# The Life of a Model: Commentary on “How the LC4MP became the DHCCST”

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Abstract

The Limited Capacity Model of Motivated Mediated Message Processing (LC4MP) is a prominent model for investigating how human biological systems engage with and process messages. Dr. Lang's (this volume) chapter titled "How the LC4MP became the DHCCST: An epistemological fairy tale" provides an engaging overview of the foundation and development of the LC4MP. In addition, Lang discusses her motivation for abandoning the LC4MP in favor of the Dynamic Human Centered Communication Systems Theory (DHCCST) and suggests that a recently published review and update of the LC4MP misrepresents the model's assumptions and predictions. In this commentary, we briefly respond to Lang's arguments, highlighting the continued utility of the LC4MP for investigating human communication behavior.

*Keywords:* LC4MP, DHCCST, motivation

# The Life of a Model: Commentary on "How the LC4MP became the DHCCST"

Lang (this volume) presents an insightful and engaging overview of the birth and history of the Limited Capacity Model of Motivated Mediated Message Processing (Lang, 2000, 2006, 2009, 2017), highlighting a breadth of published and unpublished work that has played a role in the model's[1] development over the last several decades. In Lang's view, the LC4MP is a model beset by a burden of ambiguous or countervailing evidence for its core predictions and built upon assumptions that are largely untenable with dynamic systems theory. Accordingly, Lang advocates a departure from the LC4MP in favor of the Dynamic Human-Centered Communication Systems Theory (DHCCST; Lang, 2014), which is based on an entirely new set of assumptions and predictions grounded in dynamic systems theory (Kelso, 1995). We find ourselves in agreement with Lang on many of her arguments. Indeed, we admire and support her mission of innovation, taking chances, and pursuing unpopular ideas. That said, we disagree with Lang that our recent updates to the LC4MP (Fisher, Huskey, Keene, & Weber, 2018; Fisher, Keene, Huskey, & Weber, 2018) misrepresent the model's assumptions and predictions. In addition, we challenge the idea that the LC4MP should be discarded in favor of the DHCCST. Instead, we advocate for an update of the model's assumptions, for the refinement of its predictions, and for its co-existence with the DHCCST.

## Incorrect Interpretations?

In her chapter, Lang (p. x) writes that she "would caution readers against relying on the descriptions of the LC4MP contained in recently published articles about the future and past of the LC4MP . . . as they misstate many aspects of the most up to date model and draw incorrect global conclusions about what it predicts." We appreciate caution in systematic scientific debates, but Lang does not point out which aspects of the LC4MP have been misstated or where

exactly conclusions about its predictions are incorrect. It is true that the LC4MP has been revised over time, most notably with the incorporation of the motivational aspect of the model in the mid-2000's (Lang, 2006). We are certain, however, that our description of the assumptions and predictions of the LC4MP is consistent with Lang's latest version of the model (as it is described in Lang, 2017).

With that said, in our updated model, we have made a good faith effort to highlight ways in which the new model differs from Lang's latest extant version of the LC4MP, and we welcome any debate as to how we may better represent the core aspects of the model and its development over the last two decades. We completely agree with Lang's notion of "conditional truth" in science—the idea that in science all truth is preliminary and will change through evidence and informed debate. Our updates to the LC4MP describe what is conditionally true in the model, given the latest evidence from communication and a wide range of cognate fields.

## Outdated Assumptions?

Lang highlights several core components in the model in which she no longer believes: 1) the construct of cognitive resources and resource allocation, 2) the conceptualization of memory encoding as representational, and 3) the idea that humans are information processors. These assumptions are by no means unique to the LC4MP. Each of these assumptions has been successfully used to guide research in communication as well as a wide array of cognate fields. At the same time, however, auxiliary hypotheses (specific statements that enable a theory to be rendered testable; see e.g., Popper, 1985) associated with these assumptions have progressed markedly in the last three decades, driven by huge advancements in our understanding of how the brain enables human cognition and behavior. These updates have served to modernize the

"nomological network" (Cronbach & Meehl, 1955) surrounding the LC4MP's assumptions and render them tenable within the modern scientific milieu.

This updating process can be seen perhaps most clearly in the area of cognitive resources and resource allocation. Although the exact nature of cognitive resources is still a point of active investigation (for a review, see Shenhav et al., 2017), given current evidence it is clear that cognitive resource availability is related to spatial, temporal, and/or metabolic constraints on neural activation and connectivity (Buschman, Siegel, Roy, & Miller, 2011; Feng, Schwemmer, Gershman, & Cohen, 2014; Kurzban, Duckworth, Kable, & Myers, 2013; Marois & Ivanoff, 2005). In addition, it is clear that humans take resource availability into account when deciding whether or not to engage in a task (Kool & Botvinick, 2014; Kool, McGuire, Rosen, & Botvinick, 2010; Westbrook & Braver, 2015; Westbrook, Kester, & Braver, 2013), that humans' resource availability meaningfully influences cognitive processing performance and the neural substrates thereof (Finc et al., 2017; Kurzban, Duckworth, Kable, & Myers, 2013; Lavie, Hirst, de Fockert, & Viding, 2004; Sweller, 1988), and that resources are allocated to tasks based on motivational considerations (Botvinick & Braver, 2015; Huskey, Craighead, Miller, & Weber, 2018; Pessoa, 2009; Shenhav, Botvinick, & Cohen, 2013).

Space does not permit a thorough discussion of the representational nature of encoding in the brain, or of recent advancements in our understanding of the brain as a predictive information processor. Suffice it to say that in each of these areas, the assumptions of the LC4MP have been *strengthened* rather than weakened as research has progressed over the last several decades. Interested readers are encouraged to consult Binder, Desai, Graves, and Conant (2009), Haxby et al. (2011), and Henke (2010) for more in-depth treatments of memory and Feldman-Hall and Shenhav, (2019), Krakauer, Ghazanfar, Gomez-Marin, MacIver, and Poeppel (2017), and Zénon,

Solopchuk, and Pezzulo (2019) for a discussion of information processing. With these observations in mind, we call into question Lang's assertion that the assumptions of the LC4MP are untrue. Instead, we posit that these assumptions are quite well supported and that with small updates to their auxiliary hypotheses they are still quite useful for understanding human cognition and behavior.

## Problematic Predictions?

Lang claims that a proliferation of anomalous results in published and unpublished literature led her to believe that "something was rotten" in the core of the LC4MP. Although we cannot speak to the unpublished data mentioned in Lang's chapter, it is quite clear from the literature (see, e.g., Fisher, Keene et al., 2018; Huskey, Wilcox, Clayton, & Keene, 2019) that the LC4MP has overall been impressively accurate in its "risky predictions" (Meehl, 1990; Popper, 1985). Furthermore, many areas in which the predictions of the LC4MP have been shown to be incorrect are areas in which further knowledge has been acquired through iterative scientific progress.

A notable example of this process can be seen in recent work by Clayton and colleagues (2018) characterizing individual differences in the progression of the defensive cascade. Here, the LC4MP clearly contributes to scientific knowledge of how humans process fear-inducing, disgusting, or otherwise threatening messages, as well as knowledge of the motivated processing system in general. Thus, in the ways in which the model is wrong, it is wrong in the right ways—ways that serve as footholds to catalyze scientific progress rather than quell it. As such, a handful of ambiguous or anomalous findings does not necessitate the abandonment of the LC4MP. On the contrary, these findings allow for the model to be strengthened and refined, increasing its utility for scientific inquiry.

## Complexity in Communication

It is true that the human brain is a constellation of complex systems, and that human behavior is contingent upon interactions between the brain and the environment (which is itself an amalgamation of complex systems; Weber, Mathiak, & Sherry, 2008). In addition, it has been known from the earliest days of communication research that communication behavior is complex (Schramm, 1955; Shannon, 1948). As such, we are in full agreement with Lang that communication researchers stand to benefit markedly from an approach rooted in complex (dynamic) systems theory (Sanbonmatsu & Johnston, 2019; Sherry, 2014, 2015). In fact, our own theories draw heavily from a complex systems perspective (see, e.g., Weber & Fisher, this volume; Weber, Tamborini, Westcott-Baker, & Kantor, 2009).

It is, however, not the case—as Lang suggests—that re-thinking communication research from the perspective of complex systems theory requires abandoning linear, causal ways of thinking. Not all predictions in a model informed by complex systems theory need be of non-static, non-linear nature in order to observe and meaningfully interpret complexity within a system. In fact, systems can be thought of as a set of interacting subsystems and there is a surprising amount of linearity and simple cause-and-effect relationships at play at *some level* of any system (Strogatz, 2004, 2014). With this in mind, communication researchers should work to incorporate emerging methods for studying complex phenomena, such as computational and agent-based modelling (Madsen, Bailey, Carrella, & Koralus, 2019), network science (Barabási & Pósfai, 2016; Bassett & Gazzaniga, 2011; Newman, 2010), and "computational thinking" in general (Jolly & Chang, 2019), while retaining a focus on methods and models that can precisely characterize causes and effects within a system and its subsystems.

Furthermore, there is a trade-off between the intuitive generality of complex system theories and the precision required to make predictions that are useful for applied solutions to relevant problems (Sanbonmatsu & Johnston, 2019; Watts, 2017). Our communication theories should accomplish at least three goals: a) they should be inclusive of a wide range of phenomena, b) they should strive for explanatory and predictive power, and c) they should strive for practical utility in real-world communication scenarios (Chaffee & Berger, 1987). The LC4MP has proven quite laudable in its practical utility for designing messages in a wide variety of contexts, including persuasive messaging, news, video games, advertisements, and many more (Fisher, Keene et al., 2018). It has also shown itself to be quite amenable to consideration within complex systems-based theorizing (see, e.g., Fisher, Hopp, Lonergan, & Weber, in press). In fact, Lang notes that the DHCCST contains many elements of the LC4MP. As such, we assert that the LC4MP need not be discarded to make way for a complex systems approach—rather, the refined LC4MP and the DHCCST can co-exist

## Belief vs. Evidence

Finally, and perhaps most pressingly, we reject the notion that a scientific model should be supported or discarded based on anything but empirical evidence for or against its predictions. In her chapter, Lang states that she advocates for discarding the LC4MP in favor of the DHCCST in large part because she does not "believe" in its core concepts anymore. The incremental progress of scientific inquiry, however, has little to do with belief (Kuhn, 2012; Meehl, 1978; Popper, 1985). Cumulative scientific progress is contingent upon the idea that models are appraised, amended, or abandoned in a rigorous, systematic fashion, wherein precise predictions are tested in order to gather evidence for or against the model (see, e.g., Meehl, 1990). In our updated version of the LC4MP (Fisher, Huskey et al., 2018), we outline a clear set

of falsifiable predictions that remain faithful to the core of the LC4MP (see, e.g., Lang, 2000, 2006, 2009, 2017), while providing grounds for systematically determining whether or not the model should be abandoned.

If the LC4MP is to be relegated to the dustbin of history, we argue that this should be done based on a process of rigorous falsification of its predictions. Given these standards, and our assertions outlined herein, the evidence does not warrant abandoning the LC4MP. We applaud Dr. Lang on her development of the DHCCST, and we hope that it proves to be a useful theoretical framework for the investigation of complex communication behavior. In large part, the business of science is the creation and testing of "risky predictions" (Popper, 1985), and we believe that Lang's journey as outlined in her chapter is in many ways one to be emulated. We hope that our brief response sparks an engaged, good-natured, and constructive debate on the continuing value of the LC4MP for communication scholarship.

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## Endnote

[1] In the chapter referenced herein, Lang refers to the LC4MP as a "theory" whereas in other works it is referred to as a "model." Although the LC4MP undeniably has characteristics of a theory (demarcated assumptions, description of scope, etc.), in order to maintain consistency with the larger body of LC4MP literature, it will herein be referred to as a model.