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Where is the Theory? A Critical Comment on Multiple Arousal Theory.

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Abstract

Multiple arousal theory suggests that there is more than one arousal system and that the activity of the multiple arousal systems can be observed using electrodermal measures at various body sites. The ideas expressed by multiple arousal theory are interesting but they do not constitute a theory. The absence of a specific definition of arousal and the lack of testable predictions prevent multiple arousal theory from constituting a useful theoretical framework for focussed empirical research.

Where is the Theory? A Critical Comment on Multiple Arousal Theory.

Picard, Fedor, and Ayzenberg (2014) suggest that differentiated responses of the sympathetic nervous system (SNS) reflect the activity of different arousal systems. They also postulate that the differentiated SNS response patterns can be explained by differences in brain activity. Picard and colleagues entitle these ideas multiple arousal theory. Even though the ideas that Picard and colleagues express are interesting, they do not constitute a theory. A theory is characterized by specific definitions of the central concepts as well as testable and falsifiable predictions that extend preceding findings and theorizing (e.g., Bacharach, 1989; Cramer, 2013). Picard and colleagues' multiple arousal theory does not possess any of these qualities.

Multiple arousal theory lacks a specific conception or definition of its central concept, arousal. It remains unclear if multiple arousal theory defines arousal as subjective feeling state, general physiological activation, sympathetic activity, electrodermal activity, brain activity, or any combination of these elements. The case study of Chris that Picard and colleagues present suggests a conception of arousal as subjective feeling state. However, the discussion of the empirical findings tends more to an operational definition of arousal as physiological, sympathetic, or electrodermal activity. By suggesting that differentiated sympathetic response patterns can be explained by differences in regional brain activity, multiple arousal theory also offers a conception of arousal as brain activity.

The lack of an explicit definition of arousal constitutes a serious flaw of multiple arousal theory. Without such a definition it is impossible to provide crucial tests of the theory. It is not possible to decide whether a certain empirical observation provides evidence for the hypothesis that there are multiple arousal systems. Imagine a researcher who has observed that two different situations lead to differences in electrodermal activity at different body sites. Does this indicate the activity of two different arousal systems? Do these differences need to be accompanied by differences in subjective experience, differences in brain activity, or both? What if a researcher observes differences in brain activity and subjective experience but no difference in electrodermal activity? Does this provide sufficient evidence for multiple arousal systems? Does any kind of stimulation that activates a specific brain region and that leads to a change in electrodermal activity provide

evidence for a change in arousal? Without a clear definition of arousal, multiple arousal theory leaves it to the individual researcher to decide whether an empirical result provides evidence for multiple arousal systems or not. It does not provide the unifying interpretative framework that a good theory should provide.

Multiple arousal theory also lacks testable predictions. Picard and colleagues review empirical work that suggests that limbic activity elicits ipsilateral sympathetic activity whereas premotor cortex activity elicits contralateral sympathetic activity. However, instead of drawing on these findings to postulate specific arousal systems, Picard and colleagues declare that future work should establish the link between specific brain regions and sympathetic activity at specific body sites. Multiple arousal theory does not make any predictions regarding specific arousal systems, links between brain activity and sympathetic outflow, or the conditions that activate the arousal systems. Multiple arousal theory is thus a theory about multiple arousal systems that does not include any predictions regarding these systems. The sole prediction of multiple arousal theory is that there is more than one arousal system. In conjunction with the lack of a specific definition of arousal this prediction is hardly testable or falsifiable. It is also of note that, according to Picard and colleagues, preceding research has already provided evidence for multiple arousal systems. The central prediction of multiple arousal theory thus has already been tested and supported. Consequently, multiple arousal theory does not offer any new predictions that call for critical tests in future empirical research.

Picard and colleagues' warning that one may draw wrong conclusions regarding changes in arousal if one only examines electrodermal activity at one limb is warranted and helpful. The idea that there is more than one arousal system is also interesting and has great potential. However, Piccard and colleagues miss a great opportunity. Instead of developing their idea and offering a specific definition of arousal as well as proposing specific arousal systems, they only come up with the general hypothesis that there are multiple arousal systems that are linked to activity in different brain regions and differentiated sympathetic activity. To become a proper theory, multiple arousal theory needs to take the next step and provide a specific definition of arousal as well as a set of testable, specific predictions about the arousal systems. Without these elements multiple arousal

theory is of limited use for focussed, theory-driven research.

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