

In this paper, we study something called corroborative evidence. A typical example would be a case where a witness saw the accused leaving a crime scene, and physical evidence, like DNA taken from a bloodstain, also put the defendant at the crime scene. Another common kind of example is corroborative witness testimony evidence. One witness testifies she saw the accused leaving the crime scene, but her testimony, by itself, may not be all that strong as evidence. However, when a second witness testifies independently, saying that he also saw the accused leaving the crime scene, this new evidence corroborates the testimony of the first witness, making it stronger as evidence. Another example of corroborative evidence is the case where I check to see whether my watch is keeping the right time by asking a friend what her watch says. I may think my watch is right, but this may be corroborated by my friend showing me her watch, which shows the same time as mine. Of course, both watches may be wrong, making the point that corroborative evidence is fallible.

Double counting is a fallacy that occurs where evidence, for example from counting events that support a conclusion, is counted twice, yielding an inflation of the number of events, and resulting in a boost in of what the true result should be. Examples can be given from probability theory, in cases where the calculation of the sum of probabilities for a conclusion comes out to be higher than 100%, an impossible outcome. For example, suppose we want to calculate the probability of coming up with at least one 5 showing when throwing a pair of dice. We might calculate the probability as $1/6$ plus $1/6 = 1/3$. But this would be an erroneous answer, because the argument has double counted the event of both dice showing a 5. The correct answer is that the probability is only $11/36$. The double counting improperly inflated the probability. The fallacy of double counting may also often occur in cases of assessing evidence other than on the basis of numerical calculation of probabilities. For example, a victim's recovered memory of child abuse may support the conclusion that the defendant really committed the abuse. The defendant's confession that he committed the abuse may offer even more support for the conclusion that he did in fact commit it. But should his confession also count as evidence that corroborates the accuracy of the victim's recovered memory as evidence? Or would that be counting the same evidence twice? Whether the fallacy of double counting is committed in such cases is an important and hitherto unsolved problem in the theory of argument and the theory of evidence.

In this paper we use two tools to study how to evaluate this kind of evidence.¹ One is the argument diagramming system Araucaria (Reed and Rowe, 2004) and the other is the argumentation scheme (Reed and Walton, 2005).² Deploying these tools will lead us to examine two different methods of evaluating corroborative evidence. We don't claim to have solved the problem of analyzing the fallacy of double counting, but we put forward two methods as hypotheses that analyze the argumentation structure needed for the evaluation of corroborative evidence. In addition, we adduce a number of considerations gathered from the examples studied in the paper that show that the one method has some key advantages over the other that suggest that it reveals a path for further investigations that goes more deeply into the roots of the problem.

1. Defining Corroborative Evidence

¹ Many of the issues discussed relate to questions studied in a recent paper on argument evaluation (Goddu, 2003), but we have no space to comment on them specifically, in order to fit the length requirements.

² Helpful discussions of how these tools are proving to be important both in artificial intelligence and law are provided in (Reed and Norman, 2003).

Corroboration in ordinary usage, can be taken in a very broad way to include any case in which one item of evidence boosts up the probative value of another item of evidence higher than it was before. The following definitions for ‘corroborate’ are given by the Oxford English Dictionary:

5. To strengthen (an opinion, statement, argument, etc.) by concurrent or agreeing statements or evidence; to make more sure or certain; to support, confirm: said a. of a person; b. of the confirming statement. 1706 POPE *Let. to Walsh* 22 Oct., I am glad to corroborate [these observations] by some great authorities. 1751 JOHNSON *Rambler* No. 1532 My narrative has no other tendency than to illustrate and corroborate your own observations. 1791 *Gentl. Mag.* 32/1 He appears to have taken uncommon pains to corroborate all his assertions by an appeal to original authorities. 1820 W. IRVING *Sketch Bk.* I. 88 He recollected Rip at once, and corroborated his story in the most satisfactory manner. 1860 TYNDALL *Glac.* I. vii. 54 This observation corroborates those of Professor Forbes. 1878 HUXLEY *Physiogr.* 54 The simple explanation..has been corroborated by subsequent investigators.

6. intr. To concur in testimony. Obs. rare.

That definition #6 is listed as obsolete/rare surprised us, as that represents how we originally assumed we were using it. However, it became apparent to us, after some reflection on examples, that corroborative evidence, although prominent as an aspect of witness testimony, applies to other kinds of arguments as well, like argument from sign and argument from expert opinion. Suppose we find some contusions on branches at the edge of a trail and conclude that a bear came along the path. Then we find bear tracks visible on the path. This new evidence could be called corroborative in the ordinary usage of the term, because the tracks found later support what is suggested by the contusions, namely the hypothesis that a bear passed this way earlier.

In law, as contrasted with everyday usage, corroborative evidence appears to be a narrower notion, referring to certain special, if very common kinds of evidence. First, corroborative evidence contrasts with rebuttal evidence. An example of the latter would be a case where a witness said the defendant was at the crime scene, but then later, she was found to be dishonest, or to have defective eyesight. Corroborative evidence is usually also taken to contrast with convergent evidence, where two independent pieces of evidence each provide separate reasons to support a conclusion, but neither corroborates the other. For example, suppose that DNA evidence from a bloodstain puts the accused at the crime scene, and a knife found at the crime scene was shown to have been purchased by the defendant. The two independent pieces of evidence each give a separate reason to support the conclusion that the defendant was at the crime scene, but each does not seem to corroborate the other. At least it seems on the surface that in legal usage, corroborative evidence is different from convergent evidence,

Redmayne (2000, p. 150) used the case of recovered memory evidence to clarify three different kinds of evidence that can easily be confused. What he calls corroboration takes place where one party claims that some event occurred, saying for example she witnessed it, and then a second party also claims that the same event occurred. For example, a witness claims to have a recovered memory of abuse, and then the suspect confesses that he committed the abuse. Convergence takes place where two independent pieces of evidence point in the same direction, as in a case where both witness testimony and independent forensic evidence each point to the conclusion that the suspect carried out some act. Credibility corroboration takes place where some evidence supports the credibility of witness testimony, as in a case where one witness testifies that another witness has a reputation for being honest.

Following this legal usage, perhaps the bear case is better classified as one of convergent evidence. Each sign, the tracks and contusions, is evidence independent of the

other, and each seems to give a separate reason for accepting the reasonableness of the conclusion that a bear recently passed that way.

Wigmore (1913: 751), took a different tack, seeing corroborative evidence in law functioning as a secondary kind of evidence that boosts up the value of existing evidence.

“*Corroborative evidence; i.e. for circumstantial evidence, strengthening the inference, closing up other possible explanations (No third person was near the parties when the knife was found); for testimonial evidence, supporting it by closing up possibilities of testimonial error (Witness stood close by, was not excited, was disinterested spectator).*”

Wigmore’s notion of corroborative evidence is temporally ordered and asymmetrical. For there to be corroborative evidence, there has to be some item as prior evidence that is being supported by the corroborative evidence. Wigmore’s notion suggests that corroborative evidence functions as a way of responding to doubts that might occur showing ways to attack or rebut the original evidence. In the end we will return to something like this concept of corroborative evidence. For the moment we might notice that it is different from other conceptions of corroborative evidence considered so far.

2. Logical Problems with Evaluating Corroborative Evidence

The example of the clock and gun case³ illustrates the thesis that not all instances of corroborative evidence are of the witness testimony type. It also shows that some cases of mutual corroboration are problematic.

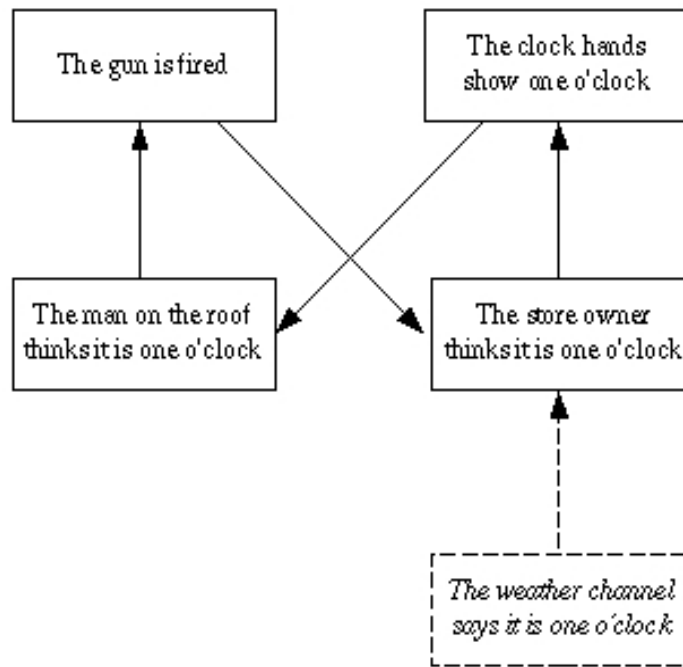
The Clock and Gun Case

An efficiency expert visiting a factory was told that the workers knew when to return to work because a gun was fired at exactly one o'clock by a man standing on the roof. When asked how he knew it was one o'clock, the man on the roof said that he verified the time by looking across the street to the clock on the store. The efficiency expert then asked the store owner how he verifies the accuracy of his clock and the store owner replied that he checks it against the firing of the one o'clock gun.

In the clock and gun case, the firing of the gun indicates that it is time to return to work. That accuracy of that indicator is confirmed by corroborating evidence: the reading of the clock on the store, showing the same time. The chain of reasoning in the case is diagrammed in the figure below.

Figure 1: Argument Diagram for the Clock and Gun Case

³ The original version of the clock and gun case can be found in (Walton, 1984, p. 16).



The reasoning in this case looks like it involves arguing in a circle, suggesting the possibility of the *petitio principii* fallacy. But really, if you look at the argument diagram more carefully, the sequences of reasoning exhibits the pattern of an infinity symbol (∞). Ignoring the statement in the dotted box at the bottom, the remaining four statements are locked into this infinitely cycling flow. However, when you take the statement in the dotted box into account, there is a noncircular chain of reasoning going from it to the box above it, to the box above that, and thence to the box containing the statement ‘The man on the roof thinks it is one o’clock’. Since we assume that the data in the dotted box has been verified independently of any of the other evidence represented on the diagram, once this implicit premise has been inserted and taken into account, the infinity-like circularity pattern in the diagram is no longer worrisome. The evidence provided by the weather channel is now corroborating the time criterion used by the man on the roof. Hence the apparent circularity is no longer a problem.

Redmayne introduces an issue of “double counting” that is very similar (Redmayne, 2000, p. 151):

C reports a recovered memory of abuse by D. Witness W also reports recovering a memory that she saw D abuse C. If you think that W’s report increases the probative value of C’s report without at the same time reducing the probative value to be drawn from W’s report, you can obtain infinite probative value from the two reports. First, use W’s report to increase the probative value of C’s report. Then use C’s report (which now has an enhanced probative value) to increase the probative value of W’s report (which will now be boosted beyond its original probative value). Next, use W’s report to further enhance C’s report. And so on, until your degree of belief in the proposition ‘D abused C’ is as high as you like.

This instance of double counting shows an infinitely cycling sequence of a similar worrisome kind found in the clock and gun case.

The argumentation in the clock and gun case shows that some cases of mutual corroboration are problematic. The problem in this case is clearly some kind of circularity, of a kind associated with the fallacy of begging the question. It is shown in this case that the problem of circular reasoning can be avoided, however, if one of the

indicators has a second information source outside the infinity loop. The problem posed by this case is how the fallacy of begging the question, and circularity of reasoning more generally, is connected to the fallacy of double counting. At the same time, a more general point about the nature of corroborative evidence is brought out by our discussion of this example. In cases where sources are not independent, either because their reliability depends on each other or their reliability depends on some third common source, citing the results of these dependent sources is not good corroborative evidence for the reliability of either source. Instead, in order for the coinciding results of sources to corroborate one another, these sources themselves must be independent. This lesson suggests the importance of the independence of sources as a condition for the reasonableness of corroborative evidence, which in turn suggests that independence needs to be defined more carefully in relation to corroborative evidence.

To define independence for the purpose of identifying the logical structure of argumentation used as evidence in an argument diagram, we can draw on the distinction between linked and convergent arguments. This distinction cannot entirely be made using Bayesian probabilities, or other ways of putting numbers on the nodes in the diagram representing premises and conclusions in a chain of argumentation. It has been shown (Walton, 2005) that various criteria are needed to analyze an argument in a given text of discourse to determine whether it is convergent or linked, including evidence drawn from the wording of the text. Still the notion of a convergent argument as defined in argumentation studies could possibly represent the notion of convergent evidence that we contrasted above with corroborative evidence. In principle, we might expect convergent argument to coincide with convergent evidence and therefore, perhaps, linked argument to coincide with corroborative evidence. This expectation turns out to be inaccurate.

Consider once again the following kind of argument that might represent convergent evidence in a typical legal case of evidence in criminal law.

Example of a Convergent Argument

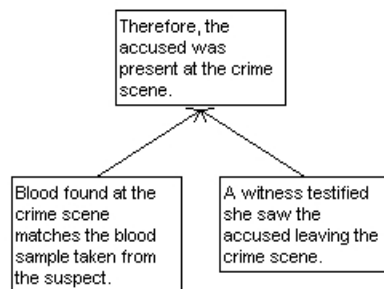
Blood found at the crime scene matches the blood sample taken from the suspect.

A witness testified she saw the accused leaving the crime scene.

Therefore, there is evidence that the accused was present at the crime scene.

As shown in the diagram in figure 2 below, this argument is classified as convergent.

Figure 2: Example of an Argument Diagram with Two Kinds of Evidence



In this convergent argument, each premise provides an independent reason to accept the conclusion. Each of the two premises shown at the bottom represents an independent line of evidence supporting the conclusion shown at the top of the diagram. Of course, the evidence in such a case would typically be expanded by drawing a larger diagram. The premise on the left could be part of argument from expert opinion based on the testimony of a forensic expert. The argument on the right could be fitted into the argument scheme for appeal to witness testimony, and by providing further details of the testimony. Normally, and under traditional rules, the probative weight lent to the conclusion by the premises would be a function of just the two premise weights (perhaps under some numerically-oriented rule such as “take the maximum” or “sum the weights”). Linked arguments, in contrast, would transfer the weight according to a different rule (perhaps, “take the minimum” to capture intuitions about weakest links).

Still the simple case represented in figure 2 presents a problem. The expert testimony evidence might be very strong, and thus might corroborate the witness testimony, making it appear much more credible to the jury. But should this effect be discounted as committing the fallacy of double counting? Looking at the diagram in figure 1 again, each premise independently supports the conclusion. Each offers a certain amount of probative weight as evidence for that conclusion. But if we are also claiming that one premise offers probative weight supporting the other, isn't that counting the weight of this premise twice? Wouldn't that be illogical? Wouldn't it be an instance of the fallacy of double counting?

3. Corroboration in Arguments from Expert Opinion

As suggested in section 1, we allow many kinds of examples of arguments with different schemes that might be included under the category of corroborative evidence. Let's begin with the scheme and critical questions for argument from expert opinion, also called appeal to expert opinion (Walton, 1997).

Appeal to Expert Opinion (Walton, 1997, p. 210)

Major Premise: Source *E* is an expert in subject domain *S* containing proposition *A*.

Minor Premise: *E* asserts that proposition *A* (in domain *S*) is true (false).

Conclusion: *A* may plausibly be taken to be true (false).

The six basic critical questions are stated in (Walton, 1997, p. 223).

1. *Expertise Question:* How credible is *E* as an expert source?
2. *Field Question:* Is *E* an expert in the field that *A* is in?
3. *Opinion Question:* What did *E* assert that implies *A*?
4. *Trustworthiness Question:* Is *E* personally reliable as a source?
5. *Consistency Question:* Is *A* consistent with what other experts assert?
6. *Backup Evidence Question:* Is *A*'s assertion based on evidence?

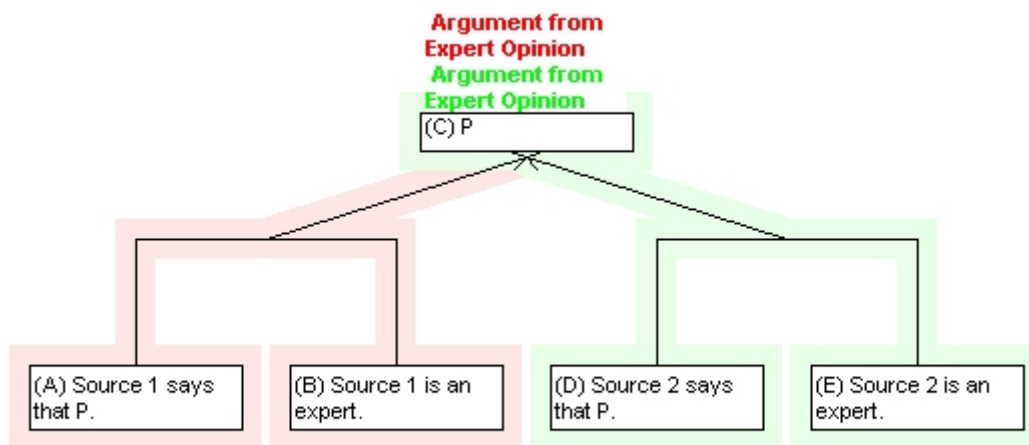
The critical questions are used to evaluate the argument by probing into its potentially weak points. If an independent appeal to expert opinion agrees with an initial appeal to expert opinion, the potentially weak point CQ5 is strengthened. The new argument

corroborates the old one by refuting any potential counter-arguments that might stem from inconsistency with what other experts assert.

To generalize from these two cases, what seems to happen is that corroboration by an independent argument that forms a convergent structure with the original one works because a critical question is headed off at the pass. But of course, this solution takes us to the more general problem implicit in the analysis of all schemes. Should the potential gaps in the argument be expressed as additional premises of the scheme or as critical questions matching the scheme? This general problem won't seem to go away, for as Bart Verheij (2003) pointed out, once the schemes are formalized, the balance between critical questions and premises will be standardized better. Still, even now we can get a general picture of how corroboration works. It fills gaps by anticipating objections, thus making the original argument more plausible than it was before. Often the boost in plausibility of the new argument is slight, but can be increased by adding in still more corroborative evidence from a series of successive arguments.

To try to diagram corroboration in a case of appeal to expert opinion, we begin with the basic situation of the convergent argument in which there are two independent arguments from expert opinion.

Figure 3: Corroborative Expert Opinion Evidence



This is fine, so far. We have argument 1 on the left and argument 2 on the right. The basic structure is that of a convergent argument. Thus under the old rule, we take the stronger argument of the pair, and judge the plausibility of the conclusion C by that method of plausibility evaluation. But how is it that argument 2 could boost up the plausibility that should be assigned to C, even if it is no stronger than argument 1?

The boost effect occurs where there are (1) two arguments directed to the same conclusion, (2) the first argument supports the conclusion with some degree of plausibility, (3) the second argument also supports the conclusion with some degree of plausibility, and (4) when the complete effect of the second argument is factored in, the outcome is that the degree of plausibility with which first argument supports the conclusion is increased from its previous value. Factor (4) is the value of the “boost”, or increase in the old degree of plausibility given by the first argument.

Now we turn to the problem of avoiding double counting while still accounting for the boost effect. In figure 4 we consider the kind of case where source 1 says that proposition P is true, and this assertion can be taken as probatively strong. Independently, source 2

asserts the same proposition, and this assertion can also be taken as probatively strong. So far so good, it is a typical case of two linked arguments, each one of which is an argument from expert opinion, and the two together form a convergent argument supporting the proposition *P*. But next, it is natural to also consider the hypothesis that when source 2 says that *P*, that proposition can be taken as corroborative evidence supporting the proposition that source 1 says that *P* is probatively strong. Indeed, as shown in figure 4, the proposition that source 2 says that *P*, if probatively strong, would make the proposition that source 1 says that *P* probatively very strong.⁴ Note that in figure 4, the statement that is a premise or conclusion in the argument appears in the top part of each box, while some of the boxes also have some words, like ‘very strong’ that appear in the bottom part of the box and are highlighted. These latter parts are ‘evaluations’ of the plausibility value of the statement appearing in the box above the evaluation.

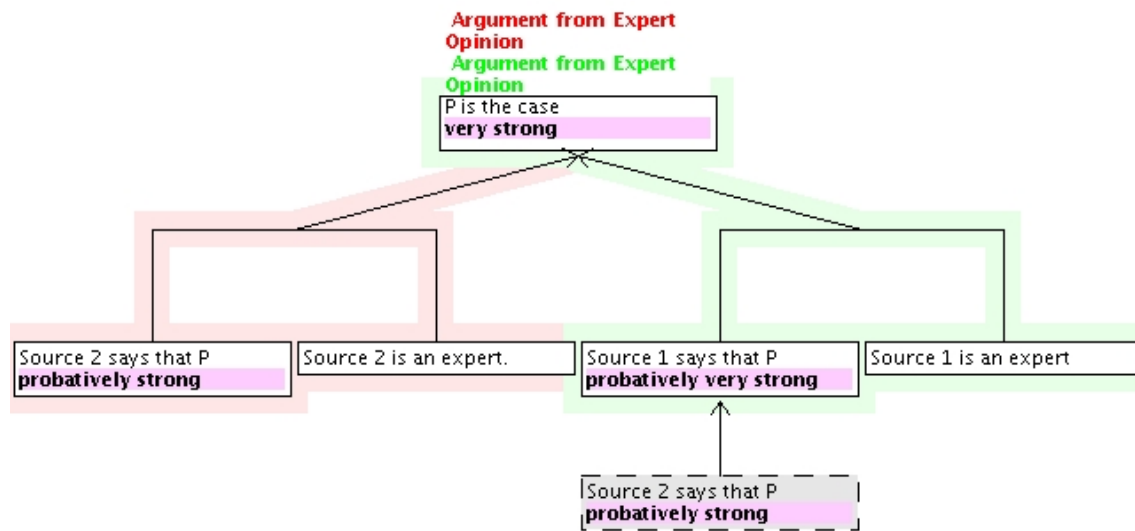


Figure 4: Plausibility and Corroboration

In figure 4, the proposition, *Source 2 says that P* appears twice. First it appears in the linked argument from expert opinion on the left. Then it appears as an implicit premise supporting the proposition *Source 1 says that P* in the linked argument from expert opinion on the right. This seems to be a form of double counting. We already have source 2 independently saying the same thing as source 1, and each of these arguments corroborates the other, meaning that it presents new evidence that boosts up the conclusion derived from the other one to make it stronger. But then the problem is that once we start considering the critical questions, we see that consistency with what other experts assert, once taken into account, boosts up the argument in a different way. Indeed, in such a case we could say that each of the arguments provides an implicit premise that answers the consistency critical question affirmatively, thus boosting up the other argument. It is a kind of mutual boost effect.

⁴ At any rate, it would make it stronger, and let’s say that in the kind of case we are considering, depending on how we are rating argument strength by some standard, it would make it very strong.

To try to explain how such a mutual effect works, we need to adopt the method of seeing corroboration as providing an anticipatory response to critical questions matching a scheme. This method fits OED definition #5 above. It offers a broad definition of ‘corroboration’, which could certainly encompass the giving of anticipatory answers to critical questions (or at least those critical questions of the type for which burden of proof is shifted). But then, how can we model the critical questions as part of the evaluation carried out using an argument diagram?

There are two ways the secondary argument could be seen as corroborating the initial one by increasing its plausibility value. The method we have already assumed is to see the new argument boosting up the plausibility value of one or more of the premises of the old one. But there is a second hypothesis. It is that the new argument proactively rebuts a possible attack on the old argument by answering a critical question. This method could be modeled on a diagram by inserting an implicit premise saying that what source 1 says is consistent with what other experts say. Then argument 2 would support that implicit premise, boosting up support for C. But is the consistency with what other experts say an additional premise, or should it be seen only as a critical question? We get into the recurring issue here of whether critical questions can be modeled as implicit premises.

One approach is to say that some critical questions can be seen as assumptions of the original argument while others need to be seen as exceptions to it (Walton and Gordon, 2005). On this approach, if an issue in a dialogue has been raised about a premise in an argument, acceptability depends on the proof standard associated with the issue. Two special kinds of premises are distinguished, presumptions and exceptions. Assumptions not at issue are taken to be acceptable, while exceptions not at issue are presumed not to be acceptable. An assumption, on this account, is like an implicit premise that is assumed to be true, while an exception is like a premise that is assumed to be false until new information might come in that shows it to be true (Gordon, Prakken and Walton, 2007). On this analysis, the critical questions for the argument from expert opinion are of two different kinds. The expertise question, field question, opinion question and backup evidence question are assumed to be true. When you put an argument from expert opinion forward, you presume the source is credible, or has some knowledge, you presume that the expert is an expert in the field of the claim made, you presume that the claim made can be extracted from what the expert said, and you presume the expert’s assertion was based on some evidence in the field of knowledge. Asking any of these critical questions makes the argument default until an appropriate answer is given. The trustworthiness and consistency critical questions are different, however. They are exceptions. To show the expert is not personally reliable, for example that she is biased, some evidence of bias has to be given. To show that the expert’s claim is not consistent with what other experts say, some evidence of such an inconsistency must be given. Just asking either of these critical questions is not enough, without some backup, to make the original argument default.

How can we explain the boost effect, in the kind of case shown in figure 4 above, on this analysis, when the opinion of the second expert corroborates that previously put forward by the first expert? There was an assumption that other experts don’t disagree. What happens when one other expert agrees? This new development offers some evidence against an exception arising. It doesn’t mean that the third expert consulted will also agree. She might not. But the more experts we get agreeing to the original claim, the more plausible it is that the claim is consistent with what the other experts assert. Thus argument 2 tends to rebut the counter-arguments that the claim is inconsistent with what other experts say. Hence it makes the original argument slightly more plausible, creating a boost effect, and thereby corroborating it.

How should corroboration be diagrammed, on this approach? In diagramming an argument, once the distinction has been drawn between assumptions and exceptions, critical questions matching a scheme can be inserted as implicit premises. An exception to argument 1 could be inserted as a missing premise stating the negative proposition that other experts do not disagree. Suppose that source 2 says that P, and that what this source says can be taken as probatively strong. This evidence boosts up the value of the implicit premise that other experts do not disagree, and this effect, let's say, has a boost effect on the plausibility of the conclusion, making to very strong.

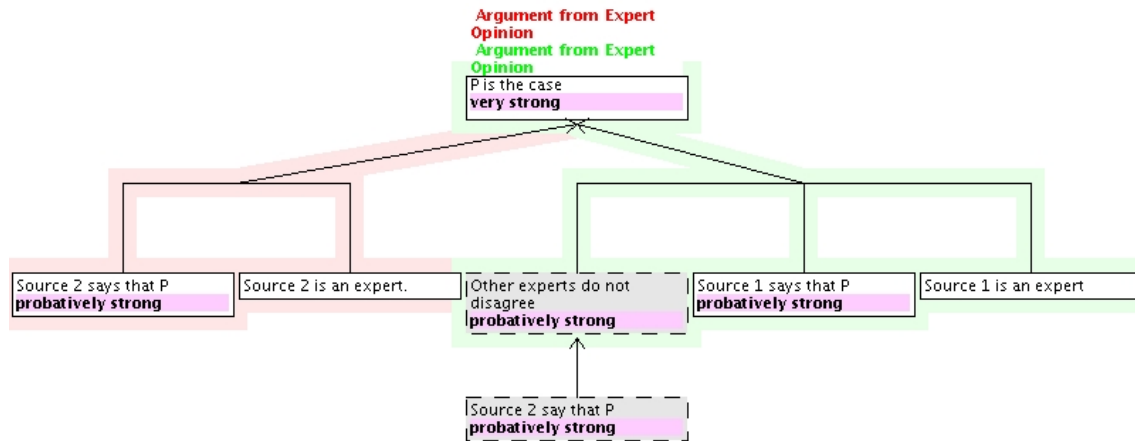


Figure 5. Diagramming Scheme-based Boosting Up

Let's assume that initially, there was no evidence so far on whether the argument was supported or undermined by evidence about what additional experts say. What happens when such evidence becomes available and is factored in? This missing premise is boosted up, because an exception is defeated or undermined by the new evidence. The exception would arise if there is evidence that other experts disagree. When this assumption is defeated by the new evidence telling us that, so far as we now know, other experts do not disagree, the outcome is to boost up the value of the ultimate conclusion.

We are not convinced that this is the ultimate solution to the problem posed by corroboration of expert testimony of one source by another, but it gives us a way of moving ahead with a solution to the problem by suggesting how the new evidence might fit in by affecting the evaluation of a missing premise of the original argument.

4. Corroborative Witness Testimony

Let's now go back to corroboration in witness testimony. Here is the argumentation scheme for appeal to witness testimony as presented in chapter one of *Argumentation Methods for Artificial Intelligence in Law* (Walton, 2005, p. 13).

Scheme for Appeal to Witness Testimony

Position to Know Premise: Witness *W* is in a position to know whether *A* is true or not.

Truth Telling Premise: Witness *W* is telling the truth (as *W* knows it).

Statement Premise: Witness *W* states that *A* is true (false).

Warrant: If witness *W* is in a position to know whether *A* is true or not, and *W* is telling the truth (as *W* knows it), and *W* states that *A* is true (false), then *A* is true (false).

Conclusion: Therefore (defeasibly) *A* is true (false).

Five Critical Questions Matching the Appeal to Witness Testimony

CQ1: Is what the witness said internally consistent?

CQ2: Is what the witness said consistent with the known facts of the case (based on evidence apart from what the witness testified to)?

CQ3: Is what the witness said consistent with what other witnesses have (independently) testified to?

CQ4: Is there some kind of bias that can be attributed to the account given by the witness?

CQ5: How plausible is the statement *A* asserted by the witness?

How could corroboration for convergent arguments be defined in relation to arguments fitting this scheme? For example, suppose witness 1 says *P* and witness 2 independently also says *P*. The old rule was that in this convergent argument, we just take the stronger of the two arguments and go with that. The new approach violates the old rule. The new approach says that by corroborating the testimony of witness 1, the testimony of witness 2 boosts up the plausibility value of the testimony of witness 1.

There are two ways the secondary argument could be seen as corroborating the initial one by increasing its plausibility value. One is that the new argument boosts up the plausibility value of one or more of the premises of the old one. But there is a second hypothesis. It is that the new argument refutes (or undermines) CQ3 as a possible attack on the old argument. What this means is that the new argument gives a positive answer to CQ3 by affirming that what the witness said is consistent with what other witnesses have (independently) testified to. It presents an instance of this consistency, and the more instances it presents, by offering independent testimony from witness 3, witness 4, and so on, the more plausible the initial argument will be. So this is quite a nice hypothesis, in that it enables us to explain how incremental additional independent testimony sequentially boosts up the plausibility value of the initial argument.

Now we can go back to appeal to witness testimony, and analyze corroboration in the same way. We have one appeal to witness testimony, argument 1, and then a second one, argument 2, that corroborates the first one because witness 2 says the same thing as witness 1. CQ 3 for the witness testimony scheme is classified as an exception. If another witness disagreed with what witness 1 said, that would be an exception, and would make the appeal to witness testimony less plausible. But as it happens, what witness 2 says agrees with what witness 1 says. That undermines the exception, or goes against it. Thus it corroborates the original appeal to witness testimony.

The problem remains of how the critical questions that correspond to assumptions, as opposed to exceptions, affect corroboration. They are even more straightforward to evaluate. Positive evidence makes the assumption more plausible, which might affect the

original argument by making its plausibility value greater. Negative evidence will detract from the plausibility of the premise, thereby possibly affecting the plausibility of the original argument.

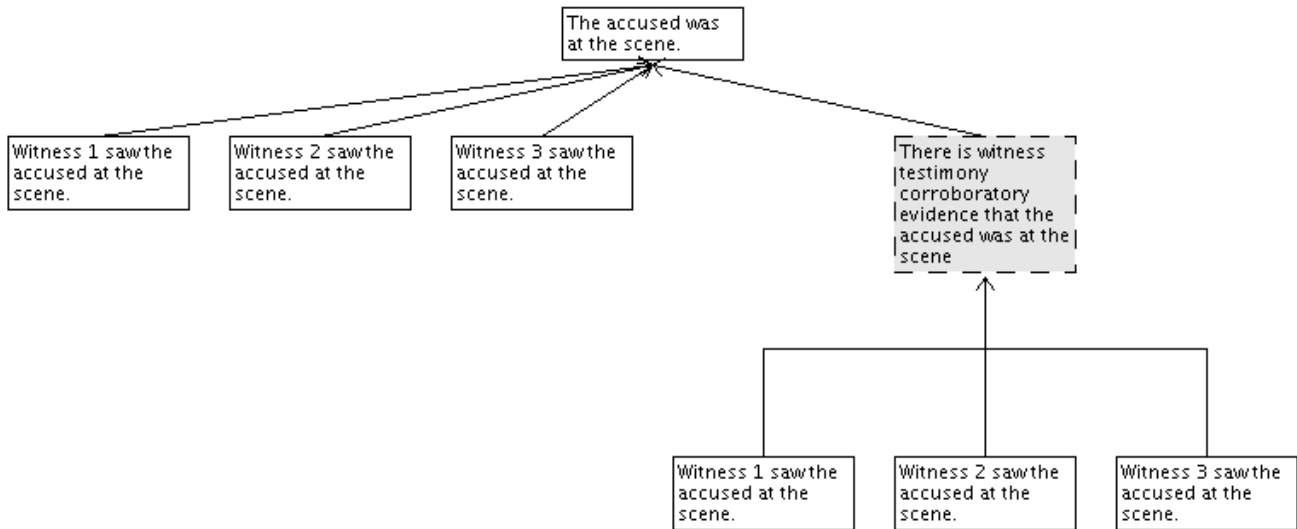
There are several advantages of this approach. One is that it provides a way of evaluating cases of corroboration so that we can draw a clear distinction between the ordinary case of the convergent argument, where each premise is independent of the others, and the case of a corroborative pair of arguments. Another is that we can model the argument evaluation to show how the plausibility boost occurs in a case of corroboration. Another is that we can do this by evaluating the nodes and arrows on the diagram, along with argumentation schemes and classifying critical questions as assumptions or exceptions. We don't need to bring in other dialectical notions.

This solution is still very sketchy, and needs some examples diagrammed, and many aspects worked out, but it provides a strong candidate approach. On this new approach, we use the old argumentation schemes, like appeal to expert opinion and appeal to witness testimony, and corroboration is evaluated as an upgrade due to bolstering of an implicit premise. The key is to model critical questions as premises that are either assumptions or exceptions. The corroboration of argument 1 by argument 2 is explained as follows. Argument 2 increases the plausibility of a premise (possibly an implicit premise) in argument 1, thus making for an upgrade (possibly slight) in the plausibility value of argument 1. We can also have negative corroboration, or undermining of one argument by another, where some new evidence lessens the plausibility of previous evidence.

5. Another Solution: An Argument Scheme for Corroborative Evidence

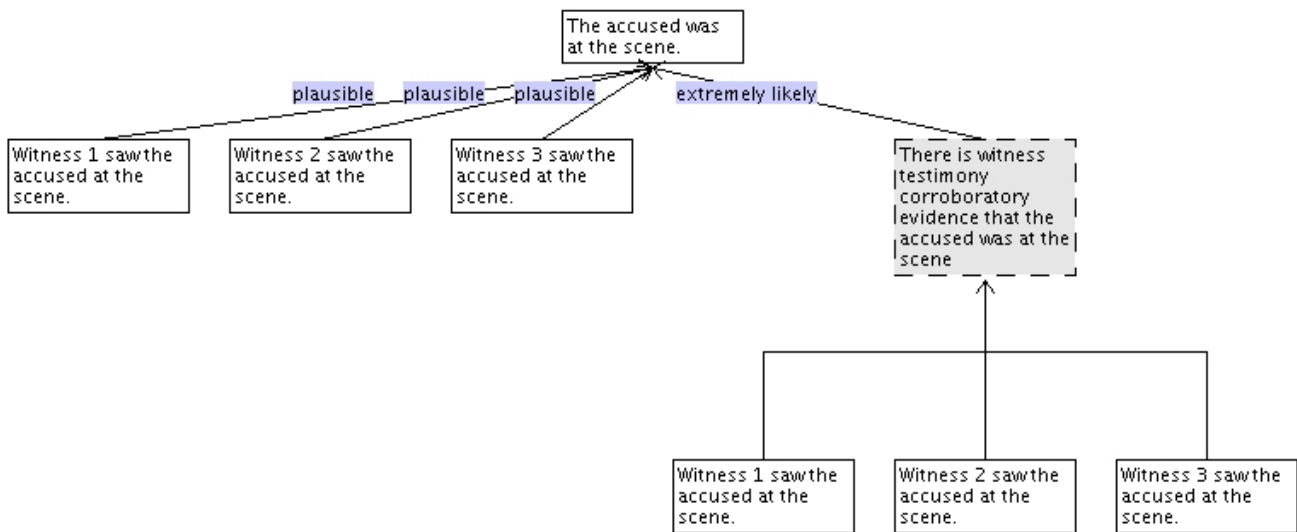
Dealing with corroboration specifically in the context of multiple witness testimony motivates the exploration of an alternative account that has some merits. How is it that such corroboration is working? Each premise in the witness testimony is lending some fixed degree of support to the conclusion. But in virtue of their all being witness testimony, they *in addition* provide corroborative support. Perhaps then, we might analyze corroboration as a separate line of support as in figure 6.

Figure 6: Corroboration in Multiple Witness Testimony



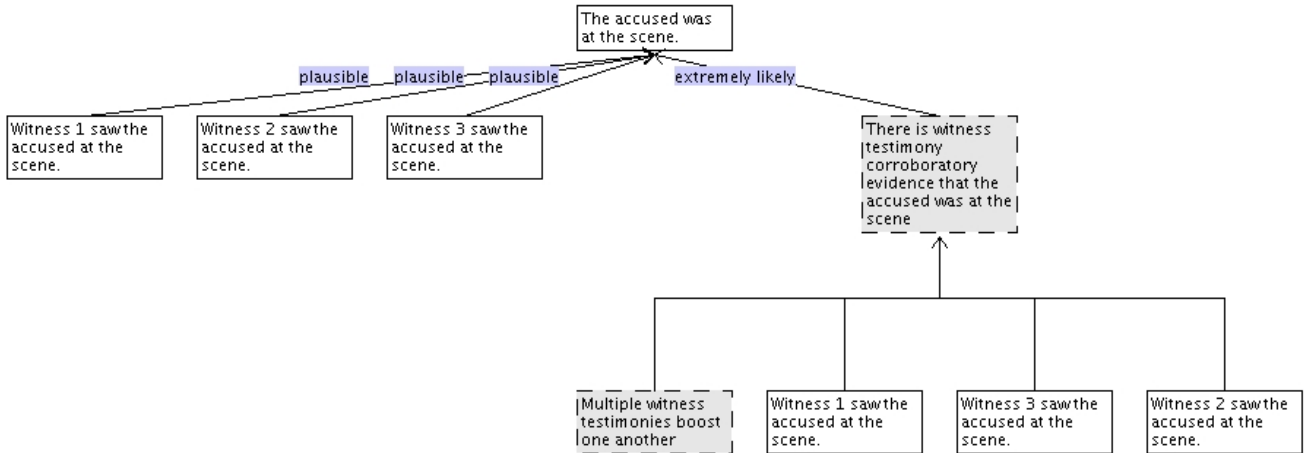
Each piece of testimony evidence might alone contribute a relatively small weight of evidence to the conclusion. But when taken together, another line of support is provided by their combination. That line of support may convey much greater support than any one on their own. Of course, in order for that second line of support to be constructed, it requires all of the testimonies to be taken together, that is, to be drawn together in a linked argument. To emphasize the way in which the evaluation of the argument is working, one might annotate the figure above as in figure 7.

Figure 7: Corroboration in Multiple Witness Testimony with Values



This analysis begs the question of what sort of argument the corroborative argument is, and how the premises can be drawn together in the appropriate way. It is almost as if there is an implicit premise, expressing that multiple witness testimonies together convey a boosted degree of evidence, as shown in figure 8.

Figure 8: Multiple Witness Testimonies Boosting Evidence



But this form of reasoning is a stereotypical pattern, so rather than simply adding in a new implicit premise, perhaps a more consistent approach is to employ an argumentation scheme that encapsulates the notion of corroborative evidence, as shown in figure 9.

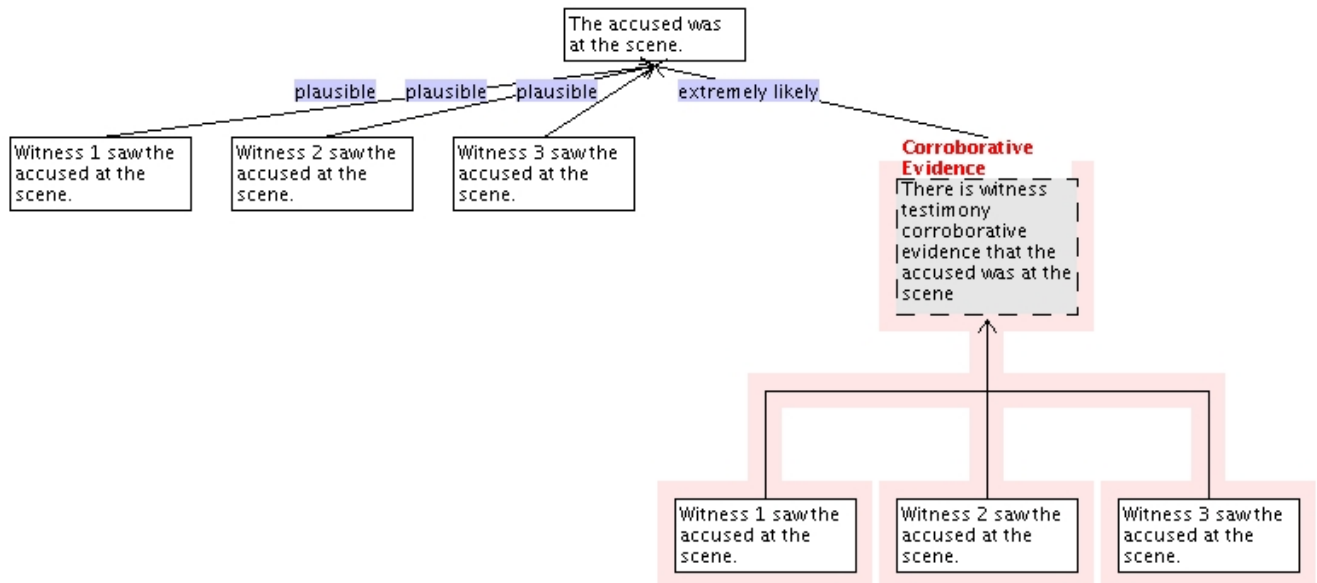


Figure 9: Argument Scheme for Witness Testimony Corroborative Evidence
The scheme for corroborative evidence runs thus:

Argument Scheme for Corroborative Evidence

Premise P1: There is an item of evidence E1 for claim C

...

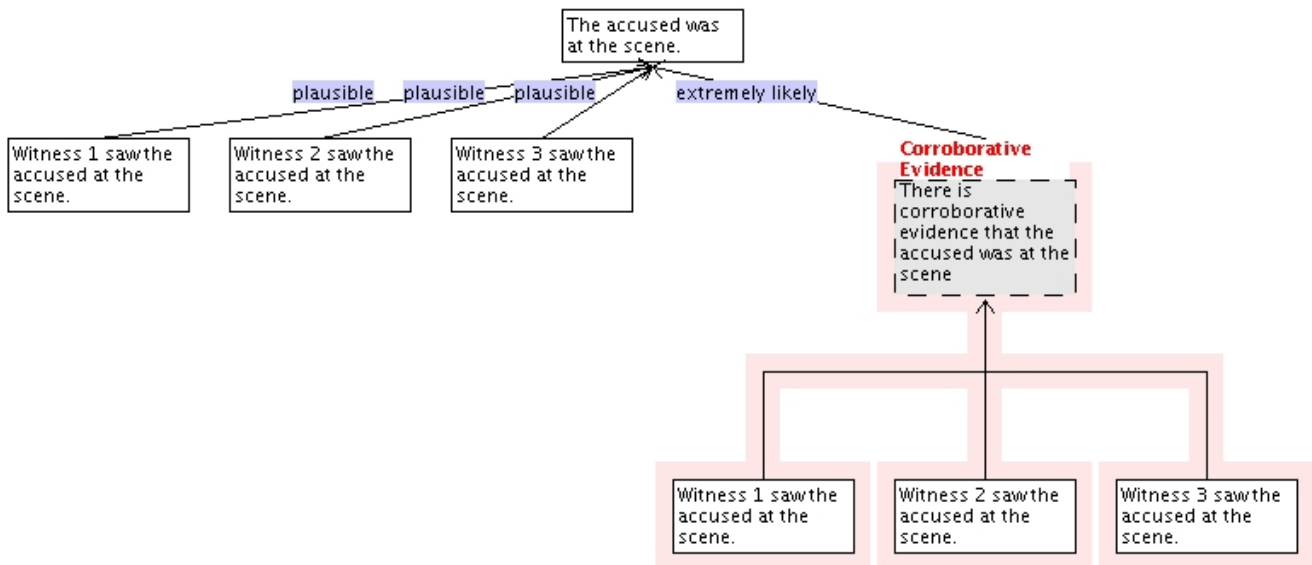
Premise Pn: There is an item of evidence En for claim C

Premise P0: All of the items of evidence E1 ... En corroborate

Conclusion C1: There is corroborative evidence for claim C

Of course, this scheme can be entirely general, and apply to any sort of evidence, not just witness testimony, so we should modify our analysis to simplify the implicit conclusion. This is shown in figure 10.

Figure 10: Corroborative Evidence with Implicit Conclusion Simplified

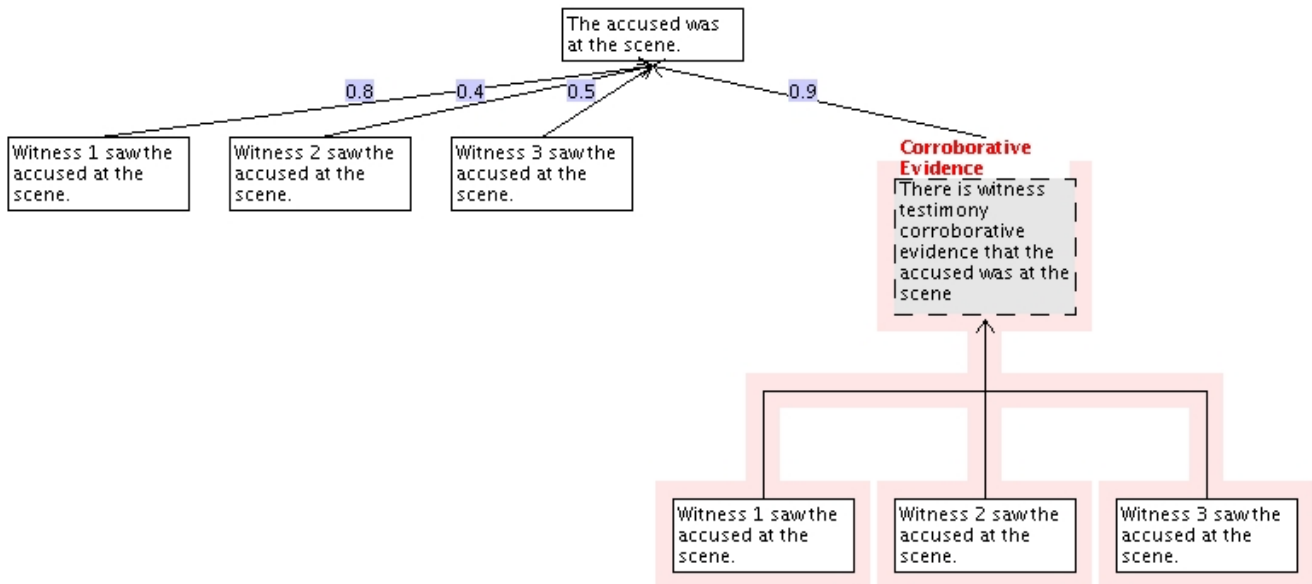


The significant boost test is in this way equivalent to the asking of a critical question associated with the Corroborative Evidence scheme:

Critical Question CQ1: Do the items of evidence really corroborate?

Finally, the degree to which the corroborative evidence supports the conclusion is not dependent upon the degree to which the individual items of evidence support the conclusion, because the degree to which they support the conclusion may be different from the degree to which they contribute to the scheme. Though numerical evaluations are fraught with difficulties, we might repeat our analysis using probabilistic values to highlight this independence. If, say, witness 1 is known to be reliable, whereas witness 2 is of poor character, and witness 3 has poor eyesight, then we might assign their testimonies 0.8, 0.4 and 0.5 respectively. Though the testimonies of witnesses 2 and 3 are somewhat unreliable, they nevertheless boost and are boosted by the testimony of witness 1. Taken together, we may say that the strength of the combined evidence is greater – say 0.9. This is shown in figure 11.

Figure 11: Witness Testimony with Numerical Probability Values

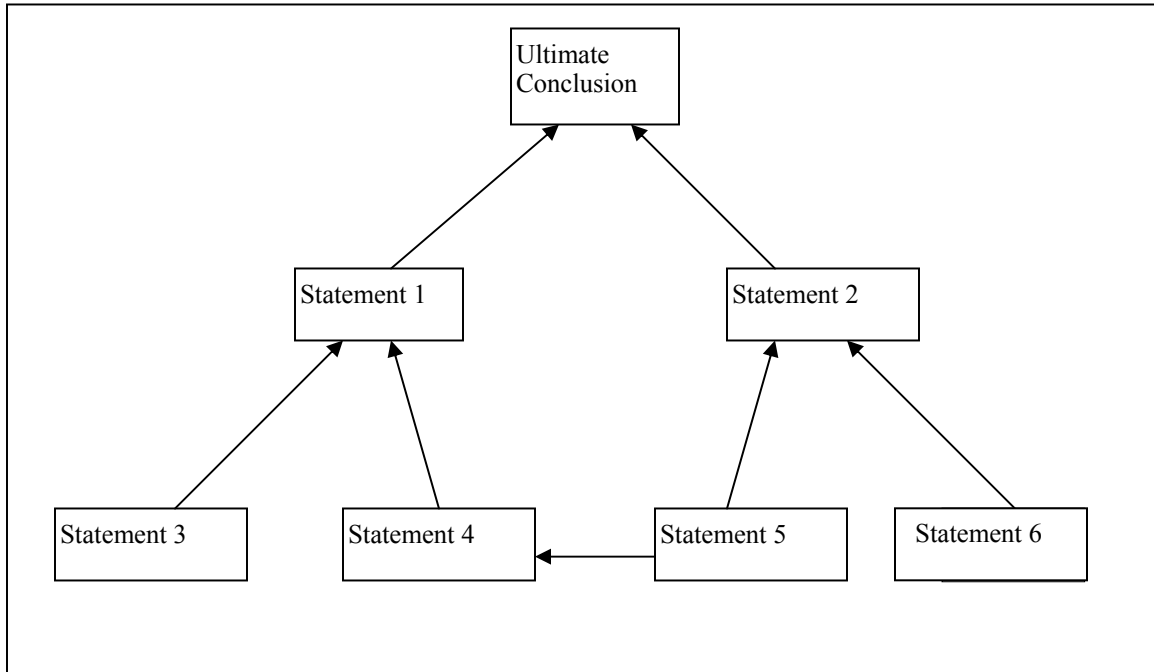


7. Independence and Convergent Arguments

The problem with many of the most common pairs of arguments considered to be corroborative is that they look corroborative even though they shouldn't properly be so classified if the one really is independent of the other. This kind of problem is typical of fallacies, where a fallacy is defined as an argument that tends to look reasonable even though, once carefully analyzed by some model of rational argument, can be shown not to be reasonable. The problem with fallacies is that they appear to be reasonable, typically by appearing to be the same as an argument that really is reasonable. At least, this will be our analysis of the problem. To set up the problem more carefully, we need to define the notion of independence, and then see how it applies to a typical but simple case where one piece of evidence often strongly appears to corroborate another even though, on our analysis, it does not.

The notion of independence of one piece of evidence from another can be defined using an argument diagram. In a linked argument pattern, each premise is dependent on the other to support the conclusion. In contrast, in a convergent argument pattern, each of the two arguments supporting the same conclusion stands on its own, and is independent of the other. A convergent argument can be seen as two separate arguments that support the same conclusion. But in some cases we can have a convergent argument where the one argument is connected to the other at a deeper level. Consider the example shown in figure 12.

Figure 12: Convergent Argument with Deeper Connection



In this example, there are two separate arguments supporting the ultimate conclusion, and each of these arguments has only one premise. However, at a second level, each of these arguments has another convergent argument supporting its premise. Finally, there is one more complication. One of the premises of one of these arguments at the second level supports the premise of the other. The resulting argument, shown in figure 13, is not circular, because the arrows in the enclosed part of the argument are not all going the same direction. Nevertheless, the convergent argument on the right side supports the convergent argument on the left side. Therefore the two converging arguments for the ultimate conclusion are not independent of each other.

What this shows is that in order to have independence, we have to have not only convergent arguments, but convergent arguments where the one argument is not connected to the other at any deeper level of analysis. Two pieces of evidence may only be properly said to be independent of each other if they can be diagrammed as convergent arguments of the kind that the one is not connected with the other in an argument diagram even when the evidential roots of each argument are fully displayed on the diagram. This definition depends on how well the evidence has been analyzed diagrammatically in a given case. We may have converging arguments for an ultimate conclusion, and because the argument pattern is convergent, we are inclined to judge that each piece of evidence is independent of the other. But this judgment depends on how deeply the argumentation has been analyzed in a given case. It may be that although each piece of evidence can be represented in the convergent argument pattern as a separate argument for the same conclusion, further analysis of the supporting evidence behind each argument may reveal some connection showing that the one argument depends on the other. Next, we need to use this definition of independence to analyze the very simplest kind of case in which corroborative evidence is typically problematic.

Consider again the typical kind of case where there is witness testimony that an event occurred, and there is also physical, circumstantial evidence that also shows that the event occurred. For example, consider a case where witness Bob claims that he saw the

defendant Carla at the crime scene, and where blood samples found at the crime scene or shown by forensic DNA analysis to match Carla. We would assume in the normal type of case that each of these two pieces of evidence should be considered independent of each other. Independence in the sense is defined as outlined above. Two items of evidence supporting the same conclusion are independent only if (1) together they form a convergent argument supporting that conclusion, and (2) neither argument depends on further supporting arguments to back it up such that any of these arguments requires support from the other convergent argument. What this means is that each of the pair of convergent arguments must stand on its own and not require support from the other. So far so good, from a logical point of view. Since each argument is independent of the other, there should be no boost effect. When the one argument is put forward, it supports the conclusion, and then when the other argument is put forward, it offers additional support for the conclusion. But since each argument is independent of the other, the evidential worth of the one should not increase the evidential worth of the other.

It is all very well for us to say this, from a logical point of view, but in reality what will generally tend to happen is that there will be a boost effect. Consider a typical case in law where witness Bob claims that he saw the defendant Carla was at the crime scene. Bob may not be perceived by the jury as an especially reliable witness, but let's say that his testimony carries some probative weight with the jury. Next suppose that a forensic expert Alice is brought in who presents virtually irrefutable evidence that Karl was at the crime scene by showing that the blood samples taken from the crime scene match her DNA. There are two effects that such testimony is likely to have on the jury. One is that it will boost the plausibility of the conclusion that Carla was at the crime scene. The other is that it will boost the plausibility of Bob's testimony by making him seem to be of more credible witness, simply in virtue of the evident fact that Bob's testimony was correct. Bob testified that she was at the crime scene, and now the expert testimony has shown that it is almost impossible to doubt that she was at the crime scene. Therefore, what is also shown is that Bob was right. This must also mean that Bob is a reliable witness. Certainly, even from a logical point of view, it can't be denied that it shows that what Bob says tends to be right. Surely then it is very difficult to resist judging the evidence in this kind of case in such a way that the expert testimony evidence boosts up the probative worth of the prior eyewitness testimony evidence. But logically speaking, according to the definition of independence of evidence given above, if the two items of evidence are independent, the one should not boost up the probative value of the other.

Here then, we have all the ingredients of a logical fallacy. We have a particular argument that fits an argument structure in such a way that logical requirements are set out on how it should be judged. The one argument should be judged to be independent of the other. But realistically speaking, in the kinds of real cases we are so commonly familiar with, it is very difficult for most of us to resist the boost affect brought into play by assuming that the one argument is somehow affecting the worth of the other. From a logical point of view we need to resist this tendency to feed the one argument into the other. But it seems hard to deny that we do this all the time, and that it is very difficult to resist the idea that the one argument does boost up the possibility of the other.

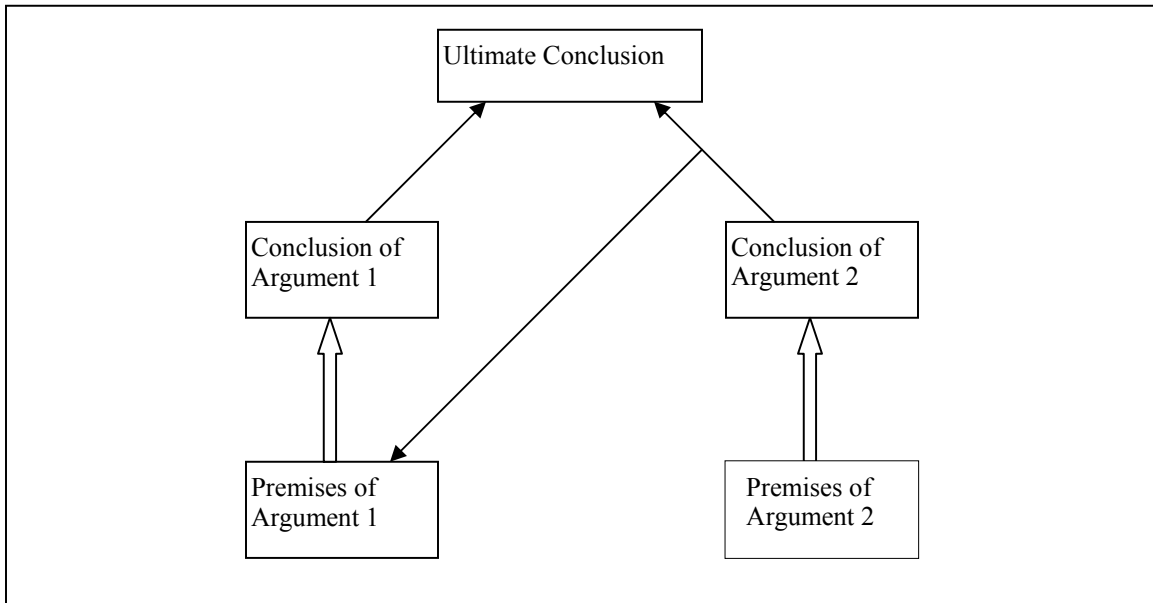
8. The Fallacy of Double Counting

The notion of fallacy suggested by this kind of case may be more subtle, and more difficult to deal with, than the traditional notion of fallacy suggests. According to the traditional notion an argument is fallacious because it seems valid but is not. This notion implies that once you analyze the argument thought to be fallacious, you see that even

though there is some irrational effect of boosting of plausibility that makes it seem reasonable, this irrational effect can be discounted. The reason is that logically speaking, there are no rational grounds underlying the boosting of plausibility. In this case however, they do seem to be rational grounds underlying the boosting a possibility. If the expert forensic testimony showed that Carla was at the crime scene, this shows that Bob was right when he testified that she was at the crime scene. Once we analyze the argument we can see that the posting of possibility is not entirely irrational, because there are rational grounds underlying it. The claim that Bob made was tested, and found to be accurate by strong and independent forensic evidence. It doesn't follow from this that what Bob says is always true, or even that what he said on this occasion has to be true, but surely it makes Bob seem more credible as a witness then he was before this very convincing evidence came in for consideration. The notion of fallacy in this kind of case is subtle, because the boosting of plausibility does not seem to be entirely irrational. There seem to be logical grounds for it. On the other hand, there may also be grounds for ignoring it, if there are grounds for treating the two pieces of evidence as independent.

What kind of grounds could there be for treating the two pieces of evidence as independent? It does seem that they really are independent. The forensic expert has her evidence, consisting of collecting samples at the scene and testing them in the lab, and so forth. The evidence presented by the witness seems entirely independent of this. The witness needs to be examined and the jury needs to make an estimate of the worth of his testimony based on factors like how consistent it seems to be, how honest the witness appears to be, and so forth. The forensic expert opinion evidence would not appear to play any role in this evaluation. The jury shouldn't be making up their minds by arguing as follows: what the witness said has now turned out to be true, or at least very highly plausible as shown by this new evidence, therefore his argument from witness testimony must be correct, or should be taken as stronger than it was before. What seems to be wrong with this argument is that it judges whether an argument is correct based on the conclusion alone rather than on the inferential link between the premises and the conclusion. It reasons backwards that since the conclusion has turned out to be true, the argument itself must be a good one, either because of the inferential link between the premises and conclusion, or because one of the premises has been shown to be true.

Figure 13: Argument Structure Giving Rise to the Fallacy of Double Counting



Somehow this argument seems wrong, because there is a circular sequence of reasoning of a sort going from argument 2 to the premises of argument 1, thence to the ultimate conclusion, which then goes back to argument 2's support of the premises of argument 1 once again. This cycle could create the infinite boosting of probative value of the kind Redmayne warned about.

On the other hand the argumentation structure visualized in figure 13 does not appear to be completely illogical either. It may be that argument 2 supports both its own conclusion, the ultimate *probandum* in the case, and also a premise of argument 1. If so, what wrong with counting argument 2 twice? We think that what is wrong is that if arguments 1 and 2 are supposed to be independent as evidence counting to support the ultimate conclusion, figure 13 demonstrates some kind of failure of independence of these two arguments. We could perhaps say that it seems to be a procedural requirement that each piece of evidence in a procedure like a trial should be treated as independent from other pieces of evidence presented during a different part of the trial in which different standards of proof and different argumentation schemes need to be applied. It could be then that the kinds of grounds there are for treating two pieces of evidence as independent are procedural in nature.

It looks like each case needs to be considered separately however. Complicating the matter, it seems that in some instances two pieces of evidence that are procedurally separate may not need to be treated as independent in nature. For example suppose one witness offers some testimony, and then when a second witness takes the stand she presents evidence from which it can be inferred that the two witnesses were in collusion. In this kind of case, the testimony of the second witness would undermine detracts from the plausibility of the evidence put forward by the testimony of the first witness. Here, the two pieces of evidence are not independent of each other, and should not be so treated. The testimony of the second witness definitely detracts from the worth of the testimony of the first witness as having evidential value. The two items of evidence should not be treated as independent.

9. Conclusions

The investigation so far has led to two different workable solutions to the problem of how to evaluate corroborative evidence. Each should be treated as a hypothesis that can be tested by further investigations. According to the first hypothesis, the corroborating argument supports one of the premises of the original argument. In doing so, the corroborating argument can boost up the plausibility value of the conclusion of the original argument by supporting that premise, which in turn contributes to the strength of the original argument. We also looked at the variation on this method in which the corroborating argument proactively rebuts a possible attack on the original argument by answering a critical question. This solution, however, can become a little complicated because it takes us into the issue of whether and how critical questions can be modeled as implicit premises in an argumentation scheme.

The second hypothesis postulates a new argumentation scheme for corroborative evidence. The nice thing about this method is that the new scheme can apply to cases of circumstantial corroborative evidence as well as testimonial. We have shown how this method can be applied very easily using an argument diagram, showing how there is a significant boost and the plausibility value once the corroborative evidence is factored in. We need to note however that the second hypothesis does not solve all the problems posed by corroborative evidence. The method of introducing a new scheme for corroborative evidence represents the boosting value of this kind of evidence as a separate and independent line of support for a conclusion. But whether it should be so treated can be questioned. The specifically corroborative value of this kind of evidence is not as a separate line of support, but it seems to work instead as increasing the degree of support given by each corroborated premise. Another problem is that several of the examples showed that corroborating evidence does not always work by supporting one of the explicit premises of a given argument. Rather, corroborating evidence works by anticipating a potential defeater of the initial argument by answering a critical question corresponding to the scheme for that argument. Indeed a central insight brought out by the consideration of examples in the paper is that corroborative evidence boosts the probative weight of other evidence by showing that a potential defeater for that initial evidence does not apply. A point is that corroboration can be seen as providing an anticipatory response to critical questions matching a scheme, but if corroborative evidence really works in this way, then we might question whether analyzing it as providing a new and separate line of reasoning for the conclusion is necessary or useful. These considerations would suggest that the hypothesis of adding a new argumentation scheme for corroborative evidence may not be the best solution to the problem.

On balance, we are inclined to think that these considerations support the hypothesis that corroborating evidence works by boosting up one of the premises of the original argument. In many of the most subtle and interesting cases, it seems to do this by showing that a potential defeater for the initial argument does not apply. Hence we feel that the most important theoretical point that needs to be made about corroborative evidence is that it works by providing an anticipatory response to critical questions matching a scheme. How this solution works we are still not yet entirely sure, we have to admit. Yet we think it shows the most promise for further investigation.

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