Task Domains in N-Space Models: Giving Explanation Its Due.

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Our colleagues tacitly agree that N-space models are better at explaining the data on human problem solving than single space models. The primary question of this symposium is how many spaces are necessary to explain the data. We will not be addressing this issue, except to suggest that more 'spaces' are probably needed. This follows from the substantive empirical claims of the three theories presented. These claims, combined with some facts about the computation power of N-spaces, provide strong evidence that the search space paradigm is not needed in theories of problem solving.

Any N-space theory is computationally equivalent to a single search space theory of problem solving. This can be shown by either creating a space that contains the other spaces as branches or by overlapping nodes from different spaces, such that every node has paths leading to nodes in other 'spaces'. By this method, the problem solver can switch from any 'space' to any other 'space', and in fact, several 'spaces' can be traversed in parallel. Thus, an N-space theory is only as powerful as a single space theory. There must be some non-computational reason for distinguishing N-space theories from single space theories. And by extension, all N-space theories are computationally equivalent.

Even if one accepts that N-space theories are computationally equivalent, one need not accept that they are equivalent at providing explanations. As pointed out earlier, N-space theories argue that we need multiple spaces to best understand human problem solving. The evidence supports this claim. N-space models are better explanations than single space models because the bulk of the explanation is in the division of labor between task domains (spaces), and not within the search space theory itself.

A distinction is important here. There is a difference between the mechanisms underlying problem solving, and the explanation of problem solving itself. Chomsky (1965) alluded to this distinction when he differentiated theories of competence from theories of performance. Simon (1981) labeled this distinction as one between substantive and procedural rationality. Similarly, Marr (1982) identifies the level distinctness between computational theories of a device and the theory of its underlying process, *i.e.*, the level of representation and the algorithm. All of these distinctions identify both an abstract specification of behavior and a mechanism for implementing that behavior.

In each case, the abstract specification of a system's behavior, performs an explanatory role. It specifies a method for a system to accomplish its goals, irrespective of how the system will accomplish them. The abstract specification is an idealization of what the system's behavior does and why it does it. This idealization is independent of its underlying process. Consequently, it offers a general description of a broad class of systems and provides information relevant for determining how the system will act as a whole. This allows us to identify significant features of the system from the noise of its lower level implementation.

N-space theorist presuppose that the only way to implement their abstract specifications are by using the low level mechanism of search space. This places an unduly mechanistic constraint on human problem solving research, which is counterproductive. If N-space theories are better theories than single space theory, then the task domains (spaces) the N-space theories define are the source of explanations about problem solving. Consequently, the processes underlying these task domains, the search spaces, become irrelevant noise in light of their specification. The task domain may be implemented in OOS, Prolog, C or even by a Turing machine. Nevertheless, the task domains are providing all the interesting information about the subject by partitioning the problem solving into identifiable high-level processes. Thus, the N-space theorists should be searching for more 'spaces', as every experimentally confirmed task domain contributes to our understanding of human problem solving.

If N-space theories are better than search space theory, then it is in virtue of their task domains' ability to identify significant aspects of the systematic behavior of human problem solving. Search space theory then only specifies one implementation of these task domains. Recognizing this, N-space theories should no longer emphasize the use of search spaces and concentrate more on the task domains to which their 'spaces' refer. Since the division of labor between task domains accounts for the power of the N-space theories, researchers should not restrict themselves to some arbitrary N. Instead, researchers should be open to as many task domains as necessary to explain the significant, observable features of human problem solving.

References

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