The complexity of developmental predictions from dual process models

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ABSTRACT

Drawing developmental predictions from dual-process theories is more complex than is commonly realized. Overly simplified predictions drawn from such models may lead to premature rejection of the dual process approach as one of many tools for understanding cognitive development. Misleading predictions can be avoided by paying attention to several cautions about the complexity of developmental extrapolations. The complexity of developmental predictions follows from the fact that overall normative responding at a given age derives from several different mental characteristics: (1) the developmental course of Type 1 processing, (2) the developmental course of Type 2 processing, (3) the acquisition of mindware usable by Type 1 processing, (4) the acquisition of mindware usable by Type 2 processing, and (5) the practicing of the mindware available to Type 2 processing to the extent that it is available to be processed in an autonomous manner. The complexity of all these interacting processes and sources of information can sometimes result in U-shaped developmental functions on some heuristics and biases tasks, making younger children look like they are responding more optimally than older children. This is particularly true when the youngest groups are ill-equipped to even understand the task and thus respond randomly. A final caution concerns terminology: The terms normative or rational should be reserved for responses and not attributed to subpersonal processes.

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Introduction

Dual-process theories of cognition have received a notably large share of attention in the last decade (Evans, 2008, 2010; Evans & Frankish, 2009; Kahneman & Frederick, 2002, 2005; Lieberman, 2003, 2007; Reyna, 2004; Stanovich, 2004, 2011). And in parallel, they also have received a sizable share of criticism (Keren & Schul, 2009; Kruglanski & Gigerenzer, 2011; Osman, 2004). Our purpose here is not to attempt an overall assessment of the state of play in this literature. Instead, our goal is to caution that drawing developmental predictions from dual-process theories is a deceptively complex endeavor. Our contention is that developmental predictions are more complex than is commonly realized. Drawing overly simplified predictions from such models may lead to a premature rejection of the dual process approach as one of many tools for understanding cognitive development.

A generic dual-process account

For our purposes here, we will lay out only the most generic of dual-process models. None of our arguments will depend on adjudicating the detailed differences among the many such models that have been discussed in the literature (see the reviews of Evans, 2003, 2006, 2008, 2009, 2010, for more detailed explications). The family resemblances among these models extend to the names for the two classes of processes. The terms heuristic and analytic are two of the oldest and most popular (see Evans, 1984, 1989). However, in order to attenuate the proliferation of nearly identical theories, Stanovich (1999) suggested the more generic terms System 1 and System 2. Although these terms have become popular, there is an infelicitousness to the System 1/System 2 terminology. Such terminology seems to connote that the two processes in dual process theory map explicitly to two distinct brain systems. This is a stronger assumption than most theorists wish to make. Additionally, both Evans (2008, 2009) and Stanovich (2004, 2011) have discussed how terms such as System 1 or heuristic system are really misnomers because they imply that what is being referred to is a singular system. In actuality, the term used should be plural because it refers to a set of systems in the brain that operate autonomously in response to their own triggering stimuli, and are not under higher-level cognitive control.

Evans (2008, 2009; see also Samuels, 2009) has suggested a terminology of Type 1 processing versus Type 2 processing. The Type 1/Type 2 terminology captures better than previous terminology that a dual process theory is not necessarily a dual system theory (see Evans, 2008, 2009, for an extensive discussion). For these reasons, I will rely most heavily on the Type 1/Type 2 terminology. An even earlier terminology due to Evans (1984, 1989)—heuristic versus analytic processing—will also be employed on occasions when it is felicitous because many developmental studies in the literature have used this terminology.

The defining feature of Type 1 processing is its autonomy—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. Autonomous processes have other correlated features—their execution is rapid, they do not put a heavy load on central processing capacity, they tend to be associative—but these other correlated features are not defining. Autonomous processes would include behavioral regulation by the emotions; the encapsulated modules for solving specific adaptive problems that have been posited by evolutionary psychologists; processes of implicit learning; and the automatic firing of overlearned associations (Barrett & Kurzban, 2006; Carruthers, 2006; Coltheart, 1999; Evans, 2008, 2009; Moors & De Houwer, 2006; Samuels, 2005, 2009; Shiffrin & Schneider, 1977; Sperber, 1994).

For the discussion of developmental issues, it is important to realize that what is called Type 1, or heuristic processing, is a grab-bag—encompassing *both* innately specified processing modules/procedures and experiential associations that have been learned to automaticity. The point stressed by both Evans (2008, 2009) and Stanovich (2004, 2011) is that Type 1 processing is not a uniform type arising from a singular system. The many kinds of Type 1 processing have in common the property of autonomy, but otherwise, their neurophysiology and etiology might be considerably different. For example, Type 1 processing is not limited to modular subprocesses that meet all of the classic Fodor (1983)