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Commentary

The mechanics of implicit learning of contingencies: A commentary on Custers & Aarts' paper ☆

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ABSTRACT

In their paper: "Learning of Predictive Relations Between Events Depends on Attention, Not on Awareness" Custers & Aarts demonstrate that when one is first exposed to a clear predictive relationship – a consequent predictive relationship will be represented as a unidirectional association ("predictor" to "predicted") in the percievers' minds regardless of their awareness of that relationship. Furthermore, a conscious intention to learn the relationship leads to the formation of a bidirectional (non-predictive) association. While these findings may prove to be a significant step in understanding other forms of implicit learning such as implicit artificial grammar learning and implicit sequence learning and why they are affected by intentional learning; Custers & Aarts' postulation that "top-down" regulation is at work here is debatable as their experimental manipulation can be understood as "bottom-up" activation of implicit learning processes.

1. Introduction

Custers and Aarts (2011) demonstrate that simple contingencies are acquired and represented as a unidirectional association without awareness of the contingency and seemingly, without an intention to learn (henceforth, implicitly). Specifically, Custers and Aarts' (C&A) findings demonstrate that not only is awareness of a specific contingency unnecessary for representing that relationship as a unidirectional association, but that awareness of the predicting stimulus itself becomes unnecessary if one is exposed to another predictive relationship beforehand. These findings address the fundamental issue of the "mind's take" on prediction and the factors affecting it. The evidence that directional associations are established implicitly grounds the predictive capabilities of so-called associative processes in sound mental machinery and raises fascinating questions about the function of awareness in contingency learning.

In the rest of this commentary I focus on three issues related to and inspired by these studies. I begin with exploring the adequacy of attentional tuning as a candidate for driving these results, continue with linking the disruptive role of intention to learn to a similar phenomenon in other implicit learning paradigms, and end with outlining the implications of these studies for dual-system models that are based on the explicit–implicit distinction.

☆ Commentary on Custers, R., & Aarts, H. (2011). Learning of predictive relations between events depends on attention, not on awareness. *Consciousness and Cognition*, *20*, 368–378.

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2. Regulation of implicit learning: top down & bottom up

C&A interpret their manipulation as ‘‘tuning” of attention. Arguably, participants’ attention was tuned by repeatedly exposing some participants to a deterministic S–S relationship while others (the control condition) were exposed to random parings of stimuli. While ‘attention’ is an important construct in recognizing various limits on our information processing it also suffers from having multiple meanings. The two most well established meanings of attention are in reference to a limited resource that is tightly bound to awareness (Kahneman, 1973) or to our ability for mental selection from the perceptual stream (e.g., Broadbent, 1958). First, C&A capitalize on both meanings. Arguing for a spurious relationship between contingency awareness and contingency learning they justly suggest that attention – in the sense of cognitive resources invested in the task – is driving both, hence the spurious correlation. But then, when introducing ‘‘tuning” as the mechanism responsible for producing contingency learning in absence of awareness, C&A refer to attention in the selection sense. The two are different and choosing either has different implications. Second, C&A’s form of attention as selection is not object, nor feature based, but tuning to a specific relationship among stimuli (e.g., temporal precedence). Specifically, they argue that the existence of a predictive relationship in the environment tunes attention (in the selection sense) to detect other such relationships. The implication is that these findings are yet another example of nonconscious cognitive control over basic processes. But is the postulation of top down involvement justified? Cognitive control involves the activation of mental representations, and past work has shown that it is possible to activate existing representations of relationships to bias the mind to ‘‘see” or apply them to consequent stimulation (Higgins & Chaires, 1980). But C&A’s manipulation does not involve the activation of concepts and we have no data that such a concept was indeed activated. As such, their data affords another very interesting explanation namely, that their manipulation led *directly* to the activation of the learning system. Supporting the possibility of such ‘‘bottom up” regulation is a finding cited by C&A; contextual cuing, a spatial form of implicit learning, *does not occur* when the observer is first exposed to environments in which no (task relevant) regularities exist (Junge, Scholl, & Chun, 2007). Compare this to asking participants to ignore a specific stimulus or offering a reward for paying careful attention to the stimuli. Indeed, all of the above may consequently affect implicit learning but pinpointing the source(s) of regulation (selection, resource recruitment, or through ‘‘feeding” a process with adequate stimulation) is important for the notion of cognitive control to continue to be meaningful. Finally, C&A’s manipulation leaves open an interesting question: is awareness of the first (‘‘attentional tuning”) contingency essential for establishing undirectional associations in the (actual) acquisition phase? Until this question is answered negatively it is still possible that awareness that ‘a relationship’ exists is needed to implicitly learn another.

3. Intention to learn disrupting of implicit learning processes

As C&A write there is some evidence that having an explicit intention to learn may actually disrupt implicit learning processes. For example, Lieberman, Chang, Chiao, Bookheimer, and Knowlton’s (2004) imaging data suggests an asymmetric inhibitory relationship between hippocampal (implicated in chunking and instance based learning) and basal areas (implicated in learning of sequences and abstract structure). Presumably, a deliberate intention to learn would inhibit the basal areas. C&A’s findings may prove to be the mental analog of these imaging data. When their participants were instructed to learn the predictive relationship (they could never explicitly learn it as the predictor was phenomenologically invisible) the resultant associations were bidirectional (Experiment 2). If these findings can be replicated within classic implicit learning paradigms such as the serial reaction time task (SRT) or artificial grammar learning (AGL) they would both establish the mental processes underlying implicit learning (i.e., unidirectional associations) and link the effect of intention at the mental and brain levels. Both possibilities are exciting.

4. Associative versus rule based

Finally, C&A’s results add credence to the growing unease with dual-system models (Keren & Schul, 2009), in this case the ‘‘explicit” system (inferential, rule based) and the implicit (‘‘associative”) one (cf., Alonso, Fuentes, & Hommel, 2006). C&A demonstrate that at least one form of predictive, If–Then like, relationship can be acquired and manifested implicitly. As rule based (If–Then) action is considered to be one of the functions/attributes of the explicit system (e.g., Sloman, 1996) it seems that that system has just lost some important ground to the ‘‘associative” one. Actually, if If–Then relations can be represented through associations and awareness of the contingency does not play a role it is not clear, apart from awareness, what is the case for stipulating two systems. A focus on the nature of acquisition and representation processes may be a more rewarding research strategy than searching for a coherent typology of features (see Henke, 2010).

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