Dual-Process Theories of Higher Cognition: Advancing the Debate

Jonathan St. B. T. Evans, Keith E. Stanovich

Paper Review by Hongzheng Wang

Introduction

- This paper is a response to various critiques to Dual-Process Theories.
  - Mentioned critics: Gerd Gigerenzer, Gideon Keren, Arie W. Kruglanski, Magda Osman and Yaacov Schul.
- Main points of Evans and Stanovich:
  - The dual-processing distinction is supported by much recent evidence in cognitive science.
  - Not all dual-process theories are same. There are some writings of other researchers are also disagreed by them.
  - The approach of them:
    - Rapid autonomous processes (Type 1) are assumed to yield default responses unless intervened on by distinctive higher order reasoning processes (Type 2).
    - What defines the difference is that Type 2 processing supports hypothetical thinking and load heavily on working memory.

Basic Information

- Italicized attributes are the proposed defining characteristics in the current article.
  - By contrast, other features are simply correlates that occur under well-defined conditions and are neither necessary nor defining features.
- Old/New mind: Evolutionarily old and animal-like form of cognition and a recently evolved and uniquely (or distinctively) human system for thinking.

Table 1. Clusters of Attributes Frequently Associated With Dual-Process and Dual-System Theories of Higher Cognition

Type 1 process (intuitive)	Type 2 process (reflective)
Defining features	
Does not require working memory	*Requires working memory*
Autonomous	*Cognitive decoupling; mental simulation*
Typical correlates	
Fast	Slow
High capacity	Capacity limited
Parallel	Serial
Nonconscious	Conscious
Biased responses	Normative responses
Contextualized	Abstract
Automatic	Controlled
Associative	Rule-based
Experience-based decision making	Consequential decision making
Independent of cognitive ability	Correlated with cognitive ability
System 1 (old mind)	System 2 (new mind)
Evolved early	Evolved late
Similar to animal cognition	Distinctively human
Implicit knowledge	Explicit knowledge
Basic emotions	Complex emotions

Basic Information

- Some misalignments of the features shown in Table 1:
  - the source of Type 1 processing in the brain is not always in areas regarded as evolutionarily old;
  - conscious thinking is not necessarily in control of behavior;
  - rules can be concrete and contextualized as well as abstract.
- In more recent writing, Evans has identified several key fallacies in what he terms the *received* view of dual-process/dual-system theories, including the beliefs that:
  - (a) Type 1 processes are always responsible for cognitive bias and Type 2 processing is always responsible for correct responses,
  - (b) Type 1 processing is contextualized and Type 2 processing abstract,
  - (c) fast processing is necessarily indicative of Type 1 processing.

Basic Information

- Dual systems is widely used but not a recommendable term, because it implies that exactly two systems underlie the two forms of processing, which is a stronger assumption than most theorists wish to make.
  - In actuality, the term System 1 should be plural because it refers to a set of systems in the brain.
- Not all dual-process theories are the same
  - Some so-called dual-process theories are really concerned with what have been defined as dual modes of processing.

Table 2. A Glossary of Dual-Process Terminologies Used in This Article

Term	Definition
Dual processes	The assumption by many theorists that cognitive tasks evoke two forms of processing that contribute to observed behavior. Unless otherwise indicated, the term refers in this article to dual-type theories.
Dual types	Terminology that implies that the dual processes are qualitatively distinct. Type 1 processes are (broadly) intuitive and Type 2 processes reflective (see Table 1).
Dual systems	It is common in the literature to use the terms *System 1* and *System 2* to refer to the Type 1 and 2 distinction. Some but not all authors associate these with an evolutionary distinction. The current authors now prefer to avoid this terminology as it suggests (falsely) that the two types of processes are located in just two specific cognitive or neurological systems.
Modes of processing	Modes of processing are forms of Type 2 thinking that may differ on a continuum. Individual differences on such continua are often assessed with thinking-disposition measures.
The autonomous set of systems (TASS)	The proposal that there are multiple Type 1 systems of different kinds, including modular, habitual, and automated forms of processing.

Five Criticisms of Dual-Process Theory

- (1) Multiple and vague definitions are offered by various theorists;
- (2) attribute clusters associated with dual systems do not consistently hold together;
- (3) distinctions refer to a continuum of processing type rather than qualitatively distinct processes;
- (4) single-process accounts can be offered for apparent dual-process phenomena;
- (5) the evidence base for dual-process theory is questionable.

Criticism 1: Dual-process theorists have offered multiple and vague definitions

- Evans and Stanovich agree with the critics that the proliferation of dual-process theories and labels has been confusing and that many of the distinctions are hard to pin down when examined closely.
  - There are many such labels, for example implicit/explicit, associative/rule-based, impulsive/reflective, automatic/controlled, experiential/rational, nonconscious/conscious, intuitive/reflective, heuristic/analytic, reflexive/reflective, and so on—but each carries with it some semantic baggage.
  - It seems that one kind of thought process must be conscious, controlled, reflective, and rule-based, whereas another is nonconscious, automatic, impulsive, and associative.
- That is why neither of them have relied on such labels or distinctions in their recent writings as defining characteristics of the two types of processing.

Criticism 2: Proposed attribute clusters are not reliably aligned

- The main argument is that the different features of the cluster are not always observed together.
  - This observation is certainly correct, but it creates a problem only if all the features shown in Table 1 are assumed to be necessary and defining features.
- Evans and Stanovich regard this as a straw-man argument.
  - This standard of proof, requiring a perfect, deterministic level of conjoined features, is higher than that generally applied in any field of psychology.
  - From a theoretical point of view, although there is a clear basis for predicting a strongly correlated set of features, very few need be regarded as essential and defining characteristics of Type 1 and 2 processes
- They have already argued that many of the features in these property lists are only correlates, and not defining features.

Normativity and rationality

- It is a fallacy to assume that Type 1 processing is invariably nonnormative and Type 2 processing invariably normative.
  - It is also a fallacy to assume that Type 1 processes (intuitive, heuristic) are responsible for all bad thinking and that Type 2 processes (reflective, analytic) necessarily lead to correct responses.
  - As an example, people's face recognition systems are neither rational nor irrational. They are, instead, either efficient or inefficient.
  - In fact, Type 1 processing can lead to right answers and Type 2 processing to biases in some circumstances.

Criticism 3: There is a continuum of processing styles, not discrete types

- This viewpoint confused the term *types* and *modes*.
  - Modes are different cognitive styles applied in Type 2 processing. Unlike types, modes can vary continuously.
  - For example, if we regard Type 2 analytic reasoning as the explicit processing of rules through working memory, then such processing could be engaged in a slow and careful but also a quick and casual manner or any point in between.
- Modes of processing is more commonly termed thinking dispositions.
  - Thinking dispositions are measures of the higher-level regulatory states of the reflective mind.
  - e.g., The tendency to collect information before making up one's mind, the tendency to seek various points of view before coming to a conclusion, the disposition to think extensively about a problem before responding, the tendency to think about future consequences before taking action.

Criticism 4: Single-process accounts may be offered for dual-process phenomena

- The main argument is that a unified theory of decision making can be made on the basis of rule processing and that attempts to separate rule-based processing from other kinds.
  - They agree that all behavior attributed to Type 1 and 2 processes by dual-process theorists can be described using rules and modeled by computer programs.
  - But they do not agree that this means there is no basis to the claimed differences between the two kinds of processing.
  - Logically, evidence that intuition and deliberation are both rule-based cannot provide a bearing one way or the other on whether they arise from distinct cognitive mechanisms.
- The claim that both types of judgment are rule-based is another strawman argument against dual systems.
  - Because no dual-process theorist has ever claimed that Type 1 processing is noncomputational.

Criticism 5: Evidence for dual processing is ambiguous or unconvincing

- The critics of dual-process theories would have readers believe that the evidence for dual processes is weak or ambiguous, that it can be explained away by single-process theory accounts that do not implicate qualitatively distinct types of mental processing.

- In this part, Evans and Stanovich will show strong (and converging) evidence comes from three separate sources and all involve direct efforts to dissociate Type 1 and 2 processing.

Experimental manipulations

- In the experimental approach, belief bias has been shown to be increased and logical accuracy decreased when people operate under time pressure or concurrent working memory load, both of which are assumed to inhibit Type 2, reflective reasoning.
  - This experiment doesn't just show the rule conflict.
  - If these manipulations were simply making the task more difficult, then we might expect guessing and random error. What is actually observed is opposite effects on accuracy and beliefs biases.
- In a second experiment, the participants showed a sharp decrease in correct responding on this task when a concurrent working memory load was used.
- Type 2 reasoning may also be biased by beliefs but in a different manner from that affecting Type 1 processing.

Neuroscientific evidence

- Neural imaging studies have shown
  - (a) that belief–logic conflict is detected by the brain and
  - (b) that when reason-based responses are observed, different brain areas are activated than when responses are belief-based than when they are responsive to the logic of the problems.
- Evidence for dual processing has also been observed in studies of decision making that use neural imaging. For example, distinct neurological systems were associated with monetary decisions made on the basis of immediate or deferred reward.
  - In the dual-process theory of Evans and Stanovich, the latter would involve mental simulation of future possibilities and hence require Type 2 processing.

Individual differences

- Although the average person in heuristics and biases experiments might well display an overconfidence effect, underutilize base rates, commit the conjunction fallacy, and so on, on each of these tasks, some people give the standard normative response.
  - Such phenomena can be better described by the dual-process theories.
- Intelligence displays positive correlations with the response traditionally considered normative on the task and negative correlations with the modal response.
  - However, the dual-process theories also predict clear exceptions. These will occur when participants are not appropriately motivated or when success can be achieved by Type 1 processing.
  - For example, if pragmatic cues to a correct answer provide a low-effort route to success, the correlation with ability measures largely disappears. Cognitive ability assists only when a problem requires difficult abstract reasoning that loads heavily on cognitive resources.

The Defining Features of Type 1 and 2 Processing

- The central feature of Type 2 processing is cognitive decoupling operations.
  - In order to reason hypothetically, we must be able to prevent our representations of the real world from becoming confused with representations of imaginary situations. The cognitive decoupling operations make this possible.
- The defining characteristic of Type 1 processes is their autonomy.
  - They do not require "controlled attention", make minimal demands on working memory resources.
  - The execution of Type 1 processes is mandatory when their triggering stimuli are encountered, and they are not dependent on input from high-level control systems.
  - The categories of Type 1 processing contain both innately specified processing modules or procedures and experiential associations that have been learned to the point of automaticity.

The Defining Features of Type 1 and 2 Processing

- Cognitive decoupling is a key defining feature of Type 2 processing that makes humans unique.
  - Quite obviously, no other animal can engage in the forms of abstract hypothetical thought that underlie science, engineering, literature, and many other human activities.
- Reasoning and decision making sometimes requires both (a) an override of the default intuition and (b) its replacement by effective Type 2, reflective reasoning.
  - Intuitive answers are often prompted rapidly and with little effort when people are confronted with novel problems.
  - Where they lack relevant experience, however, these answers may be inappropriate and fail to meet the goals set. Thus, a key concept in this kind of dual-process theory is that of intervention with reflective (Type 2) reasoning on the default (Type 1) intuition.
  - Most behavior will accord with defaults, and intervention will occur only when difficulty, novelty, and motivation combine to command the resources of working memory.

Thank you!