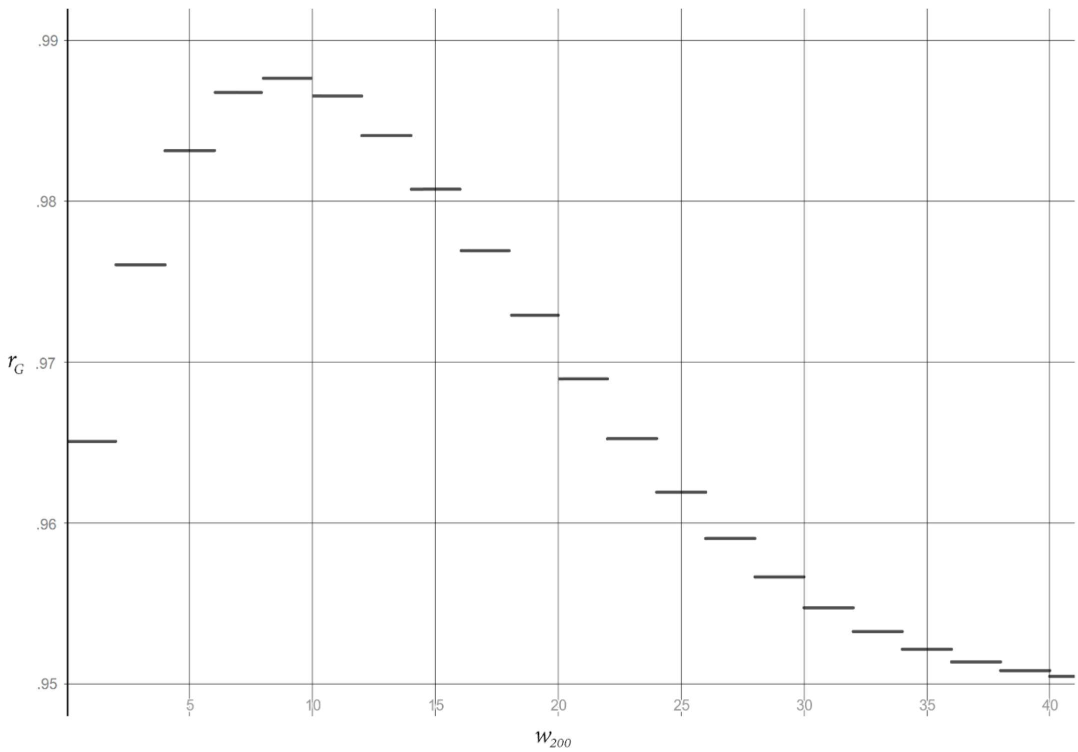


***Figure 4***: *In Different Reliability Profiles, the reliability $r_G$ of the combined group is a step-function of $w_{200}$ with a maximum on the open interval ]8,10[.*

This completes our initial presentation and motivation of our favored view of group peer disagreement. Obviously, we have only tested the view against a limited range of cases, and further refinements may prove necessary. Indeed, one might even doubt that any single theory of group peer disagreement can accommodate all cases without exception.[15] But at the very least, we hope to have said enough to make it worthwhile scrutinizing GEW in further detail. In the following section, we examine seven potential worries about GEW that have come to our attention. Defending GEW against these worries will also give us the opportunity to highlight and clarify various notable features and implications of the view.

## 4. Objections to GEW

### 4.1 First objection: GEW violates the Equal Weight Dictum

The first worry we want to examine concerns the fact that GEW sometimes advises only *one* of the disagreeing peer groups to revise its belief. We have already seen two such examples, viz. Different Majority Sizes and Different Reliability Profiles. Yet, doesn't GEW thereby imply, contrary to the Equal Weight Dictum, that disagreeing peer groups should sometimes *not* place equal weight on each other's opinions? The answer depends on what we understand by 'equal weight'. On one understanding, GEW does indeed violate the Equal Weight Dictum in virtue of saying that disagreeing peer groups should sometimes revise their beliefs in a non-uniform manner. This interpretation of the Equal Weight Dictum is what gave Uniform Conciliation its initial appeal. However, as we saw in §3, Uniform Conciliation runs into problems, because it fails to take into account epistemically relevant details about the belief profiles of the disagreeing groups. As such, we take it to be a strength of GEW that it violates the Equal Weight Dictum interpreted this way.

On another understanding, GEW satisfies the Equal Weight Dictum in virtue of saying that disagreeing peer groups should always use the optimal BAF for the combined group on all members of both groups alike. This is the sense in which GEW should be understood as an equal weight view of group peer disagreement. And, as we have seen, this interpretation of the Equal Weight Dictum makes room for cases of non-uniform belief revision such as Different Majority Sizes and Different Reliability Distributions. Obviously, it also makes room for cases of uniform belief revision. Suppose, for example, that the groups in Different Majority Sizes

[15] See Heesen and van der Kolk (2016) for considerations in this direction.

had identical belief profiles, or that the groups in Different Reliability Profiles had identical reliability profiles. So, in general, the question of whether disagreeing peer groups should revise their beliefs in a uniform manner or not depends on specific details of the groups' belief profiles and reliability profiles. The only recommendation that GEW always gives is that *at least one* of the disagreeing peer groups should revise its belief. The obvious reason is that disagreeing peer groups who comply with GEW will always end up agreeing in virtue of applying the same BAF (viz. the optimal BAF for the combined group) to the same set of belief states (viz. the total set of belief states of the members in the combined group). So, given that the groups initially disagreed, at least one of the groups will have to revise its belief in light of the disagreement.

### 4.2 Second objection: GEW conflicts with the equal weight view of individual peer disagreement

A related worry concerns how GEW relates to the equal weight view of individual peer disagreement. On every reasonable interpretation of the Equal Weight Dictum, the parties to an individual peer disagreement should always revise their beliefs in a uniform manner. Yet, as we have seen, GEW implies that the parties to a group peer disagreement should *not* always revise their beliefs in a uniform manner. This raises the worry that GEW is somehow in conflict with the equal weight view of individual peer disagreement.

On closer inspection, however, GEW turns out to be fully consistent with the equal weight view of individual peer disagreement. To see why, consider how GEW handles cases of group peer disagreement between groups with only a single member. Let $G_1$ and $G_2$ be two single-member groups and let $m_1$ and $m_2$ be their single members, where $G_i$'s belief about $p$ is simply given by $m_i$'s belief about $p$. Assuming that $m_1$ and $m_2$ are peers and that they disagree about $p$, $G_1$ and $G_2$ face a mutual group peer disagreement. Moreover, GEW trivially implies that $G_1$ and $G_2$ should suspend judgment about $p$ upon disagreement. So, according to GEW, disagreeing single-member peer groups should always suspend judgment about the disputed proposition. We take this result to be in line with the equal weight view of individual peer disagreement.

### 4.3 Third objection: GEW is based on the wrong notion of peerhood

Previously, in §3, we anticipated the worry that GEW is based on a flawed notion of peerhood, because it allows for cases like Different Majority Sizes, in which two groups $G_1$ and $G_2$ are peers, although the probability of *p* given $G_1$'s belief profile differs considerably from the probability of ~*p* given $G_2$'s belief profile. Why not instead say that two groups $G_1$ and $G_2$ are epistemic peers with respect to a proposition *p* just in case the absolute difference between .5 and the probability of *p* given $G_1$'s belief profile is identical to the absolute difference between .5 and the probability of *p* given $G_2$'s belief profile? This would prevent cases like Different Majority Sizes from counting as cases of group peer disagreement, and hence restore Uniform Conciliation as a viable interpretation of GEW.

While we doubt that there is a uniquely correct notion of peerhood out there to be discovered, we can think of at least four reasons to prefer our reliabilist conception of peerhood to the 'probabilist' conception of peerhood suggested above. First, our reliabilist conception of peerhood reflects the way in which epistemic performance is typically measured in the belief aggregation literature (see, e.g., List 2005). As such, our reliabilist conception of peerhood makes it easy to see how GEW related to the rest of the belief aggregation literature.

Second, the probabilist conception of peerhood has the implication that whether two groups are peers with respect to a proposition *p* can be determined only *after* the group members have given their votes about *p*. This deviates considerably from existing evidentialist and reliabilist notions of peerhood, all of which allow peerhood relations to be established independently of the disagreement at hand. So, here is another respect in which we take our reliabilist conception of peerhood to be in better alignment with existing conceptions of peerhood.

Third, the probabilist conception of peerhood implies that a strictly fewer number of pairs of groups will count as epistemic peers, since all groups who are peers in the probabilist sense will also be peers in our reliabilist sense, but not *vice versa*. Consequently, a theory of group peer disagreement based on the probabilist conception of peerhood will apply to a strictly narrower range of cases than does GEW. So, also for reasons of generality, we find our reliabilist conception of peerhood preferable to the probabilist alternative.

Finally, we would like to point out that someone who prefers a probabilist conception of peerhood remains free to accept GEW as it applies to those cases in which the groups are peers in the probabilist sense. Plausibly, in such cases, the disagreeing groups should suspend judgment about the disputed proposition, since their beliefs speak equally strongly for and against the disputed proposition. GEW seems to deliver precisely this result. For example, the groups in Same Majority Size and Same Reliability Profiles are peers in the probabilist sense, and, as shown in §4.1, GEW advises both of these pairs of groups to suspend judgment about the disputed proposition.

### 4.4 Fourth objection: GEW renders group disagreement and group peerhood epistemically irrelevant

A notable property of GEW is that its verdicts about how the parties to a group peer disagreement should revise their beliefs depend solely on the groups' reliability profiles and belief profiles: the groups' reliability profiles determine which BAF is optimal for the combined group, and their belief profiles determine which set of individual belief states the optimal BAF should be used to aggregate. Furthermore, as we saw in §2, there is no straightforward connection between how two groups' reliability profiles and belief profiles compare, and whether those groups are peers and/or disagree. As a result, GEW implies that the fact that two groups are peers and disagree is not directly relevant for how the groups should revise their beliefs. What *is* directly relevant, according to GEW, is the beliefs and reliabilities of the group members.

This might strike someone as a puzzling result. How can GEW be a satisfying view of group peer disagreement, if its verdicts are not somehow influenced by the fact that the groups in question are peers and that they disagree? In response to this worry, we want to maintain that there are good reasons to think that a theory of group peer disagreement in fact *should* render disagreement and peerhood epistemically irrelevant. As we have seen, a group peer disagreement need not be the result of a difference of opinion among equally reliable group members, since different BAFs may yield different group beliefs and different group reliabilities given the same belief profile and reliability profile (and, conversely, different BAFs may yield the same group beliefs and same group reliabilities given different belief profiles and reliability profiles). So, the fact that two groups are peers and disagree may simply be a product of an epistemically irrelevant factor, namely the BAFs initially used by the groups.

We may further illustrate this point by considering a variation of Different Reliability Profiles:

> **Non-Peer Agreement**: Two groups $G_1$ and $G_2$ each have a hundred members. $G_1$ uses dictatorship, and $G_1$'s dictator has a reliability of 60 %. The rest of $G_1$'s members also have a reliability of 60 %. 51 of $G_1$'s members believe *p*, including $G_1$'s dictator, which means that $G_1$ believes *p*. $G_2$ uses majority voting, and $G_2$'s dictator has a reliability of 97

> %. The rest of $G_2$'s members have a reliability of 50 %. $G_2$'s dictator believes *p*, which means that $G_2$ believes *p*. The rest of $G_2$'s members believe ~*p*.

Here $G_1$ and $G_2$ are neither peers, nor do they disagree: $G_2$ is obviously more reliable than $G_1$, and both groups believe that *p*. Yet, since the groups have the exact same belief profiles and reliability profiles as the groups in Different Reliability Profiles, GEW advises both pairs of groups to believe *p* upon learning about each other's opinions. Moreover, we take this to be the correct advice given that it is irrelevant, from a purely epistemic point of view, that the groups in Non-Peer Agreement initially used different BAFs than those initially used by the groups in Different Reliability Profiles. What *is* epistemically relevant is which BAF is optimal for the combined group, and this is the same in both cases. As such, we consider it a strength and not a weakness of GEW that its verdicts are not directly influenced by the fact that two groups are peers and disagree.

It is worth noting that matters are importantly different in the case of individual peer disagreement. An individual peer disagreement is always the result of a difference of opinion among equally reliable individuals, which means that the fact that two individuals are peers and that they disagree is always the product of epistemically relevant factors, namely the individuals' initial beliefs and reliabilities. So, the fact that two individuals are peers and that they disagree is always directly relevant for how they should revise their beliefs. This marks a central difference between individual peer disagreement and group peer disagreement, which is due to the role that BAFs play in the formation of group beliefs.

Still, one might wonder why we present GEW as a theory of *group peer disagreement*, if the view applies to a wider range of cases in which the groups are not peers and/or do not disagree. Why not instead understand GEW as a *general* theory of how groups should revise their beliefs upon learning the beliefs of other groups? We want to offer two comments in reply to this sort of suggestion. First, we take it to be a strength of GEW if the view turns out to apply beyond cases of group peer disagreement. However, our aim has not been to develop a fully general theory of how group should revise their beliefs upon learning the beliefs of other groups. So, to avoid premature generalizations, we do not want to say that groups should always comply with GEW when learning about the beliefs of other groups. Second, if we are right in claiming that a theory of group peer disagreement should render disagreement and peerhood epistemically irrelevant, we should *expect* a theory of group peer disagreement to also apply to cases like Non-Peer Agreement. The fact that GEW applies beyond cases of group peer disagreement is not an artefact of the view, but a consequence of the role that BAFs play in determining whether two groups are peers and whether they disagree. Those who find this consequence undesirable might take it as a reason to reject the aggregation model of group belief. But this would still leave intact the claim that *if* the aggregation model of group belief is correct, then a theory of group peer disagreement should render peerhood and disagreement epistemically irrelevant; and we take this conditional claim to be important and interesting in its own right.

A final worry concerning the fact that GEW renders group peerhood and group disagreement epistemically irrelevant goes as follows: if GEW effectively implies that the parties to a group peer disagreement should simply ignore the group peer disagreement itself, and instead look at the individual beliefs and reliabilities of the group members, doesn't this undermine the interest in the question we have set out to explore in this paper?[16] We want to address this worry by offering three reasons to think that the present project remains important and interesting despite the fact that GEW renders group peerhood and group disagreement epistemically irrelevant. First, as already mentioned in the introduction, group disagreement is a relatively new and underexplored topic. As such, we take it to be an open question whether there is a distinct problem of group disagreement over and above the problem of individual disagreement. If it turns out that the problem of group disagreement can be solved by looking solely at the level of the group members' beliefs and reliabilities, this would itself be an interesting result. For the reasons given below, we do not in fact think that GEW implies anything this strong. But in any case, part of the interest of our investigation derives from the light it may shed on the question of whether there is a distinct problem of group peer disagreement in the first place.

Second, although GEW implies that two parties $G_1$ and $G_2$ to a group peer disagreement should revise their beliefs in a way that depends solely on the beliefs and reliabilities of the group members, it does not thereby render it irrelevant that $G_1$ and $G_2$ are groups rather than mere collections of individuals. For one thing, the fact that $G_1$ and $G_2$ are groups means that they are to aggregate the beliefs of their group members in the first place. Had $G_1$ and $G_2$ been mere collections of individuals, there would be no question as to what the groups should believe at any point. Hence, there is a trivial sense in which it is relevant that $G_1$ and $G_2$ are groups. Less trivially, the fact that $G_1$ and $G_2$ are groups is what gives rise to one of the central

[16] We are grateful to an anonymous referee for bringing this worry to our attention.

differences between GEW and the equal weight view of individual peer disagreement, namely that GEW sometimes recommends only *one* of the parties to a group peer disagreement to revise its initial group belief. As explained in §3 and §4.1, this result flows from the fact that group beliefs are the outputs of BAFs, whereas individual beliefs are not. So, here is another sense in which there is a role to play, on our view, for the fact that $G_1$ and $G_2$ are groups rather than mere collections of individuals.

Finally, although there is a sense in which GEW renders group peerhood and group disagreement epistemically irrelevant, GEW nevertheless amounts to a substantive view of group peer disagreement that offers non-trivial advice about how the parties to a group peer disagreement should resolve the disagreement. The fact that GEW's advice is a function solely of the group members' beliefs and reliabilities does not mean that GEW fails to be a view of group peer disagreement, nor does it mean that group peer disagreement is not a genuine phenomenon worth our interest. All it means is that what ultimately matters, from an epistemic point of view, is the beliefs and reliabilities of the group members; not those of the groups.

### 4.5 Fifth objection: GEW is inconsistent with the aggregation model of group belief

The fifth worry we want to examine concerns how GEW relates to the aggregation model of group belief. The way we have introduced the aggregation framework, a group's belief state is represented as the output of a BAF whose input consists solely of the set of belief states of the group's members. Yet, if two disagreeing peer groups comply with GEW, they will end up with belief states that are *not* the result of applying a BAF *solely* to the belief states of their own members. Rather, they will end up with belief states that are the result of applying a BAF to the belief states of their own members *and* the belief states of the members of another group. As such, it looks like GEW is in tension with the aggregation model of group belief.

We can think of at least two ways of responding to this worry. First, we might deny that GEW conflicts with the aggregation model of group belief by saying that peer groups merge into a single group upon revising their beliefs in light of a mutual disagreement. The viability of this proposal obviously depends on one's view about how groups are individuated, and we do not want to take a stance on this issue here. However, we suspect that most collective epistemologists will resist the claim that whenever two peer groups revise their beliefs in light to a mutual disagreement, the groups will inevitably merge into a single combined group. After all, the groups need not jointly satisfy any of the criteria that are typically used to individuate groups (see, e.g., List 2005 and Pettit 2010): they need not have a common aim or goal, and they need not display any structural or organizational unity. So it might not be a promising strategy to deny that there is a tension between GEW and the standard aggregation model of group belief.

The second option is to grant that GEW is in conflict with the aggregation model of group belief, but instead take this to show that the aggregation framework needs to be revised to allow for a group's belief state to depend partly on the belief states of individuals *outside* the group. We actually find this view of group belief independently quite plausible. For example, it seems that the board of a corporation may well decide to let its judgment on some matter depend in part on the judgment of a disinterested party outside of the corporation. Similarly, nothing seems to prevent a scientific research group from asking a colleague from another research group to analyze a data set, and include his or her analysis in the overall assessment of the data. So we find it at least *prima facie* reasonable to base GEW on a version of the aggregation framework that allows for group beliefs to depend partly on the beliefs of non-members.

### 4.6 Sixth objection: GEW puts groups in a doxastically unstable position

Another notable property of GEW is that it advises disagreeing peer groups to revise their beliefs in a way that does not affect the belief states of their members. The belief revision is instead brought about by a change of BAF together with an extension of the set of individual belief states on which the BAF is used. Yet, it is natural to think that the members of two disagreeing peer groups should (at least sometimes) revise their beliefs. After all, how could a proponent of the Equal Weight Dictum maintain that individuals should always revise their beliefs in the face of individual peer disagreement, but never revise their beliefs in the face of group peer disagreement?

Yet, if the members of two disagreeing peer groups should (at least sometimes) revise their beliefs about the disputed proposition, the worry arises that groups who comply with GEW will end up in a doxastically unstable position. For suppose that two disagreeing peer groups revise their beliefs in accordance with GEW, and suppose that their group members likewise revise their individual beliefs in the appropriate manner (whatever the appropriate manner might be). It then follows that the resulting group beliefs will not be an aggregation of the members' *resulting* beliefs, but rather an aggregation of the members' *initial* beliefs. Thus, it looks like the groups will have to revise their beliefs a second time in order to stay "up to date" with their members' beliefs. Doesn't this show that GEW cannot be the whole story about how groups should revise their beliefs in the face of group peer disagreement?

We think it is clearly right that the members of two disagreeing peer groups should sometimes revise their beliefs about the disputed proposition. Also, it might well be that, in such cases, the disagreeing groups should make belief revisions that go beyond those advised by GEW. However, it seems to us that such additional requirements should not be accounted for by a theory group peer disagreement. To see why, note that two peer groups may well disagree even if none of their members are aware of the disagreement. Suppose, for instance, that two peer groups each hire an outside spokesperson to make a revision decision on behalf of the group upon having met with the other group's spokesperson. In this sort of case, none of the group members will know whether the groups disagree or not, and hence cannot be expected to revise their beliefs. We take this to show that it is not an essential part of a group peer disagreement that the group members should revise their beliefs about the disputed proposition. Accordingly, we find it misguided to require of a theory of group peer disagreement that it be able to account for how the members of two disagreeing peer groups should revise their beliefs in cases where such a revision is called for. This is simply the job of another theory.

### 4.7 Seventh objection: GEW is overly idealized

The seventh worry centers on the fact that GEW has been developed to handle fairly idealized cases of group peer disagreement in which each group possesses the following three pieces of information about both groups: (i) the group's BAF, (ii) the group's belief profile, and (iii) the group's reliability profile. But disagreeing peer groups obviously need not possess this much information about each other. In fact, it seems likely that most realistic cases of group peer disagreement will involve some degree of uncertainty about (i)-(iii). This raises the worry that GEW is only applicable to a very limited range of cases.

While we will not attempt to generalize GEW in any systematic fashion here, we would like to illustrate how GEW may be applied in its current form to cases of group peer disagreement in which there is uncertainty about (i)-(iii). One might consider a whole range of cases corresponding to different stocks of information that disagreeing peer groups might have about each other, but here we will focus on a case in which the groups are deprived of any information about the other group's belief profile:

**Underdetermined Belief Profiles**: Two peer groups $G_1$ and $G_2$ disagree about a proposition *p*: $G_1$ believes *p*, and $G_2$ believes ~*p*. $G_1$ and $G_2$ both use majority voting on 100 equally reliable members (with a reliability of more than 50 %). $G_1$ has a large majority in favor of *p*: 95 of $G_1$'s members believe *p*. By contrast, $G_2$ has a small majority in favor of ~*p*: only 55 of $G_2$'s members believe ~*p*. $G_1$ knows that $G_2$ is a peer, that $G_2$ disagrees about *p*, that $G_2$ uses majority voting, and that $G_2$ has a uniform reliability profile. Likewise, $G_2$ knows that $G_1$ is a peer, that $G_1$ disagrees with $G_2$ about *p*, that $G_1$ uses majority voting, and that $G_1$ has a uniform reliability profile.

How should $G_1$ and $G_2$ revise their beliefs about *p* in order to comply with GEW ? The groups are obviously not in a position to determine with certainty which set of beliefs the optimal BAF for the combined group (which is majority voting, since the reliability profile in the combined group is uniform) should be used on, since they do not know each other's belief profiles. So GEW does not deliver a verdict in the same straightforward manner as it does in the kinds of cases discussed so far.

Nevertheless, we think that GEW *can* be used to reach a reasonable verdict in Underdetermined Belief Profile. As a first step, let us distinguish three mutually exclusive and exhaustive scenarios that are compatible with $G_1$'s information about $G_2$. In the first scenario, more than 95 of $G_2$'s members believe ~*p*, in which case $G_1$ should adopt a belief that ~*p* upon disagreement. In the second scenario, precisely 95 of $G_2$'s members believe ~*p*, in which case $G_1$ should suspend judgment about *p* upon disagreement. In the third scenario, less than 95 of $G_2$'s members believe ~*p*, in which case $G_1$ should retain its belief that *p* upon disagreement. Now, the third scenario is clearly more probable than the two first scenarios in light of $G_1$'s lack of information about $G_2$'s belief profile. So if $G_1$ is to use GEW to reach a reasonable revision decision, $G_1$ should retain its belief that *p* upon disagreement.

Likewise, we can distinguish three mutually exclusive and exhaustive scenarios that are compatible with $G_2$'s information about $G_1$. In the first scenario, more than 55 of $G_1$'s members believe *p*, in which case $G_2$ should adopt a belief that *p* upon disagreement. In the second scenario, precisely 55 of $G_1$'s members believe *p*, in which case $G_2$ should suspend judgment about *p* upon disagreement. In the third scenario, less than 55 of $G_1$'s members believe *p*, in which case $G_2$ should retain its belief that ~*p* upon disagreement. Here the first scenario is much more probable than the second and third scenario in light of $G_2$'s lack of information about $G_1$'s belief profile. So if $G_2$ is to use GEW to reach a reasonable revision decision, $G_2$ should adopt a belief that *p* upon disagreement. Thus, while we have developed GEW with an eye to cases of group peer disagreement in which there is no uncertainty about (i)-(iii), we think there is a natural way of extending the view to less idealized cases.

## 5. Summary

We began this paper by exploring what it means for two groups to face a mutual peer disagreement insofar as we accept the aggregation model of group belief. A notable outcome of this investigation was that differing beliefs profiles is neither necessary nor sufficient for group disagreement, and that differing reliability profiles is likewise neither necessary nor sufficient for group peerhood. Both of these results followed from the fact that a group's belief and reliability is a function not only of its belief profile and reliability profile, but also of its belief aggregation function. This is why there is no direct connection between group disagreement/peerhood and member disagreement/peerhood on the present picture.

We went on to evaluate three different views of group peer disagreement that one might take to cohere with the equal weight view of individual peer disagreement. The view that seemed most promising to us says that the parties to a group peer disagreement should adopt the belief that results from applying the optimal belief aggregation function *for* the combined group *on* the combined group. We showed that this view implies that whether or not two disagreeing peer groups should revise their beliefs in a uniform manner depends on specific details about the groups' reliability distributions and belief distributions. As such, the proposed view implies that sometimes only *one* of the parties to a group peer disagreement should revise its initial belief, and other times *both* parties to a group peer disagreement should revise their initial beliefs. Another notable implication of the proposed view is that the parties to a group peer disagreement should revise their beliefs in a way that depends solely on the beliefs and reliabilities of the group members, and not on those of the groups. We argued that, although puzzling at first sight, this result is ultimately desirable, since a group's belief and reliability is partly determined by an epistemically irrelevant factor, namely the group's belief aggregation function.

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**References**

Ben-Yashar, R. and S. Nitzan (1997): "The Optimal Decision Rule for Fixed-Size Committees in Dichotomous Choice Situations: The General Result" In: *International Economic Review* 38, pp. 175-86.

Bright, L. K., H.Dang, and R. Heesen (2017): "A Role for Judgment Aggregation in Coauthoring Scientific Papers." In: *Erkenntnis*, online first.

Carter, A. (2014): "Group Peer Disagreement." In: *Ratio* 29, pp. 11-28.

Christensen, D. (2007): "Epistemology of Disagreement: The Good News." In: *The Philosophical Review* 116, pp. 187-217.

——— (2016): "Conciliation, Uniqueness, and Rational Toxicity." In: *Noûs* 50, pp. 584-603.

Easwaran, K., L. Fenton-Glynn, C. Hitchcock, and J. Velasco (2016): "Updating on the Credences of Others: Disagreement, Agreement, Synergy." In: *Philosophers' Imprint* 16, pp. 1-36.

Elga, A. (2007): "Reflection and Disagreement." In: *Noûs* 41, pp. 478-502.

Fitelson, B. and D. Jehle (2009): "What is the Equal Weight View?" In: *Episteme* 6, pp. 280-293.

Gilbert, M. (1987): "Modelling Collective Belief." In: *Synthese* 73, pp. 185-204.

Goldman, A. (2011): "Social Process Reliabilism: Solving Justification Problems in Collective Epistemology." In: *Essays in Collective Epistemology*, J. Lackey (Ed.), Oxford: Oxford University Press.

——— (2001): "Experts: Which Ones Should You Trust?" In: *Philosophy and Phenomenological Research* 63, pp. 85-110.

Hakli, R. (2006): "Group Beliefs and the Distinction Between Belief and Acceptance" In: *Cognitive Systems Research* 7, pp. 286-97.

Hartmann, S. and J. Sprenger (2012): "Judgment Aggregation and the Problem of Tracking the Truth" In: *Synthese* 187, pp. 209-21.

Heesen, R. and P. van der Kolk (2016): "A Game-Theoretic Approach to Peer Disagreement." In: *Erkenntnis* 81, pp. 1345-68.

Kelly, T. (2010): "Peer Disagreement and Higher-Order Evidence." In: *Social Epistemology: Essential Readings*, A. Goldman and D. Whitcomb (Eds.), Oxford: Oxford University Press, pp. 183-217.

Lackey, J. (2016): "What is Justified Group Belief?" In: *The Philosophical Review* 125, pp. 341-396.

Lam, P. (2011): “On the Rationality of Belief-Invariance in Light of Peer Disagreement.” In: *The Philosophical Review* 120, pp. 207-45.

Levi, I. (1962): “On the Seriousness of Mistakes.” In: *Philosophy of Science* 29, pp. 47-65.

Levinstein, B. (2015): “With All Due Respect: The Macro-Epistemology of Disagreement.” In: *Philosophers' Imprint* 15.

List, C. (2005): “Group Knowledge and Group Rationality.” In: *Episteme* 2, pp. 25-38.

List, C. and R. Goodin (2001): “Epistemic Democracy: Generalizing the Condorcet Jury Theorem.” In: *The Journal of Political Philosophy* 9, pp. 277-306.

List, C. and P. Pettit (2002): “Aggregating Sets of Judgments: An Impossibility Result.” In: *Economics and Philosophy* 18, pp. 89-110.

——— (2011): *Group Agency: The Possibility, Design, and Status of Corporate Agents*. Oxford: Oxford University Press.

Magnus, P. D. (2013): “What Scientists Know is not a Function of What Scientists Know.” In: *Philosophy of Science* 80, pp. 840-49.

Nitzan, S. and J. Paroush (1982): “Optimal Decision Rules in Uncertain Dichotomous Choice Situations.” In: *International Economic Review* 23, pp. 289-97.

Pettit, P. (2001): “Deliberative Democracy and the Discursive Dilemma.” In: *Philosophical Issues* 11, pp. 268-99.

Pettigrew, R. (ms.): “Aggregating Incoherent Experts.” Unpublished manuscript.

Rasmussen, M. S., A. Steglich-Petersen and J.C. Bjerring (2017): “A Higher-Order Approach to Disagreement.” In: *Episteme*. Online first.

Riggs, W. (2008): “Epistemic Risk and Relativism.” In: *Acta Analytica* 23, pp. 1-8.

Schmitt, F. (2014): “Group Belief and Acceptance.” In: *From Individual to Collective Epistemology: New Essays*, S. Chant, F. Hindricks, and G. Preyer (eds.). Oxford: Oxford University Press.

——— (1994): “The Justification of Group Beliefs.” In: *Socializing Epistemology*, F. Schmitt (Ed.), Lanham: MD: Rowman & Littlefield.

Toumela, R. (1992): “Group Beliefs.” In: *Synthese* 91, pp. 285-318.

Wray, K. B. (2007): “Who had Scientific Knowledge.” In: *Social Epistemology* 21, pp. 337-47.

——— (2001): “Collective Belief and Acceptance.” In: *Synthese* 129, pp. 319-33.