Visualizing Probative Relevancy: Transitive Chains vs. Tree-Like Argument Structures

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Abstract

Argument diagramming is an important method in understanding probative relevancy and making specific determinations of its existence. Typically, it relies upon a tree-like argument structure consisting of tiers of linked premises that are bounded by the main conclusion (ultimate probandum) at one end of the inferential network. A tree-like argument structure presents certain inherent challenges in depicting the chaining of an argument and scaffolding structural correctness. An alternative argument structure consisting of transitive membership chains, named Stepping|Stones, is proposed which is bounded at both ends of the inferential network by the subject and predicate (Aristotelian) of the main conclusion. This alternative structure replaces all the design criteria necessary to build a tree-like structure with the single criteria of transitive membership. And its scaffolding, unlike a tree-like structure, directly guides determinations of probative relevancy.

Visualizing Probative Relevancy: Transitive Chains vs. Tree-Like Argument Structures

Introduction

A probative relevant argument is one which can increase the probative weight (Walton, 2005), or degree of acceptability, of its main conclusion. Argument chaining is central to this concept of probative relevancy (Walton, 2004, p. 98). Diagramming such chaining is one method used to help make this chaining transparent so that determinations of probative relevancy can be made. One requirement of such chaining is transitivity of relevance (Walton, 2004, p. 98).

Regardless of theoretical representation, a tree-like argument structure digraph is typically used as the model for such diagramming (Reed and Rowe, 2001; van Gelder, 2002; Goodwin, 2001). A tree-like structure of argument, however, does not necessarily lend itself to supporting determinations of chaining and transitivity. A tree does not resemble a chain. An alternate foundational argument structure consisting of transitive chains is proposed to help resolve this problem. This alternative argument structure, named Stepping|Stones, provides scaffolding for diagramming arguments that specifically and naturally resolves determinations of chaining and transitivity through its structural constraints. And unlike a tree-like structure, a single design criteria guides its construction.

Bounded Argument Structures

Typical diagramming of arguments rely upon an argument structure that is tiered and bounded at one end in a tree-like structure. (Walton, 2004, p. 266). In such structures, the main conclusion (ultimate probandum) is the target providing the sole bounded end to which the premises point. Premises are the points or nodes in the diagram. They are coupled as linked units (e.g. datum and warrant, major and minor premise, or main premise and co-premises) which are joined in an inferential network of layers that connect to this single end-point main conclusion through lines representing inference. Figure 1 illustrates this underlying structure using the familiar Stephen Toulmin (1958) argument.

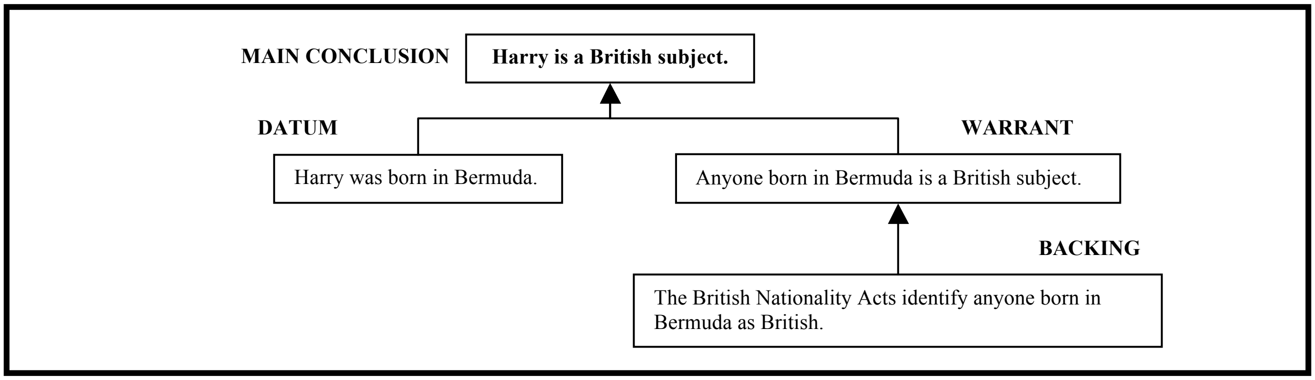

Figure 1. Toulmin argument diagram using layered tree-like structure.

Stepping|Stones diagrams the same argument in an alternative manner (see Figure 2). A more robust version of the Stepping|Stones argument structure is used in Figure 3.

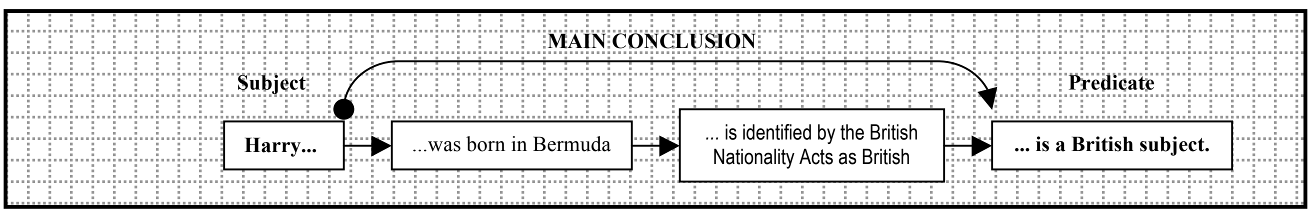

Figure 2. Simplified Stepping|Stones diagram of Toulmin argument.

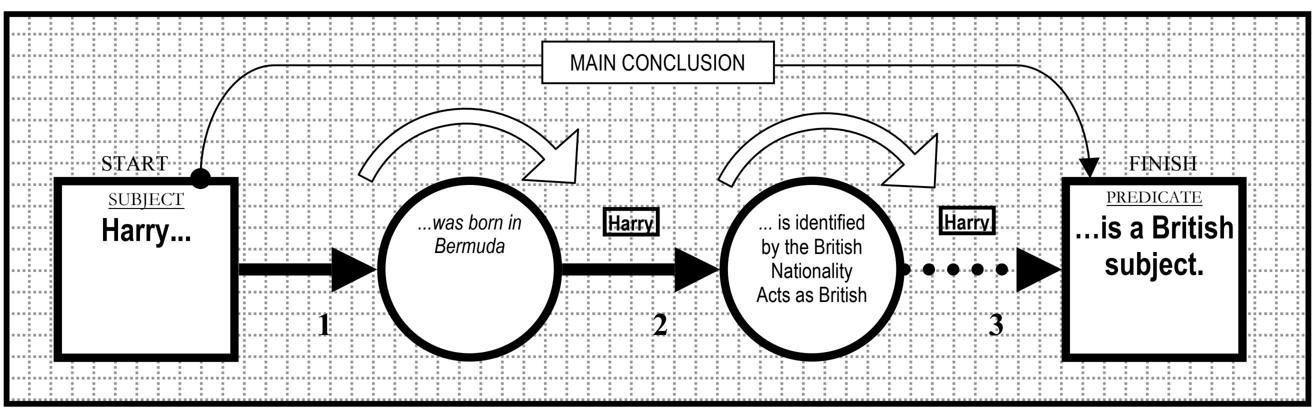

Figure 3. Robust version of Stepping|Stones diagram of Toulmin argument.

Transitive Cognitive Categories

Stepping|Stones is based upon a conceptualization of a simple argument structure consisting of a chain of interim predicates (Aristotelian) with transitive interlocking memberships that join the subject of the final conclusion (ultimate probandum) to its final predicate (Aristotelian) (see Figure 4).

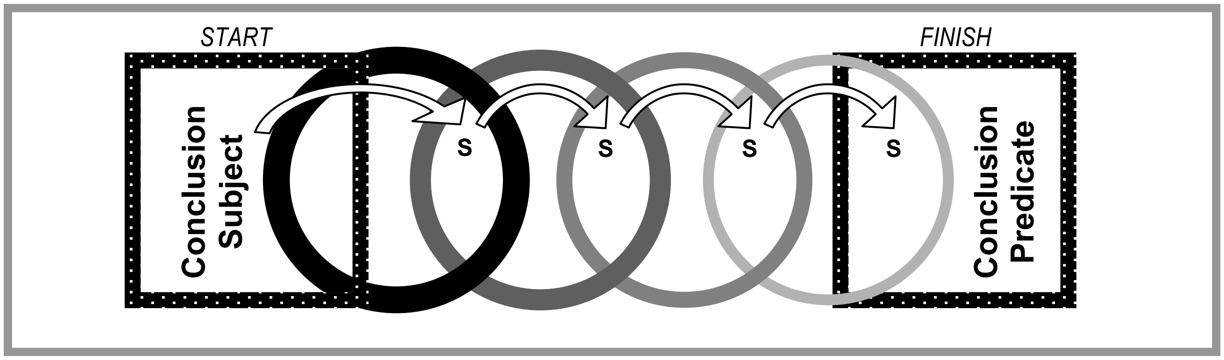

Figure 4. Stepping|Stones transitive argument chain icon.

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Each of the predicates are conceptualized as cognitive categories (Lakoff, 1987) which have specific overlapping memberships that enable the subject of the main conclusion to make inference steps through a series of membership substitutions to reach its ultimate predicate. When considered from the common perspective of making an argument as consisting of "connecting the dots," the interim predicates are the dots. By using this metaphor of the subject moving along a path of dots to reach its final predicate, this argument structure taps into an embodied understanding of the nature of reasoning (Lakoff and Johnson, 1980; Tim van Gelder, 2002) that may help increase its comprehension.

Stepping|Stones treats predication as the relation "is a member of." Predication is, however, more than membership (Cocchiarella, 2001, p. 123). What it means to say something about something differs, for example, based on a Nominalism, Realism, or a Conceptualism theory (Cocchiarella, 2001, p. 124). For purposes of determining probative relevance, however, a set theory approach to predication pragmatically functions.

Using sets to represent cognitive categories necessarily creates limits on any model of cognitive categorization (Rocha, 1999, p. 458). Stepping|Stones' argument structure can be used within a classical theory of categorization based on bivalent membership of crisp sets with shared properties. Stepping|Stones' power for determining probative relevancy, however, is more fully realized when more robust models of categorization, such a prototypicality (Rosch, 1978), and of membership, such as multivalence with degrees of membership as in fuzzy logic (Zadeh, 1965), are used as its definitional foundation. A more robust approach can better take advantage of the power and flexibility of cognitive categorization (Jacobs, 1992, p. 518).

Stepping|Stones may provide some advantages for determining probative relevancy over a tiered single-bounded tree-like argument structure comprised of premises in an inferential network. First, Stepping|Stones' structural constraints naturally resolve the requirements of chaining and transitivity. Further, it relies upon a start-to-finish structural constraint. This constraint provides two fixed points to bind the lines of reasoning at both ends. In this manner, a premise's location within the argument can, perhaps, be more easily determined based on the premise's required connection to two fixed end-points rather than its relation to a single target. In addition, this alternate argument structure makes distinctions such as datum/warrant or direct/ancillary evidence unnecessary. Further, distinguishing between linked and convergent arguments becomes readily apparent based on transitive membership. Also, the components of probative force may be more easily subjectively assessed. Finally, the structural constraints of Stepping|Stones provides a scaffolding that facilitates the construction of a correctly structured argument.

Deductive Inference

To begin to illustrate its application, several simple arguments are first considered. The first, second, and fourth examples are drawn from John Woods (1999, p.12).

Deductive Reasoning

Premises: A marble is taken from a bag of marbles. The bag contains only red marbles.

Conclusion: The marble is red.

The boxes and circles (nodes) in Figure 5 represent the premises and main conclusion separated into their component parts consisting of the main conclusion subject, interim predicate(s), and the main conclusion predicate. The dotted arrow (arc) represents membership in whatever manner it is defined. Equivalent wording for the premises and main conclusion are used when necessary to enable the argument to fit within this framework without changing the argument's reasoning and underlying intent.

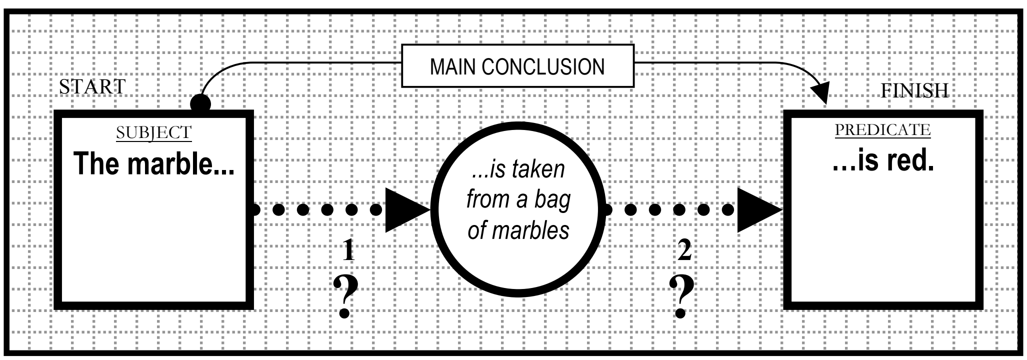

Figure 5. Stepping|Stones diagram of deductive argument with unresolved membership.

There are two determinations to judge for probative relevancy once the argument has been diagrammed in this framework. The first question is whether each of the cognitive categories (nodes) leading up to the main conclusion predicate are members (to some degree and level of uncertainty) of their following adjoining cognitive category. In this instance, if memberships 1 and 2 are established with some certainty in the premises, the question marks can be removed (see Figure 6).

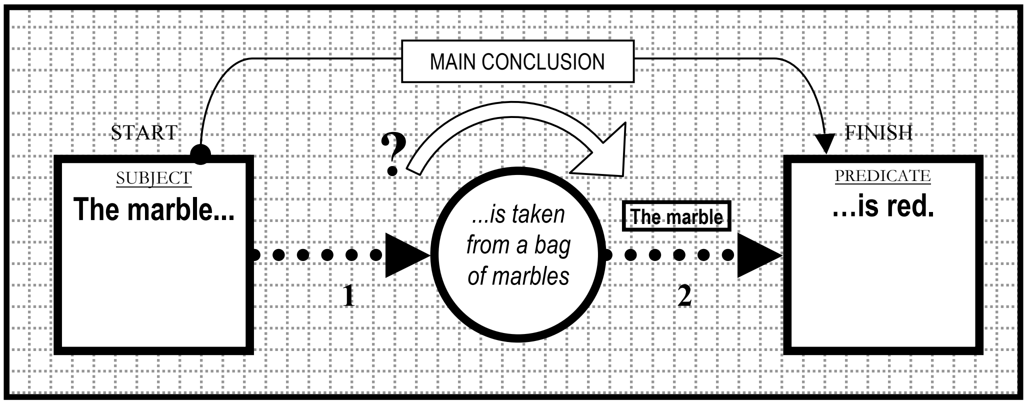

Figure 6. Stepping|Stones diagram of deductive argument with unresolved inference step.

The final determination is whether the main conclusion subject "The marble" can substitute (to some degree and level of uncertainty) for its adjoining node as a member of the following adjoining cognitive category along the path of reasoning. In this instance, through the inference step of substitution, the subject of the main conclusion "The marble" arguably can be a substitute for the interim predicate "is taken from a bag of marbles" as a member of the final predicate "is red." This inference step or leap forward of the subject is represented by the curved inference arrow and by changing the membership dotted line to a solid arrow (arc) (see Figure 7). Since this inference step adjoins a membership relationship with zero uncertainty it may be considered a deductive inference step. Based on these two determinations, it can be concluded that the argument is well structured and that each premise (membership relationships 1 and 2) has probative relevancy.

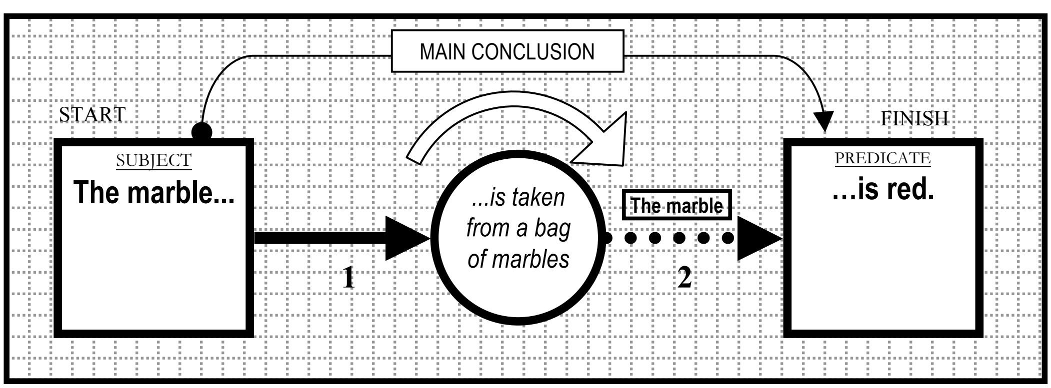

Figure 7. Stepping|Stones diagram of resolved deductive argument.

Inductive Inference

Inductive Reasoning

Premise: One marble taken from the marble bag is red.

Conclusion: All the marbles in the bag are red (see Figure 8).

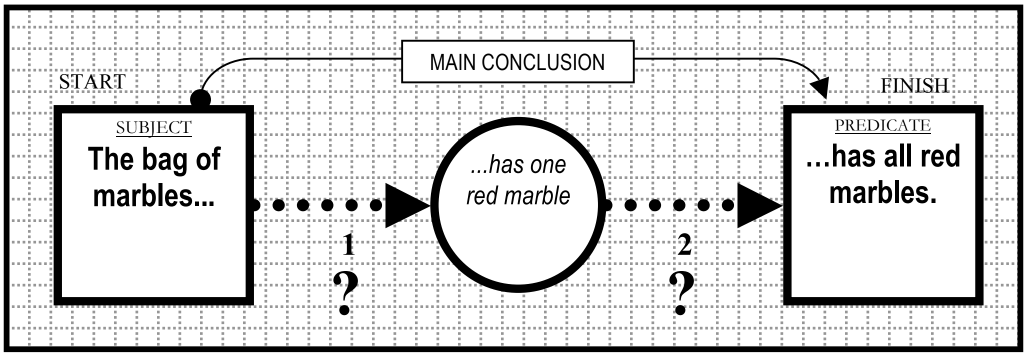

Figure 8. Stepping|Stones diagram of inductive argument with unresolved membership.

Diagramming with Stepping|Stones (see Figure 8) makes visually apparent that a single premise in a simple argument always creates two relationships, namely memberships 1 and 2, in order to be contained within a structurally correct line of reasoning. Thus, the structural constraints help make transparent missing premises (enthymemes). In this instance, membership 1 is established by the first premise. Membership 2 represents a sample generalization ("if there is one red marble in a bag, then all the marbles in the bag are red") which, depending on the number of marbles in the bag, has some level of uncertainty. If the membership relationship is judged probable, it may be considered an inductive relationship. Assuming that the level of certainty is not zero (on a scale between 0 and 1), membership 2 can be established (see Figure 9).

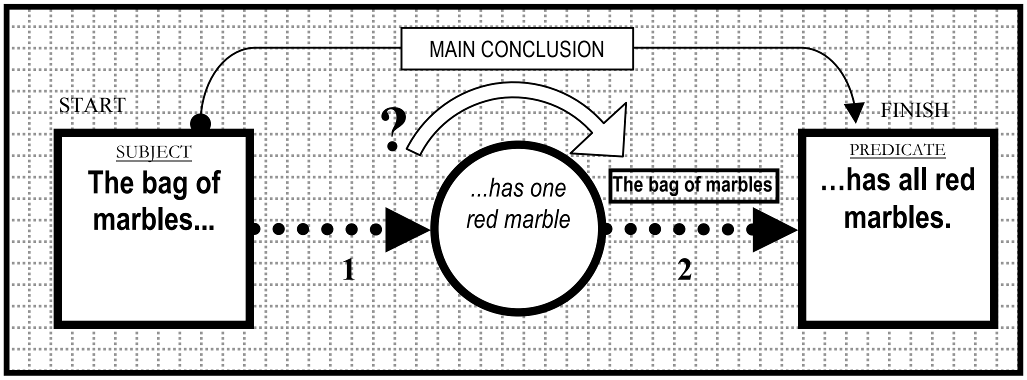

Figure 9. Stepping|Stones diagram of inductive argument with unresolved inference step.

The final determination is whether the main conclusion subject "The bag of marbles" can substitute (to some degree and level of uncertainty) for its adjoining node as a member of the following adjoining cognitive category along the path of reasoning. In this instance, through the inference step of substitution, the subject of the main conclusion "The bag of marble" is an equivalent substitute for the interim predicate "has one red marble" as a member of the final predicate "has all red marbles." Since this inference step adjoins a membership relationship based on induction, it may be considered an inductive step. Based on these two determinations, it can be concluded that the argument is well structured and that each premise has probative relevancy (see Figure 10).

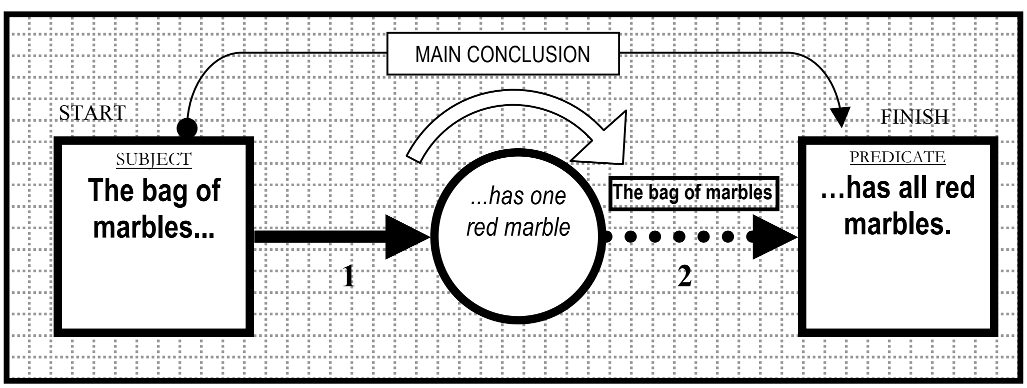

Figure 10. Stepping|Stones diagram of resolved inductive argument.

Probative Relevancy Matrix

The subjective judgment of levels of uncertainty can be facilitated by a Probative Relevancy Matrix. Table 1 contains a subjective judgment of the levels of uncertainty contained within this argument (without addressing degrees of membership).

PROBATIVE RELEVANCY MATRIX			
Main Conclusion: **The bag of marbles** (subject) ...**has all red marbles** (predicate).			
Certainty ≍	MEMBERSHIP EQUIVALENCY ≍ is a substitute member	MEMBERSHIP CHAIN ∈ is member of	Certainty ∈
		The bag of marbles ∈	1
1	**The bag of marbles** ≍	*...has one red marble* ∈	.5
		...has all red marbles.	

Table 1. Probative Relevancy Matrix of inductive argument

This matrix (see Table 1) reveals that two types of uncertainty affecting probative force can be conceptualized in an argument, namely, uncertainty of membership and uncertainty of substitution or inference step. In this instance, the uncertainty is contained in the membership statement of the generalization. There is no uncertainty in the inference substitution.

Once the individual levels of uncertainty are determined, different methods can be used to formulate a determination of probative force. It can be based, for example, on a Bayesian or argumentation approach (Walton, 2004, p. 277.) A third approach called evidence sets (Rocha, 1999) which also considers degree of membership, can be considered.

Uncertainty can, of course, exist in both membership and substitution criteria as illustrated in the following argument (see Figure 11).

Premises: The Braeburn apple is red. Red indicates stop.

Conclusion: The Braeburn apple indicates stop.

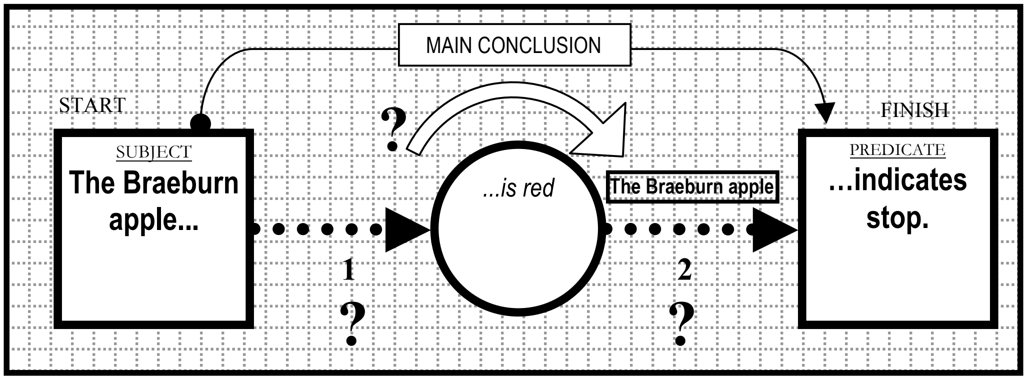

Figure 11. Stepping|Stones diagram of Braeburn apple argument.

One analysis of this argument diagram (see Figure 11) is illustrated in the following matrix (see Table 2).

PROBATIVE RELEVANCY MATRIX			
Main Conclusion: The Braeburn apple (subject) ...indicates stop. (predicate).			
Certainty $\asymp$	MEMBERSHIP EQUIVALENCY $\asymp$ is a substitute member	MEMBERSHIP CHAIN $\in$ is member of	Certainty $\in$
		The Braeburn apple $\in$	1
0	**The Braeburn apple** $\asymp$	*...is red* $\in$	.1
		...indicates stop.	

Table 2. Probative Relevancy Matrix of Braeburn apple argument.

Table 2 shows that while, arguably, there is some level of certainty in the chain of membership, there is zero certainty that the subject "The Braeburn apple" can be an inference substitute for "is red" as a member of "indicates stop." Therefore, the premise that the Braeburn apple is red has no probative relevancy. All arrows up to the final arrow must be solid, meaning some level of certainty of substitution or inference is possible, for the premises in that line of reasoning to be probative.

The zero certainty of the membership substitution inference step of the Braeburn apple may be related to the subsethood theorem. Subsethood measures the degree to which set B is contained within set A (Kosko, 1993). In this example, it would be the degree to which "is red" is contained within the set “The Braeburn apple.” The more set B is contained within set A, the more likely set A can substitute for set B as a member of set C.

Abductive Inference

The following example illustrates an abductive argument (see Figure 12).

Abductive Reasoning

Premise: A red marble is found in the vicinity of a bag of red marbles.

Conclusion: The red marble is from the bag.

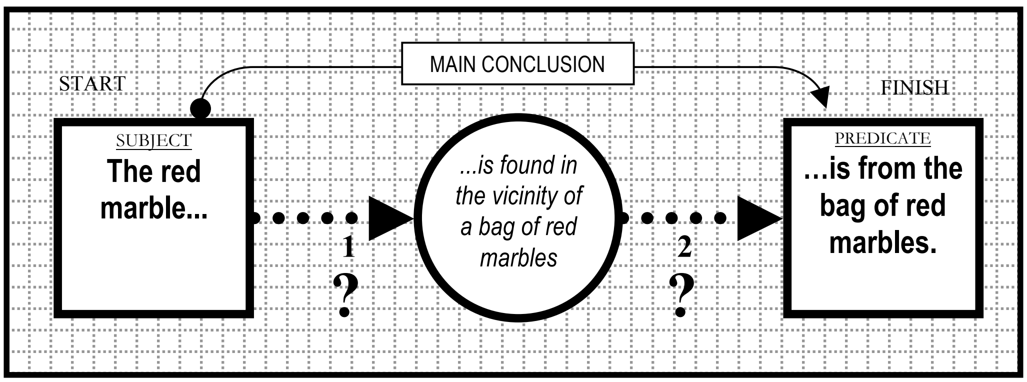

Figure 12. Stepping|Stones diagram of abductive argument with unresolved memberships.

In this instance, membership 1 is established by the first premise. Membership 2 represents a generalization with, arguable, a high degree of uncertainty, that would be implicit in the line of reasoning if the main conclusion predicate was arrived at through abductive reasoning. There could be, depending on available evidence, other possible hypotheses resulting in different final predicates. Assuming that the uncertainty is not zero, however, membership 2 can be established (see Figure 13).

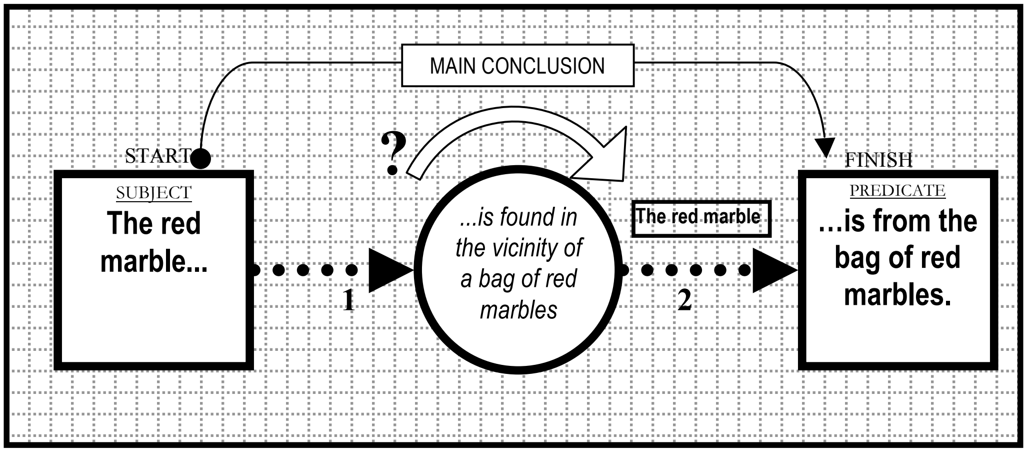

Figure 13. Stepping|Stones diagram of abductive argument with unresolved inference step.

The final determination is whether the subject “The red marble” can substitute (to some degree and level of uncertainty) for its adjoining node as a member of the following adjoining cognitive category along the path of reasoning. In this instance, through an inference step of substitution, the subject of the main conclusion “The bag of marble” is an equivalent substitute for the interim predicate “has one red marble” as a member of the final predicate “has all red marbles.” Since this inference step adjoins a membership relationship based on abduction, it may be considered an abductive step. Based on these two determinations, it can be concluded that the argument is well structured and that each premise has probative relevancy.

Presumptive Inference

The following example (see Figure 14) illustrates a presumptive argument called argument from expert opinion (Walton, 1997).

<u>Presumptive</u>

Premise: The tire skid mark expert said the car was speeding.

Conclusion: The car was speeding.

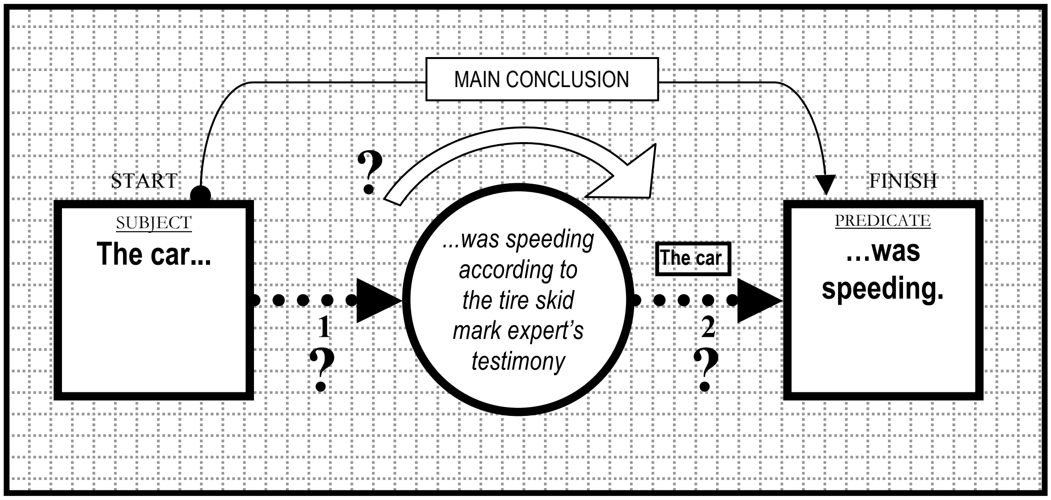

Figure 14. Stepping|Stones diagram of presumptive argument with unresolved membership.

In this instance, membership 1 is established as self-evident by the first premise. Membership 2 represents a membership derived from the "argument from expert opinion" argument scheme. The level of certainty may be considered provisionally plausible. The membership's plausibility can be further examined through considering the critical questions that are associated with this argument scheme (Walton, 2003, p. 134).

Conditionals

Such critical questions include, for example, whether the expert is biased (trustworthiness) and whether the expert's opinion is credible (expertise) (Walton, 2003, p. 134). Critical questions, in this argument framework, can be conceptualized as intervening predicates that act as conditionals. In this case they are companion conditionals since they are always associated with that specific argument scheme. These companion conditionals drawn from the critical questions can be diagrammed as shown in Figure 15.

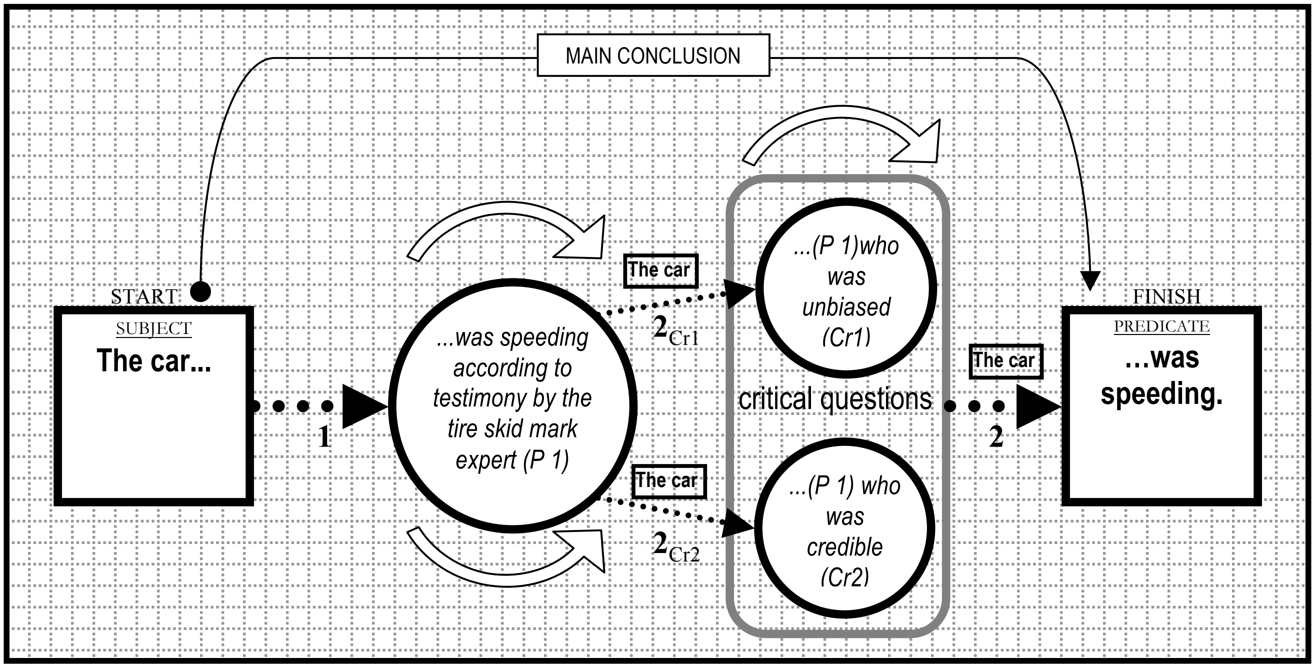

Figure 15. Stepping|Stones diagram of critical questions as companion conditionals.

In Figure 15, the critical questions were diagrammed as part of a single unit. This reflects an assumption that a level of uncertainty of zero for any one of the critical questions (companion conditionals) imparts a level of uncertainty of zero for the composite unit depicted as membership 2 based on the least plausible premise rule (Walton, 2004, p. 278).

An alternate graphic convention for conditionals, for shorthand purposes, is illustrated in Figure 16. The conditionals connect into the arc where they can be conceptualized in a position to infuse or siphon off membership certainty.

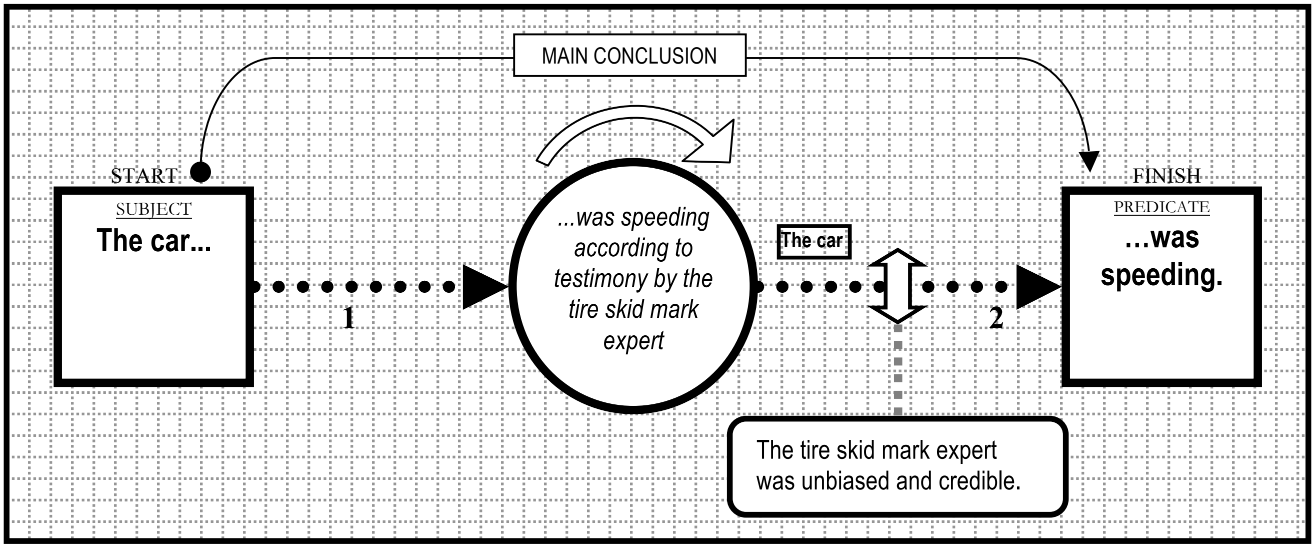

Figure 16. Stepping|Stones shorthand diagram of critical questions as companion conditionals.

In determining probative relevance, another type of conditionals that should be considered are contextual conditionals. These are conditionals that are unique to the specific premise context. Such conditionals can affect levels of certainty for membership or substitution. For example, consider the abductive example previously illustrated (see Figure 13). In this example, the level of certainty associated with the inference substitution step is affected by whether the red marble can fit within the bag of red marbles. In this case, the contextual conditional can be conceptualized as affecting either the membership relation or the inference substitution step (see Figure 17). A membership relationship between two predicates acts as a conditional to a previous membership relationship if a zero certainty of membership for the subsequent relationship would break the inference path of transitive membership leading to the main conclusion predicate.

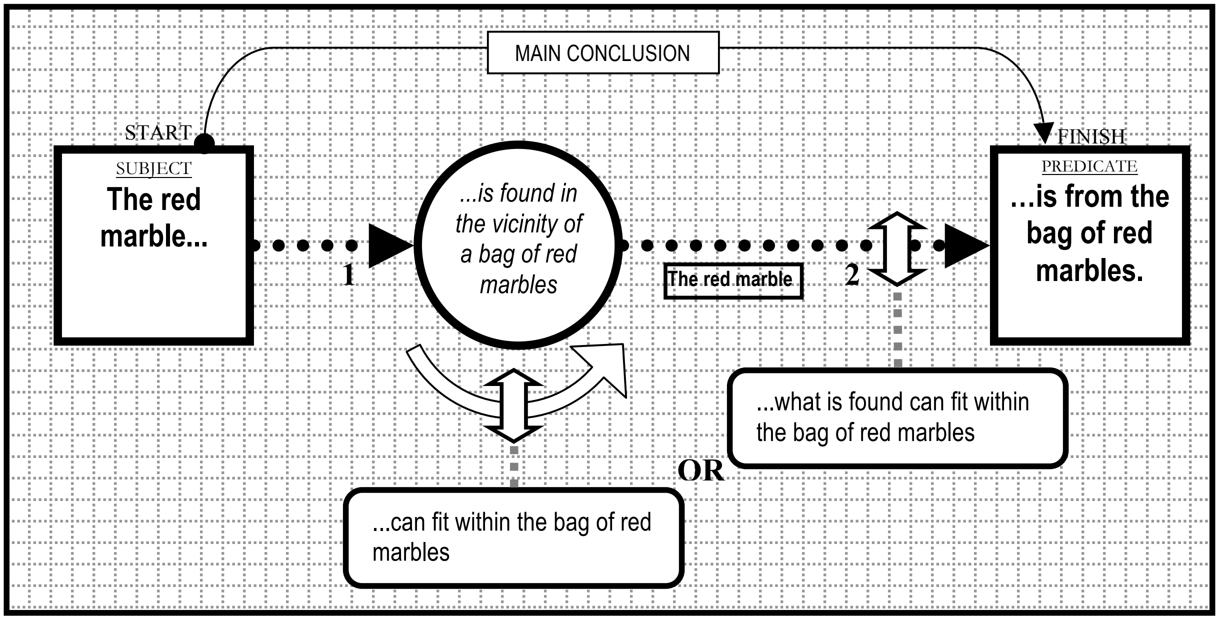

Figure 17. Stepping|Stones diagram of contextual conditionals.

Premise Classification

One advantage of the Stepping|Stones framework for determining probative relevance is that the need to make distinctions between major and minor premises or datum and warrant becomes unnecessary through the structural constraints of the scaffolding. When premises, depicted as predicate relationships, must fit between the subject and predicate of the main conclusion, their order is resolved by the structural constraint of unidirectional transitive membership. There is no functional distinction other than order in their sole purpose of joining together the parts of the main conclusion. Similarly, the classification of premises as ancillary evidence, such as a Toulmin's backing, is revealed as, perhaps, functionally indistinguishable from other premises. The following example illustrates these points. It is taken from a well known Toulmin (1958) example.

Claim: Harry is a British subject.

Datum: Harry was born in Bermuda.

Warrant: A man born in Bermuda will generally be a British subject.

Backing: The British Nationality Acts identify anyone born in Bermuda as British.

A typical tree-like single-bounded argument structure would depict this argument as shown in Figure 18.

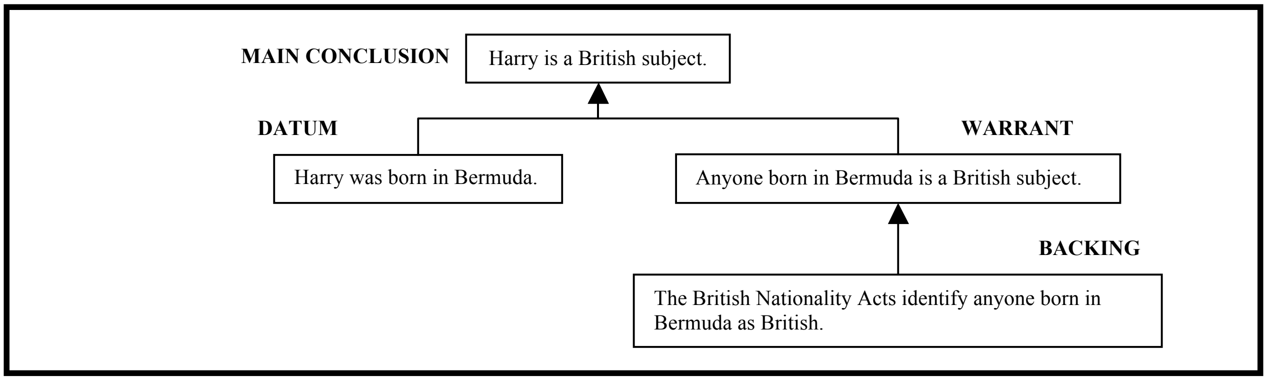

Figure 18. Toulmin argument diagram using layered tree-like structure

Diagramming this argument with a Stepping|Stones framework reveals that the backing (ancillary evidence) is simply one more predicate in the linear line of reasoning (see Figure 19). Its presence makes the connection between the predicates "was born in Bermuda" and "is a British subject" a more supportable inference leap of substitution for the subject "Harry." Further, from this argument structure perspective, the original datum/warrant relationship is shown as actually only provisional until the backing predicate intervenes alongside the "was born in Bermuda" predicate category. The complex arranging between the premises in the tree-like structure are revealed as, perhaps, unnecessary when they are disassembled and ordered into their simple linear transitive relationships.

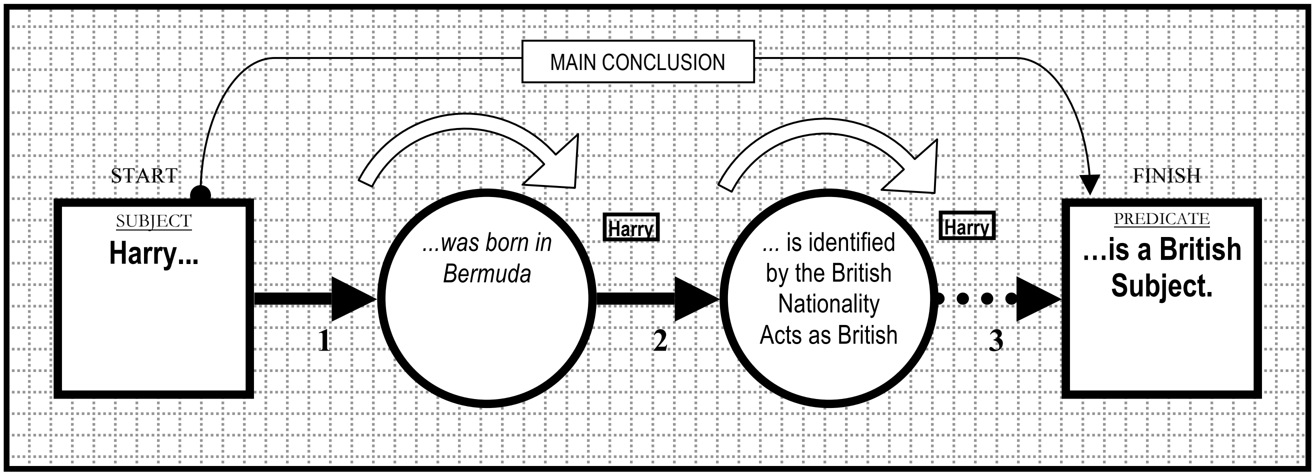

Figure19. Robust version of Stepping|Stones diagram of Toulmin argument.

A further comparison to illustrate the simple linear transitive membership relationship between the premises that is buried within the complexity of the tree-like structure is drawn from a more complex argument in Walton (2004, p. 265). A key list of propositions that match with numbers in the Walton (2004, p. 265) portion of Figure 20 is used for the tree-like argument structure. The numbers in the Stepping|Stones portion of Figure 20 match the predicates in the completed textual diagram (see Figure 21).

1. "If flesh was found under V's fingernails, then that flesh belonged to the killer.
2. Flesh was found under V's fingernails.
3. Therefore, the flesh found under V's fingernails belongs to the killer.
4. If E says that the flesh under V's fingernails belongs to S, then the flesh belongs to S.
5. E says that the flesh under V's fingernails belongs to S.
6. Therefore, the flesh found under V's fingernails belongs to S.
7. If W says she saw S leaving the house just after the crime was committed, then S left the house just after the crime was committed.
8. W says she saw S leaving the house just after the crime was committed.

9. S left the house just after the crime was committed.

10. If S left the house just after the crime was committed then S was in the house when the crime was committed.

11. Therefore, S was in the house when the crime was committed.

12. If S was in the house when the crime was committed then S is the killer.

13. S is the killer" (Walton, 2004, p. 265).

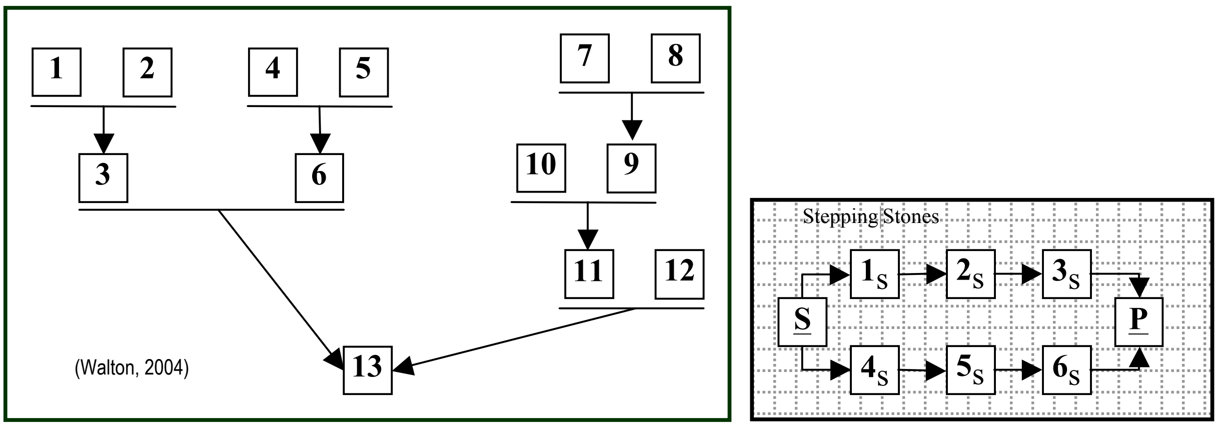

Figure 20. Comparison argument diagrams of the "S is the killer" argument.

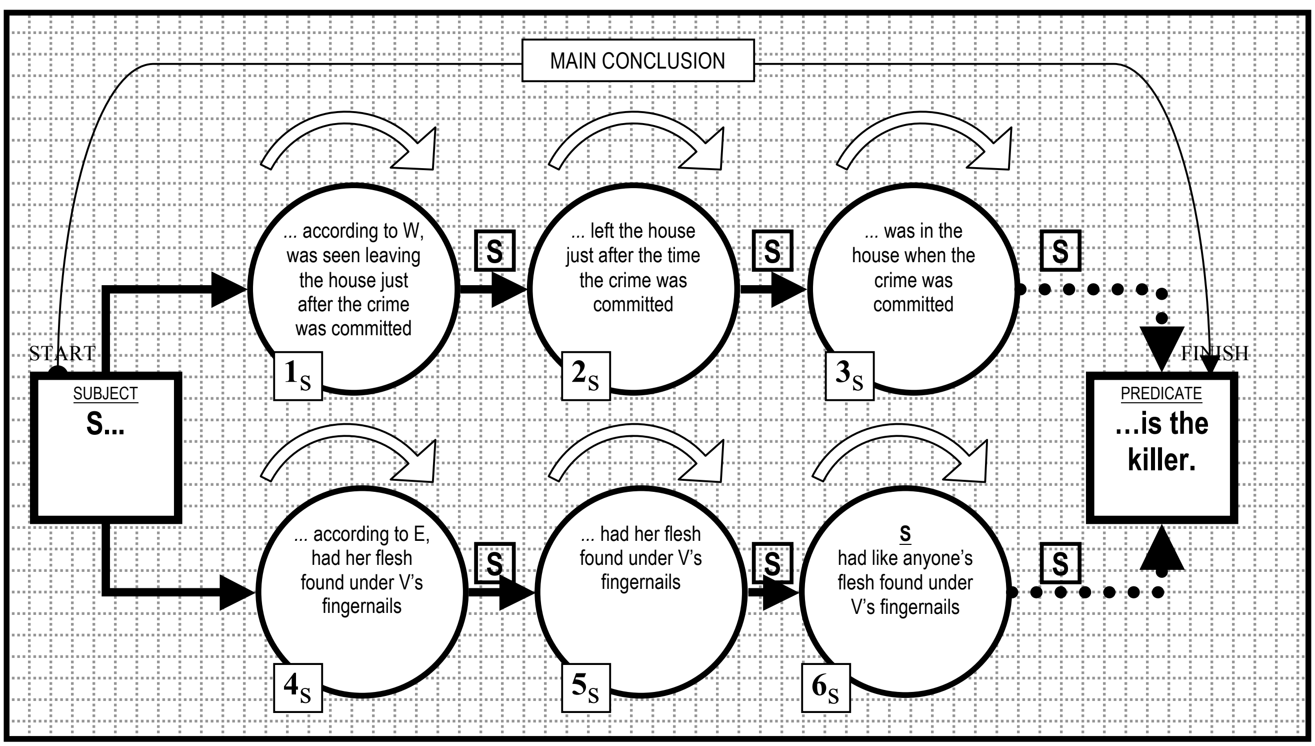

Figure 21. Stepping|Stones diagram of "S is the killer" argument.

Multiple Lines of Inference

Assessing for probative relevancy and force is similarly done when there are more than one line of reasoning as illustrated (see Figure 22).

Claim: Harry is a British subject.

Datum: Harry has a British passport.

Warrant: A person with a British passport is generally a British subject.

Datum: Harry was born in Bermuda.

Warrant: A man born in Bermuda will generally be a British subject.

Backing: The British Nationality Acts identify anyone born in Bermuda as British.

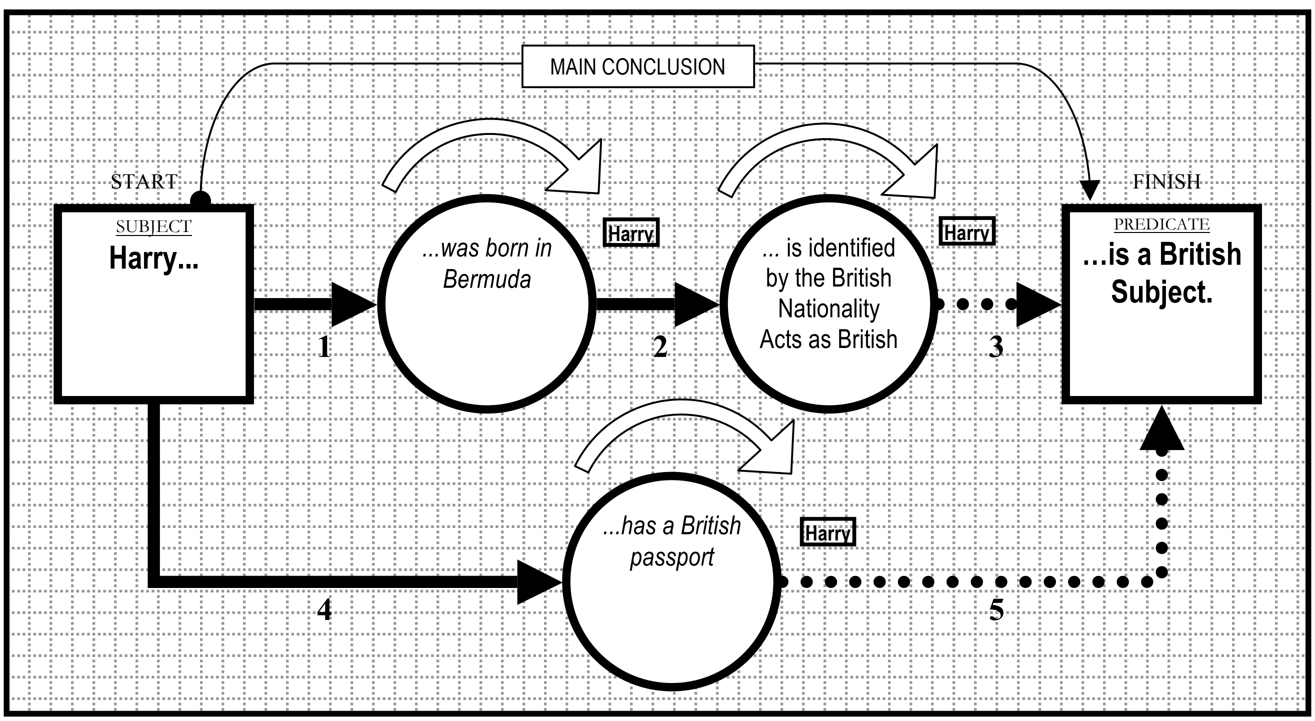

Figure22. Stepping|Stones diagram of multiple lines of inference.

Each separate line of reasoning is convergent on the conclusion predicate. So an analysis of probative relevancy and force are performed separately for each line.

Convergent and Linked Arguments

In diagramming arguments it is important to distinguish between convergent and linked arguments. (Walton, 2004, p. 278). There are various tests proposed to make this determination (Yanal, 2003). From a Stepping|Stones framework perspective, any premise contained along the line of interlocking transitive memberships is linked in relation to any other premise along the same path of transitive memberships. Any premises that exist on separate lines of transitive membership that together join the subject and predicate of the same conclusion are convergent (see Figure 22). This single criteria of transitive membership helps simplify the convergent and linked determination.

For example, consider the familiar “Socrates is mortal” argument.

Premises: Socrates is a man. All men are mortal.

Conclusion: Socrates is mortal.

The first step in diagramming with transitive chains is to separate the main conclusion into its subject and predicate with space for the intervening predicate(s) indicated (see Figure 23).

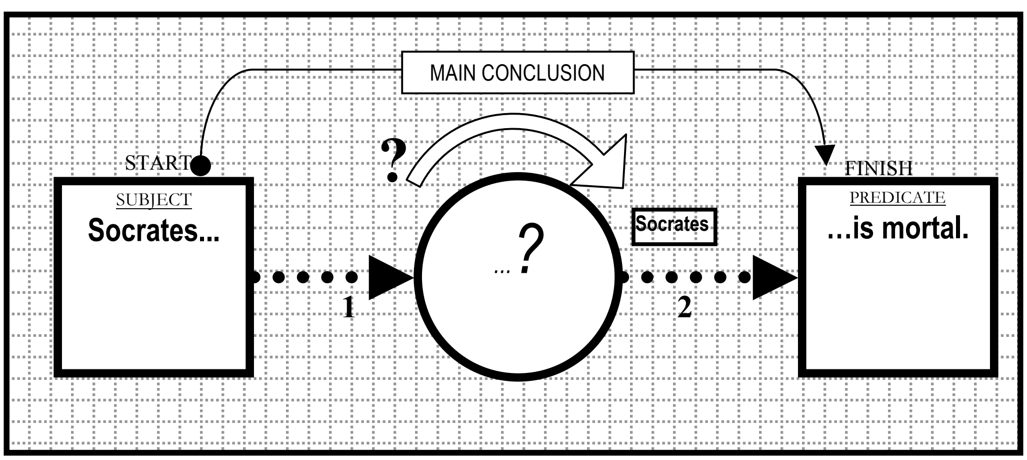

Figure 23. Stepping|Stones diagram of “Socrates is mortal” with missing predicate.

The next step is to insert the textual predicate drawn from the premises (see Figure 24). When following this scaffolding the second premise, "is a man is mortal" automatically appears as membership relationship 2. The scaffolding avoids the type of convergent/linked error that can occur with a tree-like argument structure (see Figure 25).

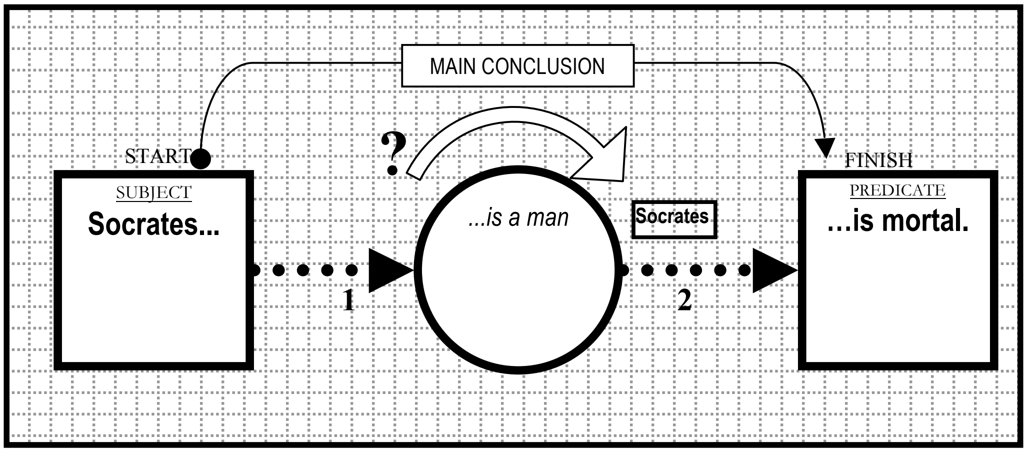

Figure 24. Stepping|Stones diagram of "Socrates is mortal" with completed predicate.

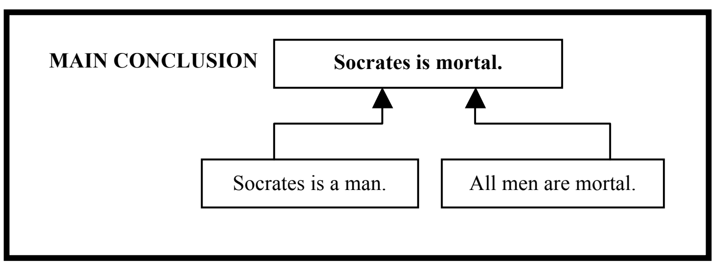

Figure 25. Tree-like structure depicting convergent/linking error in "Socrates is mortal" (Twardy, 2004).

Objections

In accessing for levels of probative relevancy, objections must also be considered. In the Stepping|Stones framework, based on the lack of a need for distinctions between types of premises or terms of an argument, objections fall into one of three broad categories. The first objection is that the argument has no probative relevance since it is structurally incorrect as indicated by its inability to fit within the constraints of the transitive membership chain. The other two objections attempt to reduce the probative force directed at a main conclusion either through the objection's connection to an arc or to a node. Any objection that legitimately connects to an arc or a node of the intended argument has probative relevancy through the act of siphoning its certainty. The following example depicts an arc objection (see Figure 26).

Premise: The suspect fled from the scene of the crime.

Conclusion: The suspect was responsible for the crime.

Objection (arc): The suspect was a scared witness to the crime.

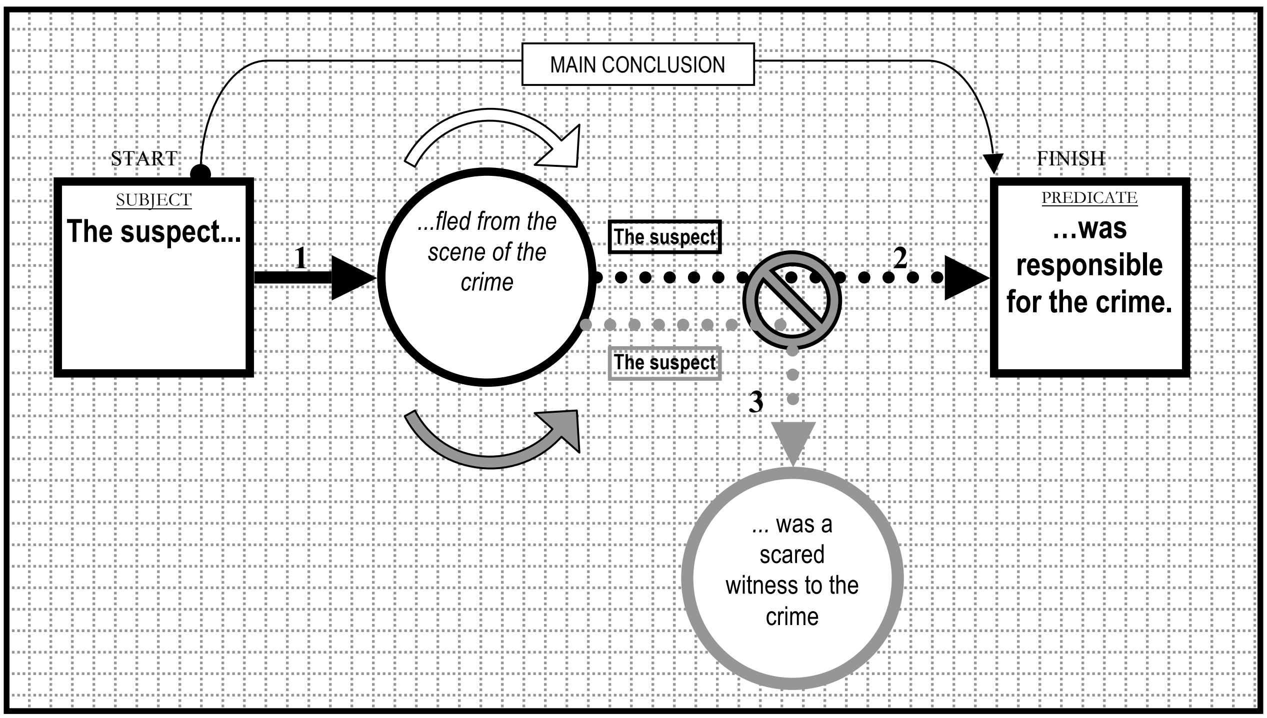

Figure 26. Stepping|Stones diagram of an arc objection.

In Figure 26, the levels of uncertainty in membership of arcs 2 or 3 compete for the most likely membership. Since, arguably, the subject "The suspect" has the same level of uncertainty as a substitute member for the node "fled from the scene of the crime," regardless of which following node is attached, the probative force of "fleeing" is determined solely by which membership is more likely, namely, belonging to "was a scared witness to the crime" or to "was responsible for the crime." Since the objection legitimately attaches to an arc, it has probative relevance.

Figure 27 illustrates the same argument with a node objection that connects to the ultimate predicate. This can be considered an off-line rather than on-line objection since it bypasses the existing line of reasoning and presents an alternative chain of predicates leading to a competing node (whether interim or ultimate).

Premise: The suspect fled from the scene of the crime.

Conclusion: The suspect was responsible for the crime.

Objection (off-line): The suspect had a solid alibi.

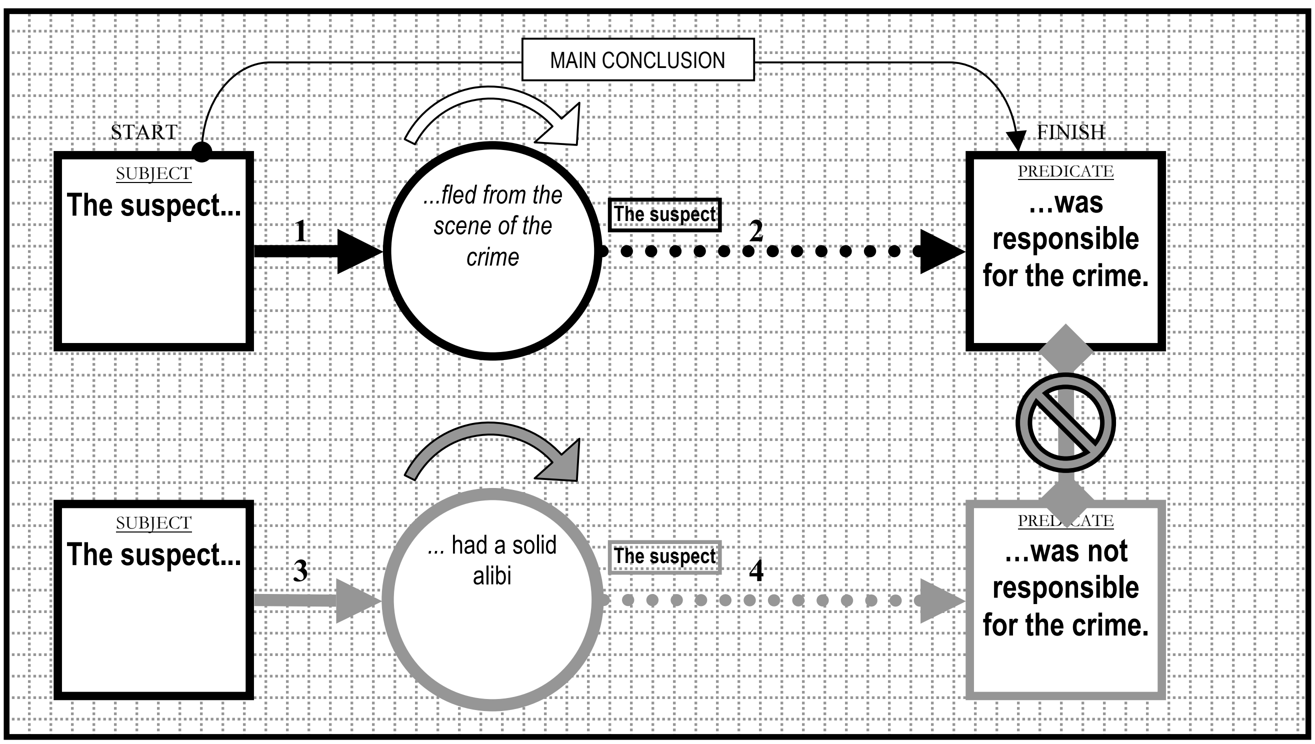

Figure 27. Stepping|Stones diagram of node objection to final predicate.

In Figure 27, rather than objecting to an inference step based on a competing predicate within the line of reasoning, different nodes and arcs are used to compete with the probative force of the original line of reasoning. Since the objection legitimately attaches to a node, it has probative relevance.

Figure 28 illustrates the same argument with a node objection that connects to an interim, rather than final, predicate. All node objections start with the subject of the main conclusion.

Premise: The witness said the suspect fled from the scene of the crime. The suspect fled from the scene.

Conclusion: The suspect was responsible for the crime.

Objection (off-line): The suspect always walked very tenuously with the aid of a "walker."

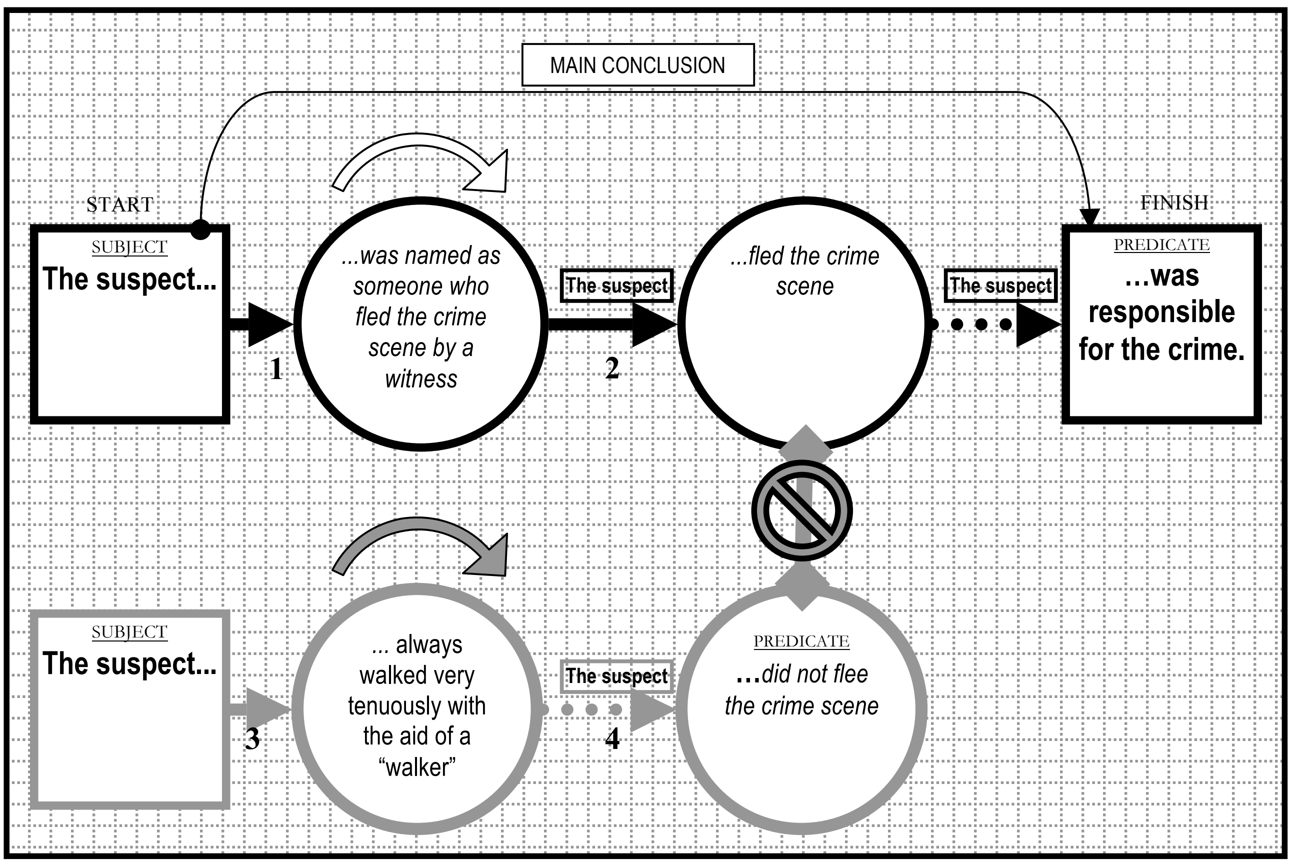

Figure 28. Stepping|Stones diagram of node objection of interim predicate.

Since the objection legitimately attaches to a node, it has probative relevance.

Degrees of Membership

A determination of degrees of membership may also be important in determining probative relevancy and probative force following a fuzzy logic perspective. For example, using a portion of the previous "fleeing" example, the degree to which the suspect fled (e.g. how fast the person left the scene) is an important factor in addition to the level of certainty that he or she did flee. This added element can be accounted for in a Probative Relevancy Matrix (see Table 3). In this case, it was assumed that the person fled at a moderate speed. Evidence sets, which provide interval degrees of membership, weighted by the probability constraint of Dempster-Shafer Theory (Rocha, 1999), can be considered in assessing probative force when degrees of membership are an issue.

PROBATIVE RELEVANCY MATRIX				
Main Conclusion: **The suspect** (subject) **...was responsible for the crime.** (predicate).				
Certainty $\asymp$	MEMBERSHIP EQUIVALENCY $\asymp$ is a substitute member	MEMBERSHIP CHAIN $\in$ is member of	Certainty $\in$	Degree of membership
		The suspect $\in$	1	.5
1	**The suspect** $\asymp$	*...fled the crime scene* $\in$	.1	
		...was responsible for the crime.		

Table 3. Probative Relevancy Matrix of "The suspect was responsible for the crime" argument.

Argument Extrapolation

Many times it is not obvious if a premise fits within the argument chain that joins together the main conclusion. Argument extrapolation can be used to make this determination. Typically the question is whether the premise "points" to the main conclusion in a tree-like single bounded argument structure. This is determined by a forward or backward chaining between the premise and the main conclusion (Walton, 2004, p. 178).

With a closed-ended argument structure, argument extrapolation is, while conceptually the same for a single bounded structure, performed slightly differently. The premise under examination is separated into two cognitive categories with a membership relationship. An assessment is then made whether the subject of the main conclusion, through inference substitutions, can reach the second cognitive category of the premise along any of the lines (arcs) as illustrated in Figure 29.

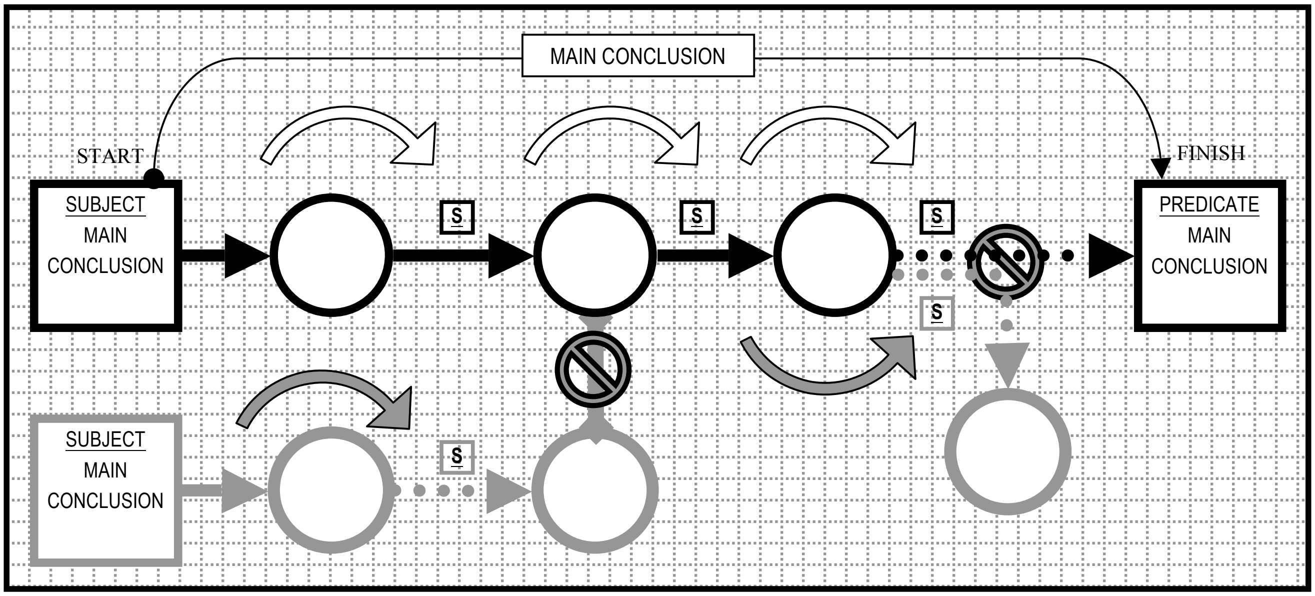

Figure 29. Stepping|Stones diagram illustrating argument extrapolation.

Structural Correctness

Argument structural correctness is a prerequisite of probative relevancy. The structural constraints of the Stepping|Stones frame help separate out many issues of structural incorrectness. For example, three simple rules have been suggested to guide the construction of a structurally correct argument. These are the Rabbit Rule, the Holding Hands Rule, and the No Danglers Rule (van Gelder, 2005). The Rabbit Rule states that “every significant term or phrase appearing in the conclusion of a simple argument must also appear in one of the premises.” (van Gelder, 2005). The Holding Hands rules states that “every significant term or phrase appearing in a premise of a simple argument must also appear in another premise or in the contention.” (van Gelder, 2005). The No Dangler Rule states that “every significant term or concept must appear in at least two claims (premise of contention) (van Gelder, 2005). The structural constraints of Stepping|Stones ensure that these three rules are met in any argument that fits within its structure.

Conclusion

Argument diagramming can be an important tool in both understanding probative relevancy and probative force and making specific determinations. Its power and likelihood of use may be a function of how well its underlying argument structure facilitates argument chaining and transitivity determinations. Stepping|Stones' chained scaffolding and single design criteria of transitive membership may enhance the usability factor of argument diagramming compared to the use of tree-like argument structures.

Despite its beneficial attributes, however, Stepping|Stones is not appropriate for every argument. As the complexity of an inferential network increases, the semantic adjustments necessary to fit within the transitive membership criteria can become too burdensome for practical purposes. Further, some arguments may just not fit within its constraints. It does provide, however, one more useful tool to understanding and determining probative relevance.

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