Commentary

Combine and Conquer: A Paean to Methodological Pluralism

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In a recent blogpost (Weber, 2017) I reflected on an earlier paper entitled "Combine and Conquer," where I argued that two analytic approaches typically used in isolation could and should be used in combination to better understand people's interpretation of the concept of risk (Weber, 1984). More generally, I have been advocating for collaboration between disciplines for a long time, be they the physical, biological, and social sciences who can better address global environmental challenges while acknowledging and complementing their respective contributions, or psychology and economics whose respective descriptive versus normative frameworks of studying choice are both essential inputs to effective prescriptions for better decision making. My blogpost argued against creating false dichotomies between cognitive and social psychological contributions to decision making, which are rarely mutually exclusive.

My task today is a positive one, namely to comment and reflect on Art Markman's (2018) target article which applies the combine-and-conquer approach to laboratory and naturalistic decision-making research, showing the complementary strengths and contributions of the two research traditions.

Markman (2018) focuses on the internal validity provided by laboratory studies, with interventions and controls that allow for testing of causal relationships, and the external validity provided by naturalistic decision-making studies that follow expert decision makers in real world settings. Another major distinction he raises may deserve equal emphasis as it is of great theoretical and practical importance and yet vastly under-investigated in traditional decision research, namely the question of how people generate choice or action alternatives. The two research traditions address different parts of the large complex of decision processes. Naturalistic decision making looks at the identification and natural emergence of different choice options over time, whereas behavioral or normative decision research and its laboratory approach look at option evaluation and associated selection processes, taking the provision of a set of choice options as a given. In this sense, naturalistic decision making is a broader enterprise and closer to problem-solving research, and traditional decision research ought to perhaps adopt that page from its playbook.

The two research traditions differ not only in their treatment of pre-choice evaluation processes (with *naturalistic decision making* examining the generation of action alternatives, whereas most traditional decision research does not), but also in their treatment of post-decision processes and variables, in particular updating processes about the value of choice options and confidence in the decision just made and possible post-decision regret. While updating of option evaluation implicitly exists in the naturalistic decision making framework, these processes are not well specified or systematically explored in that tradition. A subset of researchers in the laboratory-based decision research tradition, on the other hand, examine the consequences of choice evaluation on post-choice consequences such as confidence (e.g., Weber, Böckenholt, Hilton, & Wallace, 2000) or rumination and regret (e.g., Krosch, Figner, & Weber, 2012). There also has been an important qualitative shift in the nature of formal models of updating (i.e., learning from the outcome of a decision) from the model-free reinforcement learning models of the 1960s to a range of model-based learning theories that incorporate the insights of the cognitive revolution (e.g., Camerer & Ho, 1999; Dayan & Berridge, 2014) and thus provide a better match to the psychological framework of naturalistic decision making with its emphasis on the mental representation of the situation by decision makers.

In both of these ways, traditional laboratory-based decision research (at least in its conjunction of different decision processes explored) can thus be said to be a broader framework than naturalistic decision making. It could also be argued that

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it is a deeper framework, in that its controlled and increasingly computer-based laboratory environment provides the capacity and tools to examine a wider set of choice evaluation processes, from information-acquisition and response-time processes (e.g., Reeck, Wall, & Johnson, 2017) to brain-activation and electrophysiological responses (Gold & Shadlen, 2007), processes that provide convergent validity on hypothesized theories and an increased ability to test between them.

In his review Markman (2018) harks back to David Marr's (1982) differentiation between cognitive theorizing at the computational, algorithmic, and implementation level. Economics and much of behavioral decision research operates at the computational level, describing input–output relationships between choice options, decision context, and resulting choices, while leaving the black box of mediating psychological processes intentionally unopened. Some of these theories (expected utility) have normative status, others (prospect theory) are meant to describe observed choice patterns. More recently, however, some researchers in this largely laboratory-based tradition have started to trace observed input–output regularities back to processes at the algorithmic level (i.e., the psychological processes and knowledge structures that give rise to the documented functional relationships). While not aspiring to the level of complexity of the integrative frameworks discussed by Markman (ACT; Anderson, 1983, or SOAR; Newell, 1990), psychological process-level theories such as decision field theory (Busemeyer & Townsend, 1993), decision by sampling (Stewart, Chater, & Brown, 2006) or query theory (Johnson, Haeubl, & Keinan, 2007; Weber et al., 2007), consider and integrate basic perceptual, attentional, memory, and aggregation processes in an effort to ground judgment and choice theories in psychology and what Markman refers to as the "right taxonomy of mental systems."

Oppenheimer and Kelso (2015) review those and similar efforts and draw on another important philosophy of science contribution, Kuhn's (1962) seminal discussion of paradigm shifts, arguing that it is only such algorithmic-level cognitive-process theorizing as a new paradigm that can replace old-paradigm computational models like expected-utility theory. I would argue that the value of these laboratory-based algorithmic theory developments is less in their ability to replace computational models than in showing their psychological process-level implementations, with the added benefit that a causal process model provides valid entry points for interventions that functional computational models cannot or should not provide. In that sense, algorithmic query theory (Johnson et al., 2007; Weber et al., 2007), for example, does not make any predictions about risky choice that would differ from the predictions of computational prospect theory (Tversky & Kahneman, 1992). Instead, query theory suggests multiple ways of influencing people's decisions that directly derive from its hypothesized attentional and memory processes that are not apparent from the functional relationships of prospect theory. In addition, by virtue of focusing on psychological processes rather than specific types of choice inputs, query theory makes predictions not just for risky decisions but also for intertemporal choice and a range of other judgment and choice tasks. It has been said that imitation may be the sincerest form of complimenting someone or something. If so, psychologists pursuing psychological process models appear to be on the right track, as their efforts are being copied in increasing numbers by economists who are incorporating assumptions about memory and attention (Bordalo, Gennaioli, & Shleifer, 2017) or rational inattention (Sims, 2010) into their choice models.

One area of research capable of integrating across the two research traditions contrasted by Markman (2018) is research on the qualitatively different modes of decision making that tend to operate in parallel and to different degrees in most decisions. These decision modes have been categorized in different ways, with a prominent approach putting them into two buckets, System 1 versus System 2 (Evans & Stanovich, 2013) or thinking fast versus thinking slow (Kahneman, 2011). My own research has discriminated between decision modes on the basis of the psychological processes being brought to bear on the decision, distinguishing between three modes: calculation-based, affect-based, and rule- and role-based processes (Weber & Lindemann, 2007). Calculation-based processing refers to the analytic evaluation and integration of features of choice alternatives, whether done in a normative way or using psychological short cuts. In either form, this is a "slow," more conscious, and more deliberate form of arriving at a decision. Affect-based decisions do not rely on the head, but on the heart or gut, with positive feelings elicited by a choice alternative resulting in approach and negative feelings resulting in fight-or-flight responses. These are "fast" and essentially automatic evaluative responses to choice options. Finally, rule-based decisions get triggered in an if–then fashion by features of the choice situation including context (e.g., "if this is a risky financial decisions, I choose the safest option"). The chosen course of action, prescribed by the rule, is often learned from experience (e.g., by being burned by riskier choices) and becomes an automatic response that is triggered by the context. This process is very similar to the recognition-primed decision processes hypothesized in the naturalistic decision making framework. These rule-based responses are often associated with the decision maker's social identity. For doctors, the Hippocratic oath prescribes that medical assistance needs to be rendered when it is required, regardless of how inconvenient or aversive such action may be. Standard operating procedures are a different example of professional response rules and the Ten Commandments an example of moral rules of conduct. Rule-based responses are often designed to override individually superior but group-level inferior choices that are part and parcel of collective action challenges. With sufficient practice or acculturation, the elicitation of the rule in an appropriate context becomes automatic as does its execution, also qualifying it for a "fast" response. Culture determines the rules of an appropriate response to a given decision and the norms about the appropriateness of using calculation- versus affect- versus rule-based decision processes in a given choice setting. Different cultures encourage risk taking in different domains as a function of their degree of individualism versus collectivism (Weber, Hsee, & Sokolowska, 1998). And while American society and American novels suggest that romantic and marriage decisions ought to be made by affect-based processes, such prescription