Combining Dynamic Modeling and Continuous Behavior to Explore Diverging Accounts of Selective Attention

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Abstract

Selective attention is paramount for adaptive behavior as it biases information processing towards stimuli that are relevant for achieving our goals. The mechanisms underlying this bias are under debate, however: Whereas one class of models postulates that selective attention solely relies on the amplification of goal-relevant information (e.g. Cohen, Dunbar, & McClelland, 1990), a second class of models deems additional inhibitory processes necessary to suppress distracting stimuli (e.g. Houghton & Tipper, 1994).

Here, we explore the explanatory value of both accounts from a dynamic perspective that focuses on the continuous unfolding of goal-directed behavior over time (see Scherbaum, Dshemuchadse, Fischer, & Goschke, 2010; Spivey & Dale, 2006). We present two variants of a Dynamic Neural Field model (see e.g., Johnson, Spencer, & Schöner, 2008; Sandamirskaya, Zibner, Schneegans, & Schöner, 2013) that incorporate the diverging assumptions regarding the nature of selective attention. Running simulations of an attentional set-switching paradigm with both models, we show that – even though they make similar predictions with regard to discrete markers of performance like response times – the continuous development of response tendencies over the course of single trials differs markedly whether or not inhibitory processes take part in attentional selection.

To test these dynamic predictions empirically, human participants completed the same set-switching paradigm using mouse-tracking as a continuous measure of performance (see e.g., Scherbaum et al., 2010). Comparing modeled and observed behavior revealed clear evidence for the persisting amplification of previous target information but no signs of sustained distracter suppression.

These findings illustrate that dovetailing dynamic computational modeling with continuous measures of behavior can open promising avenues for understanding the mechanisms underlying fundamental cognitive abilities.

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