

## Corollaries for the Philosophy of Cognition Derived from the First Postulate “Event Structure Formula” in Mathematical Psychology

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### Abstract

“The Event Structure Formula” is the first postulate of “mathematical psychology” ; it is the mathematical expression of the interaction relationships among substances and their induced effects. This relational formula (axiom) can deduce human cognitive processing mechanisms: human perceptual and sensory functions, human semantic encoding, the content and nature of the products of human cognition (experience), etc., and the mathematical deductions obtained are surprisingly consistent with key experimental findings in psychology. The philosophical essence of “cognition” naturally determines that the Event Structure Formula may systematically deduce fundamental philosophical questions: (1) The universal form of material attributes in the material world. (2) The material nature of cognitive structure. (3) The material nature of cognitive content. (4) The material nature of subjective cognition. (5) The material nature of human ethics. (6) The trial-and-error relationship between materialistic and idealistic cognition. These philosophical questions become deductions of the Event Structure Formula and, with the Event Structure Formula as the fundamental logic, may constitute the theoretical framework of mathematical philosophy.

### Full Text

## The First Postulate of Mathematical Principle of Psychology: “Event Structure Formula” and Its Deductions for Cognitive Philosophy

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## Abstract

The “Event Structure Formula” constitutes the first postulate of the “Mathematical Principle of Psychology,” representing the mathematical expression of material interaction relationships and their induced effects. This relational formula (axiom) can deduce the mechanisms of human cognitive processing: perceptual functions, semantic encoding, and the content and essence of cognitive products (experience). Remarkably, the mathematical inferences derived from this deduction align astonishingly well with key experimental findings in psychology. The philosophical nature of cognition naturally determines that the Event Structure Formula can systematically deduce fundamental philosophical problems: (1) the universal form of material attributes in the material world; (2) the materiality of cognitive structure; (3) the materiality of cognitive content; (4) the materiality of subjective cognition; (5) the materiality of human ethics; and (6) the cognitive trial-and-error relationship between materialism and idealism. These philosophical problems become inferences of the Event Structure Formula, which may constitute the theoretical framework of “Mathematical Philosophy” when taken as its fundamental logic.

**Keywords:** Event Structure Formula; Mathematical Principle of Psychology; Cognition; Philosophical Inference

Physics, as the foundational discipline of natural science, can be divided into developmental stages: “experimental verification,” “phenomenology,” “theoretical architecture,” and “mathematical expression” (Yang Zhenning, 2003). Extending this framework to other natural sciences proves equally meaningful (Gao Chuang et al., 2021a). Correspondingly, scientific development has evolved three basic programs: the “classical program,” the “experimental verification program,” and the “theoretical program.” The classical program represents the pre-scientific approach where humans acquired experience through divine revelation, ancestral wisdom, natural observation, and speculation. The experimental verification program inherits these methods while expanding controlled experimental observation—inducing experimental effects through interactions between objects. The attribute quantities and interaction relationships of objects remain invariant, though their characteristic quantities vary. Discovering invariance through variability constitutes finding “laws,” or seeking constancy within variation. Conclusions from experimental verification are often localized, culminating in laws or theorems as “phenomenological hypotheses.” The theoretical program proposes axioms or postulates, logically connecting various local phenomenological theorems through deduction to form a “theoretical architecture,” typically existing in mathematical form—hence “mathematical expression.”

Psychology has accumulated historical schools including structuralism, functionalism, behaviorism, psychoanalysis, humanism, and cognitivism. According to disciplinary developmental stages, psychology remains in the experimental “phenomenology” phase. The “Mathematical Principle of Psychology” (MPOP), which logically deduces psychological phenomenological conclusions from ax-

iomatic forms, belongs to the “theoretical architecture” and “mathematical expression” stage.

The Event Structure Formula is the first postulate and primary relational expression of the Mathematical Principle of Psychology (Gao Chuang, 2021). It serves as both the fundamental expression form of “events” in the material world and the “content” processed by human cognitive systems (i.e., “event information”), while simultaneously reflecting the material foundation and cognitive mechanisms of human cognition. In essence, the Event Structure Formula connects the operational logic of the material world, cognitive processing content (mental content), and cognitive mechanisms through the fundamental logic of “carrier and content.” This determines that the Event Structure Formula can address foundational philosophical questions (i.e., questions of human cognitive mechanisms), such as (1) the mind-matter relationship problem, (2) the problem of whether the world is knowable, (3) the problem of the nature of human knowledge, and (4) problems of logical encoding. This paper systematically discusses these issues based primarily on the “mind-matter relationship problem,” covering: (1) the mathematical significance of the Event Structure Formula, (2) cognitive relationships based on the Event Structure Formula, and (3) the philosophical significance (philosophical inferences) of the Event Structure Formula based on the above logical relationships.

## 1. Event Structure Formula

Interaction constitutes the most fundamental form of mechanical action in the material world. Classified by interacting objects, interactions include physical, biological, interpersonal, and social interactions. Object interaction induces interaction effects, constituting an “event.” The mathematical expression of an “event” is:

$$1230phyEwwietwc = + + + + +$$

where  $w_1$ ,  $w_2$ ,  $i$ ,  $e$ ,  $t$ ,  $w_3$ ,  $c_0$  represent object 1, object 2, interaction, interaction effect (event result), time, location, and initial conditions (characteristic values of each element), respectively, forming the expression of a physical event  $E_{phy}$ . When either object 1 or object 2 is a mental object (human or sentient animal), it is denoted as  $E_{psy}$ , where  $bt$  and  $mt$  represent external motivational target objects and internal motivational target objects (Gao Chuang, 2021).

Since each element possesses multiple attributes, each element requires a set representation regarding “attribute quantities”:  $P = \{p_{ij} | i = 1, 2, \dots, m; j = 1, 2, \dots, n\}$ , where  $p_{ij}$  represents the  $j$ -th attribute of the  $i$ -th element in the event structure formula. Due to the independence of each element in the event structure, the “plus sign” in the Event Structure Formula satisfies Boolean algebra rules (Gao Chuang, 2021).

## 2. Basic Logic of Cognition

The Event Structure Formula represents the universal expression of material world operations (physics, biology, human society) and the mathematical expression of the information content that humans need to cognize. Through media carriers (optical, air, chemical) that enable interaction between material objects and human sensory organs, event information is loaded and input into the human cognitive system. Through decoding processes such as perception and reasoning, it becomes the “event” cognized by humans (Gao Chuang et al., 2021b). This paper first deduces the logical relationship between the Event Structure Formula and “cognitive functions.”

### 2.1 Perceptual Function

For humans to completely perceive information about different structural elements of “events” in the material world, perception must possess decoding (or recognition) functions that correspond one-to-one with “event structure.” The basic functions of perception include object recognition, motion perception, time perception, spatial perception (stereoscopic perception), etc. In perception, we can perceive the characteristic values (i.e., initial conditions) of each variable on-site. In social perception, we also need to perceive internal and external motivational target objects. Each perceptual function corresponds one-to-one with independent factors in the Event Structure Formula (Gao Chuang, 2021). This leads to a fundamental conclusion: after perception, humans obtain psychological perceptual quantities (mental quantities) corresponding to “events” in the material world, which can be expressed as:

$${}^{''''''}1230phyEwwietwc = + + + + +$$

The superscript indicates the on-site psychological quantities perceived after perceptual decoding of material events. This constitutes the expression of a “psychological event,” answering the basic function of perception: extracting events to form the basic structural expression of event information. Since the human sensory system has multiple neural channels, the expression for multi-channel integration of events can be represented as:

$$\sum \sum \sum \sum \sum \sum \sum \sum \sum {}^{''''''}1230phyEwwietwc = + + + + +$$

$$\sum \sum \sum \sum \sum \sum \sum \sum \sum \sum {}^{''''''}1230 + psyEwwietwbmtc = + + + + + + +$$

In multi-channel integration of “events,” Boolean algebra still applies (Gao Chuang, 2021).



(Miller, 1956). This ensures the completeness of our knowledge about events (Gao Chuang, 2021).

## 2.4 The Nature of Knowledge

According to the Event Structure Formula, the operational rules of the material world contain four basic relationships—also four attributes of the material world. First, spatiotemporal attributes: event operations require time  $t$  and space  $w_3$ . Second, motion attributes: the appearance (phenomenon) of motion, meaning material motion requires effects, i.e., establishing  $e$ . Third, mechanical attributes: the mechanical relationship between  $w_1$  and  $w_2$ , i.e., the relationship  $(i, f(w_1, w_2, c_0))$ . Fourth, causal attributes: the causal relationship between  $i$  and  $e$ , i.e., the relationship  $(i, R(e))$ , representing the causal relationship between mechanics and motion.

These four relationships in the material world determine that the human knowledge system (including natural and social sciences) contains four corresponding relationships: spatiotemporal concepts, motion concepts (phenomenology), mechanics (physical force, mental dynamics, social dynamics), and causality (physical causality, biological causality, attribution patterns, social causality) (Gao Chuang et al., 2021a).

## 3. Philosophical Inferences of the Event Structure Formula

Philosophy is the methodology of human thinking—the cognition of cognition, studying the causality of cognition. Fundamental philosophical questions are essentially basic questions of cognition. The Event Structure Formula is one of the basic postulates of Mathematical Principle of Psychology. In mathematical form, it deduces several key aspects of human cognition, thereby answering fundamental philosophical questions.

### 3.1 The Universal Form of Material Attributes as the Premise of Materialism

The Event Structure Formula postulate summarizes the universal operational form of the material world (physics, biology, human society) that exists independently of individual will, representing the “common” form of information structure in the material world. It constitutes the basic attribute of material world operations. Only from this mathematical form can we glimpse the fundamental relationships of the material world and isolate its four basic attributes: (1) spatiotemporal attributes, (2) motion attributes, (3) mechanical attributes, and (4) causal attributes. This mathematical revelation of material attributes provides the fundamental premise for understanding the materialist relationship between “matter” and “human” from a “mathematical” perspective. The universal form of material operation is the premise of “materiality.”

### 3.2 The Materiality of Cognitive Communication Structure

Starting from the Event Structure Formula, simple deductive reasoning surprisingly reveals that the cognitive functions evolved in humans naturally and astonishingly align with the structure of the Event Structure Formula. Mathematically and logically, this reveals that cognition possesses structural and functional properties: the endogenous logical consistency among perceptual decoding structure, semantic encoding structure, and working memory capacity (information bandwidth) all align with the “event structure” of the material world. Acknowledging this consistency means that the attributes of material event structures influence (act upon) human cognition—the material world “shapes” human cognitive structures.

The attributes of the material world (the content of cognitive information) naturally determine the material logic of human information system evolution. “Matter” determines the evolutionary direction of human cognitive functions, i.e., “material determinism.” This also provides the mathematical basis for the universality (commonality) of cognitive structures among different individuals.

All human information processing depends on the cognitive system, and the “communication processing” system of human cognition is precisely determined by the material world. The event structure of the material world determines the material attributes of the human cognitive information system: (1) the universal event structure of the material world determines the structure of perceptual events; (2) the universal event structure of the material world determines the information structure of multi-channel event processing; (3) the universal event structure of the material world determines the encoding structure of human language; and (4) the universal event structure of the material world determines the bandwidth of human information channel processing.

### 3.3 The Materiality of Cognitive Content

From the Event Structure Formula of the material world, we have isolated four attribute relationships: spatiotemporal attributes, motion attributes, mechanical attributes, and causal attributes. In human knowledge systems, we can find corresponding relationships: spatiotemporal concepts, motion concepts, mechanical concepts, and causality. Table 1 demonstrates the complete correspondence between the knowledge structure system and material attributes in human foundational sciences (physics, biology, psychology, and sociology).

This correspondence also mathematically answers the nature of human knowledge—the core concern of epistemology in philosophy. This correspondence mathematically reveals the underlying essence of human knowledge, which is determined by the spatiotemporal, motion, mechanical, and causal attributes of matter. This means that there exist four basic logics among the contents of human knowledge, determined by material attributes. Consequently, humans’ empirical knowledge of cognition possesses materiality. As empirical knowledge fundamentally drives individual mental activity, this common and universal at-

tribute enables communication among humans across different individuals and cultures.

### 3.4 The Materiality of Human Subjective Cognition

The Event Structure Formula of the material world is correspondingly mapped into the human cognitive system. This means that the characteristic quantity information and attribute quantity information of event structural elements in the material world are correspondingly mapped into the cognitive system. The material attributes of material world operations (physics, biology, society) are mapped into the human cognitive system, forming a complete system. The information about event structures obtained through the cognitive system becomes the core of human cognition. Therefore, cognizing the spatiotemporal, motion, mechanical, and causal attributes of the material world constitutes the manifestation of human subjective agency. The content of human subjective cognition may reflect true material attributes or may contain erroneous conclusions that become trial-and-error components, completing the logical loop of cognition through human practice.

### 3.5 The Materiality of Human Ethics

The social event structure formula reveals that any activity undertaken by human individuals is based on some internal purposiveness  $mt$ . To conceal this internal purposiveness, human behavior often manifests inconsistently with internal purposes, constituting behavioral purposiveness  $bt$ . Both forms of purposiveness constitute the “interest” underlying various human activities.

Event occurrence represents an “interaction” relationship—a balanced relationship where both parties’ interests are accepted. Otherwise, the interaction relationship cannot occur or becomes imbalanced, leading to destruction of the dynamic system. The emergence of interest relationships constitutes three types: altruism, egoism, and equality. As shown in Table 2,  $mt_A$  and  $mt_B$  represent the internal motivations (interests) of two different human individuals. Since  $mt$  in the Event Structure Formula refers to target objects with certain functions, measuring  $mt$  involves measuring the value and price of functional target objects. Human individual interests thus become measurable psychological quantities. When individual interests conflict with group interests, social groups need to establish social rules that each individual must follow. The interest problem then transforms into the collective formulation of social rules, becoming a “social ethics” problem. In other words, the Event Structure Formula naturally contains “ethics” —the fundamental root of all “social behavior.”

The material objects (individuals) in events can be categorized as physical objects, organisms, human individuals, and society. The human-centered Event Structure Formula yields four types of interaction relationships: human-object, human-organism, human-human, and human-society relationships. From the Event Structure Formula, human ethics can be mathematically derived. This re-

relationship also forms through human interaction with the material world, meaning human ethics originates from materiality.

### 3.6 “Idealism” as Trial-and-Error in “Materialism”

The universality of event structures in the material world as cognized by humans determines the materiality of human mental activity: (1) behind the diversity of the material world lies the universality of event structures; (2) the material structure of cognitive information systems and human decoding/encoding systems are all “shaped” by material event structures, representing the materiality of human cognitive system evolution; (3) the product of human subjective cognition—empirical knowledge—similarly possesses material event structure; and (4) ethics rooted in event interests forms through human interaction with the material world, constituting the materiality of ethics. “Materialism” thus becomes the inevitable path of human cognition, while “idealism” as the alternative knowledge product becomes its opposite. The systems of “materialism” and “idealism” naturally constitute the system of human cognition. In mathematical terms, “idealism” represents the trial-and-error component of human cognition of the material world.

### 3.7 Philosophy May Enter the Era of Mathematical Philosophy

The essential problem of philosophy is the problem of human cognition; philosophy is the methodology of cognition. Psychology’s entry into the experimental verification stage marked its separation from philosophy as an independent discipline, which also signifies philosophy’s natural entry into the experimental verification stage. Experimental philosophy will not remain an academic concept but will possess its independent methodological system, becoming an inevitable field of philosophy. The introduction of experimental verification into philosophy proves the truth or falsity of philosophical propositions. Subsequently, the unified theoretical architecture of cognition will inevitably lead philosophy into a mathematical theoretical system.

With the establishment of mechanisms in the “Mathematical Principle of Psychology” as the starting point, cognitive mechanisms will directly enter the domain of philosophy, inevitably giving rise to “philosophy of philosophy” —what we term “Mathematical Philosophy” (the mathematical principle of philosophy). Building upon phenomenological and empirical phenomenological philosophy, establishing an axiomatic system for philosophy and forming a mathematical architecture constitutes Mathematical Philosophy. The axiomatic system of the Event Structure Formula has already demonstrated that philosophy can evolve into a mathematical system.

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