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Integrating Personality Structure, Personality Process, and Personality Development

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Abstract

In this target article, we argue that personality processes, personality structure, and personality development have to be understood and investigated in integrated ways in order to provide comprehensive responses to the key questions of personality psychology. The psychological processes and mechanisms that explain concrete behavior in concrete situations should provide explanation for patterns of variation across situations and individuals, for development over time as well as for structures observed in intra- and inter-individual differences. Personality structures, defined as patterns of covariation in behavior, including thoughts and feelings, are results of those processes in transaction with situational affordances and regularities. It cannot be presupposed that processes are organized in ways that directly correspond to the observed structure. Rather, it is an empirical question whether shared sets of processes are uniquely involved in shaping correlated behaviors, but not uncorrelated behaviors (what we term 'correspondence' throughout this paper) or whether more complex interactions of processes give rise to population level patterns of covariation (termed 'emergence'). The paper is organized in three parts, with Part I providing the main arguments, Part II reviewing some of the past approaches at (partial) integration, and Part III outlining conclusions of how future personality psychology should progress toward complete integration. Working definitions for the central terms are provided in the appendix.

[213 words]

Keywords: causal process, structure, development, personality, traits, explanation, emergence, learning, information processing, affect, motivation, self-regulation, network approach, self-reflection, functional approach

Integrating Personality Structure, Personality Process, and Personality Development

Theory and research on personality and individual differences can roughly be grouped according to their main foci on (1) structures of inter-individual differences, (2) intra-individual processes that guide behavior, and (3) development (Ashton, 2013). Notwithstanding notable exceptions, these research areas have progressed in relatively independent ways (Funder, 1991; McCrae & Costa, 1995; Mischel & Shoda, 1998), and have even been described by some as incommensurate (Cervone, 1991). We argue that integration is actually necessary to advance understanding of personality to any substantial degree. The purpose of this article is to explain why integration is essential, to articulate what achieving this entails, and to offer preliminary ideas and suggestions concerning the form it might take, along with a proposed research agenda for completing the integration process.

This article grew out of an Expert Workshop that took place in July, 2015, in Annweiler, Germany. The workshop was sponsored by the European Association of Personality Psychology and the German Research Foundation. This article reflects the partial consensus that could be reached among the 19 scientists who took part in the meeting and authored this paper (and as such, allows that individual authors may disagree with an individual point or two). As a first step towards common ground, we elaborated working definitions of the most central terms. These working definitions are provided in the Appendix. In the text, those terms are highlighted in bold when used the first time as a reminder that we have specific definitions in mind when using them.

In Part I of our article, we lay out our arguments for the necessity of integrative research on personality processes, structure, and development. We are not the first to call for integration. Indeed, some of us have been calling for integration of specifically social cognitive processes with trait structures and have even proposed models of such integration (Baumert & Schmitt, 2012; Fleeson, 2001; Fleeson & Jayawickreme, 2015; Read, Monroe,

Brownstein, Yang, Chopra, & Miller, 2010; Wood & Denissen, 2015; Wood, Gardner, & Harms, 2015). But most previous calls did not tap the full potential for integration that we advocate in the present paper. In Part II, we offer initial ideas concerning how this necessary integration might be accomplished. We acknowledge some of the previous attempts at (partial) integration. We do not provide a complete review of past integrative research. Nor do we integrate all possible perspectives on personality (disregarding, e.g., interpersonal, psychodynamic, or humanistic perspectives, Funder, 2001). Rather, our aim is to highlight the close interdependencies of personality processes, structure, and development involved in answering what we regard as the key questions of personality psychology. In Part III, we summarize our group's conclusions regarding how future personality research should progress to successfully accomplish complete integration.

Part I: Why Integration Is Necessary

Three Foci in Personality Theory and Research

Structure. One of the key tasks that **personality** psychology has tackled is to provide comprehensive yet parsimonious descriptions of systematic inter-individual differences in **behavior** in a broad sense **(Goldberg, 1993; Wiggins & Pincus, 1992)**. Much effort has been devoted to identification of the **structures** of relations among **traits** and **states (Costa & McCrae, 1992; Digman, 1990; Zuckerman, Kuhlman, Joireman, Teta, & al., 1993)**. In other words, patterns of population-level covariation of systematic inter-individual differences in behavior have been identified and interpreted. Hierarchical models of personality dimensions have been proposed and discussed, such as the Five Factor Model (FFM, Costa & McCrae, 1985; Goldberg, 1981) and its precursors, especially the structural models proposed by Eysenck (1950, 1970), Cattell (1943, 1956), and Tellegen (1985), and the more recently proposed HEXACO model (Ashton, Lee, & de Vries, 2014; Lee & Ashton, 2008). Researchers have also worked to describe the structures of inter-individual differences in

other domains, such as abilities (Gustafsson, 1984; Vernon, 2014), interests (Fouad, Harmon, & Borgen, 1997; Tracey & Ward, 1998), values (Crosby, Bitner, & Gill, 1990; Schwartz & Bilsky, 1990), and motives (Bilsky, 2006; Murray, 1938). An important merit of the structural approach to personality lies in development of assessment instruments that describe aggregations of behavioral tendencies within finite multidimensional spaces (Costa & McCrae, 1985). These behavioral tendencies have shown substantial associations with future behavior and behavioral outcomes, such as educational and vocational success and health (Iwasa et al., 2008; Lahey, 2009; Noftle & Robins, 2007; Ozer & Benet-Martinez, 2006; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

Process. A second key task of personality research is to identify the psychological and physiological **processes** involved in generating concrete behavior in concrete **situations (Hampson, 2012; Revelle, 1995)**. This involves addressing questions concerning why individuals with different **trait levels** behave differently in the same situation, and why an individual with a particular trait level behaves differently in different situations. Providing such **explanations** requires articulation of **causal** or **functional** relations. Process-oriented research in personality has primarily addressed this key task of explaining behavior. Process-oriented theories describe ideas about the particular intra-individual processes that guide behavior in transaction with situational cues and affordances. These theories propose systematic inter-individual differences in how these processes unfold (e.g., Gray, 1994; Thayer, 1990). Thus, they offer potential explanations both for inter-individual differences in behavior, and for intra-individual differences across situations. Examples include biological theories of personality, such as Reinforcement Sensitivity Theory (Corr, 2008), that propose means by which neurophysiological and endocrinal processes generally shape behavior but vary systematically among and within individuals, thereby accounting for inter-individual as well as intra-individual differences in behavior. Regarding another example, social cognitive

(e.g., Mischel & Shoda, 1995; Cantor, 1990) and self-regulatory (e.g., Carver & Scheier, 2014; Muraven & Baumeister, 2000) approaches specify aspects of information processing (e.g., attention, interpretation, encoding), goal-striving, self-monitoring, and self-reinforcement that guide behavior and vary among and within individuals.

Development. A third key task of personality psychology is understanding enduring **changes** in individual trait levels across the lifespan, both normative changes as well as deviations from norms (Caspi & Roberts, 2001; Shiner & Caspi, 2012). Large-scale longitudinal studies estimate stability and change in average trait levels (normative levels and their changes) and in inter-individual differences in trait levels (rank-order stability and its changes; Caspi & Silva, 1995; Roberts & DelVecchio, 2000). For example, rank-order stability in broad personality traits is substantial, but far from perfect throughout the lifespan, and this stability is higher during some periods than others (Roberts & DelVecchio, 2000). Age-graded mean-level (normative) changes in trait levels have been observed (Funder, 2010; Soto, John, Gosling, & Potter, 2011), and there is substantial inter-individual differences in degree of conformity to these 'normal' patterns (Roberts, Walton, & Viechtbauer, 2006; Schwaba & Bleidorn, 2017). Researchers have asked whether enduring intra-individual changes are genetically influenced using participant samples that differ in degrees of genetic relationship and quantitative genetic models (e.g., Bleidorn, Kandler, Riemann, Spinath, & Angleitner, 2009; Roberts, Wood, & Smith, 2005). Results suggest that along with genetic influences, **development** is also influenced by experiences (Baltes & Schaie, 2013; Bleidorn, Kandler, & Caspi, 2014; Briley & Tucker-Drop, 2014; 2015; Caspi & Roberts, 2001).

Integration of Structure, Process, and Development

To date, the three key tasks of personality psychology have been tackled independently of each other. As we argue next, this is insufficient, if not potentially misleading.

Substantiating Structure through Process-Oriented Research. Structural models

have been proposed and elaborated without systematic investigation of the processes responsible for bringing about the observed inter-individual differences in behavior and the patterns of covariation described in these models (Cervone, 1997). Researchers have rationalized this neglect by assuming that statistical clusters of inter-individual differences in behavior, whether self-reported, peer-rated or observed, correspond to underlying causes of behavior within individuals (e.g., McCrae, 2005; McCrae & Costa, 2008). In other words, some have assumed that a structural approach to personality serves to reveal the underlying causes of behavior. We disagree and instead argue that structural models need to be systematically linked with process-oriented approaches to personality, for two reasons.

First, broad traits cannot serve as explanations of inter-individual differences in behavior if they are not defined independently of the behaviors they are used to explain (e.g., Cervone, 1999; Mischel, 1968). The factors in structural models are derived from patterns of covariation in inter-individual differences in behaviors, and are thus 're-descriptions', aggregations, or summaries of behaviors (Buss & Craik, 1983). Such summaries illuminate higher levels of organization that can offer *suggestions* of groups of phenomena that could have common causes, from the perspective often labeled 'top-down' (e.g., Cervone, 1997; Kitcher, 1985). However, to illuminate causal **mechanisms**, lower levels of organization that are distinct from the behaviors themselves and that can exert driving forces that influence the behaviors of interest need to be identified, from the perspective often labeled 'bottom-up' (e.g., Cervone, 1997, 1999; Kitcher, 1985). To reach true understanding of personality, we argue that these two perspectives must be linked, with the goal of revealing how lower and higher levels of organization relate to each other. Gaining insight into these causal processes will be highly valuable for theory development because it will allow articulation of causes independent of the behaviors they explain (Mischel & Shoda, 1994). This will require experimental manipulation of the conditions that initiate potentially causal processes.

Moreover, insight into causal processes will be of practical relevance because this will serve to guide potential interventions intended to change behavior. Finally, knowledge of conditions modulating these processes will increase precision in predicting behavior and behavioral outcome.

As a second reason for integrating structural models with process-oriented approaches, we argue that only by identifying the processes that generate behavior and individual differences in behavior, can we understand the causes of covariations among behaviors. Ultimately, it is an empirical question whether underlying causal processes correspond to the structures observed in collections of behavior, at the population level (Eysenck, 1992; Mischel & Shoda, 1994). Possibly, research will reveal that correlated behaviors are caused by common or overlapping (sets of) processes, and those processes are not involved in shaping uncorrelated behaviors. This would mean that each process exerts a specific causal influence. If so, we can conclude that factor structures inform us about common causes of behavior. In what follows, we use the term 'correspondence' to describe the pattern of common causes of correlated behaviors that are not common causes of uncorrelated behaviors. However, alternatively, we might find that basic processes are not organized in correspondence to observed structures, and their influences may not map one-to-one in this way. Correlated behaviors might not share common (sets of) causal processes and uncorrelated behaviors may share causal influences. It is possible that several processes may act together, counteracting or enhancing each other dynamically, and that such complex patterns of joint actions of processes are responsible for correlations or their absence among behaviors.

For example, Wood, Gardner, and Harms (2015, in Figure 1) have suggested that perceiving others favorably might shape agreeable behaviors (such as those that tend to cluster empirically under the labels "polite" or "politeness"), and may also shape extraverted

behaviors (such as those that tend to cluster under the labels “assertive” or “assertiveness”). In addition, desiring power might motivate these behavioral dimensions, but with positive influences on assertiveness and negative impacts on politeness. In this example, behavioral tendencies (i.e. aggregates of agreeable or extraverted behaviors across time and situations) can be uncorrelated because their shared causes (tendencies to perceive others favorably and to desire power) work against each other, thereby suppressing their effects on the overall correlation between variables. To the extent that such patterns of causal processes are prevalent, population patterns of covariation will not correspond to the causes of individual behavior. If this is the case, personality structure would have to be understood as *emerging* from complex causal processes (Bedau, 2003, 2008a).

In short, a full understanding of structure requires integration with process-oriented research in order to explain inter-individual differences in behavior. Integration is also necessary to determine empirically whether patterns of covariation of behavior reveal its common causes or instead emerge from underlying processes that do not themselves correspond to the observed structures.

Substantiating Personality Development through Structural and Process-Oriented Research. Knowledge of the basic intra-individual processes together with the ways in which processes unfold differently among individuals is necessary to enable complete understanding of how and why behavior varies inter-individually within any given situation as well as intra-individually across situations. Relatedly, we argue that knowledge of the causal and functional mechanisms of behavior is required for full understanding of development. These processes and mechanisms in transaction with situational circumstances ultimately give rise both to the patterns we term ‘trait levels’ and to relatively enduring changes in them (e.g., Geukes, van Zalk, & Back, 2016; Roberts, Wood, & Caspi, 2008; Wrzus & Roberts, 2016).

Enduring intra-individual changes in behavioral tendencies (including thoughts and emotions) could arise due to gradual or abrupt shifts over time in how processes unfold (e.g., intra-individually increasing strength of affective reactions to particular types of stimuli). This includes the possibility that enduring changes in behavioral tendencies are caused by changes in environmental constellations or affordances that exert their influence through psychological processes. Shifts in intra-individual processes can result from biological processes (e.g., brain maturation); but they could also be triggered by experiences. Single experiences may cause such shifts if they are extreme and have traumatic consequences (Löckenhoff, Terraciano, Particiu, Eaton, & Costa, 2009), but we hypothesize that, mostly, development is triggered and perpetuated by repeated experiences and enduring changes in those patterns (Wrzus & Roberts, 2016). For example, social consequences of particular behaviors may change due to entering new social roles. If these novel patterns of consequences then remain stable, enduring changes in behavioral tendencies should result. Importantly, we hypothesize that in most instances, changes in patterns of experiences will not shape behavioral tendencies in simple, linear fashions. Rather, processes translating the effects of changed experiences will most likely transact in complex ways.

Besides intra-individual changes in trait levels, these processes and mechanisms can also explain covariation in development across two or more traits. Enduring intra-individual changes in levels of distinct traits can co-occur across time. This synchrony may arise because there are simultaneous changes in situational constellations that feed into distinct processes that shape behavioral tendencies belonging to distinct traits. Alternatively (in cases of *emergence* rather than *correspondence*), this synchrony may arise because the behavioral tendencies belonging to distinct traits share underlying processes, and are thus simultaneously affected by changes in relevant cue constellations or affordances. Returning to Wood and colleagues' (2015) example, if an individual's generalized evaluation of other people changes

due to repeated pleasant social interactions, this could affect his or her assertiveness and politeness, and numerous other distinct traits simultaneously.

Correlated intra-individual changes in trait levels due to simultaneously activated or shared causal processes can parallel changes in inter-individual personality structures across the lifespan. However, only if there are inter-individual differences in correlated intra-individual changes can we expect structural changes. For example, age-graded changes in the (inter-individual) correlations among cognitive performance tasks have been observed. Specifically, the magnitudes of the average correlations among such tasks is hypothesized to be a u-shaped function of age (e.g., de Frias, Lövdén, Lindenberger, & Nilsson, 2007; Li et al., 2004; but see Deary, Egan, Gibson, Austin, Brand, & Kellaghan, 1996). It is hypothesized that biological factors strongly influence performance on different cognitive tasks in young childhood. Older childhood and adolescence then gradually allow differential training of specific facets. If the level of training varies inter-individually (e.g., some individuals emphasizing development of spatial skills, and others emphasizing verbal or math skills), it will give rise to decreasing correlations among the facets (Baltes, Nesselroade, & Cornelius, 1978). In older age, facets of intelligence could become reintegrated due to overall neuroanatomical and neurochemical decline in combination with substantial inter-individual differences in onset and degree of this decline (Lövdén & Lindenberger, 2005).

Within the domain of childhood temperament and personality, similar steps have been taken toward fruitful integration of structural, process-oriented, and developmental perspectives. As children's behavioral repertoires expand, and environmental opportunities and affordances increase, traits broaden in content and become more differentiated at the facet level (Shiner & DeYoung, 2013). In addition, re-organizations in the correlational patterns among traits have been observed from infancy to childhood. Behaviors labeled "intellectual" have been found to co-vary with behaviors labeled "conscientious" and its precursors (De

Pauw, Mervielde, & van Leeuwen, 2009) much more strongly in early childhood than in adolescence or adulthood, when intellect is robustly found as a facet of openness. It has been proposed that inter-individual differences in speed of brain maturation (specifically maturation of the prefrontal cortex) might be responsible for this early covariation that declines as maturation is completed (Shiner & DeYoung, 2013). The work done with cognitive abilities as well as with childhood temperament and personality traits illustrates that consideration of the processes (e.g., differential training, differential biological maturation or decline) that shape behavior can inform us about what patterns of development and changes in intra- and inter-individual structures we can expect. Conversely, observation of developmental patterns can provide working hypotheses of the kinds and functions of processes we need to identify (Shiner & DeYoung, 2013).

Finally, the integrated consideration of structure, process, and development is necessary to understand when and why intra- and inter-individual personality structures may differ (Allik, Realo, Mõttus, Borkenau, Kuppens, Hrebícková, 2012; Borkenau & Ostendorf, 1998; Molenaar, 2004). Both kinds of structures reflect correlations among vectors of multidimensional data spaces (Cattell, 1966). Consider, for example, just four relevant dimensions: persons, situations, behaviors, and time points. Inter-individual structures can be obtained by correlating single behaviors across individuals. Behaviors can also be aggregated either across situations or time points or both. Intra-individual structures can be obtained by correlating, for each individual separately, behaviors across situations or time points or both (P-factor analysis, Cattell, 1946). Depending on whether and how cells of the data space are aggregated, different structures may be observed (Baltes, Reese, & Nesselroade, 1978; Molenaar & Campbell, 2009).

Importantly, observing different structures does not mean that the processes underlying the behaviors in the cells as the basic elements of the data matrix differ. However, aggregation

can accentuate or attenuate the effects of processes. Aggregation across time attenuates effects of occasion-specific processes and accentuates effects of recurring processes. Aggregation across behaviors attenuates effects of behavior-specific processes and accentuates effects of processes shared by the aggregated behaviors. The same holds for aggregation across situations and individuals (Epstein, 1979; Fleeson, 2001). Different structures obtained from different ways of aggregating cells in the data box and the systematic comparison of these structures can therefore inform about shared and unique processes and guide their identification. Relying on only one structure obtained from only one type of aggregation can disguise processes and preclude their identification. For example, structures obtained from data that were aggregated across time may disguise processes that explain intraindividual changes in state-levels or even in trait levels – depending on length of the time interval across which aggregation was performed.

In summary, we argue that structure, process, and development are inherently connected. Psychological processes and inter-individual differences in their unfolding should provide explanation for patterns of variation in concrete behavior across concrete situations and individuals, but also for development over time as well as for structures observed in intra- and inter-individual differences. The processes in transaction with environmental (including social) constraints will likely determine what structures of intra- and inter-individual variability we should expect and to what extent these structures should look alike.

Part II: Preliminary Ideas on How Integration Can Be Reached

In Part I, we laid out our arguments concerning why integration of personality research on process, structure, and development is not only beneficial but urgently necessary. Comprehensive responses to the key questions of personality psychology, namely how to explain (a) behavior, (b) structure, and (c) development, are inherently interconnected. Part II is organized along these key questions. We address causal or functional accounts of behavior,

structure, and development, aiming to identify and refine convincing explanatory approaches. While doing this, we will acknowledge some (though not all) of the previous attempts to partially integrate personality processes, structure, and development.

Key Question 1: Explanation of Behavior

What mechanisms and processes can explain concrete behavior in concrete situations? This general question implies two more specific questions: (a) what mechanisms and processes can explain that individuals with different trait levels behave differently in the same situation? (b) what mechanisms and processes can explain that an individual with some trait level behaves differently in different situations?

In the following three subsections, we elaborate upon **cognitive**, **affective**, and **motivational** processes that researchers have focused on to explain variation in behavior across individuals and across situations. Psychology has an extended history of investigation of these processes and their interconnections. It is beyond the scope of this article to cover all the complexities of these phenomena. Instead, we want to highlight how personality psychology can profit from drawing upon this knowledge, and how this knowledge can be extended to enable better understanding of individual differences in how these processes unfold and cause individual differences in behavior.

Cognitive Processes. Cognitive and social cognitive approaches to explaining behavior follow from the idea that patterns of selective information processing might be responsible for emotional and behavioral responses to concrete situations (Fiske & Taylor, 1991). Systematic inter-individual differences in selective perception, attention, interpretation, and memory might cause people to react to situations in systematically different ways. For example, Beck (1985) proposed that clinically anxious people automatically attend to threatening stimuli, which contributes to their elevated tendencies to experience anxious **states.**

The importance of information processing patterns in the determination of behavioral responses has sometimes been emphasized over that of traits derived from structural personality models (Cervone & Shoda, 1999). Here, we argue instead that traits in structural personality models can be understood in terms of their social cognitive operations. A premise of some of this work is that processes such as selectivity in perception and interpretation may be important to all traits, but each trait would be associated with selective processing in a unique domain of informational content (Higgins, 1996). For example, perceptual and interpretive biases that enhance sensitivity to negative information in the environment might contribute to emergence of the behavioral patterns belonging to a broad domain trait we label 'neuroticism' (Rusting, 1998), while perceptual and interpretive biases that instead enhance sensitivity to particular types of negative information concerning unfairness might contribute to the patterns belonging to a narrow facet trait we term 'justice sensitivity' (Baumert, Gollwitzer, Staubach, & Schmitt, 2011). There is evidence consistent with this sort of trait-content matching (Baumert et al., 2011; Robinson, 2007).

However, different traits could potentially result from patterns of selectivity in quite different types of cognitive process. Some evidence for this comes from the experimental psychopathology literature. Selectivity in attention-related processes (such as orienting to threat) are most strongly implicated in the determination of anxious disposition, while selectivity in memory-related processes (such as rumination) plays a stronger role in shaping depressive disposition (Mathews & MacLeod, 1994). Further evidence comes from research on agreeableness. Angry and aggressive reactions in daily life appear to be shaped by *accessibility* (Higgins, 1996) of hostile thoughts, whereas the generalized tendency to behave in agreeable ways depends on individual differences in capacity and motivation to control these kinds of thoughts (Bresin, Fetterman, & Robinson, 2012; Meier & Robinson, 2004; Wilkowski & Robinson, 2010). More generally speaking, each personality trait could have its

own information processing signature, and systematic investigations of these signatures across traits is needed.

Affective Processes. Besides cognitive processes, affective processes can contribute to explanation of behavioral variation across situations and across individuals. Clearly, affective processes are closely linked with cognitive processes as discrete emotions critically involve cognitive appraisals (Moors, Ellsworth, Scherer, & Frijda, 2013). Nevertheless, affective processes serve unique functions in catalyzing behavioral reactions.

Personality research has started to integrate research on affective processes and systematic individual differences in behavior. Mostly, research has focused on broad domain traits and their affective underpinnings. For example, investigators have sought to determine the extent to which extraversion and neuroticism, and also conscientiousness and openness to experience, are associated with differential affective reactions to situational stimuli (e.g. stressors) and with tonic affective levels independent of situational experiences (Gross, Sutton, Ketelaar, 1998; Howell & Rodzon, 2011; Leger, Charles, Turiano, Almeida, 2016).

In this context, studies that have used experience sampling or experimental methodologies are particularly valuable, because they have shed light on the mechanisms responsible for the observed associations. For example, participants reported higher positive affect after having been experimentally induced to behave extravertedly (McNiel & Fleeson, 2006; McNiel, Lowman, & Fleeson, 2009; Smillie, 2003). A recent experience sampling study found comparable results and, additionally, revealed that immediate increases in positive affect after extraverted behavior were followed by fatigue (Leikas & Ilmarinen, 2016). Trait extraversion did not moderate these effects, suggesting that persons low and high in trait extraversion react similarly after displaying extraverted behavior (Zelenski, Santoro, & Whelan, 2012). Srivastava, Angelo, and Vallereux (2008) also observed equivalent responses following social interactions, though persons high in extraversion more frequently initiated

such interactions (Wilt, Noftle, Fleeson & Spain, 2012; Zelenski, Whelan, Nealis, Besner, Santoro, & Wynn, 2013). Depending on situational demands (i.e., specifically when anticipating social or non-social performance tasks), persons low and high in extraversion were found to be differently motivated to feel happy (Tamir, 2009), and future research needs to look into why this is the case.

Taken together, this line of research exemplifies how integration of affective processes and personality traits can be achieved. Such integrative work can shed light on intra-individual processes related to extraversion, and on aspects of these processes that vary systematically among individuals, thus potentially contributing to the explanation of trait differences in extraverted behavior. So far, however, most research in this vein has focused on broad domain traits, and has linked them to processes of global positive or negative affect. We believe that the outlined approach can be fruitfully extended by considering more specific facet traits as well as discrete emotions.

Motivational Processes. We operationalize motivation as selective approach/avoidance of certain situations (or features thereof). We theorize that these choices align with distributions of perceived rewards and punishments within these situations. As an example of motivated behavior, consider a person who exhibits affiliative behavior, such as initiating a friendly conversation with a stranger. This behavior would qualify as 'motivated' if the behavior is exhibited because similar behaviors have produced rewarding consequences in the past or because the individual expects these behaviors to produce desired future consequences (see Wichers et al., 2015, for a recent demonstration).

However, the motivating potential of a given stimulus is not completely determined by past experiences of reward, or by future expectations of positive outcome. Many factors can modify the reinforcement value of a given reward from situation to situation. For example, if an individual has not drunk water for very long, its reinforcement value is increased, but this

drops after having drunk a large quantity of water. These factors are called ‘motivating operations’ in the field of applied behavior analysis (Cooper, Heron, & Heward, 2013).

In daily life, many behaviors can be construed as investments to reach desired end states that are temporally and chronologically detached from observable cues. Depending on their specificity, temporal location, and degree of conscious awareness, such end states have been conceptualized as mid-level goals (e.g., Cantor et al., 1991, Emmons, 1986), values (Doering et al., 2015), implicit motives (Schultheiss, Kordik, Kullmann, Rawolle, & Rösch, 2009), or specific goals (McCabe & Fleeson, 2012), among other constructs. For example, an individual might drink water because it is a healthier alternative to sugary soda, bypassing opportunities and short-term temptations (e.g., a vending machine in the hallway selling sugared drinks that taste better).

From a motivational perspective, inter-individual differences in behavior within one situation as well as within-person differences across situations can have a range of explanations. To begin, there are individual differences in the links between perception and behavior (Perugini & Prestwich, 2007). For example, environmental cues are likely to trigger different memory configurations in different people that in turn can activate different responses linked to different unconscious goals (Aarts & Dijksterhuis, 2000). Some evidence also suggests that people differ in the readiness with which certain classes of goals can be primed, and that these differences are associated with broader traits (Hart, & Albarracín, 2009).

Furthermore, there are established between-person differences in strength of motivations to pursue rewards and punishments in general (e.g., reward sensitivity; see Corr, 2004, for a review) and in specific motivational domains. For the domain of affiliation, Dufner, Arslan, Hagemeyer, Schönbrodt, and Denissen (2015) showed that individuals differ

systematically in affective reactions to affiliative stimuli and these differences predicted preference for affiliative behaviors.

Besides such relatively stable inter-individual differences, also homeostatic processes make individuals more (or less) responsive to certain rewards, and this might contribute to the explanation of inter-individual differences in motivated behavior within a given situation, and intra-inidvidual differences in motivated behavior across situations. For example, a person who has been deprived of opportunities for social contact might behave in a more affiliative way than a person who has just spent a long time reaching out to make new friends (Maner, DeWall, Baumeister, & Schaller, 2007).

Interestingly, individuals' reports concerning their goal motivation have been found to be closely associated with these same persons' assessments of the extent to which their behavior is representative of the Big Five personality dimensions (intra-individually regarding moment-to-moment covariation, McCabe & Fleeson, 2012; and inter-individually regarding generalized goals and behavioral tendencies, Denissen & Penke, 2008). These findings might suggest that there is close correspondence between motivational processes and behavioral tendencies described in terms of the Big Five dimensions. However, motivational models need to take account of the possibility that conflicting motives may operate within situations. Such conflicts are common, not just between basic drives (e.g., hunger and safety) but also between basic biological drives and socialized motivations (e.g., between hunger and desire to be well-mannered while eating; Baumeister, 2016) and between two or more socialized motivations (e.g., desires to appear 'cool' and do well in school). Humans resolve these conflicts by consciously or unconsciously comparing competing motive strengths and selecting the strongest one while simultaneously repressing the others or their behavioral expression (for a mathematical model, see Revelle & Condon, 2015; for a computational account, see Read et al., 2010).

Moreover, motivational models of personality also need to take into account that behaviors are multifunctional in that they can serve various goals at the same time, and equifinal in that there are usually alternative behaviors available to reach one and the same goal. As we will address more systematically under Key Question 2, these functional properties of behaviors can account for emergence of inter-individual structure observed at the population level.

Conclusions to Key Question 1. Psychology has made substantial progress toward understanding the cognitive, affective, and motivational processes that explain behavioral variation across situations. Despite the close interconnectedness of these processes, they cannot be reduced to or replaced by one another. Given their partial independence, they will often complement or conflict with each other in shaping behavior as part of a causal chain. Personality psychology can profit from these insights and, in turn, further advance understanding of behavioral causes by illuminating systematic individual differences in how those cognitive, affective, and motivational processes operate. Targeting psychological processes for explaining behavior, instead of other levels of explanation such as physiological, endocrinal, or molecular processes, may yield opportunity for effective psychological interventions to change behavior (e.g., MacLeod & Mathews, 2012).

Key Question 2: Explanation of (Between-Person) Structure

What mechanisms and processes can explain occurrence of population-level covariation of inter-individual differences in behavior? In other words, we seek the psychological processes that, in combination with biological and environmental constraints, including social constraints, explain occurrence of broad dimensions of human variability in behavioral patterns.

One of the main claims of this article is that it is an empirical question whether causal and functional processes are organized in correspondence to observed personality structures

or whether these structures emerge from more complex interactions of processes. In the past, the assumption of correspondence was prevalent. Consequently, observed patterns of covariation have consistently not been recognized as phenomena that need explanation. In other words, Key Question 2 has not received sufficient attention by personality psychologists. In the following subsections we highlight approaches that explicitly tackle the possibility that structure is an *emergent property*. Network models offer methodological tools to describe relations between processes and observed structures; cognitive learning and functionalist approaches propose substantial hypotheses about causal and functional processes that might underlie personality structure.

Network Approaches. A network is a model of a system of interacting elements as a set of nodes, which represent the elements, and a set of edges connecting pairs of nodes, which represent their interrelations (e.g., de Nooy, Mrvar, & Batagelj, 2011; Newman, 2010). Personality can be modeled as a network of behaviors in a broad sense (acts, thoughts, feelings, and motivations, but also physiological reactions) that interact with each other and with situations over time (Borsboom & Cramer, 2013; Costantini, Epskamp, et al., 2015; Cramer et al., 2012). Using such models, personality structure can be understood without assuming that broad personality factors reflect specific and unitary psychobiological or causal entities (Borsboom, Mellenbergh, & van Heerden, 2003; Mõttus, 2016). They are instead seen as *emergent* from interactions among the elements of the personality network over time (Cramer et al., 2012; Schmittmann et al., 2013).

In particular, the emergence of structure in the personality system can be interpreted as a case of *weak emergence*. Weak emergence occurs when properties of superordinate levels are *in principle* deducible from properties of the lower levels, but the mechanistic explanations are complex and irreducible (Chalmers, 2006). For

instance, consider a traffic jam (the macroscopic phenomenon): Although in principle it would be possible to trace the causal history that brought each and every car in a certain place in a certain moment (the microscopic level), this kind of mechanistic explanation cannot be easily reduced to a simple, understandable, or useful form (Bedau, 2008a). Conceptualizing personality as a weakly emergent system may seem discouraging, because identifying mechanistic explanations of emergent phenomena is difficult. However, some important properties of emergent macroscopic structures can be understood in terms of simple regularities in microscopic network processes (e.g., for an explanation of the structure of the World Wide Web, see Barabási & Albert, 1999).

In personality research, network analysis allows connecting personality processes and structures in several ways. A first approach involves investigating the properties of the system through computer simulations, by reproducing microscopic processes and examining their effects at the superordinate level over time (Bedau, 2008b). For instance, it has been shown that the mutual interactions of a set of interacting nodes in a network of behaviors, under certain conditions, can result in the emergence of a five-factor structure (Costantini, Epskamp, et al., 2015; Read et al., 2010). Second, exploratory network methods (e.g., Gaussian Graphical Models, Vector Autoregressive Models; Bringmann et al., 2013; Epskamp, Waldorp, Mõttus, & Borsboom, 2017) allow identifying associations between microscopic and macroscopic levels that can generate hypotheses (Bedau, 2012). If a researcher observed that the strength of specific links in a network (e.g., between motivation to success and working hard) is associated with higher individual scores on a personality trait (conscientiousness), she could hypothesize that such links play a crucial role for the trait to emerge. A similar logic has been applied to depression, in which the strength of links between moods has been shown to predict the onset and termination of depressive episodes (van de Leemput et al., 2014). Finally, network analysis allows identifying patterns of transactions

among behaviors and between behaviors and situations within a certain level of the personality system (for examples regarding the facet level in conscientiousness, see Costantini, Richetin, et al., 2015; Costantini & Perugini, 2016), and can inspire targeted experimental research.

From the network perspective, regularities in personality structure are construed as fundamental macroscopic phenomena that constrain and simplify the range of possible models of the microscopic processes. In turn, models of microscopic processes have implications for emergent personality structure. For instance, a macroscopic phenomenon such as the relative stability of trait levels (Roberts & DelVecchio, 2000) suggests that patterns of interactions among behaviors and situations (the microscopic level) typically reach relatively stable equilibria (Cramer et al., 2012), which however can change relatively quickly in response to external perturbations (Roberts, Luo, Briley, Chow, Su, & Hill, 2017; van de Leemput et al., 2014). Similarly, although patterns of behavior and situation-behavior transactions vary among individuals (Epskamp, Waldorp, et al., 2017), cross-cultural consistency of the personality structure suggests that (a) these intra-individual patterns have some degree of similarity among individuals even in different cultures and that (b) the kinds of situations that are encountered across cultures bear some degree of similarity and generally lead to similar equilibria (Costantini & Perugini, in press; Guillaume et al., 2016).

Importantly, network analysis should not be considered as a replacement for other statistical techniques, such as factor analysis, nor should it be seen as a replacement for experimental research. Factor analysis and network analysis can be used in combination to identify regularities in patterns of behavior and behavior-situation transactions (e.g., Costantini & Perugini, 2016; see also Epskamp, Rhemtulla, & Borsboom, 2017). Understanding these patterns requires in-depth exploration of the underlying functional

and causal processes, which can be tested and established with experimental research (e.g., Wilkowski & Robinson, 2010). In this way, network modeling can bridge personality research with other research domains within psychology (e.g., learning, cognition) and beyond it (e.g., biology), given that the study of more microscopic levels is synergic and informative rather than in opposition or irrelevant to the understanding of personality structure.

Cognitive-Learning Approaches. According to cognitive learning approaches, behavior depends on the mental organization of schemas and scripts (Bandura, 1989; Kelly, 1955) because these shape information processing, attributions, and expectancies in concrete situations (Williams, Watts, MacLeod, & Mathews, 1991). While fundamental commonalities in human socializing experiences should lead to inter-individual similarities in organizations of mental representations, schemas and scripts will inevitably vary among individuals in terms of specific details (Williams et al., 1991). The organization of mental representations and individual differences in these representations can have implications for personality structure.

Mental representations may partially overlap (e.g., representations of threat and loss might partially overlap intra-individually because of co-occurrences of related experiences during the learning history), leading to intra-individual covariation of behaviors affected by these representations (Wentura, Rohr, & Degner, 2017). In addition, if individuals have similarly organized mental representations, but their representations differ in content, complexity, or valence, these differences should result in inter-individual covaration of pertinent behaviors. For example, individuals who tend to perceive situations as threatening might be more prone to experience anxiety and sadness than others.

However, the intra-individual organization of mental representations does not necessarily correspond to the structures observed at the population-level. Individual

differences in mental representations might interact in complex ways. For example, inter-individual differences in the complexity of a schema in interaction with its valence could shape patterns of correlated behaviors. People may differ in the complexity of their concept of 'rejection,' which can involve a larger or smaller number of situational constellations (e.g., being teased, receiving funny looks, being pointed at, others turning away; Leary, 2005). If people also differ in how negative they consider rejection, affective reactions in the situations included in this schema will come to correlate among persons with a complex schema. In comparison, among persons with a simple schema, such clusters of correlated behavior will involve reactions in fewer situations. The facet structure of neuroticism, as the domain trait under which rejection sensitive behaviors should come to cluster, might be a result at the population-level, of such complex interacting processes.

Mischel and Shoda (1995, 2008) have provided perhaps the most widely noted social cognitive account of inter-individual personality differences, the cognitive-affective personality system model (CAPS). They argued that cognitive, affective, and motivational factors (such as encodings, expectancies, affects, competencies, and self-regulatory plans) underlie the situation-specific tendencies in behavior. For example, a child may be aggressive when peers tease but compliant when adults make behavioral demands because the child has learned that aggressive behavior can intimidate peers and stop their teasing, but that adults will insist on compliance or punish.

While some psychologists taking this social cognitive perspective have remained skeptical of broader traits (e.g. Bandura, 1997; Mischel & Schoda, 1995), we argue that social cognitive processes are mechanisms that contribute to the population-level covariations of inter-individual differences in behavior whose dimensions are termed domain and facet traits (Fleeson & Jolley, 2006; Fleeson & Noftle, 2010; Read et al.,

2010). Fleeson and Jayawickreme (2015) have followed Allport (1937) in arguing that infants initially respond to each situation uniquely, but, with increasing experience with recurring and similar situations, their responses slowly come together, or *accrete,* into broader dimensions of individual differences represented by facet and domain traits via mechanisms such as stimulus and response generalization.

Functionalist Approaches. Functionalist frameworks are compatible with contemporary network and social cognitive models that suggest that trait covariation emerges from interactive dynamics of large numbers of distinct processes, rather than from small numbers of directly causal factors (e.g., Cramer et al., 2012; Mischel & Shoda, 1995). However, functionalist approaches to personality place greater emphasis on understanding that trait levels are shaped toward their real or perceived levels of functionality to the actor via processes operating over momentary, developmental, and evolutionary time scales (e.g., Skinner, 1981; Thorndike, 1913). Perhaps the most intuitive example of functional processes is conscious planning, particularly when individuals simulate the effects of possible responses to a situation before ultimately choosing the response expected to produce the most valued effects (Hastie & Dawes, 2010). For instance, an individual may envision spending the night cavorting at a party versus holing up to study in the library, and prefer the party, but also envision getting exam results two weeks later, and consequently decide to study for the test rather than go to the party. That is, they may choose to behave *responsibly* rather than *sociably,* by deciding to prioritize progress toward long-term achievement goals.

Because functionalist frameworks predict that individuals will gravitate toward trait levels that allow them to maximize their most valued outcomes, classes of psychological variables which concern the ends people ultimately try to attain – such as *motives, goals, values, preferences,* and *interests* – are particularly important to understanding basic personality phenomena. In expectancy-value language, we can understand *values* as the

outcomes a person is ultimately trying to maximize (i.e., serving the same role as motivational processes discussed earlier), and *expectancies* as the individual's understanding of causal relations linking features of the environment, and thus the pathways afforded to attaining these valued outcomes.

Importantly, the actual structure of the environment is the ultimate arbiter of a trait's functionality. As Anderson (1991) has argued, "the mind has the structure it has because the world has the structure it has" (p. 428). Features of the environment can be regarded as any regularity of a person's experience, which can include not just 'external' features such as social status, wealth, and geographic location, but also biological characteristics (e.g., one's genetic code, sex, height, dopaminergic functioning). In this way, better detailing (a) the motivational systems that underlie particular behaviors and (b) the structure of the environment will result in considerable progress toward explaining trait-related phenomena such as stability and structure (Read, Droutman, & Miller, 2017).

Regarding stability, many environmental features have substantial and enduring effects on the functionality of behavioral and psychological tendencies. For instance, one's level of physical attractiveness, strength, or social power is often quite enduring over time, and higher levels tend to make *sociable* and *assertive* actions more functional by affecting how positively others are likely to respond (Lukaszewski, 2013; Lukaszewski, Simmons, Anderson, & Roney, 2015; Wood & Harms, 2017). Such differences in environmental pathways linking behavior to desired outcomes among individuals can be major mechanisms for trait variation and stability (Read et al., 2010). Traits with greater variation in desirability across individuals (e.g., traditionalism, dominance, organization) also tend to be more stable, consistent with the idea that rank-order stability is facilitated when individuals actively pursue different levels of the trait (e.g., some people wishing to be more traditional or dominant, and others less; Wood & Wortman, 2012). Individuals also actively work to place themselves in environments

structured to help them attain their valued outcomes. When suitable developmental niches are found, there is less pressure to change behavior over time, which should facilitate trait stability.

Regarding personality structure, functionalist frameworks afford opportunities to represent how different traits come to covary via models that provide no role for broad factors such as the Big Five to explain covariation (Wood, Gardner, & Harms, 2015). Generally, since individuals are expected to actively seek trait levels that facilitate goal attainment, possessing particular goals will tend to create drive to develop *any* trait that is expected to facilitate goal attainment (Hennecke, Bleidorn, Denissen, & Wood 2014). This in turn will result in greater trait covariation at the population level (Read et al., 2010). In other words, behavioral tendencies that serve to reach the same goal (equifinality) covary, unless some of them are detrimental to other goals (multifinality). For example, socializing with fellow students and studying hard can both contribute to social approval. Yet only studying hard contributes to academic success. Individuals differ in goals (social approval, success), but also in expected functionalities of behaviors (socializing, studying), resulting in complex interactions that have direct implications for intra- and inter-individual covariation of behavior and thus for personality structure.

Read, Droutman, and Miller (2017) have recently developed a computational model that demonstrates how the Big Five personality structure in a population could arise from suitably structured motivations within individuals. Although recent work has begun to show that more general 'strategies' for functional trait development can be formally represented in ways that may help to account for observed covariation between different process units (e.g., Wood & Denissen, 2015), this work is still in its infancy.

Conclusions to Key Question 2. The approaches described under this key question converge in hypothesizing that, by interacting with the structure of the environment,

cognitive, affective, and motivational processes may jointly bring about the patterns of inter-individual covariation among behavior, thoughts, and feelings at the population level as described in factor models of personality. Rather than assuming correspondence between causes of behavior and personality traits, many presented approaches view personality traits as *emerging* (in the sense of weak emergence) from regularities in the environment (situational demands, behavioral opportunities, consequences) to which individuals respond based on experiences made during their learning history or via deliberate choices in cases where no habits have been established yet.

The possibility that broad traits emerge from, rather than correspond to underlying causal processes, raises the question whether traits may nevertheless acquire causal status with regard to so-called behavioral or life outcomes (Mõttus, 2016). Here, again, traffic jams offer helpful analogies because they emerge from the transacting behaviors of many drivers and road conditions (Bonabeau, 2002), and they can act as causes of outcomes themselves, such as being late for work, both to individuals and to larger groups of people (Costantini & Perugini, 2016). However, considering traits as emergent properties should caution against two kinds of potential causal misinterpretations. First, as we emphasized in Part I, traits cannot serve as explanations for those behaviors they summarize. By contrast, behavioral outcomes, such as health or marital status, could be explained by clusters of behavioral tendencies, in non-circular ways. Second, if traits indeed emerge from complex transactions of causal processes, we will be particularly keen to know whether each of the behaviors clustered under the trait exerts a direct effect on a particular outcome (Mõttus, 2016) and if those behaviors might transact in complex ways themselves in causing the outcome (Schmittmann, Cramer, Walrdorp, Epskamp, Kievit, & Borsboom, 2011).

Key Question 3: Explanation of Development

What mechanisms and processes can explain enduring changes in relatively consistent and stable patterns of behavior? Personality research has provided evidence for personality development across the lifespan. This has revealed normative developmental trajectories as well as systematic individual differences in patterns of development. To explain how development is triggered and perpetuated, hypotheses about psychological processes must be formulated and tested. Research has started to develop such hypotheses, organized in recently proposed frameworks (Geukes et al., 2016; Wrzus & Roberts, 2016). In the following subsections, we review approaches to integrate process and development, centered on learning, self-regulation, and self-reflection processes.

Learning. Classical (Pavlovian) and instrumental conditioning have long been thought to be critical 'building blocks' for understanding behavior, personality, and enduring personality change. Personality research can be informed by a long history of research on learning and memory, including work on non-human models (e.g., McGaugh, 2000). Inter-individual differences in behavior can be seen as the result of differences in learning histories, including stimulus-stimulus pairings (*classical conditioning*) and contingencies between actively performing certain actions and resulting outcomes (*instrumental conditioning*). Enduring changes in co-occurrences of stimuli or in contingencies of actions and outcomes can potentially lead to enduring changes in behavioral tendencies. Thus, investigating patterns of daily experiences and enduring changes therein should be fruitful ways to understand personality development (Wrzus & Roberts, 2016).

However, large heterogeneity in human classical conditioning responses is commonly observed. Similarly, there is inter-individual variability in reinforcement learning. This re-directs attention towards inter-individual differences in how learning processes unfold. As outlined in the section on motivational processes, individuals differ in how attractive or aversive they find particular stimuli or outcomes. These evaluations can vary intra-

individually from moment to moment (e.g., being less thirsty after having drunk) as well as inter-individually in rather enduring manners. Thus, the desirability of approaching or avoiding a particular stimulus or of taking a particular action that predicts the availability of an outcome varies greatly. Moreover, individual differences in motive strengths can influence likelihoods of encountering rewarding and punishing outcomes. For example, greater strength of avoidance motives should lead to avoidance of potentially punishing situations, but may also reduce likelihoods of exposure to rewarding settings (Fazio, Pietri, Rocklage, & Shook, 2015). Also, greater motive strength (approach or avoidance) may foster greater learning from each stimulus pairing or from contingencies between responses and outcomes.

Much recent work on classical conditioning has been driven by computational models of reward learning and extinction (Alonso & Schmajuk, 2012). For example, Gershman and Harley (2015) examined whether there are qualitative individual differences in the nature of human classical conditioning responses (e.g., in spontaneous recovery of fear following extinction) that may contribute to differences in trait anxiety, and explain why some people are more vulnerable than others to develop anxiety disorders. Fitting individually-based computational models of human fear acquisition to extinction data suggested two distinct groups, with the much smaller group (17%) exhibiting faster learning in acquisition and extinction but higher levels of "spontaneous recovery" of the conditioned fear. Investing in further computational modeling work leveraging human data (e.g., propensities to segment situations/states differently; biobehavioral outcomes) is a promising direction for better understanding complex dynamics undergirding personality development, change, and maintenance.

Habits. From a learning perspective, habits can be understood to emerge as combinations of classical and instrumental conditioning (Pavlovian-to-Instrumental Transfer, PIT). The argument is that through classical conditioning the organism learns a link between

conditioned stimuli (CSs) and representations of rewarding or punishing stimuli (UCSs), and through instrumental conditioning learns links between responses (R) and the stimulus representations of the rewarding or punishing stimuli. It has been argued that a habit initially starts as a CS -> UCS^{rep} -> R chain, where a CS activates the representation of the UCS or goal object and the activated goals then strongly influence what action or response is triggered. Through repeated exposure the outcome representation becomes irrelevant and the behavior is purely a function of the link between the triggering stimulus cues and the behavior: CS -> R (W. Wood & Rünger, 2016). That is, a response might be directly triggered by situational cues and the probability of enactment might be relatively insensitive to current goals.

Habits in one's current situation/environment develop as outgrowths of earlier goals and, if those goals continue, such habits may automatically support personality stability and consistency, even when not adaptive. Moreover, if an individual attempts to change (e.g., in therapy), old habits may resist behavioral and thus personality change unless the individual reduces the habit-based triggering cues for behavior (e.g., relocation). From a functional perspective, formation of habits affords the advantages of automaticity, such as faster and more consistent performance, and conservation of psychological resources (e.g., attention). Accordingly, habits resist behavioral change also because displaying novel behaviors in a particular kind of situation involves cost to time and energy, and thus will regularly be experienced as less positive (Gershman, Horvitz, & Tenenbaum, 2015; W. Wood & Neal, 2007).

In sum, enduring changes in patterns of daily experiences most likely will not match directly with enduring changes in behavioral tendencies. Rather, we expect that individual motives and habits modulate the impact of experiences and changes therein. We suggest that because goals and motives play central roles in development of habits, through their central

mediating roles in chains from cues to behavior, clusters of habits should develop aligned with those goals and motives.

Self-Regulation (Changes in Goal-Oriented Processes). Self-regulatory perspectives on personality focus directly on explaining how behavior is shaped by conscious or unconscious goals, which can be regarded more generally as desired or valued end-states (e.g., Carver & Scheier, 1998). In a case of self-regulated behavior, the individual is motivated to perform actions because there is a discrepancy between *actual states* and *goal states*, and actions are oriented to reduce this discrepancy. Alternatively, actions can be motivated to maintain a low or no discrepancy between the two. Action initiation can be catalyzed by affective processes, such as negative affect associated with goal failure, and positive affect associated with goal attainment (Carver & Scheier, 1998).

Lifespan changes in goals can predict trait changes. According to developmental theorists, most individuals are motivated to form goals to meet societal expectations regarding important developmental milestones (Heckhausen, Wrosch, & Schulz, 2010). Age-correlated shifts in goals that facilitate trait development may be prompted by developmental milestones (Hutteman, Hennecke, Orth, Reitz, & Specht, 2014), which emerge through the interplay of psychological, social, and biological forces (Erikson, 1994). As an example of the latter, evolutionary life history theories suggest that most individuals place greater emphasis on reproductive goals in young adulthood than in childhood and older age, and in situations where efforts to fulfill these goals are most likely to be successful (Del Giudice, Gangestad, & Kaplan, 2015).

Indeed, such normative changes in motives and goals seem to parallel normative trajectories of behavioral tendencies. For instance, endorsement of motives and preferences for cooperation, fairness, and generosity seem to increase largely in concert with age-related increases in more general measures of trait agreeableness (Lehmann, Denissen, Allemand, &

Penke, 2013). If goals are indeed driving forces in trait development, studying development in people with anti-normative goals would allow critical tests of the extents to which goals guide trait development, as these individuals should show developmental decreases in maturity-related traits (e.g., conscientiousness). There is some indirect evidence of this, where people engaging in non-normative roles show diminished (and sometimes opposite) patterns of trait development from normative patterns (Helson, Mitchell, & Moane, 1984). However, more research needs to be carried out to determine whether non-normative goals and motives are appropriately cast as instigating these processes.

Mechanisms that translate goal processes into trait changes. In many cases, discrepancies between perceptions of current and valued states are likely to produce behavioral change indirectly through goals specifically related to these states, rather than via goals that are directly related to the personality traits themselves. For example, desire for a life partner might motivate an individual to join a club to increase the likelihood of meeting potential mates. 'Bottom-up' frameworks, which regard levels of at least some traits as largely equivalent with observed or expected rates of certain types of actions (see our working definition of trait; Buss & Craik, 1983; Fleeson & Gallagher, 2009; Wood, Tov, & Costello, 2015), construe the resulting behavioral change as being 'true' trait change. Some might require the new behavioral patterns to become habits that persist into the future. In this example, the individual's goal was not to 'become more extraverted,' but arguably the level of extraversion has increased (Hennecke et al., 2014). More recent evidence is consistent with the possibility that people do specifically intend trait change (Hudson & Fraley, 2015), but even then this trait change is mediated by more specific goals to increase particular behaviors (Robinson, Noftle, Guo, Asadi, & Zhang, 2015).

This does not mean, however, that personality has necessarily changed when trait-related behaviors are modified. For instance, people can learn to carry out, and even enjoy,

temperamentally difficult behaviors in the service of particular goals, but may find doing this psychologically taxing so that some kind of recovery or compensation is necessary afterwards (see Leikas & Ilmarinen, 2016). This is consistent with the idea that some of the most fundamental parts of an individual's personality may be preferences for certain classes of stimuli that are quite deeply seeded (Denissen & Penke, 2008; Johnson, 2010). An important question for future researchers is to address concerns to what extent self-regulatory efforts to modify *these* aspects are effective. More generally, our sense is that the contributions of self-regulatory skills and strategies to trait development have only recently begun to be rigorously explored empirically, and establishing the causal influences of such factors on trait development will require further experimental and longitudinal work.

Self-Reflection. Personality development is often studied using self-reports of personality. This implies, strictly speaking, that changes and continuities in propositional representations of trait levels (i.e., explicit self-concepts) are examined, while behavioral tendencies may or may not change to the same degrees, at the same paces, or even in the same directions. Thus, change and continuity in self-reports may not be equated with other manifestations of personality. Nevertheless, reported self-concepts are thought to reflect typical functioning of intra-individual processes and to capture inter-individual differences in behavior (Back, Schmukle, & Egloff, 2009). Investigation of self-reflective processes and inter-individual differences in these processes is crucial for understanding to what extent, how, and under what conditions behavioral tendencies actually affect the self-concept. Conversely, the personality self-concept is thought to shape behavior in consistent ways through action plans and behavioral intentions (Schmitt, Hofmann, Gschwendner-Lukas, Gerstenberg, & Zinkernagel, 2015). Therefore, self-reflective processes can contribute to the perpetuation of change, and thus, personality development.

Reflective processes include cognitions about **state levels** that have manifested, about related antecedents (e.g., situations and goals) and consequences (e.g., Staudinger, 2001; Hennecke et al., 2014; McAdams & Olson, 2010; Wood & Denissen, 2015), as well as about trait levels. When reflecting about their personalities, individuals compare perceived state and trait levels, and integrate the remembered and evaluated state levels into their explicit self-concepts of personality by confirming or adjusting their propositional representations of trait levels (Back et al., 2009; Bem, 1972; Gawronski & Bodenhausen, 2006; Krampen, 1988). For example, being highly talkative during one night might either correspond to, or deviate from, a person's propositional representation of his or her level of extraversion. In case of correspondence between perceived state and current trait levels, reflective processes confirm and consolidate the current representation of level of trait extraversion. In case of deviation, several ways to resolve discrepancies between perceived state and trait levels exist.

Theoretical models posit that self-perceptions of trait levels should largely track actual rates of trait-indicative state levels (e.g., Buss & Craik, 1983; Fleeson & Gallagher, 2009; Wood, 2007). When aiming at achieving accuracy, individuals tend to adjust their propositional trait levels to the perceived state levels in case of repeated discrepancies (comparable to accommodative rather than assimilative processes; Brandtstädter, 1989; Piaget & Inhelder, 1969). In addition to achieving accuracy, however, other self-perception goals such as aiming at consistency, self-enhancement, or popularity (or their opposites) can govern self-perceptions (Finnigan & Vazire, 2017; Robins & John, 1997; Wilson & Dunn, 2004).

When aiming at achieving consistency, for instance, individuals (re)interpret or assimilate (Piaget & Inhelder, 1969; Robins & John, 1997) self-perceptions of state levels in line with self-perceived trait levels. Talkative behavior might be attributed to consumption of alcohol, and interpreted as a behavior that is atypical of one's perceived shyness (low

extraversion), in order to maintain the perceived trait level of shyness. Different goals of self-perception, and accordingly reflective processes, help to explain why repeated state levels do not necessarily translate into matching changes in self-reported trait levels of personality characteristics (Hofmann, Gschwendner, & Schmitt, 2009; Zinkernagel, Hofmann, Gerstenberg, & Schmitt, 2013).

In addition to reflection on specific states, further research could usefully address self-reflective processes on broader levels. *Self-narration* describes the process through which individuals phrase, interpret, and evaluate (life) events and their consequences for generalized self-view or identity (King, 2001; McAdams & Olson, 2010; McLean, Pasupathi, & Pals, 2007; Pals, 2006). *Life reflection* is the social cognitive process of remembering, interpreting, and evaluating one's life overall (Staudinger, 2001). Similar to the reflective processes discussed before, self-narration and life reflection are thought to contribute to a coherent self-concept, including knowledge of one's personality characteristics (McAdams & Olsen, 2010; Staudinger, 2001). Empirical evidence for this theory is still limited, because most studies to date have employed cross-sectional designs. One longitudinal study on life narratives (i.e., reflecting difficult life events) observed that reflective processing and coherent, positive resolution of difficult events predicted increases in personality maturity in late adulthood nine years later (Pals, 2006).

Conclusions to Key Question 3. The various processes described in this section work in concert. Change in elements that feed into each of these processes can trigger change in behavioral tendencies. For example, changed social feedback about certain behaviors can initiate behavioral change; novel personal goals can elicit changes in behavior; and changing attributions of one's own behavior as typical or atypical can affect the likelihood of showing this behavior again. If changes in those elements are enduring, learning, self-regulation, and self-reflection can contribute to personality development.

Moreover, learning, self-regulation, and self-reflection can work together and mutually perpetuate and amplify their effects on behavioral tendencies. For example, changes in associative and reinforcement patterns likely contribute to the development of implicit personality characteristics (Gawronski & Bodenhausen, 2006). By triggering state levels that are accessible for self-reflection, these processes can also lead to change in explicit self-concepts of personality (Zinkernagel et al., 2013), which in turn can shape behavior through action plans and behavioral intentions (Schmitt et al., 2015). Similarly, goals to change behavior can be strengthened when displaying alternative behaviors has positive consequences.

However, these processes can also work against each other, thus diminishing the impact of changes (e.g., in cue constellations, goals, or self-reflective cognitions) on behavior and stabilizing existing behavioral patterns. For example, habits may override goals to change behavior, experiences of atypical states may be assimilated to the self-concept, and learning opportunities may be avoided because of mismatches with important goals. Thus, process-oriented research on personality development needs to consider these processes simultaneously to understand the conditions under which change is perpetuated or blunted (Geukes et al., 2016).

The discussed processes may contribute not only to explanation of enduring changes in trait levels, but they also may help to explain structural change. To the extent that domain and facet traits, or concrete behaviors at the item level, develop in the same directions consistently among individuals, the structure of personality traits will be maintained. Alterations in personality structure can occur, however, if domain or facet traits or behaviors captured by single items develop at different rates or in different directions (Hülür, Ram, Willis, Schaie, & Gerstorf, 2015; Mõttus, Realo, Allik, Esko, Metspalu, & Johnson, 2015; Roberts et al., 2008). Changes in personality structure could be explained by changes in reward structures. For

example, if attaining developmental milestones alters costs and benefits of different kinds of conscientious behavior intra-individually (conscientious behavior is rewarded at the new first job but not in the new independent living situation), they tend to become intra-individually independent, with one kind increasing in frequency and strength and another kind remaining constant or even decreasing. If such intra-individual changes in reinforcement patterns differ among individuals (some being rewarded for conscientiousness only at home, others only at work, others both at work and at home, others neither at work nor at home), inter-individual correlation between the behaviors will decline over time.

Structural change can also result from gains or losses in behavioral opportunities (Shiner & DeYoung, 2013; due to biological maturation or decline, age-dependent social constraints, historical innovations, or individual development of skills and competencies, and changes in individual living conditions). Only once behavioral opportunities have appeared can the behaviors at issue vary intra- and inter-individually. Only then can they become parts of clusters of correlated behaviors that define traits. Accordingly, we propose that for a complete understanding of personality development, relevant psychological processes need to be scrutinized in concert with each other as well as with environmental regularities, including behavioral opportunities.

Part III: Conclusions, Limitations, and Future Steps

Conclusions

The main proposition of this paper is that personality process, structure, and development are inherently inter-connected. For complete understanding of personality, we need to identify the intra-individual psychological processes that explain variation of behavior across situations as well as the systematic inter-individual differences in those processes that explain variation in behavior across individuals. This knowledge is necessary to get insight into how personality structure emerges and how enduring changes in trait levels and in

personality structure across the lifespan come about. While patterns of behavioral covariation can provide working hypotheses regarding functionalities and specificities of processes (Shiner & DeYoung, 2013), it would be shortsighted to presuppose that processes are organized in a way that directly corresponds to the observed structure. Rather, it is an empirical question whether shared sets of processes are uniquely involved in shaping correlated behaviors, but not uncorrelated behaviors (what we have termed 'correspondence' throughout this paper) or whether more complex interactions of processes give rise to population patterns of covariation (in the sense of 'weak emergence').

Consistent with our main proposal that process, structure, and development are inherently connected, our theoretical reasoning and research examples provided in Part II demonstrate that the processes discussed under Key Question 1 are mirrored under Key Questions 2 and 3. Cognitive, affective, and motivational processes not only contribute to variation in behavior, both within and across individuals, but also provide explanations for personality structure and development. Identifying intra- and inter-individual differences in causal processes and their parameters can contribute to the explanation of intra- and inter-individual differences in behavior (Key Question 1). Identifying environmental regularities that stimulate these processes can explain patterns of covariation in behavior (Key Question 2). Identifying change in elements of these processes can explain enduring change in trait levels and structure (Key Question 3). These conclusions are unsurprising given that the data box described in Part I provides as basic information the behavioral outcomes of cognitive, affective, and motivational processes. The very same outcomes are used in personality research to indicate personality structure and development. By definition, therefore, the mechanisms that generate the cell entries of the data box also account for the structures that can be extracted from it, for changes in these structures across time, and for trait-level changes.

As a note of caution, the way cells are aggregated (across individuals, across situations, across behaviors, across time points) will have substantial consequences for the resulting structures or developmental trajectories. For example, if behaviors that cluster under a facet trait change in different directions to the same degree, then the change trends may cancel each other out if the behaviors are aggregated (Mõttus et al., 2015). Accordingly, if behaviors belonging to one facet trait correlate differently with the behaviors belonging to another facet trait (some positive, some negative), then the correlations between the facet traits will disguise the complex correlation patterns on the level of concrete behaviors. An important and often undesirable consequence of such aggregations is that the aggregate can no longer be traced to the processes that generated its elements (Asendorpf, 2016; Costantini et al., 2015).

Nomothetic personality research frequently aggregates across individuals. If we measure several behaviors in a population of individuals, the means, variances, and correlations of the behaviors are parameters that describe the population but no individual member of it. This widely accepted and practiced nomothetic research strategy may disguise potential idiosyncrasies in the processes that are responsible for variation in behavior. Two people might react with the same strength of protest against an allocation of rewards, but for Person A this is because she interprets the allocation as extremely unjust, whereas for Person B it reflects a strong emotional reaction despite perceiving the situation as only moderately unjust. Moreover, Person A, who evaluates unfairness cognitively, may react emotionally to something else such as an adverse medical diagnosis, whereas Person B may instead react cognitively to the same news. In other words, processes may be idiosyncratic both within and between individuals. Such idiosyncratic causal patterns will result in very small effect sizes when scrutinizing processes at the population level.

Some process-oriented researchers have tended to assume that most such processes are idiosyncratic within and between individuals as described above, and consequently have

considered that they have little relevance to traits (Cervone, 1991; Lamiell, 1981; Morf, 2006; Mischel & Shoda, 1995). However, this results in major blind spots. Unravelling all idiosyncracies of situation and individual person is beyond realistic reach, but it is possible to develop ways to link the two levels. For example, moderator models can identify general patterns linking micro-level processes to macro-level traits and outcomes that are applicable to many. The moderating variables should be chosen on theoretical grounds, and must be carefully measured using appropriate research designs (Schmitt, 2009; Schmitt et al., 2015). For example, for some individuals, justice may be a moral mandate (Mullen & Skitka, 2006), accompanied by a strong commitment to fight for justice. For these individuals, cognition concerning injustice will particularly strongly motivate behavior.

Inclusion of moderator variables can increase explanatory specificity and offer a general strategy preventing false or imprecise conclusions that would result from averaging out relevant differences via aggregation. As an alternative approach, data-driven explorations, for example by means of machine learning (Yakoni & Westfall, 2017) could provide additional insight into complex interactions between processes that allow prediction of behavior. As a note of caution, however, previous moderator research has demonstrated that theory-based moderator effects can be replicated whereas data-driven moderators often fail replication attempts (Snyder & Ickes, 1985).

Limitations

Our discussion and review of causal processes has been constrained by a number of limitations. Importantly, we touched on biological processes (DeYoung, 2013; DeYoung & Gray, 2009; Shiner & DeYoung, 2013), and the processes underpinning gene selection and expression (Johnson & Penke, 2015; Penke & Jokela, 2015), only occasionally in our paper. The comprehensive discussion of these processes, their evolutionary and genetic origins, and how they transmit and modulate thoughts, feelings, and desires was beyond the scope of this

article. Obviously, cognitive, affective, and motivational processes are rooted in neural and hormonal processes. This does not limit the explanatory relevance of psychological processes for understanding behavior, however. As explained in the section on network approaches to personality, different levels of explanation can be addressed and each level can be hypothesized to emerge from complex relations of processes at lower levels. This insight seems to result, for instance, from failure of molecular genetics to find direct correspondence between single gene expressions (SNPs) and phenotypic variance in personality or intelligence (e.g., Chabris et al., 2012; Deary, Penke, & Johnson, 2010; Munafo & Flint, 2011; Smith et al., 2016). Moreover, the level of processes we have chosen for our analysis is particularly suited for effective psychological interventions to change behavior (e.g., MacLeod & Mathews, 2012).

We also did not address interpersonal or intergroup processes in the present paper, and such processes are without doubt important for complete understanding of personality (Back et al., 2011). Further, the examples we have chosen to illustrate how cognitive, affective, and motivational processes can serve to explain behavior, how these processes are involved in learning, self-reflection, and self-regulation, and how they contribute to the explanation of structure and development are inevitably incomplete. Our main goal was to highlight convincing approaches towards integration that have been proposed in the literature, bring together those previous partial attempts at integration, and illustrate how further integration can be achieved using examples from our own substantive research programs.

Implications for Future Personality Research

What should be done in future personality research to accommodate the central proposals of this article?

Investigating Processes in Concert. Process-oriented research has often focused on isolated processes (e.g., attention, goal striving) to explain specific behaviors. This approach

has brought considerable progress in those domains of behavior under focus. For progress in understanding personality more completely, we propose to extend process-oriented research in two ways. First, given the close connection between cognitive, affective, and motivational processes, we believe that these processes should be considered simultaneously to fully realise their combined explanatory powers, and to delineate their unique constributions. Second, we propose that processes should be compared across domains of behavior. This will help to determine whether processes are shared among domains, whether processes are parallel but content-specific, or whether processes are specifically involved in some domains but not in others. Gaining this kind of understanding will help to identify fundamental mechanisms of behavior.

Linking Macro- and Micro-Levels of Assessment. For a fruitful joint investigation of personality processes, structure, and development, we believe that the level of aggregation at which we measure behavior needs to be considered carefully. The need for "disaggregation" in personality research has been brought forth in two regards, both of which are crucial in the present context.

First, authors have discussed aggregation of items used in the measurement of behavioral tendencies (Asendorpf, 2016; Costantini et al., 2015; Wood et al., 2015). Aggregation into facets or broad factors (e.g., Big Five factors) has important advantages for description (i.e., parsimony) and prediction of outcomes (i.e., consistency and stability). However and as indicated earlier, aggregation can disguise causal and functional relations among the aggregated elements. In particular, in many questionnaire measures, cognitive, affective, motivational, and behavioral items are aggregated. Clearly, attempting to explain aggregate individual differences by cognitive, affective, or motivational processes used to define them is circular (Back, 2017; Mõttus, 2016). Moreover, as Wood et al. (2015) pointed

out, aggregation can also obscure relations that some of the aggregated elements might independently have with behavioral tendencies that are uncorrelated with the aggregate.

Second, aggregation often already takes place at the level of measurement, even at the item level. Specifically, self- and informant-reports generally feature items that ask for appraisal of generalized tendencies (e.g., "I easily resist temptation" Goldberg, 1999; "It makes me angry when others are undeservingly better off than me" Schmitt et al., 2010). These kinds of reports require target participants or informants to remember (expressions of) cognitive, affective, motivational or behavioral responses and aggregate across relevant situations and time. Besides distortions due to memory biases (Robinson & Clore, 2002a, b), such generalized reports may be unable to capture the processes across time and situations that we are most interested in. With personality processes, we aim to understand intra-individual dynamics of states (i.e., momentary behavior in a broad sense) in interaction with situational cues, and inter-individual differences in how these processes unfold (Wrzus, Quintus, & Baumert, in press). To gain insight into these processes, it is necessary to link description of behavioral tendencies at "macro levels" of high generalization across time and occasions with "micro level" descriptions entailing high time resolution and fine distinction of situational constellations.

Methodological requirements for assessment of personality processes have been addressed in detail elsewhere (Geukes et al., 2016; Wrzus & Mehl, 2015; Wrzus et al., in press). Broadly speaking, we must have measures of cognitive, affective, motivational, and behavioral states under specified situational conditions. To depict processes, we need repeated measures paired with (at best, systematic) variation of situational constellations. This methodological approach of repeated momentary assessments, whether adopted in the field or the lab, will allow us to describe in detail inter-individual differences in how processes unfold across time and situations. These differences may be short-lived or relatively stable in the

sense that they are found repeatedly under the same conditions. Once identified, these differences can explain inter-individual differences in subsequent processes. Considered in concert, differences in various processes can explain personality structure (Wood et al., 2015).

Multi-Method Assessments. To ascertain substantial relations among personality processes, use of multimethod approaches can help to overcome problems of common method variance and item overlap (Diener & Eid, 2006; Mõttus, 2016). The extent to which correlations between measures obtained via the same method (e.g., self-report) can be inflated by irrelevant variance (e.g., acquiescent or careless responding) is probably underappreciated (Credé, 2010; Huang, Liu, & Bowling, 2015). Therefore, correlations among inter-individual differences assessed by means of different methodologies (e.g., behavioral observations, e.g., Back & Egloff, 2009; Kurzius & Borkenau, 2015; indirect "objective" tests; e.g., Mathews & MacLeod, 1994) seem to be more informative than correlations found with the same assessment method.

Causal Relations among Processes. While correlational approaches are necessarily limited with regard to causal conclusions that can be drawn, repeated momentary assessments allow studying lagged associations between process variables, thus testing their predictive power. Besides correlational approaches, the direct experimental manipulations of processes of interest can help to establish causal relationships. Cognitive bias modification may serve as an example. Recent research has demonstrated that the selective interpretation of ambiguous situations as less threatening can be trained. Using such training procedures, the causal impact of such interpretive selectivity on emotional disposition, as indicated by intensity of affective reactions to stress can bee determined (Mathews & Mackintosh, 2000). In combination with correlational studies, the results of such bias modification research indicates that the patterns of selective information processing previously found to correlate with measures of trait anxiety make a causal contribution to this disposition by functionally influencing anxious

reactions to stress (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). More generally, we argue that experimental manipulations of processes can yield insight into causal relations of relatively stable inter-individual differences in these processes (e.g. Maltese, Baumert, Schmitt, & MacLeod, 2016; MacLeod et al., 2002).

Final Remarks. To conclude, our selective reviews of previous research that has attempted or reached partial integration of process, structure, and development highlight that we are not the first to tackle these issues. In consensus with previous approaches, we see integration as the direction for progress in personality psychology toward an explanatory science (Asendorpf, 2016). We hope that our article has drawn a comprehensive picture of why integration is necessary and how it might be achieved.

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Appendix: Working Definitions

Examples of definitions in the literature serve as contexts for understanding our working definitions. Definitions will be given in alphabetic order of the terms to be defined.

Affective processes

Examples of definitions in the literature.

1) "Emotion is a complex set of interactions among subjective and objective factors, mediated by neural~hormonal systems, which can (a) give rise to affective experiences such as feelings of arousal, pleasure/displeasure; (b) generate cognitive processes such as emotionally relevant perceptual effects, appraisals, labeling processes; (c) activate widespread physiological adjustments to the arousing conditions; and (d) lead to behavior that is often, but not always, expressive, goaldirected, and adaptive." (Kleinginna & Kleinginna, 1981a, p. 355)

2) "Core affect - A neurophysiological state that is consciously accessible as a simple, nonreflective feeling that is an integral blend of hedonic (pleasure–displeasure) and arousal (sleepy–activated)". (Russell, 2003, p. 147)

Working definition for this article

Those processes involved in, bringing about, or altering subjective experiences (feelings) of pleasure/displeasure and activation

Clarifications.

Affective processes subsume emotions, which have been construed as affective episodes directed at objects which are being appraised in a way characteristic to a concrete emotion, involving bodily changes, and motivational consequences (Kleinginna & Kleinginna, 1981; Mulligan & Scherer, 2012).

Behavior

Examples of definitions in the literature.

1) "The totality of intra- and extra-organismic actions and interactions with its physical and social environment. Psychology deals with three types of phenomena: 1) Observable behavior […] 2) Introspectively observable phenomena […] 3) Unconscious processes […]" (Dictionary of Behavioral Science, Wollmann, 1975)

2) "behavior—defined in the broad sense to include actions, cognitions, motivations, and emotions" (Fleeson & Noftle, 2008, p. 1357)

3) "The behavior of an organism is everything it does, including covert actions like thinking and feeling" (Pierce & Cheney, 2004, p. 1)

4) "behaviour may be defined as verbal utterances (excluding verbal reports in psychological assessment contexts) or movements that are potentially available to careful observers using normal sensory processes." (Furr, 2009, p. 372)

5) "behaviour is what an organism observably does or says" (Watson, 1925, p. 6)

Working definition for this article.

a) Behavior in a broad sense: everything an organism does. This includes observable actions, covert actions, cognitions, motivations, and emotions (see definitions 1, 2, 3).

b) Behavior in a narrow sense (observable/overt behavior, according to definitions 4, 5): overt behaviour defined as verbal utterances and their content (e.g. asking for help), non-verbal utterances (e.g., clearing one's throat), movements that are potentially available to careful observers using normal sensory processes, certain physiological

reactions (e.g. blushing), lack of movement in certain contexts (e.g. sleeping, freezing, ignoring)

Clarifications.

Available definitions in the literature vary from broad and inclusive (1, 2, 3) to rather narrow conceptions of behavior (4 and 5).

Causality

Examples of definitions in the literature.

1) "Three criteria of Mill (1843). These hold that X can be considered a cause of Y if (a) X and Y covary; (b) X precedes Y; and (c) ceteris paribus, Y does not occur if X does not occur." (Borsboom et al. 2003, p. 211).

2) "Aristotle distinguished four causes—efficient, final, material, and formal—that may be illustrated by the following example: a statue is created by a sculptor (the efficient) who makes changes in marble (the material) in order to have a beautiful object (the final) with the characteristics of a statue (the formal)." (*The Columbia Electronic Encyclopedia®,* 2013)

3) "A cause is…an insufficient but non-redundant part of a condition which is itself unnecessary but sufficient for the result" (INUS condition; Mackie, 1965, p. 245)

Working definition for this article.

Definition 3) from above

Clarifications.

Causes antecede their effects; causes are necessarily followed by their effects only if hindering conditions are absent. Causes are not necessarily singular, but multiple (not even simultaneous) causes are possible.

As an example of the INUS condition, take rain as a cause of the grass being wet. Rain is not necessary for the grass's wetness because other causes can have the same effect (e.g. sprinkler); and rain is also not sufficient in cases that hindering conditions are present (e.g. a roof).

Change

Working definition for this article.

We use the term "change" to describe differences between behavior at one time from that at some other.

Clarifications.

Changes can be short-term or long-term. Short-term changes are intra-individual differences in state levels. Long-term changes are intra-individual differences in trait levels (see development below).

Cognitive processes

Example of definitions in the literature.

processes by which "sensory input is transformed, reduced, elaborated, stored, recovered, and used." (Neisser, 1967, p. 4)

Working definition for this article.

Definition from above

Clarifications.

Such processes include perception, attention, interpretation, semantic relationships, and memory.

Development

Example of definitions in the literature.

"The progressive series of changes in structure, function and behavior patterns that occur over the life span of a human being or other organism" (APA Dictionary of Psychology, VandenBos, 2006)

Working definition for this article.

Relatively enduring change, including i) decrease or increase in a person's trait level; ii) relatively enduring change in trait expression; ii) relatively enduring change in personality structure

Clarifications.

Development can be due to a normative process like maturation or to individual-specific life circumstances and events. Development can be positive (adjustment, growth) but also negative (loss, decline, emergence of disorder).

Explanation

Example of definitions in the literature:

"a) Something that serves to … clarify (clarification, construction, decipherment, elucidation, exegesis, explication, exposition, illumination, illustration, interpretation); b) Statement of causes or motives (account, justification, rationale, rationalization, reason)" (American Heritage® Dictionary of the English Language, 2011).

Working definition for this article.

An explanation articulates a causal or functional relation, or a linked series of them, that can act or do(es) act to bring about some phenomenon.

Clarifications.

Explanations enable understanding of the mechanisms and processes that link cause or function and behavior. Naming the processes involved in a phenomenon is not necessarily an

explanation, namely in cases when it does not offer reasons or causes for their co-involvement.

Function

Examples of definitions in the literature.

1) "Function - Animal behavior: In studying the function of a behavioral characteristic of an animal, a researcher seeks to understand how natural selection favors the behaviour. In other words, the researcher tries to identify the ecological challenges, or "selection pressures," faced by a species and then investigates how a particular behavioral trait helps individuals surmount these obstacles so that they can survive and reproduce. In short, the question being asked is: What is the behaviour good for?" (Encyclopedia Britannica, Seeley & Sherman, 2009)

2) "The meaning of function … refers to the fact that elements in the current and past environment of an organism influence its behavior. Hence, behavior is a function of the environment (*function-of*). Nevertheless, the term functional can have other meanings, the most common of which in psychology refers to the goals or purposes of a specific construct in a broader context (*function-for*)." (Perugini, Costantini, Hughes, & De Houwer, 2016, p. 34)

Working definition for this article.

The term 'function' can be used in at least three distinguishable senses. Accordingly, we distinguish three types of functions:

Type a) *Function* as causal relations between behavior and past and present situations as well as past state levels of the person (*function of)*

Type b) *Function* as behavior being adaptive for the organism (*function for*)

Type c) *Function* as an organism's goal (conscious or unconscious) to produce a consequence (which may or may not occur)

Clarifications.

As an example, a mother might praise her son because he behaved prosocially and this has pleased her. In this sense her praising is a *function of* (type a) the boy's behavior and her mood. Her goal might be to encourage him to show this behavior again in the future. Encouraging his behavior is the *function (type c*) of her praise, even if she is wrong and praising does not have the intended consequence. Finally, receiving praise might be adaptive in the sense of affecting the boy's self-esteem and academic achievement. This in turn may affect his success in finding a mate (and reproducing). Praising in this sense would be *functional for* (*type b*) the organism at the individual level (self-esteem, academic achievement) and the level of his family's continuity (survival fitness).

In the mathematical sense, the term function can be used for describing relations among variables without involving causal relations. For the purpose of this article, however, we restrict the use of function to the three meanings outlined above.

Mechanism

Example of definitions in the literature.

"A mechanism is a structure performing a function in virtue of its component parts, component operations, and their organization. The orchestrated functioning of the mechanism is responsible for one or more phenomena" (Bechtel & Abrahamsen, 2005, p. 423).

Working definition for this article.

A system of components, operations, and their organization that together produce a phenomenon (in the context of this article, behavior or clusters of behaviors).

Clarifications.

The concept of "psychological mechanism" implies a mechanistic view of causality and functions (a, b, c). When we posit psychological mechanisms, we try to view human experience and behavior in analogy to physical (mechanical) laws. This does not necessarily imply deterministic links among the components. In fact, unlike the operation of mechanisms in classical physics, these links are usually conceptualized as being probabilistic.

We can take a clock as an example of a deterministic mechanism, typical of the physical conceptualization. Knowledge of the clock's component parts, component operations, and their organization allows understanding of how the hands are set in motion by an impulse from the turning of the spiral.

It is almost certain that there are no mechanisms related to behavior that are as deterministic as the clock. Evidence for most of those hypothesized is mixed, likely precisely because of their highly probabilistic nature and thus high variability of operation both across and within individuals. One for which there is (arguably) reasonably consistent evidence is that people carrying a short allele of the serotonin transporter gene who experience stressful life events are more likely also to experience depression. This combination of stressful experience and tendency to express less serotonin in the brain can at best be considered a partial and probabilistic mechanism in generating a depressive episode, but it is perhaps a start.

Mechanisms can unfold as processes, involving steps that take place across time. But mechanisms do not have to be processes, as the example of the clock depicts a mechanism that does not precede the phenomenon it produces.

Motivational processes

Example of definitions in the literature.

1) "The phenomena of motivation are said to be (1) the maintenance of direction in behavior and (2) an increase in energy level." (Duffy, 1941)

2) "Motivation refers to those energizing/arousing mechanisms with relatively direct access to the final common motor pathways, which have the potential to facilitate and direct some motor circuits while inhibiting others." (Kleinginna & Kleinginna, 1981b, p. 272)

Working definition for this article.

Processes involved in the selective approach/avoidance of certain situations (or features thereof).

Parameter

Example of definitions in the literature.

"A numerical constant that characterizes a population with respect to some attribute" (APA Dictionary of Psychology, VandenBos, 2006)

Working definition for this article.

a) Properties of variables (such as sample mean)

b) Properties of associations between variables (such as beta weight of predictor)

Clarifications.

Parameters are estimates of hypothesized population-level constants generated by application of hypothesized model mathematical relations among variables in particular samples using particular measurement instruments. As such, parameters represent properties of psychological processes, functions, and mechanisms whenever these are described in mathematical language.

Personality

Examples of definitions in the literature:

1) "… an individual's characteristic patterns of thought, emotion, and behavior, together with the psychological mechanisms – hidden or not – behind those patterns" (Funder, 2004, p. 5)

2) "… individual differences in characteristic patterns of thinking, feeling and behaving" (APA, n.d.)

3) "… those characteristics of the person that account for consistent patterns of feelings, thinking, and behaving" (Pervin, Cervone & John, 2005, p. 6)

4) "Personality psychology attempts to describe, predict and explain those recurrent behaviours that set an individual apart from some or all other age-mates" (Asendorpf, 2009, p. 43).

Working definition for this article.

A person's characteristic pattern of behaviors in the broad sense (including thoughts, feelings, and motivation).

Clarifications.

The characteristic pattern of a person's behaviors is relatively stable across time and useful to distinguish this individual from others. A pattern may be defined, for example, along several dimensions considered relatively independently, collections of relations among dimensions, or both. Relevant patterns can also include characteristic recurring patterns of change (e.g., patterns of emotional variability, reactivity, sensitivity).

Personality structure

Example of definitions in the literature.

"[…] a relatively stable arrangement of elements or components organized so as to form an integrated whole. Structure is often contrasted with FUNCTION to emphasize how something is organized or patterned rather than what it does. […]" (APA Dictionary of Psychology, Van den Bos, 2006)

Working definition for this article:

Manner in which traits or states are organized with respect to each other among individuals, or states organized within individuals.

Clarifications.

Traits (including motives, values, abilities, etc.; see working definition of traits above) can be ordered and aggregated according to the patterns of relations among them across individuals. This allows a parsimonious and potentially exhaustive system for the description of inter-individual differences in behavior.

Most research on personality structure has been concerned with inter-individual differences. However, the term 'structure' also applies to the relations among states within individuals as expressed over time.

Process

Example of definitions in the literature.

"A series of actions, changes, or functions bringing about a result" (American Heritage® Dictionary of the English Language, 2011).

Working definition for this article.

A process is a series of steps (elements, components, actions) through which some phenomenon takes place or emerges. The term "process" necessarily makes reference to passage of time and implies changes or development during the referenced period.

Clarifications.

Processes of interest in psychology can be operations at the intrapersonal psychological level (e.g. perception, learning, thinking, information processing, or activity regulation), but also at the interpersonal level (e.g. turn-taking in conversation), at the intergroup level (e.g. emergence of group identity from an initial collection of strangers), and at intrapersonal biological levels (e.g. transaction of synapses).

Psychological Trait

Example of definitions in the literature.

"A relatively stable, consistent, and enduring internal characteristic that is inferred from a pattern of behaviors, attitudes, feelings and habits in the individual. Personality traits can be useful in summarizing, predicting, and explaining individual conduct, and a variety of personality trait theories exist, among them Allport's Personality Trait Theory and Cattell's Factorial Theory of Personality. However, because they do not explain the proximal causes nor provide a developmental account, they must be supplemented by dynamic and processing concepts such as motives, schemas, plans, projects and life stories." (APA Dictionary of Psychology, Van den Bos, 2006)

Working definition for this article.

Quantitative dimension describing relatively stable inter-individual differences in the degree/extent/level of coherent behaviors, thoughts, feelings.

Trait level: individual score on a scale measuring a trait

Clarifications.

Relative temporal stability is the defining characteristic of traits. Content and breadth of expression are not defining characteristics of traits. This means that traits include all psychological dimensions of stable individual differences regardless of their content

(personality, temperament, ability, attitude, value, belief, motive, emotion) and their width (habits, facets, domains, types). One can distinguish widths, for example, by using the terms ‘facet trait’ and ‘domain trait’. Personality as defined above consists of the levels of a person on all psychological traits.

Situation

Examples of definitions in the literature.

1) "A situation is a set of fleeting, dynamic, and momentary circumstances that do not lie within a person, but in his/her surroundings (i.e., in a more general and enduring environment). The situation harbors objectively quantifiable stimuli (cues) that may be perceived and interpreted by a person (thus creating psychological situation characteristics)." (Rauthmann, personal communication 2015.11.17)

2) “The environment is the general and persistent background or context within which behaviour occurs; whereas the situation is the momentary or transient background. Stimuli can be construed as being the elements within a situation” (Endler, 1981, p. 364)

3) “… seven circumstantial concepts related to situations: (i) occurrence, (ii) situation, (iii) episode, (iv) life event, (v) typical or commonly occurring situation, (vi) environment and (vii) context. One may think of these concepts as being ‘nested’ within each other like layers of an onion: specific occurrences (e.g. a new colleague is shaking hands with you) take place within a situation (e.g. being at your welcome reception as a new coworker), and this situation may be part of a longer episode in someone’s life (e.g. the first day at a new job). Certain episodes can amount to or represent life events (e.g. the first job), if they are significant, intense or enduring

> enough. Additionally, typical situations (e.g. going to work or doing some grocery shopping near home) may occur with some regularity. Occurrences, situations, episodes, life events and typical situations are all nested within someone's habitual environment or socio-ecological niche (e.g. the workplace or home), which, in turn, are nested within sociocultural and historical contexts. Transitions from an occurrence to a situation or from a situation to an episode can be gradual, and generally, occurrences, situations, episodes, life events and typical situations may seep into each other" (Rauthmann, 2015, p. 242)

Working definition for this article.

A situation is a set of circumstances outside the person consisting of objectively quantifiable properties (often including other people) that may be perceived and interpreted by a person.

Clarifications.

Circumstances outside the person can be conceptualized more broadly or more narrowly and vary in their temporal duration (enduring environment, context, e.g., the school a student attends vs. occurrence, stimulus; e.g. being ask a question by the teacher). Stimulus is the smallest conceptual unit of circumstances outside the person. Examples of stimuli are the temperature of the hand one shakes, particular objects in the surrounding environment, and words used in experiments to trigger reactions, or in unstaged discussions.

State

Examples of definitions in the literature.

1) "State: (R.B. Cattell) Dimension describing change over-time within a single individual or in groups of individuals. Essentially, a factor-dimension in *intra*-individual change as

contrasted with a Trait which describes *inter*-individual differences at any one time. […]" (Dictionary of Behavioral Science, Wollmann, 1975)

2) "A personality state is defined as having the same affective, behavioral, and cognitive content as a corresponding trait (Pytlik Zillig, Hemenover, & Dienstbier, 2002), but as applying for a shorter duration." (Fleeson & Jayawickreme, 2015, p. 84)

Working definition for this article.

Quantitative dimension describing the degree/extent/level of coherent behaviors, thoughts, feelings at a particular time.

State level: individual momentary score on a scale measuring a state.

Clarifications.

A state dimension can be used to describe inter-individual differences at a specific time as well as intra-individual differences across time. States include all dimensions on which individuals tend to vary with considerable frequency over rather brief time spans, regardless of their content (e.g., emotion, motivation, cognition) and their breadth (e.g., negative affect vs. sadness or disgust).

The main difference between traits and states is the persistence of individual status. State levels can vary over short time periods; trait levels develop slowly or in rather persistent manners (even in cases of sudden increases or decreases in trait levels, e.g. due to traumatic experience or brain lesions, these changes then persist). Nevertheless, the content of some states can be identical to the content of some traits.