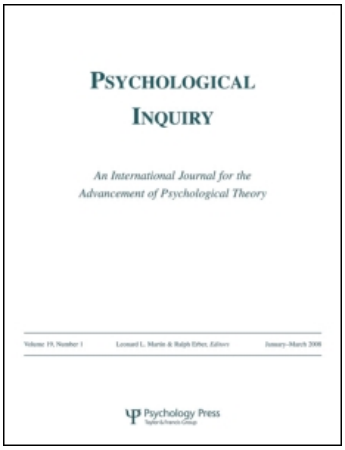

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COMMENTARIES

Toward a Theory of the Big Five

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I first interacted with Jack Block when he wrote to me to point out the parallels between a theory my colleagues and I have been developing (DeYoung, 2006; DeYoung, Peterson, & Higgins, 2002; Hirsh, DeYoung, & Peterson, 2009) and a theory he first developed many years ago (J. Block, 2002; J. Block & Block, 1951; J. H. Block & Block, 1980). I am glad to have had the recent opportunity to correspond with him and very sorry that our correspondence has now ended. In his target article, Block wrote little about his own theory. However, by exploring the parallels between our constructs of Stability and Plasticity and his constructs of ego-control and ego-resiliency, I hope to suggest an approach to the Big Five themselves that might produce a theory Block could have appreciated. (Throughout, I use "Big Five" as synonymous with Block's phrase "five factor approach.") One of Block's primary criticisms of the Big Five model was that it has been largely atheoretical, so any theory of the Big Five might represent a step forward (e.g., McCrae & Costa, 2008; Nettle, 2006; Van Egeren, 2009). However, a theory of personality that would have satisfied Block must have certain qualities, which he outlined explicitly in relation to his own theory (J. Block, 2002). In essence, my project in this commentary is to rescue the Big Five from Block's critique using principles he espoused.

Two Theories of Personality

I think it is fair to say that Block considered the most important aspect of his theory to be its specification of personality as an adaptive system. In such a system, the constructs represent integrated, interacting psychological mechanisms that cause the ongoing flux of behavior and experience; and the adaptive function of the system as a whole is to allow the organism to survive and fulfill its needs. In this context, personality traits can be understood as parameters of the adaptive system that vary from person to person. In other words, the mechanisms that constitute the system are present in every person, but their manner of functioning varies. The benefit of such a theory is that it offers a causal explanation of the phenotypic regularities that constitute personality, rather than merely describing them.

Block's theory focused on two traits, ego-control and ego-resiliency, that reflect variability in central mechanisms within the adaptive system of personality. Block (2002) described personality as "an affect processing system," with its main task being to avoid anxiety by successfully constraining and channeling impulses or drives emerging from within and successfully comprehending the environment perceived without. Ego-control reflects the modal level of the individual's tendency to control impulses, with high levels of ego-control producing the tendency to delay gratification and restrain impulses, even when this level of restraint is unnecessary, and low levels of ego-control producing the tendency to seek immediate gratification and express impulses freely, even when inappropriate or counterproductive. Ego-resiliency reflects the individual's ability to modify his or her current state-level of ego-control, in response to the demands of the situation. Those high in ego-resiliency display "resourceful adaptation to changing circumstances and environmental contingencies" (J. H. Block & Block, 1980, p. 48), whereas those low in ego-resiliency are rigid under conditions of stress or challenge and tend to perseverate with maladaptive strategies, regardless of whether these are under- or overcontrolled strategies.

Prior to encountering our theory of Stability and Plasticity, Block (2001, 2002) had already noted the parallels between his constructs of ego-control and ego-resiliency and the content of the two higher order factors, or "metatraits," of the Big Five discovered by Digman (1997). (Digman circumvented one of Block's criticisms of the Big Five simply by refusing to assume that they should be orthogonal.) Our interpretation of these high-order factors (DeYoung et al., 2002) brought the parallels into sharper focus by positing a theory of the metatraits as parameters of an adaptive system. Inspired by Block's example, in what follows

I delineate a theoretical perspective on the psychological mechanisms of that system more explicitly than in our previous publications on the topic.

Whereas Block emphasized affect as the fundamental driver of the personality system, my colleagues and I view personality, first and foremost, as a goal-directed or cybernetic system (Peterson, 1999; Peterson & Flanders, 2002; cf. Carver & Scheier, 1998; Van Egeren, 2009). We would argue that affect is primarily in the service of goals and that affect can be overridden for the sake of goals. Personality, as a cybernetic system, comprises (a) a set of goals, defined broadly as both conscious and unconscious representations of a desired future state; (b) a set of evaluative interpretations (again both conscious and unconscious) of the present state, framed in relation to those goals; and (c) a set of strategies, plans, and automatized routines used to transform the present state into the desired future state.

This description is a simplification for many reasons, of which I note three. First, goals are organized hierarchically, as broad goals must be achieved through the accomplishment of many subgoals (Carver & Scheier, 1998). Strategies and plans are thus equivalent to nested sequences of goals. Second, the existence of subgoals highlights the fact that goals exist on many different time scales. Those on shorter time scales (e.g., finding an article on some topic) come and go frequently, whereas those on longer time scales (e.g., achieving tenure) certainly can change but do so less frequently. Third, the goal hierarchy is not completely unified, meaning there is not just one overarching goal, of which all the others are subgoals. Goals may be (and often are) in competition with one another, such that strategies one might use to pursue one goal may make it more difficult to pursue others. Thus, human functioning hinges on multiple constraint satisfaction, often leading to compromise, and the desired future state, as a whole, is often specified somewhat vaguely.

As a parameter of this system, the metatrait Stability (defined operationally as the shared variance of Conscientiousness, Agreeableness, and low Neuroticism) appears to reflect the ability and tendency of the individual to avoid disruption, by impulses, of ongoing goal-directed functioning. Stability can be described as the degree to which the cybernetic system resists replacing its operative goal with narrower, immediate goals (like expressing anger or pursuing a distraction) that could interfere with longer-term goals. The metatrait Plasticity (the shared variance of Extraversion and Openness/Intellect) appears to reflect an exploratory tendency, whereby the individual is actively engaged with the possibilities of the environment, both generating and attending to novel aspects of experience. (In plastic exploration, novelty is pursued for its positive—i.e., rewarding—possibilities. This is distinct from the kind of exploration, triggered by threat, that consists of vigilance and rumination designed to scan for further threat; Gray & McNaughton, 2000.) Plasticity can be described as the degree to which the personality system is prone to generating new goals, new interpretations of the present state, and new strategies to pursue existing goals, even when this generation is not required by threat to an existing goal. We posit that Stability and Plasticity reflect between-person variation in the mechanisms that fulfill two basic needs of any cybernetic system existing in an environment that is not fully predictable: first, to be able to maintain the stability of its own functioning so that goals may be accomplished, and second, to be able to adapt plastically to complex, changing, and unpredictable circumstances, thereby increasing its effectiveness in accomplishing goals.

Comparing Stability and Plasticity to Ego-Control and Ego-Resiliency

The parallels between Stability and Plasticity and ego-control and ego-resiliency should by now be obvious. Both theories associate one major trait with restraint of impulses and the other with flexible adaptation. Although in the target article Block emphasizes possible links between Stability and Plasticity and the Piagetian constructs of assimilation and accommodation, in our correspondence we discussed the similarities of Stability to ego-control and Plasticity to ego-resiliency. Although similarity is obvious, its extent remains in question. There are at least three ways in which one might probe the similarity of Stability and Plasticity to ego-control and ego-resiliency. First, one can consider their definition in theory. Here, despite differences in the way mechanisms of the personality system are described, the two theories are remarkably similar in terms of the functions ascribed to each trait (as illustrated previously).

Second, one might examine their operationalization in questionnaires. This is made difficult by the fact that, although questionnaire measures of ego-control and ego-resiliency exist (Letzring, Block, & Funder, 2004), we have always operationalized Stability and Plasticity through latent-variable modeling of Big Five scales. I have therefore taken this opportunity to identify the strongest markers for Stability and Plasticity in the International Personality Item Pool (Goldberg, 1999), using a method described by Hirsh et al. (2009). This involved calculating composite Stability and Plasticity scores based on self- and peer ratings using the Big Five Inventory (John, Naumann, & Soto, 2008), in a largely middle-aged sample of 600 people (347 female) rated by at least two peers (a subset of the Eugene-Springfield community sample; Goldberg, 1999). These scores were then correlated with more than 2,500 International Personality Item Pool items, and the correlations were rank ordered to identify the

Table 1. *Strongest International Personality Item Pool Correlates of Stability and Plasticity*

Stability	Plasticity
1. Get out of control. (–.35)	1. Have a strong personality. (.55)
2. Find myself in the same kinds of trouble, time after time. (–.35)	2. Have little to say. (–.47)
3. Am self–destructive. (–.34)	3. Have a natural talent for influencing people. (.46)
4. Talk even when I know I shouldn't. (–.34)	4. When with a group, have difficulties selecting a good topic to talk about. (–.45)
5. Grumble about things. (–.33)	5. Express myself easily. (.45)
6. Feel desperate. (–.32)	6. Am able to come up with new and different ideas. (.44)
7. Shoot my mouth off. (–.32)	7. Have a colorful and dramatic way of talking about things. (.44)
8. Find life difficult. (–.31)	8. Am skilled in handling social situations. (.44)
9. Am not sure where my life is going. (–.30)	9. Know how to captivate people. (.44)
10. Feel that others misunderstand me. (–.30)	10. Can say things beautifully. (.43)
11. Feel that people are against me. (–.30)	11. Have leadership abilities. (.43)
12. Have a dark outlook on the future. (–.30)	12. Have difficulty expressing my feelings. (–.43)
13. Think that my moods don't change more than most people's do. (.30)	13. Don't mind being the center of attention. (.43)
14. Behave in unusual and strange ways. (–.29)	14. Carry the conversation to a higher level. (.43)
15. Often express doubts. (–.29)	15. Am an original thinker. (.42)
16. Try to follow the rules. (.29)	16. Engage in discussions. (.42)
17. Feel that my life lacks direction. (–.29)	17. Would describe my experiences as somewhat dull. (–.41)
18. Act or feel in a way that does not fit me. (–.29)	18. Am good at making impromptu speeches. (.41)
19. Habitually blow my chances. (–.29)	19. Look forward to the opportunity to learn and grow. (.38)
20. Feel that people have a hard time understanding me. (–.28)	20. Am interested in many things. (.37)

Note. Correlations are in parentheses.

strongest correlations in absolute value. Finally, items were excluded if their association with the metatraits could be better explained purely by their association with a single Big Five trait (or two, for Stability), as determined by structural equation modeling.

The 20 strongest markers of Stability and Plasticity (avoiding redundant items) are listed in Table 1. Low Stability is characterized by items reflecting (a) a tendency to succumb to disruptive and counterproductive impulses, (b) a general incoherence or incomprehensibility of behavior, and (c) the lack of a clearly conceived future state. This is strongly consistent with the notion that what is stable or unstable at this level of personality description is the goal-directed functioning of the individual. Plasticity is characterized by innovation and curiosity and by leadership, skill, and expressivity in social situations, which is consistent with its hypothesized function of exploration and engagement with novel possibilities in complex and unpredictable environments. A number of the Plasticity items suggest a likely flaw in Block's (this issue) equation of Plasticity with accommodation. Certainly, one can explore through accommodation (altering one's way of thinking or acting), but one can also explore through assimilation (attempting to apply one's existing strategies in a new context). People high in Plasticity seem likely to be as prone to the latter as the former.

In terms of face validity, there are some strong matches between these items and those in Block's ego-resiliency and ego-control scales (Letzring et al., 2004) but also some poorer matches. For example, the ego-control item, "My way of doing things can be misunderstood or bother others," is very close to the Stability item, "Feel that others misunderstand me," and the ego-resiliency item, "I would be willing to describe myself as a pretty 'strong' personality" is almost identical to the Plasticity item, "Have a strong personality." However, the ego-control item, "In a group of people, I would not be embarrassed to be called on to start a discussion or give an opinion about something I know well," would seem more at home among the Plasticity items, and the ego-resiliency item, "I get over my anger at someone reasonably quickly," seems more like a Stability item. The 40 Stability and Plasticity items in Table 1, or the latent variable approach, could be used in future research to estimate empirically the strength of association between Stability and Plasticity and ego-control and ego-resiliency (though our 40 items should be validated in other, demographically different populations before they can be assumed to generalize).

The third approach one can take to assessing the similarity between these pairs of traits is to examine how each pair has been associated conceptually and empirically with other constructs. The evidence from this approach is consistent with the blending of Stability and Plasticity that seemed apparent in the ego-control and ego-resiliency questionnaires. When Block reviewed the constructs he considered conceptually related to ego-control and ego-resiliency (e.g., J. Block & Block, 2006; J. H. Block & Block, 1980), and when others have reported associations of ego-control and ego-resiliency with various traits (Robins, John, &

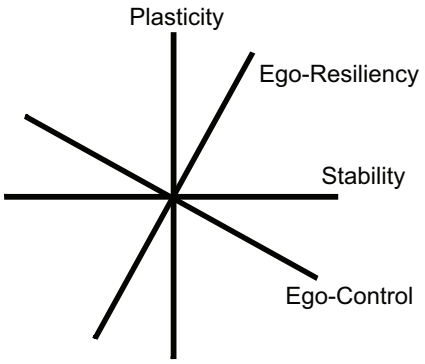

Figure 1. Hypothesized approximate relations between Stability and Plasticity and ego-control and ego-resiliency.

Caspi, 1994), it has appeared that Block's constructs may be rotated in relation to Stability and Plasticity (as represented schematically in Figure 1). Ego-control appears to reflect primarily high Stability but also, to a lesser degree, low Plasticity, whereas ego-resiliency appears to reflect primarily high Plasticity but also, to a lesser degree, high Stability. This pattern would be consistent with our findings that conformity with societal norms (associated with overcontrol) is associated positively with Stability but also negatively with Plasticity (DeYoung et al., 2002) and that externalizing behavior (associated with undercontrol) is associated negatively with Stability but also positively with Plasticity (DeYoung, Peterson, Séguin, Pihl, & Tremblay, 2008).

Ultimately, the purpose of this comparison of theories is not to determine the exact degree of similarity of Stability and Plasticity to ego-control and ego-resiliency. The theories are distinct enough in their descriptions of personality as an adaptive system that neither is fully reducible to the other. Rather, my purposes in considering the parallels between our theory and Block's were two: first, to draw insights from Block's theorizing that might enrich our understanding of Stability and Plasticity, and second, to illustrate the kind of theory that needs to be developed for the Big Five.

In relation to both purposes, Block's emphasis on understanding traits as between-person variation in integrated, interacting mechanisms is paramount. Recall that Block conceived of ego-control and ego-resiliency as intimately linked mechanistically, in that ego-resiliency reflects variation in the ability to modulate ego-control in response to situational demand. Although the modal level of a trait is not necessarily related to the ability to modulate that level, high levels of ego-resiliency are likely to prevent the individual from maintaining an extremely high or low modal level of ego-control (J. H. Block & Block, 1980). This hypothesis is supported by observations of an inverted U-shaped association of ego-control with ego-resiliency (Asendorpf, Borkenau, Ostendorf, & van Aken, 2001). (The existence of this nonlinear relation highlights the degree to which Figure 1 can be only a crude schematic, as it depicts the possible association of all four traits linearly.)

The complex causal relation between ego-resiliency and ego-control might provide an interesting analogy for Stability and Plasticity. We do not believe that the mechanism of Plasticity directly modulates the mechanism of Stability, but extremes of Plasticity might nonetheless have consequences for Stability (DeYoung et al., 2002). Extremely low Plasticity should hinder the ongoing maintenance of Stability, as a dearth of exploration and adaptation will render the cybernetic system increasingly unable to move toward its goals effectively as circumstances change. However, high levels of Plasticity might also render the maintenance of Stability difficult, as constant exploration of novel possibilities would be likely to interfere with stable goal pursuit. Future research might test for a curvilinear relation between Plasticity and Stability, perhaps moderated by situational variables. (Although Stability and Plasticity are positively linearly related in ratings by single informants, this correlation appears to be the result of rater bias, and they are typically uncorrelated in multi-informant studies; Anusic, Schimmack, Pinkus, & Lockwood, 2009; DeYoung, 2006; McCrae et al., 2008).

The Big Five in an Adaptive System

The parallels between our theory of Stability and Plasticity and Block's theory of ego-control and ego-resiliency show a fortuitous convergence between theoretical and empirical approaches to models of personality. Block's constructs were initially developed on purely theoretical grounds, whereas ours were developed as an interpretation of a pattern of covariance observed in factor analysis. Block was critical of overreliance on factor analysis in the development of personality models, and, indeed, factor analysis cannot provide a definitive solution to the question of the most important dimensions of personality. However, it seems reasonable to me to desire that any theoretical model of personality be consistent with factor analyses of personality descriptors sampled from a reasonably comprehensive and unbiased pool of descriptors; after all, a good theory should explain existing patterns of covariation, and each factor is likely to be indicative of common causes underlying covarying traits (Haig, 2005). Our two best approximations of a comprehensive and unbiased pool of descriptors (though neither is likely to be fully unbiased) are personality descriptors in the lexicon and the universe of existing personality questionnaires. Both of these sources have provided evidence that the Big Five constitute a reasonable model

of the major dimensions of covariation among personality traits (John et al., 2008; Markon, Krueger, & Watson, 2005). (The six-factor model that is a potential alternative to the Big Five simply divides two subtraits within Agreeableness and can therefore be subsumed by the Big Five conceptually; De Raad et al., 2010; DeYoung, Quilty, & Peterson, 2007; McCrae & Costa, 2008).

The question, then, is whether the Big Five can be described as parameters of an adaptive system and, specifically, of the same adaptive system of which Stability and Plasticity are parameters. Personality researchers have sometimes treated the two metatraits as if they were an alternative to the Big Five, but this is not the case; both levels of personality description must be considered together. The metatraits are higher order factors, contributing variance to the Big Five, but each of the Big Five has considerable unique variance, unexplained by the metatraits. These five sources of unique variance must be ascribed to causal mechanisms if we are to have a real theory of the Big Five.

The first step toward such a theory is to identify likely psychological mechanisms that unify the traits encompassed by each of the Big Five. The attempts that have been made in this direction show considerable agreement (e.g., DeYoung & Gray, 2009; DeYoung et al., in press; Nettle, 2006; Van Egeren, 2009). Extraversion and Neuroticism are thought to be the primary manifestations in personality of sensitivity to reward and positive affect and sensitivity to threat, punishment, and negative affect, respectively. Conscientiousness appears to reflect the ability and tendency to exert top-down control of behavior and impulses in order to follow rules and pursue nonimmediate goals. Agreeableness appears to reflect the tendency toward altruism and cooperation as opposed to exploitation of others. Openness/Intellect appears to reflect the ability and tendency to detect, explore, and utilize patterns of abstract and sensory information. (In the target article, Block objects to the conjoining of Openness to Experience with Intellect, but the two traits do covary, and we should try to understand what they have in common. The answer to his request to treat them separately is to do so at a level of personality structure below the Big Five; DeYoung et al., 2007; DeYoung, Shamosh, Green, Braver, & Gray, 2009.)

Block (1995, 2001, 2002, this issue) questioned the incisiveness of the labels used for the Big Five. However, any set of labels for broad personality traits is likely to be imperfect because these traits encompass such a wide range of correlated behaviors. More important than choosing a perfect label is developing a nomological network that describes each trait in considerably more detail than any single label could and then developing theoretical accounts of mechanisms common to the various behaviors encompassed by each trait.

The next step is integrating these mechanisms in a cybernetic system. As noted by Block (this issue), Van Egeren (2009) has made a substantial contribution to this integration. In Van Egeren's model, each of the Big Five (except Agreeableness) can be seen as reflecting variation in a single stage in the process of working toward any particular goal. First, Extraversion, as reward sensitivity, reflects the energy with which the goal motivates behavior—what Block (2002) might have called "drive." Second, Conscientiousness reflects the likelihood that an appropriate behavior for pursuing the goal is selected from those afforded by the situation. Third, Openness/Intellect reflects the ability to comprehend the complex effects of behavior on situation that constitute the outcome of behavior. Finally, Neuroticism, as threat sensitivity, reflects the sensitivity of the system to detect a mismatch between the outcome and the desired goal state. If a mismatch is detected, the cycle starts again (or the goal is abandoned); if a mismatch is not detected, the goal is felt to be achieved. Agreeableness is not left out of the model but rather exists as a separate trait because human beings are a social species. Agreeableness reflects variation in the mechanisms that serve to coordinate one's goals with the goals of others.

Van Egeren's model is elegant but oversimplified in several ways. First, mapping four traits onto four stages of the cybernetic process is convenient, but one could segment the stages of the process somewhat differently. It would probably be useful to distinguish three processes—(a) being motivated to act, (b) selecting an action, and (c) carrying out the action—where Van Egeren identifies only two. The third of these processes is spread across Van Egeren's first two stages (those associated with Extraversion and Conscientiousness). Making this distinction produces a model with five stages and highlights the fact that Extraversion will be relevant to at least two stages of the cybernetic process, which are not contiguous in time (i.e., the emergence of motivation to approach a goal and the vigor of carrying out an action, which are separated by action selection). Other traits are also likely to influence multiple stages. For example, Neuroticism is likely to influence the initial motivation stage, especially if the goal in question is an avoidance (or prevention) goal rather than an approach (or promotion) goal. Openness/Intellect is likely to influence not only the interpretation of outcomes following behavior but also the selection of behavior, with the person high in Openness/Intellect selecting a more complex or creative behavior (regardless of appropriateness for the goal). In short, the mechanisms associated with each trait do not seem likely to act entirely serially, performing a particular task and then switching off until the next iteration of the system. Each trait may be relevant to multiple stages of the cybernetic process.

The other major limitation of Van Egeren's model is that it focuses primarily on psychological functioning only when a single goal is already specified. As previously noted, humans often have multiple competing and even conflicting goals, and new goals must often be established because old goals have been achieved or abandoned. Developing a new goal or arbitrating among competing goals is just as challenging, if not more so, than pursuing an existing goal. Simple cybernetic systems, like a home-heating system or a missile-guidance system, have a single specified goal. If that goal becomes inappropriate, the system cannot adapt by changing its goal (though a human may intervene to change the goal). What makes human beings special, as complex cybernetic systems, is that they can adjust their own goals—even those at the highest levels of the goal hierarchy—in response to novelty (Peterson, 1999; Peterson & Flanders, 2002). It is precisely the appearance of novel or unpredicted circumstances, the unknown or unfamiliar, that makes Stability a challenge and some degree of Plasticity a necessity.

Considering the relation of the Big Five to Stability and Plasticity may be useful in further delineating the roles of the Big Five in the cybernetic system of personality and might even provide a substantive answer to Block's question, "Why are there five factors?" The manner in which the Big Five cluster within the metatraits suggests that for each metatrait there is an affective, evolutionarily ancient, and largely automatic mechanism for achieving the function of that metatrait over relatively small time scales, and an abstract, evolutionarily more recent, and more voluntarily controlled mechanism for achieving the function of that metatrait over relatively long time scales. This yields four mechanisms, which are associated with four of the Big Five.

A low level of Neuroticism (often labeled Emotional Stability) is a tactic for maintaining the immediate stability of the cybernetic system, preventing one from being disrupted by minor threats or panicking and abandoning one's current goal prematurely. Conscientiousness, in contrast, is a tactic that prioritizes the stability of longer term goals. This might entail either being deterred by a minor threat or suppressing reaction to such a threat, depending on which was conducive to achieving nonimmediate goals. Similarly, it should entail suppressing exploration that is a distraction from nonimmediate goals but encouraging exploration that furthers nonimmediate goals. Extraversion is a tactic for exploring the immediate environment through behavioral output, which may lead to the discovery of useful and rewarding concrete possibilities (e.g., potential mates or allies). In contrast, Openness/Intellect is a tactic for abstract exploration of possibilities that are distant in time or complex in their instantiation. Such possibilities are likely to be relevant to achieving or identifying nonimmediate goals that depend on complex knowledge structures (i.e., abstract interpretations of the state of the world). Personality neuroscience research is consistent with the aforementioned characterizations, linking Extraversion and Neuroticism to phylogenetically older brain systems involved in affect and linking Conscientiousness and Openness/Intellect to phylogenetically more recent, top-down control systems, particularly in prefrontal cortex (DeYoung & Gray, 2009; DeYoung et al., 2009; DeYoung et al., in press).

Like Van Egeren's (2009) model, this hypothesis about mechanisms for short and long time scales requires a separate explanation for the fifth trait, Agreeableness. As Van Egeren did, I would attribute Agreeableness to the mechanisms that allow the coordination of goals among people. Why is there a third trait within Stability but not within Plasticity? The most likely answer would seem to be that the tendency to work stably toward one's own goals (even toward long-term goals) does not ensure that one is not in conflict with the goals of others. Thus, a separate mechanism is needed to maintain the stability of one's social relations. Because this involves restraining impulses (such as those related to anger; Meier & Robinson, 2004) and monitoring one's actions for their distal consequences for others, it can be modulated by the same general mechanism responsible for modulating Stability as manifested through low Neuroticism and Conscientiousness.

The existence of the metatraits suggests the presence of general mechanisms that modulate the more specific affective and abstract mechanisms of the Big Five traits. Evidence points to serotonin and dopamine as likely major components of the general mechanisms of Stability and Plasticity, respectively (DeYoung et al., 2002; DeYoung & Gray, 2009). As the earlier discussion suggests, the existence of specific mechanisms hierarchically below these general mechanisms may be explained by the facts that goals at short and long timescales may easily conflict and that human beings must interpret the world at multiple levels of abstraction. A complete theory of the Big Five would specify more fully the manner in which the mechanisms associated with each trait interact with each other and with the broader mechanisms of Stability and Plasticity, within the cybernetic personality system that governs human behavior and experience. More detailed specification of the likely functioning of this integrated system is possible, aided by neuroscience, but further theoretical development is beyond the scope of this commentary.

The Big Five in Ontogeny

By starting to develop a theory that places the Big Five within an adaptive system, I have attempted to produce the kind of theory that Block could have

appreciated. The absence of such a theory seems to me to have been the root cause of many of Block's criticisms of the Big Five. For example, Block (this issue) criticizes the application of the Big Five model to developmental research on personality and warns strongly against extending the Big Five to descriptions of children. If the Big Five are defined purely as descriptions of behavior and experience, this caution is probably reasonable. Adult behaviors and experiences are so different from those of childhood that it would be difficult to feel confident in matching them up. If, however, the adult Big Five are interpreted as manifestations of interacting psychobiological mechanisms, then they might be more appropriate for a description of childhood personality. Even young children will show variation in the degree to which they are sensitive to reward and punishment; in their tendency to regulate behavior voluntarily to achieve nonimmediate goals; in their curiosity, imagination, and perceptiveness; and in their tendency to interpret and accommodate the goals of others. Thus, the Big Five, as cybernetic theoretical constructs, are likely to be relevant at all ages and can be applied to children as long as two conditions are met.

First, the developmental trajectory of the mechanisms must be considered. A premise of the adaptive-system view of personality is that the same mechanisms exist in all biologically intact individuals, despite individual differences in their functioning. However, these mechanisms mature at different rates during development and many, if not most, are not present in their adult form from infancy. Postnatal development is especially dramatic and extended for the abstract, top-down, cortical systems associated with Conscientiousness and Openness/Intellect (Casey, Tottenham, Liston, & Durston, 2005). Because the affective and abstract mechanisms related to different Big Five traits continually interact, developmental changes are likely to influence both the covariation and the manifestation of many personality traits.

Second, developmental changes in the phenotypic expression of mechanisms underlying the Big Five must be considered. In children, for example, activity level is a more important and central trait than in adulthood, when it is a relatively peripheral subtrait within the Assertiveness aspect of Extraversion (Caspi & Shiner, 2006; DeYoung et al., 2007). This shift might be seen as a developmental change in the way reward-seeking behavior is typically expressed. As children age, their top-down control over motor output increases, as does their verbal skill, and their social goals become increasingly complex. These changes seem likely to result in a shift from reward seeking that is motorically mediated to reward seeking that is verbally mediated. Nonetheless, both activity level in childhood and assertiveness in adulthood can be described as manifestations of the same broader trait of Extraversion, produced by the mechanism of reward sensitivity, that exists throughout life. This kind of continuity in personality despite surface change cannot be adequately conceived without a theory of the underlying mechanisms responsible for traits.

Conclusion

Jack Block was a paragon of psychological exploration. He provided many insights into the human condition and developed a grand theory of personality, inspired by psychodynamic ideas. Even if the current generation of personality psychologists find inspiration in other sources, like factor analysis or neuroscience, they can carry on his work by developing theories of personality as an adaptive system. Any researcher who develops such a theory is likely to find Block's ideas relevant. Block (this issue) cites physicist Robert Millikan, who said in his 1924 Nobel lecture, "Science walks forward on two feet, namely theory and experiment . . . Sometimes it is one foot that is put forward first, sometimes the other, but continuous progress is only made by the use of both." The Big Five represent an impressive accomplishment of empiricism, but, in order to take the next step, we need to pursue theory as enthusiastically as Block did.

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Note

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