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Why It Matters: The Implications of Autonomous Processes for Dual Process Theories—Commentary on Evans & Stanovich (2013)

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Abstract
Evans and Stanovich (2013, this issue) propose that Type 1 processes should be defined in terms of autonomy, such that they are initiated and run to completion in the presence of relevant triggering conditions. In this commentary, I argue that their autonomous execution has implications for the nature of the representation that is formed and for the shape and outcome of subsequent Type 2 processes. In addition, I argue that Type 2 processes may also be triggered automatically, but that, unlike Type 1 processes, their completion requires working memory resources, and that the outcome of those processes is more flexible than that of Type 1 processes.

Keywords
dual-process theories, autonomous processes, reasoning, working memory

In their article, Evans and Stanovich (2013, this issue; hereafter E&S) have clarified a number of issues concerning the basic assumption of dual process theories, definitively distancing themselves from the dual systems approach and reducing a large number of potentially disjointed dichotomies to a single, more coherent, dichotomy between autonomous processes and those requiring working memory resources. In this commentary, I discuss the implications and utility of this distinction for theory development.

Dichotomous Versus "All or None" Processes

At least in terms of Type 1 processes, the move to a single characterizing feature provides valuable simplification and clarity. Autonomous processes are those whose execution is mandatory, given the presence of their triggering conditions. This is a clear cut and testable definition. It does not really matter if, as Keren and Schul (2009) argued, some processes that are usually autonomous can, in some circumstances, be subject to top-down control. It does matter that, for a given person confronted with a given situation, a process is initiated without any intention on their part. Similarly, it does not matter, if, as Keren and Schul argued, processes are capable of gradually moving from explicit procedures to autonomous ones—it matters only if a process has become sufficiently autonomous that it is triggered in the current context without the intent of the participant. Under these circumstances, the outcome of the autonomous process(es) will have an immediate and consequential effect on the information that is represented about the problem space.

If Type 1 processes are defined as autonomous, why not define Type 2 processes as their complement? That is, why not define Type 2 processes to be controlled processes that can, in principle, be initiated by the individual? E & S do not say, although one might speculate that this is too close to the conscious/unconscious distinction that the authors wish to avoid. Instead, they focused on the criterion of working memory (WM) capacity. Such a focus is understandable, given their default interventionist view: WM capacity is undeniably required to "override" an initial representation of the problem in favor of another or to simulate the consequences of a representation (i.e., hypothetical thinking), which are also defining features offered for Type 2 thinking. The problem, as I see it, is that much

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Type 2 thinking does not involve an override. In many previous studies (Shynkaruk & Thompson, 2006; Thompson, Prowse Turner, & Pennycook, 2011; Thompson et al., in press), we have shown that when offered an opportunity to rethink an initial, intuitive response, many reasoners do not change it, even though they have spent some additional time engaged in the task. This finding suggests that although participants did not override their initial answer, they are nonetheless engaged in a manner of Type 2 thinking, such as rationalizing their initial choice or searching for confirming evidence that presumably engages WM to some degree. As additional evidence that thought processes are taking place during this time, confidence in their answer generally increases during this rethinking interval, even for answers that do not change (Shynkaruk & Thompson, 2006). Thus, indicating that an override or a mental simulation is a requirement for Type 2 thinking may be unnecessarily restrictive.

WM engagement is not an all-or-none criterion but varies continuously with the depth of processing engaged. This implies that Type 2 processes are defined along a continuum rather than a dichotomy. I am less troubled than many dual-processes critics about the fact that dichotomous variables often exist as continua, but it does raise the question of how much WM needs to be engaged to qualify as Type 2 thinking. Alternatively, perhaps we could say that all Type 2 thinking involve WM to at least some extent. This phrasing is somewhat less clear-cut than that advocated by E & S, but is it not clear to me that we can avoid speaking of continua when we discuss Type 2 processes.

The Value of Distinguishing Two Types of Processes

This assertion then raises the obvious question "Why bother?" What does it matter whether we posit two qualitatively different types of processes, as opposed to two processes that differ continuously in degrees? Conversely, what do we lose by forgoing the assumption that there are two types of processes? For example, it is clear that processes differ in their speed of execution. Would we not be better off to label fast processes as Type 1 and their slower counterparts as Type 2? Because of their speed, the faster Type 1 processes would form a default response, which may suffice. If not, they would be followed by slower Type 2 processes. This dichotomy does not carry a lot of theoretical baggage and can explain quite a bit of the data with added assumptions about the relative demands placed on WM by faster and slower processes. For example, as Kruglanski and Gigerenzer (2011) argued, one might posit that the faster processes are computationally simple, whereas the slower ones are computationally more complex and thus require additional WM resources.

But isn't that, in and of itself, an important distinction to make? WM capacity, as we know, is a limiting factor in our ability to engage in reflective thought. Given this, the fact that some processes can be executed without much drain on that capacity, and others may not be executed for want of it, has profound implications for the outcome of our decision making and for other cognitive processes. Conversely, the fact that some information becomes an obligatory part of the problem space carries implications for subsequent processing. For example, take the following three problems:

$$2 \times 3 = ? \qquad 23 + 18 = ? \qquad 2314 \times 63 = ?$$

They are all arithmetic problems solvable with recourse to the same set of arithmetic rules and, as such, by some arguments, not different process "Types" at all. Nonetheless, it matters that the first answer suggests itself without intention, the second with little reflection, and the third only with great effort. The reason it matters is this: The answer "6" becomes part of the problem space; it is now part of the representation that you have of the problem. Depending on one's level of skill, the answer to the second problem may also be part of the representation. One may, with some effort, prevent oneself from doing the addition for the second problem, but that is not the case for the first problem. The answer to the third problem may never become part of your representation, because you may well decide that the effort that it will take to produce it is not worthwhile. Moreover, even if you do attempt it, the processes engaged to solve it—the representation of intermediate steps, memory for previous calculations, and the ability to produce subsequent calculations while remembering earlier ones—are qualitatively different than the simple memory retrieval that produced "6".

Why Autonomy Matters

This example goes to the heart of E & S's argument: Type 1 processes are not a matter of speed or simplicity, but of autonomy. The consequence of autonomy are simple and profound—the outcome of autonomous processes automatically become part of the representation of the problem space. Some autonomous processes, such as simple arithmetic, may once have been controlled but are now learned to the point of automaticity. Others, such as the way in which we categorize objects and stereotype people, may also be learned (as are habitual responses), but they nonetheless unfold when triggering conditions are present in the environment. Others, such as reflexes, emotions like surprise or fear, or judgments of pleasantness may reflect a mix of learning and hardware. Still others will be functions computed by the brain and relatively immune to learning. It doesn't really matter.

What matters is the fact that their output becomes an obligatory part of one's representation.

Why does it matter? Let us go back to some cognitive psychology basics and assume that the representation that people form of the problem space is then the basis for subsequent actions or decisions. It follows, therefore, that understanding the content of this representation is key to understanding reasoning and decision making. At the extreme, because autonomous processes tend to be fast, they may form the basis of a default decision, even if it involves answering a different question by a process of attribute substitution (Kahneman, 2003).

In less extreme cases, autonomous response might also influence the course of subsequent Type 2 processes. Because quickly retrieved answers are accompanied by high degrees of confidence (Thompson et al., 2011; Thompson et al., in press), they may actively signal that further reflection is not required. Even if further reflection is engaged, having one salient representation available may make it difficult to conceive of others. Moreover, any alternative representations of the problem, and the judgments based on them, may be anchored in the original representation (Tversky & Kahneman, 1974). Consequently, even if one has engaged Type 2 processes to revise one's initial judgment of probability, risk, or willingness to pay, the initial anchoring value may limit the degree of subsequent change. Alternatively, the initial representation may form the starting point for a deliberate search for additional information (e.g., a search for counter-examples; Thompson, 2000). Moreover, even if one successfully initiates an override of the initial answer, the original answer may give rise to a sense of lingering doubt about the subsequent answer (Sloman, 2002).

Of course, representations are multiply determined and may change over time. In some cases, there may be two or more Type 1 processes engaged, which may either converge on a single representation or give rise to competing representations. This, in turn, might trigger an attempt to evaluate which of the two responses is more reliable (Pennycook & Thompson, 2012). In addition, the outcomes of both Type 1 and Type 2 processes might cue additional information that is incorporated into the problem space, for example, by priming. Regardless, the nature of the representation that is used to make a final decision will likely have been substantially shaped by the initial Type 1 process. Thus, it matters whether its representation is obligatory.

Autonomy and the Control of Type 2 Processes

In this way, Type 1 processes are qualitatively different from Type 2 processes, which, as E & S point out, are characterized by flexible cognitive control. For example, if the task at hand has low stakes (a boring laboratory task or a purchasing decision where little money is involved), a reasoner may explicitly decide to forgo additional thought, even if he or she was not completely satisfied with the initial answer. High-stakes decisions under time pressure may produce the same outcome, but because of external pressures rather than an internal decision. However, in many situations, the reasoner could potentially pursue a variety of strategies. These strategies could be induced by instructions, deliberately chosen by the reasoner, or cued or constrained by the content of the representation, as for example, when believable conclusions prompt a search for confirmation and unbelievable ones for disconfirmation (Klauer, Musch, & Naumer, 2000). Again, knowing about the content of the initial representation will be useful in understanding the nature of subsequent, deliberate processing.

I have been talking about situations where the reasoner has some autonomy with respect to the initiation, mode, and depth of Type 2 thinking. However, there are certain to be situations in which Type 2 thinking is triggered automatically by an unusual or startling situation in the environment or by a metacognitive feeling of unease (Thompson et al., 2011; Thompson et al., in press). Unusual situations are likely to be an autonomous trigger to Type 2 thinking, such as when one confronts a bizarrely dressed person in the mail room, when one starts to experience unusual symptoms after eating, or when one encounters an unpleasant smell. Similarly, we know that Type 2 thinking may be engaged or repressed in response to a metacognitive feeling of rightness based on an implicit feeling of fluency or familiarity (Thompson et al., 2011; Thompson et al., in press).

Do these examples create a contradiction in definition (i.e., that both Type 1 and Type 2 processes can be engaged autonomously in response to the appropriate triggering conditions in the environment)? Not necessarily, because there is a qualitative difference between Type 1 and Type 2 processes: Whereas Type 1 processes are both triggered and run to completion in response to triggering stimuli, Type 2 processes are just initiated. Whether or not they run to completion will require time and WM capacity; moreover, their outcome is, at least to some extent, under the control of the reasoner. Consider the situation in which one encounters a bizarrely dressed person in the mail room. A number of Type 1 processes are initiated, and their contents delivered to WM: a feeling of surprise, an assessment of familiarity (is this someone I know?), an assessment of threat, and so on. Type 2 processes may also be triggered and represented as a desire to make sense of the situation. At this point, one may engage several strategies that vary with respect to the demands placed on WM (such as trying to figure out who it is, deciding whether to call security, etc.). Alternatively, one could decide that the situation does not merit further thought and move on to thinking about

something else. Again, once initiated, there is a degree of control over how Type 2 processing proceeds. The fact, however, that it may be initiated automatically suggests that control, though a strong coexisting feature of Type 2 processes, should not be considered a defining feature.

Conclusions

In sum, E & S have presented a simplified model of dual processes. This model clarifies the key assumptions of dual process theories and provides testable hypothesis. In addition, there are several consequences of those assumptions—in particular, the assumption of the autonomy of Type 1 processes—that have important implications for further theory development. Specifically, autonomous processes produce outputs that are obligatorily represented as part of the problem space. Their representation in the problem space may either pre-empt the subsequent engagement of Type 2 thinking and, if not, may nonetheless shape its outcome in important ways. Type 2 thinking, in contrast, is more flexible, so that unlike Type 1 thinking, its outcome is not a foregone conclusion.

Declaration of Conflicting Interests

The author declared no conflicts of interest with respect to the authorship or the publication of this article.

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