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# Issues in Self-Regulation Theory and Research

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Three general problems in self-regulation theory and research are discussed in terms of their application to the model of biofunctional cognition. The three problems are: (1) the development of a tractable conceptual foundation and consistent nomenclature for discussing self-regulation, (2) clarification of the structures or components of self-regulation, and (3) clarification of the processes of self-regulation. These issues are discussed in terms of how they apply to the model of dynamic self-regulation as represented in the articles for this special issue. It is suggested that the model of dynamic self-regulation, as well as all models of self-regulation, can be improved by serious theoretical and empirical attention to these issues.

The articles on brain, knowledge, and self-regulation for this special issue represent an intersection of current issues in educational psychology regarding the role of knowledge and self-regulation in learning as well as the relation between psychological models of learning and behavior and models focused on the physiological aspects of brain functioning. As a researcher in the area of self-regulated learning, I have been asked to comment on the articles in this special issue in terms of the issues they raise for self-regulation theory and research. Accordingly, although issues of knowledge and brain processes are interesting, I will limit my response to issues in self-regulation.

The area of self-regulation in general, and self-regulated learning in education specifically, is a very popular research topic currently. For example, there is a new *Handbook of Self-Regulation* (Boekaerts, Pintrich, and Zeidner, 2000a) which examines how different theories and models of self-regulation are being used in many different areas of psychology including social, personality, developmental, organizational, clinical, educational, and health. Of

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course, given all these different fields of inquiry, the use of self-regulation models and constructs is quite diverse and there are few commonalities among the different models. As Zeidner, Boekaerts, and Pintrich (2000) have pointed out, there are many theoretical, conceptual, and empirical issues left to be resolved in the area of self-regulation theory and research. The current articles in this special issue raise some of the same issues regarding the use of self-regulation constructs and models. I will comment on three general issues that are generated by the articles here.

First, as Zeidner et al. (2000) note, a key issue for research on self-regulation is the development of a tractable conceptual foundation and consistent terminology of self-regulation constructs. There are many extant models of self-regulation and these varied models often use different terms for similar components and processes and similar terms for different components and processes (see Boekaerts et al., 2000a, for numerous examples). Of course, it makes scientific progress very difficult if researchers in the area can't agree on the conceptual foundations and nomenclature of the constructs. There is a clear need for theoretical and empirical work to clarify these issues. Of course, there may never be "one" model or theory, but it seems crucial that we have agreement on the basic components and processes.

In the set of articles in this special issue, the model of biofunctional cognition suggests that there are two systems of self-regulation, one labeled active self-regulation and the other one labeled dynamic self-regulation. Active self-regulation is the more normative process of self-regulation that is conscious, intentional, effortful, and involves the regulation of attentional resources, cognitive and metacognitive strategies, and presumably motivational, volitional, and behavioral resources as well. This process, although not specified in much detail here, is similar to many social cognitive models of self-regulation (see Boekaerts et al., 2000b). In contrast, the process of dynamic self-regulation as proposed in these special issue articles is not conscious, occurs outside the spotlight focus of active attention, operates spontaneously and flexibly across many domains simultaneously, involves tacit and implicit knowledge as well as intuitive self-awareness, and is closely tied to brain functioning and the interaction of brain systems and subsystems.

Although neither of these self-regulation processes is specified in much detail here, it seems clear that dynamic self-regulation processes are being proposed as one way to describe knowledge and skill acquisition, learning, and actual performance that occur without active, conscious self-regulation. For example, as the articles in this issue point out, individuals may learn vocabulary in a second language without active self-regulation or drive a car on different road conditions without much conscious and effortful self-regulation. Moreover, the model of biofunctional cognition suggests that the dynamic processes of self-regulation are not completely isomorphic with automaticity as traditionally defined in information processing and cognitive models of memory and learning. This proposal is certainly a useful one as it seems likely that there are many types of activities and learning processes that are not actively self-regulated or that are automatized after concerted practice. In fact, a common criticism of social cognitive models of self-regulation is that they often describe a very elaborate process of goal-setting, monitoring, evaluating, and making decisions that just seems too cognitive and metacognitive for many daily activities. In some ways, these cognitive and metacognitive decision making models may be open to the old behaviorist criticism of Tolman's rats that were "lost in thought" and could not perform. In this sense, a second type of dynamic regulatory system may be a useful complementary system to the active model of self-regulation in order to cover many activities that are not so consciously, intentionally controlled and regulated.

On the other hand, it is not clear to me how much the dynamic system in the biofunctional cognitive model is similar to the cybernetic systems approach that has been used in organizational psychology to describe how different levels within a system communicate with one another (see Vancouver, 2000, for a review). Common adaptations of this general approach include perceptual control theory (Powers, 1978) as well as Carver and Scheier's (1998) model of self-regulation. In the cybernetic systems approach there are multiple levels (or subsystems) in the larger system that communicate with one another through the various input, output, and comparator functions in the system. These cybernetic models have been outlined in some detail, have empirical support, and seem to be very dynamic models that accomplish many of the same functions as the dynamic biofunctional cognition approach. The cybernetic models seem to allow for both more deliberate active self-regulation as well as relatively automatic and less effortful self-regulation. Moreover, they attempt to specify the processes by which the different subsystems or levels within the system communicate with one another. However, there is little apparent overlap in the terminology used or constructs in the dynamic model proposed here and these cybernetic models. Accordingly, the problem of a lack of a common nomenclature and conceptual foundation is demonstrated again when comparing the dynamic biofunctional model to other extant models of self-regulation.

A second general issue, related to the first issue of a lack of common terminology and conceptual framework, is the clarification and specification of the structures and components of self-regulation (Zeidner et al., 2000). Or, in other words, what is being regulated in the model? Although the articles in this special issue do not represent a formal explication of all the components involved in dynamic regulation, there is discussion of what structures or components are involved in dynamic regulation. For example, in the article by Iran-Nejad (2000, this issue) on "Knowledge, Self-Regulation, and the Brain–Mind Cycle of Reflection," there are various components described. The two components of intuitive self-awareness are thematic knowledge (TK) and categorical knowledge (CK), and thematic knowledge is further divided into themes and wholethemes, and wholethemes can include direct and indirect representations.

Besides the fact that many of these terms do not map directly onto more common, but seemingly similar, terms used in other models of cognition and self-regulation (again, the first problem of lack of a common terminology occurs), it is also not really clear to me how they operate to promote self-regulation. In this sense, the structure of what is being operated on or regulated is not defined very well. First, in terms of the structures or components of self-regulation, it seems that knowledge, whether called declarative and procedural knowledge in more common terms, or thematic and categorical knowledge in the biofunctional model, is one structure that is being regulated. This is an important issue because many models of self-regulation focus more on general processes and do not consider very seriously the role of prior conceptual knowledge. There is a clear need to integrate knowledge-driven models regarding expertise and performance with more process-oriented models of self-regulation and self-regulated learning (Pintrich, 2000). Accordingly, the biofunctional model is a good attempt to integrate knowledge and self-regulation components. However, there should be more overlap in the terminology used so that comparisons and synthesis across models can be more readily accomplished.

In addition, knowledge is not the only component that can be regulated. Most models of self-regulation suggest that cognition, motivation, affect, volition, as well as actual behavior can be regulated to varying degrees by an individual (Pintrich, 2000). It is not clear to me whether the model of biofunctional cognition is a general model of regulation that can be applied to all components of cognition, knowledge being one aspect of cognition, as well as various motivational, affective, volitional, and behavioral components in line with a general cybernetic approach. Or, is it mainly designed to describe how knowledge, behavior, and actual brain systems are regulated? This type of clarification and more detailed specification needs to be worked out in future versions of the model of biofunctional cognition.

Moving beyond the issue of clarifying the structure of what is being regulated, the third general issue concerns the need for better specification of the processes of regulation (Zeidner et al., 2000). Or, in other words, how does self-regulation take place? There are many different processes mentioned in the special issue articles including ongoing brain activity (OBA), momentary constellation firing (MCF), as well as propositional and dispositional comprehension, wholetheme reorganization of knowledge, and biofunctional automaticity or a series of self-guided insights. Although these processes are described and examples given, it is still not really clear to me how regulation really works in the dynamic model of biofunctional cognition. It seems to be implied that regulation is constantly ongoing, but there still should be some ways in which different systems or subsystems are started up or activated and also some processes for stopping the system or subsystem activities. It is not clear to me, but in many of the examples (reading a story, learning new vocabulary, driving a car), it seems that contextual features of the external environment activate or stop the biofunctional system, but the general model suggests that many internal cues can also be part of the self-regulatory system. However, the relations between these external and internal cues is never really set forth.

One of the main difficulties in specifying the processes involved in the biofunctional model of dynamic self-regulation is the seeming lack of a goal-setting or standard specification process. One of the main commonalities of almost all models of self-regulation is the fact that some goal-related construct is used in the model (Boekaerts et al., 2000b; Zeidner et al., 2000). This goal then represents a criterion by which progress is monitored and assessed and then efforts to regulate are guided by feedback on progress toward or away from the goal. This is true of models that propose a more active and conscious process of self-regulation, as in many social cognitive and decision making models of self-regulation and self-regulated learning. It is also true in more cybernetic models that propose some goal, standard, or criterion by which a comparator function makes comparisons to, as in the operation of a simple thermostat (which obviously requires no conscious being), as well as in the self-regulation effort of a conscious human being. Essentially, the goal or standard provides not only guidance for regulation efforts, it also provides a "stopping" rule for when regulatory behaviors can be completed and allows the individual to move onto another task.

However, in the biofunctional cognition model it is not apparent to me what the goal or standard is, or where it comes from, or how it is generated from the person interacting with the context, or how different systems or subsystems set goals or standards. At some level, the biofunctional model may rest on a general assumption that the systems or subsystems are always working toward maintaining equilibrium or avoiding disequilibrium. This would provide the stopping rule, that is, when the system reaches equilibrium, then efforts to regulate are completed and the system is not activated again until there is some new perturbation in the system. This may be useful in models that attempt to describe regulation based on the operation of brain and physiological functions. And it is certainly a time-honored assumption that has served cognitive developmental models (e.g., Piagetian theory) and social psychological models of dissonance reduction well, but it seems rather vague at this point in the development of our models of self-regulation.

Moreover, as Zimmerman (2000) has pointed out, the difficulty with discrepancy reduction as a principle in cybernetic closed-loop systems is that it does not allow for the fact that individuals sometime attempt to create discrepancies in order to develop their skills or adapt their behavior. Students often choose to try harder tasks in order to learn more. Athletes often choose to compete against stronger players by changing their league or moving up in the rankings of players. Individuals move to new jobs that provide a challenge in order to learn new skills. In this case, open-loop systems that allow for the active, intentional production of disequilibrium or discrepancies through the setting of higher goals or standards seem to reflect an important aspect of active self-regulation in humans. It is not clear to me how the model of biofunctional cognition deals with goals, standards, or active, intentional attempts to produce discrepancies between behavior and goals or standards.

In summary, the three general problems of developing a consistent framework and terminology for self-regulation, specifying the structure or components of self-regulation, and clarifying the processes of self-regulation, are common to all models of self-regulation, not just the biofunctional cognition model (Boekaerts et al., 2000b; Zeidner et al., 2000). Nevertheless, the biofunctional cognition model would benefit from serious consideration of these problems in the refinement of the theoretical propositions of the model as well as the empirical support for the model. As we all attempt to develop better models of self-regulation that are theoretically generative, empirically supported, and also useful in practice, these three problems can serve as good goals or standards to strive for in our own research. As we attempt to approach these goals, they can serve as useful guides to monitor and regulate our own scientific work on self-regulation and hopefully lead us to more productive and fruitful exchanges as well as to a better understanding of how individuals self-regulate and learn in different contexts.

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