Dual Process Theory 2.0 provides a comprehensive overview of the new directions in which dual process research is heading. Human thinking is often characterized as an interplay between intuition and deliberation, and this two-headed, dual process view of human thinking has been very influential in the cognitive sciences and popular media. However, despite the popularity of the dual process framework, it faces multiple challenges.

Recent advances indicate that there is a strong need to re-think some of the fundamental assumptions of the original dual process model. With chapters written by leading scholars who have been actively involved in the development of an upgraded ‘Dual Process Theory 2.0’, this edited volume presents an accessible overview of the latest empirical findings and theoretical ideas.

With cutting-edge insights on the interaction between intuition and deliberation, Dual Process Theory 2.0 will be of interest to psychologists, philosophers, and economists who are using dual process models.

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DUAL PROCESS THEORY 2.0

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DUAL PROCESS THEORY 2.0

An introduction

Wim De Neys

Background

Human thinking is often characterized as an interplay between intuition and deliberation. Sometimes a solution to a problem pops up in our minds without any effort. At other times, arriving at a sound conclusion will take time and laborious inferencing. These types of reasoning are often referred to as intuitive and deliberative thinking. Intuitive thinking is effortless and fast. It provides us with problem solutions in the blink of an eye. Deliberative thinking is slower and burdens our cognitive resources, but will sometimes be indispensable to correct the output of our intuitions. Indeed, many cases of biased decision-making – from bad financial investments to racial or gender-based discrimination in job hiring – have been attributed to a failure to switch from intuitive to deliberate thinking. This two-headed, dual process view of human thinking has been very influential in the cognitive sciences and popular media. Examples range from the Nobel Prize–winning work of Daniel Kahneman to the best-selling popular science writing of Malcolm Gladwell.

However, despite the popularity of the dual process framework, it faces multiple challenges. A key issue that has long bothered dual process theorists is that the precise interaction between intuitive and deliberate thought processes (or System 1 and System 2, as they are often referred to) is not well understood. There is little dispute that sometimes intuitions can be helpful and sometimes deliberation is required to arrive at a conclusion. But how does our reasoning engine decide which route to take? Are both processes activated simultaneously from the start, or do we initially rely on the intuitive system and switch to deliberate processing when it is needed? But how do we know whether deliberation is needed and determine whether merely relying on our intuitions is warranted or not? What mechanism signals the need for more deliberate reflection?

In recent years empirical work has started to address these outstanding issues. This has resulted in theoretical advances that indicate that there is a need to re-think
fundamental assumptions of the original dual process model. The aim of this edited Dual Process 2.0 volume is to give the reader a comprehensive overview of these new directions in which dual process research is heading.

**Book structure**

The book consists of nine chapters. The seven chapters that follow this brief introduction are all written by leading experts who have been actively involved in the experimental testing and development of the dual process framework in the last years. The chapters present an accessible overview of their main findings, the theoretical modifications they propose, and discussion of pressing issues and challenges. In the closing chapter, Jonathan Evans presents a reflection on the evolutions that are highlighted in the book.

**Chapter overview**

**Chapter 2**

_A perspective on the theoretical foundation of dual process models_

Gordon Pennycook (Yale University, USA)

In his thought-provoking chapter Pennycook lays out what he views to be the core theoretical groundwork for future dual process models. He draws on these foundations and parallels them with the executive functioning literature to outline an updated framework.

**Chapter 3**

_The parallel processing model of belief bias: review and extensions_

Dries Trippas (Max Planck Institute for Human Development, Germany) and Simon J. Handley (Macquarie University, Australia)

In their chapter Trippas and Handley describe how the classic Stroop effect inspired them to introduce a new reasoning paradigm in which participants have to switch between belief-based and logic-based thinking. They clarify how this led them to present a new dual process model in which multiple problem features are processed simultaneously from the start. The chapter presents a comprehensive overview of the core assumptions and critical empirical tests.

**Chapter 4**

_Bias, conflict, and fast logic: towards a hybrid dual process future?_

Wim De Neys (CNRS & Université Sorbonne Paris Cité, France)
In my personal chapter contribution, I present the basic dual process model that I believe to be supported by my own empirical findings and the work of many of the contributors to this volume. I review critical findings from my team and discuss outstanding questions and issues.

**Chapter 5**

*Comparing dual process theories: evidence from event-related potentials*

Adrian P. Banks (University of Surrey, UK)

Banks and his collaborators have pioneered the use of event-related potentials (ERP) to test dual process theories of reasoning. ERP research has the potential to tap fast intuitive processes that can be difficult to investigate using behavioural paradigms. In his chapter Banks reviews the relevant ERP literature and shows how his findings favour a model in which logic and belief are processed in parallel by fast System 1 processes.

**Chapter 6**

*The fuzzy-trace dual process model*

Valerie F. Reyna, Shahin Rahimi-Golkhandan, David M. N. Garavito, and Rebecca K. Helm (Cornell University, USA)

Reyna and collaborators present an overview of their fuzzy-trace dual process framework. The unique cornerstone of the fuzzy-trace approach lies in the distinction – inspired by classic psycholinguistics – between verbatim and gist-based representations of presented information. Within this framework, intuitive gist-based processing is placed at the apex of advanced thinking. Reyna et al. present an extensive overview of the wide range of studies that tested the fuzzy-trace predictions.

**Chapter 7**

*Conflict and dual process theory: the case of belief bias*

Linden J. Ball (University of Central Lancashire, UK), Valerie A. Thompson (University of Saskatchewan, Canada), and Edward J. N. Stupple (University of Derby, UK)

Traditional dual process theories were heavily inspired by research on the belief bias effect in syllogistic reasoning. Ball et al. present an overview of this literature and recent challenges to the traditional dual process model of belief bias. They sketch the core tenets of an attempt to reconcile the traditional framework with the contradictory challenges.
Chapter 8

**Logical intuitions and other conundra for dual process theories**

Valerie A. Thompson and Ian R. Newman

(University of Saskatchewan, Canada)

Thompson and Newman review how recent findings have challenged three pillars of the traditional dual process framework with respect to the speed, sequence, and cognitive capacity dependency of intuitive and deliberate processing. They discuss key implications and questions for the future of dual process research.

Chapter 9

**Dual process theory: perspectives and problems**

Jonathan St B. T. Evans (Plymouth University, UK)

As an editor, I am very grateful that Jonathan Evans agreed to write the closing chapter to this volume. Jonathan is widely considered the godfather of the standard dual process model that has come to dominate the field. Various contributors to this book indicate that there is a need to revise key features of this model and re-think our conceptualization of the way intuition and deliberation interact. Although Jonathan is now officially retired, he agreed to use the chapter to comment on these new developments. He points to possible misconceptions and ways to integrate the recent findings in the default-interventionist model that he favours.

In closing

Taken together, I believe that the book presents an excellent overview of the state of the art of the dual process field. My hope is that the volume will help to familiarize the wide range of psychologists, philosophers, and economists who have grown an interest in dual process models with the latest insights and discussions. At the same time, the book should also make it clear that the field is still in full development and the last word on key debates has not been said. More work is definitely needed. I hope that the book will stimulate at least some readers to join in this exciting journey.
Dual process theories formalize a salient feature of human cognition: we have the capacity to rapidly formulate answers to questions, but we sometimes engage in deliberate reasoning processes before responding. It does not require deliberative thought to respond to the question “what is your name.” It did, however, require some thinking to write this paragraph (perhaps not enough). We have, in other words, two minds that might influence what we decide to do (Evans, 2003; Evans & Frankish, 2009). Although this distinction is acceptable (and, as I’ll argue, essentially irrefutable), it poses serious challenges for our understanding of cognitive architecture. In this chapter, I will outline what I view to be important theoretical groundwork for future dual process models. I will start with two core premises that
I take to be foundational: 1) dual process theory is irrefutable, but falsifiable; and 2) analytic thought has to be triggered by something. I will then use these premises to outline my perspective on what I consider the most substantial challenge for dual process theorists: we don’t (yet) know what makes us think.

Introduction

The distinction between intuition (heart, senses, passion, faith) and reflection (mind, reason, analytic thinking) dates, at least, to antiquity and has been the object of philosophical musing for centuries (as evidenced by the opening quotations). It is perhaps unsurprising, then, that dual process theories are popular in many domains of psychology (see Evans, 2008 for a review), such as reasoning (Evans, 1989; Sloman, 1996; Stanovich & West, 2000), decision making (Barbey & Sloman, 2007; Kahneman, 2011; Kahneman & Frederick, 2005), social cognition (Chaiken & Trope, 1999; Epstein, Pacini, Denes-Raj, & Heier, 1996), cognitive development (Barrouillet, 2011; Brainerd & Reyna, 2001; Klaczynski, 2001), clinical psychology (Beckers, 2005; Pyszczynski, Greenberg, & Solomon, 1999), and cognitive neuroscience (Goel, 2007; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Lieberman, 2007). Indeed, as evidenced by Figure 2.1, dual process theories in psychology have proliferated (see Frankish & Evans, 2009 for an historical overview).

Naturally, contemporary dual process theories go well beyond the musings of philosophers like Aristotle and Voltaire (see De Neys, this volume). The proliferation of dual process theories evidenced in Figure 2.1 corresponds with a proliferation of characteristics that have been used to distinguish the two types of processes. Intuitive (or ‘Type 1’, or ‘System 1’) processes have been considered autonomous, fast, domain specific, evolutionarily old, unconscious, high capacity, and associative (among others), whereas analytic (or ‘Type 2’ or ‘System 2’) processing has

![FIGURE 2.1 Number of journal articles using the terms “dual process theory,” “dual process theory,” or “dual processes” in the field of psychology since 1970. Search completed on November 25, 2016.](image-url)
been considered deliberative, slow, domain general, evolutionarily young, conscious, capacity limited, and rule-based (among others). Recently, Evans and Stanovich (2013a) noted that most of these are merely correlated features of intuition and reflection and that a few characteristics can be isolated as defining features of Type 1 and Type 2 processes. Specifically, they argued that Type 1 processes operate autonomously and do not require working memory, whereas Type 2 processes require working memory and allow for cognitive decoupling and mental simulation.

Evans and Stanovich’s (2013a) new synthesis represents a crucial step forward for dual process theories insofar as they have provided a framework that can be used to organize and guide future theorization. This work corresponds with previous attempts to delineate and eliminate common fallacies in dual process theorizing (Evans, 2012), such as the claim that intuition always leads to errors, whereas reflection always produces normatively correct responses. Nonetheless, there is still much work to be done (hence the necessity of this volume). The goal of this chapter is to discuss what I think is the most crucial problem facing dual process theories: we have a good sense of what intuitive and analytic processes are, but we do not have a good sense of how they operate. That is, dual process theories have not sufficiently modelled analytic engagement.

My goal with this chapter is to lay out what I take to be the core theoretical foundations that should guide the pursuit of a better understanding of analytic engagement. I will then use these foundations to briefly outline an updated dual process theory – the three-stage dual process model (Pennycook, Fugelsang, & Koehler, 2015b) – as a way to formalize and (begin to) address the crucial question: “What makes us think?” (i.e., What triggers Type 2 processing?).

Prior to outlining the three-stage dual process model, which I view as largely a synthesis of previous models (with a few added components), I will explicate the two key premises that form the motivation for the model and by which the model is built. The premises are as follows:

Premise 1: Dual process theory is irrefutable, but falsifiable.
Premise 2: Analytic thought has to be triggered by something.

These premises will provide the organization for the first half of this chapter.

**Premise 1: dual process theory is irrefutable, but falsifiable**

Evans and Stanovich (2013a) isolated both autonomy and working memory as defining features of dual process theories. However, it is only necessary for a single dimension to distinguish intuitive and reflective processes for the theory to be based on an acceptable proposition. Indeed, Thompson (2013) has argued that autonomy is the only feature needed to distinguish the two types of processes – an argument that I agree with. Thus, to understand why dual process theory, at its most basic level, is irrefutable, the concept of autonomy needs to be explained.

Plainly, some cognitive outputs are engendered directly as a result of stimulus–response pairings. One cannot help but think of their name when asked “what is
your name,” Autonomous processes initiate and complete outside of deliberate control, and there is little doubt that this is something that actually occurs in the mind (Stanovich, 2009). However, there is also little doubt that humans are capable of reasoning in the absence of an immediate autonomous response. Consider the following arithmetic problems (c/o Thompson, 2013): \([2 \times 0 = ?]\) and \([2217 \times 72 = ?]\). The former cues an autonomous response (assuming a basic level of mathematics education), whereas a response to the latter can only be generated with some effort. This highlights an important aspect of analytic processing: the reasoner can decide whether to carry out (or continue carrying out) a mental operation. That is, humans are able to decide about deciding. Crucially, this can occur even in cases where an intuitive response is evident. Imagine, for example, if you were told to perform addition when the symbol for multiplication was present. The problem \([2 \times 0 = ?]\) would still engender the initial response (‘0’), but (under normal conditions) you would be able to stop yourself from answering ‘0’ in lieu of the alternative analytic response (‘2’). Naturally, one could also choose to not bother with the addition operation. Note in this case, the actual operation of adding 2 and 0 does not require analytic thought. Rather, replacing multiplication with addition is what requires analytic thought.

It is important to note that this is a falsifiable claim. It needn’t be the case that people are capable of autonomous processing – \(2 \times 0\) does not have to automatically equal 0. Similarly, it needn’t be the case that people must be able to purposefully deliberate. Bechara, Damasio, Damasio, and Anderson (1994) famously observed that patients with damage to the ventromedial prefrontal cortex are insensitive to the future consequences of decisions. Moreover, analytic thinking increases during adolescent development (Kokis, Macpherson, Toplak, West, & Stanovich, 2002). That most adult humans are capable of generating both intuitive and reflective answers to questions is merely an empirical observation. Dual process theory – or, at least, the basic claim that individual dual process theories all assume – is irrefutable. The very act of arguing against this proposition would require deliberative processes (following, perhaps, an autonomous visceral reaction to the polemical use of the term ‘irrefutable’).

The observation that the distinction between intuition and reflection is irrefutable is foundational because it means that dual process models should not be concerned with justifying this claim. That is, dual process models must take this distinction as a given and build from there. If we know with a reasonable degree of certainty that the mind has this capacity for two different types of processes (autonomous and non-autonomous), where do we go from there?

**Premise 2: analytic thought has to be triggered by something**

The irrefutability of dual process theory does not bear on its usefulness. Indeed, the true test of a good theory is whether it can be applied successfully to problems and generate hypotheses (see Evans & Stanovich, 2013a for a discussion of this