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# The Interaction of Explicit and Implicit Learning

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## The Focus of the Symposium

The role of implicit learning in skill acquisition and the distinction between implicit and explicit learning have been widely recognized in recent years (see, e.g., Reber 1989, Stanley et al 1989, Willingham et al 1989, Anderson 1993). Although implicit learning has been actively investigated, the complex and multifaceted interaction between the implicit and the explicit and the importance of this interaction have not been universally recognized; to a large extent, such interaction has been downplayed or ignored, with only a few notable exceptions.<sup>1</sup> Research has been focused on showing the *lack* of explicit learning in various learning settings (see especially Lewicki et al 1987) and on the controversies stemming from such claims. Similar oversight is also evident in computational simulation models of implicit learning (with few exceptions such as Cleeremans 1994 and Sun et al 2000).

Despite the lack of studies of interaction, it has been gaining recognition that it is difficult, if not impossible, to find a situation in which only one type of learning is engaged (Reber 1989, Seger 1994, but see Lewicki et al 1987). Our review of existing data has indicated that, while one can manipulate conditions to emphasize one or the other type, in most situations, both types of learning are involved, with varying amounts of contributions from each (see, e.g., Sun et al 2000; see also Stanley et al 1989, Willingham et al 1989).

Likewise, in the development of cognitive architectures (e.g., Rosenbloom et al 1993, Anderson 1993), the distinction between procedural and declarative knowledge has been proposed for a long time, and advocated or adopted by many in the field (see especially Anderson 1993). The distinction maps roughly onto the distinction between the explicit and implicit knowledge, because procedural knowledge is generally inaccessible while declarative knowledge is generally accessible and thus explicit. However, in work on cognitive architectures, focus has been almost exclusively on “top-down” models (that is, learning first explicit knowledge and then implicit knowledge on the basis of the former), the bottom-up direction (that is, learning first implicit knowl-

edge and then explicit knowledge, or learning both in parallel) has been largely ignored, paralleling and reflecting the related neglect of the interaction of explicit and implicit processes in the skill learning literature. However, there are a few scattered pieces of work that did demonstrate the parallel development of the two types of knowledge or the extraction of explicit knowledge from implicit knowledge (e.g., Willingham et al 1989, Stanley et al 1989, Sun et al 2000), contrary to usual top-down approaches in developing cognitive architectures.

Many issues arise with regard to the interaction between implicit and explicit processes, which we need to look into if we want to better understand this interaction:

- How can we best capture implicit processes computationally? How can we best capture explicit processes computationally?
- How do the two types of knowledge develop alongside each other and influence each other’s development?
- Is bottom-up learning (or parallel learning) possible, besides top-down learning? How can they (bottom-up learning, top-down learning, and parallel learning) be realized computationally?
- How do the two types of acquired knowledge interact during skilled performance? What is the impact of that interaction on performance? How do we capture such impact computationally?

## Titles of the Talks

Axel Cleeremans: “Behavioral, neural, and computational correlates of implicit and explicit learning”

Zoltan Dienes: “The effect of prior knowledge on implicit learning”

Bob Mathews: “Finding the optimal mix of implicit and explicit learning”

Ron Sun: “The synergy of the implicit and the explicit”

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<sup>1</sup>By the explicit, we mean processes involving some form of generalized (or generalizable) knowledge that is consciously accessible.