International Journal of Philosophy
2022; 10(4): 159-162
http://www.sciencepublishinggroup.com/j/ijp
doi: 10.11648/j.ijp.20221004.16
ISSN: 2330-7439 (Print); ISSN: 2330-7455 (Online)

A New Syllogism Closer to the Reality of Human Thinking --On Lei Ma's Substitution Logic

Xiangqun Chen[1, 2]

[1]Mind, Brain Imaging and Neuroethics Unit, Institute of Mental Health Research, University of Ottawa, Ottawa, Canada
[2]Department of Philosophy, Nanchang University, Nanchang, China

Email address:
owen.xq.chen@hotmail.com

To cite this article:
Xiangqun Chen. A New Syllogism Closer to the Reality of Human Thinking --On Lei Ma's Substitution Logic. *International Journal of Philosophy*. Vol. 10, No. 4, 2022, pp. 159-162. doi: 10.11648/j.ijp.20221004.16

Received: November 24, 2022; **Accepted**: December 12, 2022; **Published**: December 23, 2022

Abstract: The follow-up research of Aristotle's syllogism has different approaches. The traditional syllogism follows Aristotle's conceptual system and hopes to make improvements within Aristotle's theory. Mathematical logic proposes a new conceptual system to accurately interpret Aristotle's syllogism. Lei Ma puts forward an extended syllogism whose conceptual system is different from Aristotelian logic and mathematical logic. He thinks that Aristotle's syllogism and traditional syllogism have tedious figures, moods, and reasoning rules, which are difficult for us to memorize. It is a theoretical conclusion of the human reasoning process but does not conform to the actual human thinking process. Ma's syllogism is called substitution logic, which mainly concerns the substitution characteristics of a human thinking process, and summarizes the substitution rules in the reasoning process. Substitution logic appropriately describes the actual human reasoning process, thus inspiring us to establish a unified scientific theory of thinking and carry out normative research on the unity of abstract thinking and imaginative thinking. Substitution logic may be applied to the field of artificial intelligence, making artificial intelligence closer to the reality of human thinking. It seems that the research direction of substitution logic will give birth to human-like AI systems and promote the revolutionary transformation of AI research.

Keywords: Aristotle's Syllogism, Traditional Syllogism, Substitution Logic

1. Introduction

Since Aristotle works out the theory of syllogism in *Prior Analytics* [1], the research on the syllogism has developed along the following directions:

The first is the direction of traditional syllogism, which develops the three figures of Aristotle's syllogism into four figures, but turns Aristotle's inference model into an argument theory. In traditional syllogism, the premise is determined according to the conclusion, and the major and minor premises are fixed, which loses the flexibility of Aristotle's syllogism [6, 9, 11, 19].

The second is the direction of calculus logic, which has a wider application than Aristotle's logic and can express Aristotle's logic as a special case. It explains the quantifiers in terms of mathematical functions and shows all mathematics was derived from logic and makes arithmetic rigorous. Researchers in this direction attempt to show that traditional Aristotelian logic can be useful for computational thinking [4, 5, 10, 18].

The third direction is to reconstruct Aristotle's syllogism. It aims to find out a logic closer to Aristotle's original text. To accomplish this, the first-order variables system is abandoned and replaced by a novel system developed by Ben-Yami [2]. This system resembles Aristotle's way of developing his logic, showing that it relates to classical logic and all of Aristotle's claims can be proved within this system [8].

The fourth is the direction of the argument, arguing that Aristotle did not consider his syllogistic as a science in its own right, but saw it as part of a general theory of argument. Such a theory covers the entire field of valid deductive argument with methods of constructing proofs, refuting arguments, and discovering fallacies [3, 7, 20].

Now there is a new research direction, namely, Lei Ma's substitution logic. It retains the flexibility of the major premise and minor premise of Aristotle's syllogism, simulates the reality of human brain thinking, looks at reasoning from the perspective of dynamic thinking element replacement, and greatly simplifies the inferential rules. It abandoned the logic design path of calculus thinking and found a novel logical model that conforms to the reality of human thinking.

2. What Is Substitution Logic

As a Chinese logician, Lei Ma is full of critical spirit and theoretical creativity. He invented the truth-graph method [12], constructed the combined calculus theory [13, 16], criticized Aristotelian logic [14, 15], and conceived substitution logic. In *Substitution Logic: An Extension of Syllogism* [17], he proposed a new syllogism system, which is considered to be another masterpiece of syllogism after his job in recent years. The main feature of the substitution system is to grasp the substitution of terms, the reasoning process is characterized as the substitution process of terms, and the substitution rules are simple and easy to remember. In Lei Ma's view, a significant and indispensable feature is substitution in the process of human behavior and thinking. For example, if a person's table lamp does not work, he is likely to replace the bad light bulb with a good one, thus he can continue to use his table lamp. If a baby has learned to say "I love my mom". Shortly, he will naturally replace "mom" with "dad," forming a new sentence: "I love my dad". In contrast, a traditional syllogism is just a static argument occurring in thinking, and its figures, moods, and reasoning rules are very cumbersome and do not conform to the actual human thinking process.

The traditional syllogism with two premises and one conclusion only deals with categorical propositions. In a categorical proposition, the predicate is, without qualification, affirmed or denied of all or part of the subject. For instance, "all crows are smart animals"; "some leaves are not green." However, in the process of actual thinking, we can conclude from mixed premises, such as a categorical premise and a relation premise. However, a traditional syllogism cannot properly deal with this mixed reasoning, it needs to convert the relation proposition into a categorical proposition in advance. For example, the relation proposition "A likes B" needs to be transformed into the categorical proposition "A is a person who likes B", but this transformation is unnatural. Substitution logic distinguishes two kinds of propositions, namely passive proposition, and active proposition. In a passive proposition, the anterior or posterior terms will be replaced with other terms; The active proposition determines which term in the passive premise can be replaced to ensure the validity of conclusions.

Substitution Logic includes two types of inference, namely, symmetric institution inference and asymmetric institution inference. Symmetric institution inference means for symmetric passive premises the anterior and the posterior as parent terms can be validly replaced by their child terms. It has three inference rules:

Rule a1) The universal anterior term (or the universal posterior term) can be completely replaced by its child term, that is, the quantifier of the child term should be retained when its parent term is replaced.

Rule a2) The universal anterior term (or the universal posterior term) cannot be completely replaced by its parent term but can be incompletely replaced by its parent term, that is, the universal quantifier of the parent term must be changed into the particular when its child term is replaced.

Rule a3) The particular anterior term (or the particular posterior term) cannot be completely replaced by its parent term, but if the particular term has turned into a universal term, the parent term of the universal term can incompletely replace the particular term, that is, the universal quantifier of the parent term must be changed into the particular when its child term is replaced [17]. According to the above rules, symmetric inference has 16 valid inference forms.

Asymmetric Inference means for an asymmetric passive premise the anterior term can be validly replaced by its child term, and the posterior by its parent term. For an asymmetric passive premise, we have the following inference rules:

Rule b1) The universal anterior term can be completely replaced by its child term, that is, the quantifier of the child term should be retained when its parent term is replaced.

Rule b2) The universal anterior term cannot be completely replaced by but can be incompletely replaced by its parent term, that is, the universal quantifier of the parent term must be changed into the particular when its child term is replaced.

Rule b3) The particular anterior term cannot be completely replaced by its parent term, but if the particular term has turned into a universal term, the parent term of the universal term can incompletely replace the particular term.

Rule b4) The posterior term can be completely replaced by its parent term, not by its child term [17]. According to the above rules, we have 8 valid inference forms. Using the seven rules of substitution logic, we can not only deduce all the valid formulas of Aristotle's syllogism and traditional syllogism but also deduce many new valid formulas that the current syllogism cannot deduce. There are two reasons for this. First, substitution logic can contain more types of propositions, such as relational propositions and modal propositions; Second, the anterior terms and the posterior terms are quantified at the same time. Aristotle's syllogism and traditional syllogism cannot do these two things.

3. The Advantages of Substitution Logic

Substitution logic inherits the advantages of Aristotle's syllogism, that is, its premise is not fixed, and it can freely choose the major premise and minor premise. In this way, the disadvantage of traditional syllogism in determining the major premise and minor premise according to the conclusion is avoided. Traditional syllogism is more like an argument than reasoning. In substitution logic, the major and minor premises are not fixed, so we can take the relation proposition as the passive proposition and the categorical proposition as the active proposition. When the substitution is completed, we will get the conclusion. Take an example, we can have such a syllogism:

1) Passive premise: All students of Class One do not know all students of Class Two;

2) Active premise: All students of Group Three are students of Class Two;
3) Conclusion: All students of Class One do not know all students of Group Three.

According to Rule a1, the posterior term "all students of Class Two" in the passive premise "All students of Class One do not know all students of Class Two" can be completely replaced by its child term "All students of Group Three" which is the anterior term of the active premise "All students of Group Three are students of Class Two," leading to the conclusion "All students of Class One do not know all students of Group Three."

This is a daily thinking logic that is more unified and flexible, and different from Aristotle's syllogism, traditional syllogism, and mathematical logic. It considers human thinking as the substitution of thinking elements, changes the complex static rules of current syllogism reasoning into simple dynamic rules, and then forms a new syllogism inference method. The new syllogism is a deductive substitution logic, which focuses on completing the deductive inference process through the valid substitution of terms. In the inference process, the passive premise which used to be the substituted premise can be a categorical proposition, relation proposition, modal proposition, and so forth. The active premise called a substitution premise must be a categorical proposition. Therefore, the research direction of substitution logic can be extended to abstract thinking forms, such as inductive reasoning, analogical reasoning, and even image thinking, to achieve a unified theory of daily thinking.

Different from traditional logic, mathematical logic has helped scientists to invent computers and artificial intelligence. However, the reasoning procedure of computers and AI is far from the actual thinking process of the human brain. The advantages of computers and AI lie in accurate reasoning and big data memory, which is beyond the reach of the human brain. However, the creative thinking of the human brain, including abstract thinking and image thinking, can tolerate ambiguity and contradiction and can obtain more information through a small amount of information and some simple rules, such as replacement, association, etc. The working principle of people's daily thinking is not as complex and accurate as that of computers. People make progress by trial and error. Lei Ma found that replacement is a basic feature of human thinking, which conforms to abstract thinking and imaginative thinking. The substitution logic depicts the replacement characteristics of human abstract thinking, and its simple reasoning rules are more consistent with human thinking habits. Important enlightenment of substitution logic is that in abstract thinking, substitution logic may expand from term replacement to proposition replacement, forming a more unified reasoning model. Among them, induction, deduction, and analogy are only different forms of replacement. In the research of image thinking, the replacement principle and rule of thinking elements will also be important research objects. Therefore, substitution logic will inspire us to open up new research directions of thinking science. If AI is combined with substitution logic in the future, it is believed that we will invent a new kind of AI that is closer to human thinking.

4. Conclusion

Substitution logic proposes a series of new concepts, such as the active premise that replaces the major premise, the passive premise that replaces the minor premise, the anterior term instead of the subject, and the posterior term instead of the predicate. It determines simpler inferential rules and forms a more unified logic system. The research route of substitution logic is not only different from Aristotelian syllogism and traditional syllogism but also different from mathematical logic. It is a kind of dynamic logic and natural logic, which upgrades the dynamic replacement more in line with the actual thinking to the highest principle and natural method of thinking.

The research way of substitution logic can inspire us to establish a unified scientific theory of thinking and carry out normative research on the unity of abstract thinking and imaginative thinking. The research will help us to design human-like AI systems and promote the revolutionary transformation of AI research.

References

[1] Aristotle. (2014). Prior analytics. (A. J. Jenkinson trans.). Retrieved from http://etext.library.adelaide.edu.au/a/aristotle/

[2] Ben-Yami. (2014). The quantified argument calculus, *The Review of Symbolic Logic*, 7: 120–46.

[3] Bueno, O.(2013). Logical constants: a modalist approach. *Noûs,* 47 (1): 1-24.

[4] Castro-Manzano, J. M.; Lozano-Cobos, L. I.; Reyes-Cardenas, P. O. (2018). *Programming with Term Logic*. BRAIN Broad Res. Artif. Intell. Neurosci. 9: 22-36.

[5] Castro-Manzano, J. (2021). Traditional Logic and Computational Thinking. *Philosophies*, 6 (1), 12. https://doi.org/10.3390/philosophies6010012

[6] Copi, I. M., Cohen, C., & McMahon, K. (2014). *Introduction to Logic*. (14th Eds.) Harlow: Pearson Education Limited.

[7] Council, N.; Sciences, D.; Board, C. (2010). Thinking, C. *Report of a Workshop on the Scope and Nature of Computational Thinking*. National Academies Press: Washington, DC, USA.

[8] Jonas Raab (2018). Aristotle, Logic, and QUARC, History and Philosophy of Logic, 39 (4): 305-340. https://doi.10.1080/01445340.2018.1467198

[9] Kneale, W., & Kneale, M. (1962). *The development of logic.* Oxford: The Clarendon Press. (Chn. trans. by Zhang, J. L., & Hong, H. K., (1995, pp. 453-454). Beijing: The Commerce Press).

[10] Kowalski, R. (2012). *Computational Logic and Human Thinking*: *How to Be Artificially Intelligent.* Cambridge University Press: Cambridge, UK.

[11] Lukasiewicz, J. (1957). *Aristotle's syllogistic: From the standpoint of modern formal logic* (2nd ed.). Oxford: The Clarendon Press.

[12] Ma, L. (2015a). Truth-graph Method: A Handy Method Different from that of Lesniewsk's. Studies in Logic, Grammar and Rhetoric, 42 (1): 79-111. https://doi.org/10.1515/slgr-2015-0032

[13] Ma, L. (2015b). Traditional Inference and its Versions in the Combined Calculus. The Philosophical Forum, 46 (2): 155-174. https://doi.org/10.1111/phil.12062

[14] Ma, L. (2016). Aristotle's Formal System of Modal Logic and its Modal Paradoxes. The Philosophical Forum, 47 (1): 5-15. https://doi.org/10.1111/phil.12090

[15] Ma, L. (2017). The Essential and the Derivative Moods of Aristotelian Syllogism. Cogent Arts and Humanities, 4 (1), 1-11. https://doi.org/10.1080/23311983.2017.1282689

[16] Ma, L. (2018). The Normal-Form Decision Method in the Combined Calculus. Axiomathes, 25 (76): 1-29. https://doi.org/10.1007/s10516-018-9376-4

[17] Ma, L. (2019). Substitution Logic: An Extension of Syllogism. The Philosophical Forum, 50 (2), 191-223. https://doi.org/10.1111/phil.12221.

[18] Noah, A. (2015). *Sommers's cancellation technique and the method of resolution*. In *The Old New Logic: Essays on the Philosophy of Fred Sommers*; Oderberg, D. S., Ed.; Bradford Book; MIT Press: Cambridge, MA, USA, 169-182 pp.

[19] Sellars, R. W. (1917). *The essentials of logic*. Cambridge: The Riverside Press.

[20] Striker, Gisela. (2022). Aristotle and the Uses of Logic. From Aristotle to Cicero: Essays in Ancient Philosophy (Oxford, 2022; online edn, Oxford Academic, 20 Jan.). https://doi.org/10.1093/oso/9780198868385.003.0005