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Metaphors of Attention and their Role in Scientific Reasoning

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The traditional view of the role of metaphors in scientific reasoning is that, in the final analysis, metaphors are not essential. The basic claim of this eliminativist program is that ultimately a mature science will eliminate metaphors and other imaginative structures from its theories. In contrast, evidence from cognitive science about the nature of conceptualization and reasoning argues that metaphors are essential to the structure of those concepts.

An analysis of metaphors of attention in the history of psychology reveals the crucial role played by a small number of conceptual metaphors. It also illustrates the benefits of metaphor analysis for science practitioners: understanding the underlying metaphors of attention clarify the metatheoretical bases of past and current debates in the field, and make hidden assumptions explicit.

Conceptual Metaphors

A conceptual metaphor is a mapping of entities and structures from one conceptual domain (called the source domain) onto another domain of a different kind (called the target domain). One of the dominant metaphors of attention is *attention as a spotlight*, which has the following map:

Source Domain	Target Domain
Spotlight	-----> Mechanism of attention
Agent who controls it	-----> Executive System
Agent who sees	-----> Awareness System
Potential field of vision	-----> Representational Space
Area illuminated by spotlight	----> Attended area

As scientists, we apply our knowledge of the source domain (spotlight) to reason about the target domain (attention). This is illustrated by many research questions that stem from the spotlight metaphor, including whether or not attention: (1) moves in an analog fashion, (2) has a focus that is homogeneous, (3) has a focus of fixed size and sharp edges, and (4) can be split into two or more locations. The metaphor have also played a role in the interpretation of attentional effects in brain imaging data. When a spotlight sheds light, the brightness of the field increases, and the contrast of objects within the beam increases as well. In the target domain, this piece of knowledge predicts that when attention is expressed in a brain area, the neuronal activity of that area will increase (brightness), and so will the signal-to-noise ratio (contrast). Thus, we are enticed to assume that a 'lighted' area in the fMRI (brightness increase) is evidence for attentional modulation (contrast increase), even when data from animal research suggest that attentional modulation (contrast) is independent of the overall level of neuronal activity (brightness).

Metaphorical Pluralism

Several different metaphors are used to conceptualize attention, and each of them gives partial structuring to the concept. Current and past theoretical debates have been driven by the logic of these underlying metaphors. For example, is spatial attention a supramodal system or an emergent property of the visual system? A spotlight is neither part of the agent who controls it, nor is it part of the visual system of the person who sees what the spotlight illuminates. Thus, in the spotlight metaphor, attention is conceptualized as a supramodal system, separate from the executive system by which it is controlled and also separate from the awareness system that consciously perceives representations.

In contrast, in the *attention is seeing* metaphor, the fovea maps onto attention and rapid eye movements map onto shifts of attention. This metaphor is used when covert orienting of attention is thought of as 'looking' out of the corner of one's eyes. In the *attention is seeing* metaphor, attention is conceptualized as an emergent property of the visual system. Part of the debate between supramodal and pre-motor theories stems from the failure to recognize their grounding in two different metaphors. Although the names are misleadingly similar, *attention is a spotlight [for vision]* and *attention is vision* have different epistemological entailments, and create different ontologies in the target domains.

Other examples exist, such as whether attention is best described by a structural model (spotlight metaphor) or by a capacity model (limited resources metaphor). Rather than asking which metaphor is best, one should ask which aspects of attention are best captured by each. Understanding attention as a competition for limited resources prompts questions such as: What makes an activity more or less demanding? What factors control the total amount of capacity available? Can the resource be increased? Which rules are applied to decide where the resources are allocated?

Summary

Each metaphor leads to different inferences about what attention *is*, determines research hypotheses, and suggests which attentional phenomena are likely to be observed in the experimental setting. Any adequate explanation of a theory of attention must recognize the central role of conceptual metaphors. Moreover, an analysis of metaphors shed light on current debates, such as the existence of a supramodal system of attention (vs. pre-motor theory), the unity of attention (vs. multiple foci), the enhancement of attended information (vs. attenuation of unattended information), and the interpretation of imaging data.