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Modal Justification of Testimonial Knowledge: A Logical Assessment

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Abstract

This paper is a logical assessment of testimonial knowledge through modal reasoning. The question of the validity of testimonial knowledge is significant to epistemic-logicians. The reality of false testimonies in our contemporary societies make the reliability of testimony as a source of knowledge questionable. Testimonial knowledge is a kind of knowledge gained when a speaker transmits a declarative statement as information to the hearer and the hearer receives the information as knowledge on the basis of trust. This process has raised significant questions concerning the justification of testimonial knowledge: is it ideal to rely on testimony for knowledge that is valid, certain and consistent? How do we justify the validity of testimonial knowledge? This paper adopts Kripke's S5 system of modal logic as a framework to model reasoning about testimonial knowledge. This paper employs the philosophical method of analysis. It demonstrate how modal operators, axioms and logical semantics help in assessing testimonial claims. This paper posits that testimonies can lead to knowledge either through necessity or possibility, with the verification principle serving as a crucial justification. It concludes that since true belief does not imply knowledge, any testimonial knowledge formulated on the basis of trust alone without justification cannot be valid until its validity is logically proven through the verification principle.

Keywords: Modal Reasoning, Testimonial Knowledge, Kripke's logic, Verification Principle.

Introduction

The need for a rigorous logical assessment of testimonial claims and justification for the validity of testimonial knowledge is a prerequisite in a time when testimony has become an invaluable source of information that forms the basis of human judgement. It is arguable that "most of what we take ourselves to know about the world comes from the testimony we have received" (Wright, 2001:43), upon which our beliefs are formed and our judgement are carried out. This agrees with David Hume's assertion that" there is no species of reasoning more common, more useful and even more necessary to human life than that which is derived from the testimony of men, and from the reports of eyewitnesses and spectators" (1978:43). However, there are countless recorded cases of false testimonies which have led to the formation of false-beliefs and wrong judgments as well as the destruction of lives and properties in our contemporary society. There are evidence of false-testimonies in religious practices, socio-economic relationships, judicial processes and executive orders. Totackle this problem, there is need to assess the validity of testimonial claims, as well as to develop measures to identify and distinguish between true from false testimonies. Consequently, this paper addresses the aforementioned problem by employing Saul Kripke's modal logic as a framework in logically assessing and justifying testimonial knowledge.

Testimonial Knowledge

Knowledge is the English equivalent of the Greek word "*episteme"*. It is the subject matter of epistemology. Epistemology is a core branch of philosophy that is interested in the nature, scope and source(s) of knowledge. Among the recognized sources of knowledge in epistemology is testimony. Testimony involves "the transmission of information from the speaker to the listener with the aim of conveying information which can be passed as knowledge" (Etuk & Edet, 2025:133). Testimonyis regarded as source of knowledge because "virtually everything we know depends in some way or other on the testimony of others; what we eat, how things work, where we go, even who we are" (Lackey, 2011:71). This implies that testimonial knowledge is one of the most basic sources of human knowledge.

The question concerning the reliability of testimony as a source of knowledge is a widely discussed debate between the reductionist and non-reductionist camps. The reductionist epistemologists believe that information gotten from testimonies can form the basis of our beliefs upon which knowledge can be deduced. This deduction, however, relies on other sources of knowledge like perception, inferences and memories. The non-reductionist epistemologists, on the other hand, argue that testimony does not need the support of other sources to convey knowledge. Hence, testimony, for them, is a primary source of knowledge. This kind of knowledge is formulated on the basis of trust established between the speaker and the hearer where the hearer trusts the information received from the speaker and accept it as knowledge. Despite the approaches to testimonial knowledge, it does seem that none of the approaches could exhaustively justify testimony as a reliable source of knowledge as far as the question of validity of testimonial claims, means of distinguishing between true and false testimonies and other such questions are concerned. These questions remain to a great extent unanswered. Hence, the need to develop a logical framework that will aid in resolving the problem.

Modal Reasoning

Modal reasoning is a kind of reasoning that goes beyond actual facts. It refers to a form of hypothetical logic that considers possible alternatives as well as necessities. Reasoning is one of the English equivalents for the word "logic"; and modality is conceived by Michael Proud foot and Alan Lacey as "ways in which something can exist or occur or be presented, or stand" (2010:258). A thing can be of necessity, possibility, contingency and soon. Modal reasoning refers to the process of thinking and making inferences about what is necessary, contingent, possible and impossible. It is also called modal Logic. Roy Cook defines modal logic as" the branch of logic concerned with arguments, reasoning or inferences about necessity, possibility, obligation and so on"(2009:191). Logic is fundamental tool of philosophy, and modal logic as a branch of logic is a pertinent instrument for analyzing truth-value that goes beyond actual facts in metaphysical, epistemological and axiological claims. Modal Logic is divided into Alethic modal Logic, Deontic modal Logic, Temporal modal Logic, Epistemic Modal Logic etc

Epistemic Modal Logic is concerned with the logical analysis of epistemic properties. J. Hintikka defines it as "the main vehicle of speaking and reasoning about knowledge" (1989:17). Epistemic modal reasoning is employed by logicians to assess epistemic propositions that their truth-value seems to transcend actual facts. For instance, the truth of a testimonial knowledge goes beyond mere trusting the testimony of the speaker, it requires a logical assessment to ascertain the validity of the testimonial knowledge. For example, when a speaker tells a listener that "Emmanuel is intelligent" for some unverified reasons, the listener accepts the information on the basis of trust for the assertion of the speaker and forms a body of knowledge which holds that "Emmanuel is intelligent". The validity of this testimonial knowledge is questionable and the truth-value is uncertain until logically verified and proven through a rigorous logical assessment. To achieve this kind of assessment, Kripke's S5 system of modal logic becomes very useful.

Kripke's S5 System of Modal Logic

Saul Kripke (1940-2022), an American philosopher and logician, was one of the outstanding modal logicians that made enormous contributions to the development of modal logic. He is the progenitor of a semantic approach to modal logic. He developed his system of modal logic which becomes one of the most influential systems of logic in modern discourse on modal logic. S5 system was a reaction and modification of C. I. Lewis system of modal logic which aimed at formalizing reasoning about necessity and possibility from a purely synthetic standpoint (Etuk & Edet, 2025:135). While establishing the background for his modal logic, Kripke, in his famous work *Semantical Consideration on Modal Logic,* asserts that "the emphasis of this paper will be purely semantical..." (1963:83). Kripke's semantics serves as the missing link in modal logic. Kripke's S5 system is a composite of modal operators, modal logical axioms and semantics.

Modal Operators of Kripke's S5 System

An operator is a symbol or function which represents expression. Modal Operators are therefore symbols or words that express modality. It is the symbols or words used to express the ways in which a statement can be necessary, possible or contingent. They are used to modify the truth-value of propositions that goes beyond the traditional two-value system (truth or false).

Kripke's S5 system employs the modal operators of necessity and possibility. He symbolizes "necessity" with box (□) and "possibility" with diamond (♦) . *?p* becomes *p* is necessary or it is necessary that *p*. □*p* becomes *p* is possible or it is possible that *p*. In Kripke's S5 system, both necessity and possibility are inter-definable such that:

"□$p \equiv -\blacklozenge p$" implies that p is necessary if and only if it is not possible that p is false

"$\blacklozenge p \equiv -\blacklozenge p$" which implies that p is possible if and only if it is not necessary that p is false.

For instance, consider the statement: Emmanuel is intelligent as *p*

From inter-defining necessity from possibility, it follows that" Emmanuel is intelligent" is necessary if and only if it is not possible that "Emmanuel is intelligent" is false. The impossibility of the proposition to be false in all possible worlds accessible by the agent makes the proposition a necessary truth(Etuk & Edet, 2025:136).

Key Axioms of Kripke's S5 System

Axioms are foundational statements that are accepted as true without proof. Axioms are either logical or non-logical. While the non-logical axioms are specific to subjects like mathematics, physics and geometry, logical axioms are axioms that are valid in all logical systems regardless of the subject matter. Logical axioms are starting point for formal reasoning in logic. They are accepted as truth and are used to deduce further truths using formal rules. Logical axioms are essential for building consistent logical systems. Kripke's S5 system makes use of axioms that help to ascertain the consistency and completeness of the system. These axioms include distributive axiom, truth axiom, S4 axiom, S5 axiom, and Brouwer's axiom.

Distributive Axiom: This axiom is foundational in Kripke's model such that it is named after Saul Kripke and it is logically presented as *K* axiom. This axiom ensures the logical distribution of the modal operator of necessity over implication. It holds that if it is necessary that *A* implies *B*, it follows that if *A* is necessary, *B* is also necessary. Distributive axiom is logically symbolized as "$\Box(A \rightarrow B) \rightarrow (\Box A \rightarrow \Box B)$". For instance, if it is necessary that "if it is raining, the street will be wet", then, it is necessary that it is raining, it is also necessary that the street is wet.

Truth Axiom (T Axiom):This axiom is another very important axiom in Kripke's S5 system. It holds that necessity implies truth and it is logically symbolized as "$\Box A \rightarrow A$". It follows the reasoning that if *p* is necessary then *p* is true. For instance, if it is necessary that "all bachelors are unmarried men" then the statement" all unmarried men are bachelor" is true.

S4 Axiom: This axiom is fundamental because it lays emphasis on the modal operator of necessity. The axiom states that if a proposition is necessary, then the proposition is necessarily necessary. The axiom, according to Kripke, is semantically characterized by the property of reflexivity (1963:84). It states that for every world *w* and *x*, if *w* is necessarily related to *x*, and *x* is necessarily related to itself, then *w* is necessarily related to *x*. Consider the semantic analysis of the proposition "feeding is essential to human being" using S4 axiom:

- □ *p* implies that it is necessary that "feeding is essential to human being"
- □□*p* implies that it is necessarily the case that it is necessary that "feeding is essential to human being". S4 axiom is logically symbolized as "$\Box A \rightarrow \Box\Box A$". This implies that if feeding is necessary to human being, then it is necessarily necessary that human being feed.

S5 Axiom: This is a key axiom in Kripke's S5 system. Kripke employs this axiom in his semantics to analyse logical propositions through accessibility relations. He shows that the property of accessibility relation corresponds to the axiom through the rule of equivalence. Consider the following:
For all worlds *w* and *x*, if *w* is related to *x*, then *w* and *x* are the same world (identical).
This argument is semantically symbolized as "$\blacklozenge A \rightarrow \square \blacklozenge A$ *or* $\square A \rightarrow \blacklozenge \square A$", where:
W is a set of possible worlds
R is the accessibility relation between worlds
W and *x* are individual worlds.
Supposed we have three possible worlds (*W=w1,w2,w3*) where:
w1 represent a world where p is cooking
w2 represent a world where p is singing
w3 represent a world where p is dancing,
The accessibility relations R between these worlds are as follows:
w1 R w1 (the world where p is cooking is accessible from itself)
w2 R w2 (the world where p is singing is accessible from itself)
w3 R w3 (the world where p is dancing is accessible from itself).

This implies that each world is accessible from itself. In this scenario the S5 axiom holds because; given the logical representation of the S5 axiom which states that "for any world *w* and any world *x*, if *w* is accessible from *x*, then *w* and *x* are the same world. As such the supposition becomes:
$w1Rw1 \rightarrow \square w1=w1$ is true.
$w2Rw2 \rightarrow \square w2=w2$ is true.
$w3Rw3 \rightarrow \square w3=w3$ is true.
This example shows that the S5 axiom ensures that accessibility relation is an equivalence relation where each world is only accessible from itself.

The semantica representation of S5 axiom captures the logical essence of the axiom which states that given any proposition *p*, if *p* is necessary is true, then it is possible that"*p* is necessary" is true. The logical equivalent of this argument is given a proposition *p*, if *p* is possible is true, then it is necessary that *p* is possible is true. This argument is logically symbolized as:
$\square p \rightarrow \blacklozenge \square p$
$\blacklozenge p \rightarrow \square \blacklozenge p$ respectively.
For instance, consider the argument:
Given "all bachelors are unmarried" as *p*
$\square p$ will mean that "it is necessary that all bachelors are unmarried
$\blacklozenge \square p$ will mean that "it is necessary that all bachelors are unmarried is possible".
This argument shows that "$\square p \rightarrow \blacklozenge \square p$" logically.

Brouwer's Axiom: This axiom is also a key axiom in Kripke's semantic approach. It asserts that truth implies possibility. It states that if a proposition is true then it is necessary that the proposition is possible. Brouwer's axiom is logically symbolized as "$p \rightarrow \square \blacklozenge p$". An example is its application on the statement "Calixtus is Intelligent". It reads that if "Calixtus is Intelligent" is true, then it is necessary that the statement "Calixtus is Intelligent" is possible.

Semantics of Kripke's S5 System

Kripke introduced a semantical approach to the study of modal logic. His semantics is grounded on the possible world analysis that was introduced to philosophical reasoning by Gottfried Wilhelm Leibniz (1646-1716), a German philosopher. The possible world of Leibniz has to do with the realm of ideas or the realm of possibilities, in which the possible worlds exist. Kripke's possible world semantics is a logical framework use to analyse and interpret how things or state of affairs could possibly be. Kripke's possible world semantics, also known as Kripke's semantics, allows for clear interpretation of modal statements. After analysing his S5 system, Kripke opines that the basis of his analysis which motivated his conception is that a proposition is necessary if and only if it is true in all possible worlds (*A Completeness Theorem*, 1959:2). He asserted further that "in modal logic, however, we wish to know not only about the real worlds but also about other conceivable worlds" (1959:2-3) because *p* may be true in an observable/factual world but false in other conceivable/possible worlds. Hence, modal truth; truth of necessity and possibility should be derived from assessing other possible worlds because the truth value of an actual world can be deceitful.

Kripke's possible world semantics is based on the principle of accessibility relation which explains the relation between possible worlds. It shows the kind of relation which assigns truth-value to related statements in modal logic. It follows the reasoning that in a semantical consideration of modal logic, some worlds are possible or accessible from others. This is express through the properties of accessibility relation. The properties are reflexivity, transitivity and symmetry.

Reflexivity: this property states that "for all worlds *w, w* is accessible from itself". It is symbolized as *wRw*

Transitivity: this property states that for all worlds"*w,x,* and *y*". if *w* is accessible from *x*,and *x* is accessible from *y*, then *w* is accessible from *y*. It is symbolized as "*wRs* and *sR*y implies *wRy*".
Symmetry: this property states that for all worlds *w* and *x*, if *w* is accessible from *x*, then *x* is accessible from *w*. It is symbolized as"*wRx* implies *xRw*".

These properties form the definitive power of accessibility relation which is a necessary requirement for analysing relations between worlds in Kripke's semantics.

Testimonial Knowledge in Kripke's S5 System

Knowledge derived from testimony of others remains a fundamental concern to epistemic-logicians in the contemporary society, since it has resulted to countless problems that have turned people, organizations and institutions against each other. However, we cannot do without testimonies because it forms a great part of our beliefs. Since we cannot do away with testimonial knowledge, there is need to logically verify testimonial claims so as to identify and distinguish between true and false testimonies. The fact that testimonial knowledge is acquired through the process of transmission of information from speaker to listener, it therefore involves testifying two epistemic agents and the information which needs to be assessed.

Does the speaker have knowledge of the testimony he/she is? Has the listener verified the information before its acceptance? Does the listener have the capacity to evaluate testimony so as to distinguish between true and false testimonies? These questions revolve around the problem of reliability, trust, misinformation, deception and validity. Hence, to resolve the

issues associated with testimonial knowledge, there is need to develop a logical framework that will help in analysing these properties. Kripke S5 system that is characterized by modal operators, axioms and semantics, is useful in this analysis.

Analysis of Testimonial Knowledge Using Modal Operators:

When a testimonial claim is passed for knowledge, it is pertinent to understand the kind of knowledge that can be derived from such claim. This analysis is necessary because it helps to ascertain the truth-value of the proposition beyond mere belief. It is good to know if the testimony is one that can necessarily lead to knowledge or one that rests upon possibilities. This suggests that testimony can generate a true belief, which may potentially lead to knowledge after further verification. For instance, a testimony, *p* can necessarily lead to knowledge if and only if it is not possible that the testimony, *p* is false. This is symbolized as "$\Box p \equiv \neg\Diamond\neg p$". Additionally, a testimony *p* is possible if and only if it is not necessary that the testimony, *p* is false. This is logically symbolised as "$\Diamond p \equiv \Box\neg p$".

Analysis of Testimonial Knowledge Using Logical Axioms:

Logical axioms serve as the building blocks for truth that are valid and consistent. They are always accepted as truth and are used to deduce further truths. If a testimony is classified under any of these axioms then the testimony can necessarily lead to knowledge. Using the distributive axiom for instance, if it is necessary that "if a student studies hard, the student will pass his or her examination" then if it is necessary that "the student study hard", it is also necessary that "the student will pass his examination". It is symbolised as "$\Box(A\rightarrow B)\rightarrow(\Box A\rightarrow\Box B)$". Truth axiom shows that if a testimony can necessarily lead to knowledge then the testimony is true. For instance, if it is necessary that" man feed to survive" then the statement" man feed to survive" is true. It is symbolised as "$\Box A\rightarrow A$". Any testimony that does not fit into the structure of these axioms and their kinds should not be accepted as knowledge.

Analysis of Testimonial Knowledge Using Kripke's Semantics:

Possible worlds semantics is simply the possible scenarios or ways the outcome of a proposition or things could be. Kripke's semantics is a logical framework used to analyse the relation of this possible scenarios and how to assign truth-value to propositions. Kripke's semantics suggests that for a testimony to be accepted as knowledge, it should be verified in every possible scenario accessible from the testimony. This means that it must be verified in every instance where the testimony is made. The outcome of the assessment determines the truth-value of the testimony.

Modal Justification of Testimonial Knowledge

Kripke'sS5 system is valuable for examining the properties of testimonial knowledge. It allows for the analysis of testimonial properties such as reliability, trust, deception and misinformation by using logical operators, axioms and semantics in the assessment. This assessment will enable one to know whether a testimony is reliable or not, whether the testifier can be trusted or not, as well as the possibility of the speaker to mislead the hearer with the aim

of deceiving the hearer. The overall assessment, however, is to verify if the testimony is a true-testimony or false-testimony. It is here pertinent to ask, does true testimony suffice for knowledge, or is additional justification needed to substantiate its assertions?

This paper is of the view that testimonial knowledge is justifiable through modal reasoning and through application of the principle of verification. The verification principle proposed here is different from that of the logical positivists of the Vienna Circle. The Vienna Circle used verification principle to justify their claims that all meaningful statements are reducible to empirical facts. They laid emphasis on sense-data (Archibong, 2024:99). In the context of this paper, however, it is applied in a distinct manner, specifically through a modal analysis of testimonial claims that utilizes possible worlds semantics. The verification principle is employed to assess the justification of testimonial knowledge through semantic verification. For example, consider an office receptionist who, after assisting a new staff member with registration, makes the following statements:

- The name of the new staff is Emmanuel
- The new staff is intelligent

Let us represent both propositions with *p* and *q* respectively. While it is more convincing that *p* is true. It is however the case that *q* will need further justification to ascertain its truth-value. *p* gives necessary knowledge because it follows the reasoning that *p* is necessary if and only if it is not possible that *p* is false and is symbolize as "□p ≡ −♦−p". If *p* is necessary, then *p is true* (truth axiom) and truth implies knowledge. Whereas *q* proposition on the other hand gives possible knowledge because it follows the reasoning that *p* is possible if and only if it is not necessary that *p* is false and is symbolize as "♦*q* ≡ −□−*q*,". if *q* is possible is true, then it is necessary that *q* is possible is true (S5 axiom). To ascertain the truth-value of the testimony (*q)*, there is need to employ the principle of verification.

The verification principle allows us to subjects testimonial claims to a rigorous semantical analysis. It holds that for the proposition "Emmanuel is Intelligent" to be true, it must imply that for every possible world accessible from the testimony "Emmanuel is Intelligent" (that is, possible scenarios where the intelligence of Emmanuel has been tested), Emmanuel has always proven to be intelligent. Otherwise the testimony is false. Because the receptionist examined Emmanuel, test his intelligence and confirmed that "Emmanuel is Intelligent" is not sufficient enough for the testimony to be accepted as knowledge. It can only be accepted as knowledge when further semantical verification has been made and the truth-value remains the same in all possible scenarios that tests Emmanuel's Intelligence.

To further strengthen this position, let us consider this life scenario concerning the acquisition of a land as a case study:

Three people were involved in a land transaction; let us call them agent A, B, and C. Where:

- Agent *A* is the owner of the land, *p*
- Agent *B* is the realtor that introduce the buyer to the land, *q*
- Agent *C* is the person that bought the land (the buyer), *r.*

This transaction was done on the basis of trust established in the testimony among agent *A*, *B* and *C* without any presentation of document. This transaction was done based on the following testimonies:

- Agent *A* testifies to agent *B* that *p*.
- Agent *B* testifies to agent *C* that *p* is true.
- Agent C bought the land, knowing that *p* is true.

This testimonial claim is accepted as knowledge based on the following reasons:

- Agent *A* and *B* has done land transactions in the past where *A* has served as a land agent and guide *B* through purchasing lands from others for *B* clients. *B* trust *A* and sees *A* as being reliable and accept testimony from *A* as knowledge.
- Agent *B* and *C* has done several land transactions in the past where *C* had purchased lands through *B. C* trust *B* and sees *B* as being reliable and accept testimony from *B* as knowledge.

This argument is logically presented as thus:

- *p* is possible, i.e., $\blacklozenge p$
- *q* knows that *p* is necessary, therefore *p* is true, i.e., $\Box pKq$ implies *p* (Truth axiom)
- If *p* is necessary then *r* is true, i.e., $\Box p$ implies *r.* (Transitively)

This argument, though seemingly valid, lacks necessity and sufficiency for forming logically consistent knowledge. For the argument to be necessarily valid, the first proposition (*p*) requires further verification to ascertain the claim of the second proposition (*q*) since the truth of the third proposition (*r*) is dependent on the testimony of the second proposition (*q*) and is transitively dependent on the nature of the first proposition (*p*). If *p* is not necessary then it is possible that *p* is false, as such agent *A* may not be the owner of the land.

Subsequently, a fourth person surfaces and claims ownership of the land. Let us call the fourth person agent "*D*". The appearance and claims of agent *D* becomes a counter-position. Agent *D* argues that the land belongs to him. To prove the validity of agent *D's* claim, *D* provides the following information:

- The document of the land which shows that he bought the land from someone else
- The person he bought the land from as his witness to testify that he is the rightful owner of the land.

Let us represent agent *D's* claim with *s* where *s* will be read as "agent *D* is the owner of the land". It is possible that *s* is true. However, *s* can necessarily be true if and only if *s* passes the test of semantic verification which shows that for all possible worlds where *s* is assessed, *s* is true. If *s* appears to be false in any possible world scenarios accessible from *s* then *s* will be false.

Since *s* is semantically verified in all possible worlds accessible from *s* (the world where he has proven to be the owner of the land by presenting the document which shows that he purchased the land from someone else, and the world where he presented the previous owner he bought the land from, to stand as a witness and testify) without being false in any, it follows that *s* is necessarily true and *D* reflectively knows that *s* is true (Reflexivity), i.e., $\Box s \rightarrow s$. (Truthaxiom).

Since agent *D* has been logically proven to be the owner of the land, it logically implies that agent *A* deceived agent *B* who in turn misinformed agent *C*. It is upon this deception and misinformation that agent *B* and *C* wrongly developed their testimonial knowledge.

Conclusion

Modal reasoning has transformed the traditional binary logic system, enabling the analysis of possibilities and necessities in metaphysical, axiological, and epistemological claims. This is particularly relevant in testimonial knowledge, which is often compromised by inconsistencies and falsehoods. This approach reveals the complexities of knowledge formation, particularly when based on trust. By applying Saul Kripke'sS5 modal logic system, this study demonstrates how modal operators, axioms and semantics can evaluate the validity of testimonial claims, highlighting the distinction between necessary knowledge and possible knowledge through the verification principle.

This logical principle provides a valuable framework for evaluating the truth-value of testimonial information in everyday conversations and decision-making, as well as in investigative and judicial contexts where testimony is crucial for determining truth and ensuring justice.

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