CHAPTER ONE

The functional architecture of human motivation: Personality systems interactions theory

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Abstract

In this article, we present the theory of Personality Systems Interactions (PSI) as an overarching framework for analyzing the functional architecture of human motivation and personality functioning. Section 1 delineates how PSI theory integrates various traditional motivation theories into seven distinct levels of human motivation and individual differences thereof. Section 2 covers principles of PSI theory that determine how motivational systems, located at the same level or at different levels, interact with each other. Sections 3 and 4 show how these principles can explain two major paradoxes in motivation psychology, namely (a) people's frequent failure to act upon their best intentions, and (b) people's tendency to adopt goals that run counter to their personal preferences and needs. Section 5 discusses how PSI theory conceives of implicit motives as "switch boards" that connect motivational systems at different levels. Section 6 reports neuroscientific evidence supporting PSI theory. Finally, Section 7 reflects more broadly on PSI theory's key contributions to motivation science and its applications.

During his high school years, one of the authors (JK) tutored younger German students whose parents wanted them to improve their school grades. A common remark from parents, and even sometimes from teachers, was: "Give the child a hard time, s/he is just lazy and needs strict discipline". When working with these children, it became apparent that the term *laziness* did not really explain their motivational difficulties. Instead, the laziness attribution obscured an array of different reasons for the children's lack of motivation. For instance, some children had not developed habits conducive to learning, others seemed to have low energy, and other children were unable to calm themselves down when faced with stress. Yet others showed low achievement motivation or explicit interests in other spheres such as relationships, or even suffered low self-management skills. It was also clear that many children had more than one reason for underperforming.

Might children be helped better if caregivers and teachers could address the particular causes or competencies that the individual child was lacking? This question, along with other related questions, inspired us to develop a program of research on the basic mechanisms that underlie human motivation and personality functioning. The resulting work, which currently spans across four decades, culminated in Personality Systems Interactions (PSI) theory (Kuhl, 2000a; Kuhl, Koole, & Quirin, 2015; for a recent overview, see Baumann, Kazen, Quirin, & Koole, 2018). The term *personality* here refers to the ensemble of cognitive and motivational-affective processes, and how they interact differentially in individuals to determine behavior and experience. PSI theory thus qualifies as a comprehensive approach toward motivation and dynamic personality functioning (rather than static personality traits).

In this article, we demonstrate why and how PSI theory can provide a comprehensive framework for understanding human motivation. First, we relate how PSI theory integrates various modern motivation theories in a hierarchical model that differentiates between seven interacting levels, which represent fundamental sources of human motivation. Second, we discuss the principles that, according to PSI theory, govern interactions between motivational systems. Third and fourth, we describe how these principles can explain two major motivational paradoxes, (a) people's frequent failure to act upon their best intentions and (b) people's less publicized—but no less common—tendencies to adopt goals that run counter to their psychological needs. Fifth, we consider how PSI theory can illuminate the scientific understanding of implicit motives, which function like "switch boards" connecting different levels of motivational functioning and underlying systems. Sixth, we consider how PSI theory is grounded in modern biobehavioral and neuroscientific insights. Seventh and last, we reflect broadly on PSI theory's contributions to motivation science and its relevance for motivational counseling in domains like education, sports, business, and health.

1. A unified framework of human motivation: Seven levels of motivation and personality functioning

Motivation science is characterized by a bewildering number of different theories and constructs. For instance, in a comprehensive review of goal constructs, Austin and Vancouver (1996) observed "[…] considerable diversity of terms and methods across the domains, which conceals what we believe is an underlying continuity" (p. 361). Likewise, a review by Braver et al. (2014) found that different research traditions have emphasized different aspects of motivation, so that "a key challenge for cross-disciplinary integration is to establish a unified definition for motivation and how motivational consequences are operationalized in experimental investigations" (p. 3).

These and related observations suggest that theoretical integration is a major priority for motivation science. PSI theory (Kuhl, 2000a; Kuhl et al., 2015) was developed to provide such a theoretical integration. In this section, we illustrate what this integration entails by relating PSI theory to the sources of motivational impairments among the students that were described in the opening of this article. According to PSI theory, at least seven different reasons for children's (and adults') loss of motivation can be distinguished. Note that we use a broad conception of motivation here

as any determinant that causes behavioral "movement," be it a habit, a drive, volition, or other processes determining an action (which is in line with the meaning of the Latin verb movere as "to move" or even "to cause").

Notably, each of the seven sources of motivation can be related to processes and traits central to at least one of the theories of personality typically described in textbooks of personality psychology (e.g., Carver & Scheier, 2016). Accordingly, PSI theory has the potential to explain why individuals' behavior varies over situations and time despite showing (relatively) stable personality or "traits" (e.g., Fleeson, 2001; Read et al., 2010; Revelle & Condon, 2015). We review the seven sources of motivation and related personality theories in the next paragraphs (for an overview, see Table 1).

Table 1 Seven sources of motivation and related theories of personality.

Source of motivation	Initial theories	Within-level subsystems
Habits	Skinner (Behaviorism)	Object Recognition vs. *Intuitive Behavior Control*
Arousal	Eysenck (Extraversion, Neuroticism)	Sensory Arousal vs. *Motor Activation*
Affect	Gray (Sensitivity for Punishment or Reward)	Negative vs. *Positive* Affect
Regression	Freud (Defensive Coping)	Regression vs. *Progression*
Motives (Instrumental vs. *Experiential*)	Murray, McClelland, Atkinson (Achievement, Power vs. *Affiliation, Autonomy*)	Explicit Values vs. *Implicit Motives*
Complex Cognition	Jung, Kelly (Thinking vs. Feeling; Constructs)	Specific vs. *global* goals Local vs. *global* meaning
Self-Management (Executive Systems Coordination)	Rogers, Mischel, Deci & Ryan, Kuhl (Agency; Autonomy, Volition)	Self-Control vs. *Self-Regulation* (focused an effortful vs. *integrative* and *easy*)

Note: The dashed lines above and below the center line of the table is to denote theory and evidence suggesting that stress-dependent regression inhibits the impact of higher levels of processing (i.e., motives, conceptual processing, and self-management) on elementary levels (i.e., habits, activation, and affect); in contrast downregulation of stress (progression) presumably facilitates top-down modulation of elementary levels.

1.1 Level 1: Elementary perception and motor control

First, some students did not seem to have developed useful *habits* conducive to learning. For example, they may do their homework with their cellphone turned on, thus being distracted by incoming messages. This motivational problem relates to the first level of motivation as habits form on the basis of connections between two elementary cognitive processes of object (stimulus) recognition and intuitive behavior (response) control (Table 1). Habits and other forms of automatic behavior constitute central constructs in behaviorist approaches.

According to Skinner's (1953) radical behaviorism, behavior (and personality) is largely determined by the hierarchy of habits that has been formed during an individual's learning history. Empirical studies suggest that automatic behavioral programs have an enormous impact not only on overt behavior but also on judgment and motivation (Bargh, 2002; Gollwitzer, Schwörer, Stern, Gollwitzer, & Bargh, 2017). In fact, study habits mediate the relationship between some personality factors and scholastic performance (Aluja & Blanch, 2004). Automatic cognition and behavior are not confined to habitual behavior in terms of simple stimulus-response or if-then connections (Gollwitzer & Sheeran, 2006): Intuitive behavior programs are also important for guiding context-sensitive and quick adaption of ongoing behavior to changes in the environment. Context-sensitive and flexible intuitive behavior programs can be observed in caretakers' interactions with their infants (Keller, Chasiotis, & Runde, 1992). Other examples are intuitive communication, synchronization, and emotional contagion (mirroring) in social interaction (Dumas, Nadel, Soussignan, Martinerie, & Garnero, 2010; Miller, Xia, & Hastings, 2019).

In Section 6 we will discuss neurobiological evidence for an implicit perceptual system supporting the flexibility and context-sensitivity of intuitive behavior control. This intuitive form of context perception can dissociate from the more familiar conscious perception of objects (e.g., Goodale & Milner, 1992). Object recognition can be conceived of as a process of feature integration (Wolfe, 2014) and figure-ground differentiation (Brincat & Connor, 2006). The end product of this process is called an *object,* which can be defined as a perceptual entity that has been extracted from its context. Accordingly, when an intuitive behavioral program is connected with a perceptual object, intuitive behavior loses some of the context-sensitivity associated with its inherent implicit perceptual system. This loss may be disadvantageous, for example, when an anxious novice taking the lead in

dancing a tango ironically provokes collisions with other couples as soon as he switches from intuitive performance to object-guided behavior (with its tunnel vision for single objects) in an effort to avoid collisions: Fixated on one approaching couple the dancer is at risk to miss other approaching couples.

However, sacrificing the context-sensitivity and flexibility of implicit intuitive behavior control can be adaptive when the organism is dealing with aversive situations. In this case, object recognition facilitates the recognition and avoidance of an aversive object. Another adaptive aspect of the automatic level of processing is the fact that it opens an incentive and emotion-free pathway into action: Automatized routines such as brushing one's teeth in the morning can be easily executed even if not promoted by positive incentives or facilitating mood (Hebb, 1949). Incentive-free behavioral facilitation can help people steer free of the tyranny of the pleasure-principle and disburden them from deliberate, effortful volitional control.

1.2 Level 2: Global arousal and activation

Second, some students seemed to run on a rather low energy level, as if their energy were impeded for some reason, for example, because of low *global arousal* or global inhibition of behavioral activation due to a lack of stimulating activity in the morning (Table 1). This motivational problem relates to the second level of motivation, which involves global motivational energy (Moruzzi & Magoun, 1949). Eysenck (1967, 1990) chose the global energy level as the key process underlying individual differences in extraversion and neuroticism, the two major dimensions of personality according to Eysenck's three-factor model as well as the well-known five-factor model of personality (Digman, 1990). Empirical findings suggest that, not only global arousal, but each of those general personality factors can be regarded as a source of motivation (Judge & Ilies, 2002). Whereas global arousal may affect motivation through facilitating sensory perception (e.g., for attractive objects), global activation may enhance unspecific readiness for action (Gelbard-Sagiv, Magidov, Sharon, Hendler, & Nir, 2018). One of the adaptive functions of global emotions may be seen in the increase of degrees of behavioral freedom: By bringing more behavioral tendencies above the performance threshold (Hull, 1943), global activation frees the individual from the dictate of the strongest habit in the personal hierarchy of habits.

1.3 Level 3: Positive and negative affect

Third, sometimes students failed to develop sufficient positive *affect* for learning (i.e., reward motivation, as they did not anticipate the nice feeling of having finished their homework or enjoy the activity itself). This third level of motivation relates to specific emotions in terms of positive or negative affect that is reliably associated with an object (Table 1). Sigmund Freud's concept of "cathexis" (1917/1957) defines object-specific emotions as having a pivotal motivational function. According to Freud, people become mentally ill when they attach emotional energy to inappropriate objects that do not satisfy some underlying need (e.g., when a mourning patient develops a severe depression because he remains overly fixated on his lost partner and cannot satisfy his social needs). The adaptive value of object-specific emotions is their directive function: They do not only globally energize behavior, but also direct the individual toward a desired or away from an aversive object. Object-specific emotions further expand the degrees of behavioral freedom beyond the range provided by global emotions. When people strive for specific incentives the scope of behavioral options is not limited to above-threshold habits: *Any* behavior that may help approach the desired object or withdraw from an aversive one can be selected for execution.

Contrasting specific with global emotions (i.e., levels 2 and 3), we can say that emotional states associated with *global* arousal or activation are orthogonal to emotional states based on *valence* which is conceptualized as positive or negative emotional response to a *specific* object (Bliss-Moreau, Williams, & Santistevan, 2019; Lang & Bradley, 2007; Schimmack & Rainer, 2002). In contrast to global sources of energy, object-specific emotions have a more immediate impact on the directive component of motivation (McClelland, 1985): The latter impact on motivation in terms of desiring or "wanting" incentives (Cerasoli, Nicklin, & Ford, 2014). The distinction between global and object-specific emotions goes beyond emotional arousal. For example, the terms *fear* and *anger* can denote object-specific emotional states (fear of snakes or anger reliably associated with a particular person) or global emotions (e.g., some diffuse state of temper or anxiety). A common feature of various unspecific emotions (i.e., diffuse "proto-emotions"; Arieti, 1967) is their impaired conscious accessibility and communicability. In contrast, being connected with eliciting objects, specific emotions facilitate conscious awareness of the emotion and its eliciting condition. This explicability of specific emotions facilitates the

regulation and explicit communication of one's emotional state. In contrast, impaired communicability of global emotions impairs communicability and may increase the risk of interpersonal misattribution of one's emotion: One's own anger, sadness or anxiety is misattributed to the behavior of one's interaction partner (Schultz, Izard, & Ackerman, 2000). If, as in this case, diffuse proto-emotions are not elicited by another person's behavior the question arises as to what may be the cause of an individual's tendency to develop strong proto-emotions? Answers to this question would be especially useful for motivational counseling. One possible determinant of an increased sensitivity for global emotions can be impaired satisfaction of basic needs during childhood (Schultz et al., 2000) because infants can express frustrated needs by global emotions more than by object-specific affect, especially before their developing "object permanence" (Bremner, Tham, & Dunn, 2019). Note that personality traits related to anxiety and sensitivity to punishment (e.g., neuroticism) or to reward sensitivity (e.g., extraversion) do not always distinguish between global and specific emotionality.

1.4 Level 4: Progressive versus regressive coping with stress

A fourth group of students displayed a stress-dependent impairment of motivation: In this case, achievement motivation was replaced by competing incentives such as getting involved in favorite activities or well-established habits (playing computer games or soccer, or checking social media, etc.). Notably, this distraction by attractive incentives or habits frequently happened when children experienced school as very demanding and stressful.

The fourth level of motivation relates to stress and its impact on *regression*, which is defined here in terms of the preponderance of low-level determinants of behavior (i.e., habits, global emotions, and object-specific emotions) over high-level determinants (i.e., motives, goals, and self-regulation). In his *Outline of Psychoanalysis,* Freud (1949/2011) considered regression a powerful determinant of motivation, perhaps even more important than object-specific affect (cathexis). His insight into the limited success of psychoanalytic attempts to have patients transfer their motivational energy from inappropriate to more appropriate objects may be a possible reason for this shift in emphasis. From a process-oriented (functional) view, the explanatory value of regression is not limited to psychotherapy. Specifically, when the "progressive" (top-down) impact of high-level processes, that is motives, goals and self-regulation is weakened, behavior becomes more dominated by habitual behavior elicited by available stimuli or impulsively directed toward immediately available incentives (see Table 1).

In addition to this weakening of the predictive power of motives, goals and self-regulation, regression explains motivational phenomena such as complex (i.e., configurational) conditioning, generalization, and context-adequate behavior. Positive patterning is an example for configurational or conjunctive learning: When a response (such as an eye blink elicited by an air puff) is reinforced only if the two components of a stimulus configuration are simultaneously present (e.g., a red light and a sound), even animals need the cooperation of the neocortex for the ability (apparently mediated by the hippocampus) to inhibit an automatic subcortical response when only one of two stimuli is present (Schmajuk, 2010; Schmajuk & DiCarlo, 1991). Even this simple configuration of two stimuli defines a context, which is in this case described by two coinciding (conjunctive) conditions.

The relevance of this phenomenon for human motivation is obvious: If people under stress lose the ability to identify complex contexts and inhibit context-inadequate behavior they are at risk to satisfy their needs in a conflict-prone or context-inadequate way. Suppose a girl has formed the goal to enjoy being with her friends only if both (a) her homework is finished and (b) those friends are doing something she likes to do. In this case, regression, perhaps aroused by her test anxiety, would facilitate conflict-prone behavior. She may, for example, try to satisfy her need for social contact with unpleasant activities. But she may thereby neglect the second condition implied by her intention: Even if she has finished her homework she violates the second condition and her need to do things she likes to do, thereby generating a conflict between two of her needs (i.e., her need to finish homework and her need to join pleasant activities with friends).

1.5 Level 5: Motives

A fifth group of students, although not suffering from poor memory in general, seemed to simply "forget" the homework until it was too late in the evening to get it over with. So one may think of their more fortunate friends and wonder what mysterious "agent" might help those well-motivated children to spontaneously think of their homework at the right moments (we will later discuss implicit motives as mediators of implicit recall of opportunities for enacting intentions that satisfy current needs).

The fifth level of motivation relates to motives. According to the seven-level taxonomy (Table 1), motives belong to the three high-level (neocortical) processes that are to inhibit low-level habits and affective impulses unless they are compatible with one's current needs, goals, intentions,

and circumspect self-concerns. Although the terms *motive* and *need* have sometimes been used interchangeably in classical motivation research (Atkinson, 1958; McClelland, Atkinson, Clark, & Lowell, 1953), they may be distinguished as follows: Motives are conceived of as the component of the extended network of personally relevant experience (which may be called *the self*; e.g., Kuhl et al., 2015) that provides knowledge about behavioral options for satisfying *needs* in a context-adequate way (see McClelland, 1985, for a similar conceptualization). In contrast to motives, needs can be conceived of as pre-cognitive and pre-affective detectors for discrepancies between actual and required states (based on an "actual-target" comparison). This is to say that even without the impact of a motive, a need can instigate primitive (i.e., context-insensitive) behavior, which is provided by prewired behavioral routines.

An early report of this phenomenon can be found in Pavlov's (1935/1953, p. 369) writings: When he disabled cortical processing in his food-deprived dogs they showed primitive, prewired behaviors such as erratic sucking or search movements. Presumably, just as a thermostat, the human (and animal) brain is able to instigate relevant (pre-set) operations without the necessity of a cognitive representation of or emotional response to a detected discrepancy between an actual and a desired state (e.g., detectors for needs for nutrients, power, nurturance, etc. in the hypothalamus: Blouet & Schwartz, 2010; Hirschberg, Sarkar, Teegala, & Routh, 2020; Sewards & Sewards, 2003). It goes without saying that such subcognitive and subaffective levels of processing do not suffice for employing intelligent, context-adequate behavior toward need satisfaction.

Motives are conceived of in terms of cognitive processes that generate context-adequate ways of need satisfaction (McClelland, 1985). Context-inadequate, impulsive need satisfaction (e.g., clinging to an abusive person; greedy or uncultivated eating etc.) is often observed in stressed or traumatized individuals (Gilligan, 1997; Lovallo, 2013). This impairment of context-sensitive need satisfaction can be interpreted in terms of the inhibition of top-down control caused by excessive stress (i.e., regression). We will elaborate on the processing characteristics of motives in a later section.

1.6 Level 6: Complex cognition—Conceptual versus associative processing

A sixth group of students had trouble forming goals: Even strong motivation may not suffice without having a clear achievement goal in mind. On a sixth level of motivation and personality functioning, we deal with complex

cognition in terms of concepts and analytical or intuitive (holistic) modes of processing of conceptual information as compared to elementary processes of cognition attributed to level 1 (Table 1). Analytical concepts are embedded in hierarchical structures that include at least one level above a concept (i.e., supraordinate term) and one below (subordinate term), for example, chair—furniture—office chair). Kelly (1955) was convinced that beneficial interaction with another person requires deep understanding of his or her inner world of concepts or "constructs" as he called them. His role repertory test is still a valuable tool for the assessment of personal constructs and their interrelatedness (Montesano, López-González, Saúl, & Feixas, 2015). As concepts specifying desired outcomes, *goals* refer to one of the most popular enduring classes of mental concepts in motivational science (Austin & Vancouver, 1996; Carver & Scheier, 2017; Emmons, 1997; Locke & Latham, 1990; Pervin, 2015). Goals, just like other concepts, are embedded in a hierarchical structure: A goal such as "I want to be able to speak a little French on my next trip to France" may be related to a superordinate goal "Get in touch with people" and subordinate goals (or behavioral "intentions") such as "I will sign up for a French class". By denoting aspired outcomes, goals can be conceived of as motivationally relevant constructs (or even as a cognitive replacement of the term "motivation"; Kelly, 1955).

According to Jung (1921/1932) analytical thinking as based on semantic concepts, goals or personal constructs is only one out of two fundamentally different forms of high-level (i.e., "rational") cognitive processing (Table 1). *Feeling* was his label for associative emotional experience that enables people to intuitively discriminate between right or wrong behaviors and deal with complex environments and decision-making. Today we can elaborate the basic processes underlying high-level intuition: The functional characteristics of parallel-distributed processing (PDP) in associative (connectionist) semantic networks (McClelland, Rumelhart, & Group, 1987) explain some of the features of intuitive judgment: The latter's vague and impressionistic nature can be derived from the "subsymbolic" nature of parallel processing, which contrasts with the manipulation of more precisely defined symbols in analytical processing. The greater robustness of intuitive judgment compared to analytical judgment in dealing with missing information can be explained by a feature of parallel processing that has been called "graceful degradation": In contrast to parallel processing of many input elements, sequential step-by-step processing is likely to break down if only one element in the sequence is missing. Likewise, the fact that intuitive judgment outperforms analytical judgment whenever many, even remotely associated,

inputs (constraints) have to be taken into account (Bowden, Jung-Beeman, Fleck, & Kounios, 2005; Morrison, McCarthy, & Molony, 2017), can be related to "multiple constraint satisfaction", a key feature of parallel processing.

From a motivational point of view, these features may help understand what has been called global goals (Ferguson, 2007) or life goals (Emmons, 1997), which cannot (and perhaps should not) be precisely defined by a concrete outcome aspired: Global goals such as "finding meaning in life" or "having a long-lasting and satisfying relationship" can be modeled on the basis of implicit associative processing in networks containing innumerable outcomes that potentially promote some global goal. Parallel processing of outcomes that potentially promote a global goal may explain how people can be guided intuitively toward a global goal recognizing and utilizing even unanticipated opportunities emerging over time: An extensive associative network can be conceptualized as a basis for navigating through life and be implicitly guided by some global goal without following a ready-made explicit plan (Engel & Kuhl, 2015). For example, when somebody would reduce his or her goal to find a partner for a long-lasting satisfying relationship to a specific goal (join a dating platform), he or she might lose contact with its extensive experiential knowledge base (i.e., the self) facilitating creative, sometimes remote spontaneous ideas for moving toward the goal. Confining oneself to a specific plan entails the risk of missing many situations in everyday life that might entail, albeit implicitly, opportunities for moving toward a global goal (Masicampo & Baumeister, 2012).

1.7 Level 7: Self-management—Self-control versus self-regulation

Finally, a seventh group of students did not use adequate self-regulatory strategies. Self-regulatory strategies include a variety of competencies, for example, the ability to plan ahead when and how to work for school, the ability to motivate oneself when faced with unpleasant tasks and calm oneself down when confronted with anxiety and stress.

The parallel-processing model of intuitive guidance by global goals can be regarded as closely related to self-coherence, one of the key features emerging on the seventh level of personality functioning. On this highest level of personality organization, implicit experiential networks generate an integrated sense of "self": The integrated self can be conceived of in terms of the top level of processing networks of blended, implicit-experiential (including autobiographical) representations of personal needs, emotions,

somatic markers, and abilities into a coherent sense of personal identity (Kuhl et al., 2015; Sheldon & Kasser, 1995). Through its extended connectedness with emotions and somatic markers, implicit self-regulation can easily recruit emotional facilitation of goal-oriented behavior. Whenever decision-making and selection of personal goals is based on the integrated self, we can speak of self-compatibility and self-determination (Kazén, Baumann, & Kuhl, 2003). According to PSI theory and related approaches (Koole, Schlinkert, Maldei, & Baumann, 2019; Quirin, Tops, & Kuhl, 2019), participation of the integrated self in decision-making and goal-formation activates several self-regulatory competences associated with self-access, notably the ability to restore and maintain emotional facilitation (i.e., positive affect) of self-congruent action (i.e., self-motivation) and the ability of non-defensive downregulation of negative affect (i.e., self-relaxation).

The mode of self-regulation described in the preceding paragraph differs from a more familiar form of self-management that is characterized by a more focused, conscious, and effortful form of volition that may or may not be self-compatible (Table 1). In PSI terms this self-disciplined form of self-management is called "self-control": Being based on an explicit goal or intention, self-control enables people to enact behavioral intentions even when their emotional support is weak or missing. Being based on explicit processing self-control is open to explicitly mediated social norms and explicitly communicated demands and instructions (i.e., "introjects"). According to self-determination theory (Ryan & Deci, 2019) such external control can undermine autonomous, need-congruent motivation, which we regard as the basis of the self-regulatory mode of motivation.

2. Interactions between levels of motivation

The seven levels of human motivation have traditionally been studied in separate theories of motivation or personality. To the extent that a theory focuses on one or a few of these levels only, it may not easily lend itself to investigating interactions across levels of processing. To address this gap, PSI theory outlines a key set of principles that govern the interactions between levels of motivational systems. Understanding systems interactions is especially useful for elucidating processes underlying self-management competences such as the ability to enact difficult intentions (*action control*) and the ability to learn from mistakes and painful experience, and thus to extend the network of integrated positive and negative experiences, that is the self (*self-growth*). According to PSI theory, these two self-management

competences, action control and self-growth, require the interaction between the highest level (in the case of action control: intention memory) and the lowest level of processing (i.e., intuitive behavior control; Kuhl, 2000a, 2000c).

2.1 Action control: Putting intentions into action

According to PSI theory, action control requires the interaction between a top-level system that maintains explicit behavioral intentions active until they are completed, *intention memory,* and a largely implicit system operating on the lowest level of processing, *intuitive behavior control,* which is basically able to coordinate behavioral enactment itself (e.g., motor movements required). Presumably, the interaction between intention memory and intuitive behavior control can be facilitated by an increase in positive affect (Fig. 1). Specifically, according to the *action control assumption* of PSI theory

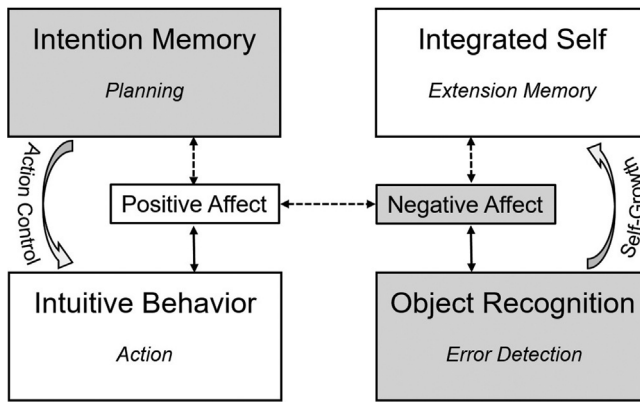

Fig. 1 Core of PSI theory: How Affective Change Modulates Systems Interactions Necessary for Volitional Facilitation (i.e., Action Control), Error-Based Learning, and Self-Growth. Notes. Solid vs. dotted straight arrows refer to activating vs. inhibitory connections, respectively. Intuitive Behavior Control (IBC) and Integrated Self (white color) operate in an associative and effortless way, and represent mechanisms underlying self-regulation (implicit self). Object Recognition and Intention Memory (gray color) operate in a conceptual and effortful way, and represent mechanisms underlying self-control (explicit ego). Bent arrows schematically indicate flow of information between systems as a function of the following mechanisms: Action control (transition of intentions into action) is facilitated by the upregulation of positive affect (see solid line between PA and IBC), whereas self-growth (integration of schema-discrepant information into the integrated self) is facilitated by the downregulation of negative affect (see dotted line between NA and Self, implying that downregulation of NA intensifies the transition toward the Self).

(also known as the first modulation assumption), forming an intention (i.e., activation of intention memory) dampens positive affect and inhibits its connectivity with behavior control (Fig. 1, straight arrows), whereas an enhancement of positive affect facilitates the interaction between intention memory and behavior control (bent arrows, see also Figure notes).

The latter process supports the enactment of an intention even against a powerful impulsive response tendency. We therefore propose the term *volitional facilitation* to refer to the selective strengthening of an explicitly intended action against a dominant behavioral tendency (Kuhl & Kazén, 1999). The coordination between dampening impulsive behavior and facilitation of intended action may describe the dynamics underlying delay of gratification and other examples of non-impulsive behavior (Mischel, Shoda, & Rodriguez, 1989): Dampening of positive affect prevents premature, impulsive behavior and creates a time window for thinking and problem-solving or simply waiting for the right moment to act. Presumably, executive control is experienced as effortful under those conditions. Moreover, dampening positive affect that is presumably associated with an uncompleted intention may generate a sense of tension (Lewin, 1935) that "reminds" the person that some intention has not been completed yet. In fact, inducing an intention by announcing an upcoming task, enhances subjective feelings of tension unless it can be reduced by generating positive affect (Koole & Jostmann, 2004).

The fine-tuning between volitional facilitation and behavioral inhibition may be impaired when positive affect is mainly energized by global activation (cf. level 2): Because diffuse emotions such as global activation are less controllable compared to specific affect, action control based on global activation should be characterized by impulsive insistence of an intention combined with impaired flexibility and context-sensitive enactment. In contrast, when the dampening of positive affect is not fueled by reduced global activation (i.e., when it is elicited by a specific object), the greater controllability of specific compared to global affect permits this dampening to be switched on and off according to situational conditions.

Experimental evidence for volitional facilitation (as part of the action control assumption) was obtained from experiments using a modification of the well-known Stroop task. This task requires participants to keep a difficult intention in mind (e.g., respond to the red color that the word "blue" is written in) and overcome a strong counter-intentional habit, that is read out a written word, (i.e., "blue"), irrespective of the ink color it is written in. The highly robust Stroop interference effect consists of increased response

times when ink colors and color words are incongruent compared to congruent trials, (MacLeod, 1992). Applying a systems interactions perspective to this example, we can say that intention memory is trying to respond with "red," whereas responding with "blue" would be the dominant, overlearned automatic action tendency within the intuitive behavior control system. According to the volitional facilitation assumption, the shift from dampened positive affect toward an increase in positive affect should facilitate the necessary interaction between intention memory and intuitive behavior control. Experimental findings are consistent with this assumption: When positive primes such as "success" or "excellent performance" precede incongruent color words, Stroop interference is significantly reduced or even removed (Kazén & Kuhl, 2005; Kuhl & Kazén, 1999) (Fig. 2).

PSI theory interprets this effect in terms of volitional facilitation, that is, selective facilitation of explicit intentions rather than the more popular effect of behavioral facilitation, or facilitation of the dominant automatic behavior by positive affect. In contrast to behavioral facilitation, volitional facilitation means that positive affect results in faster response times at difficult tasks, more than at easy tasks. Notably, primes related to situations that benefit from intuitive behavior more than from explicit control (e.g., positive interaction with other people) generate behavioral rather than volitional facilitation resulting in increased rather than decreased response times at the Stroop task (Kazén & Kuhl, 2005). In Section 5 we interpret this effect in terms of

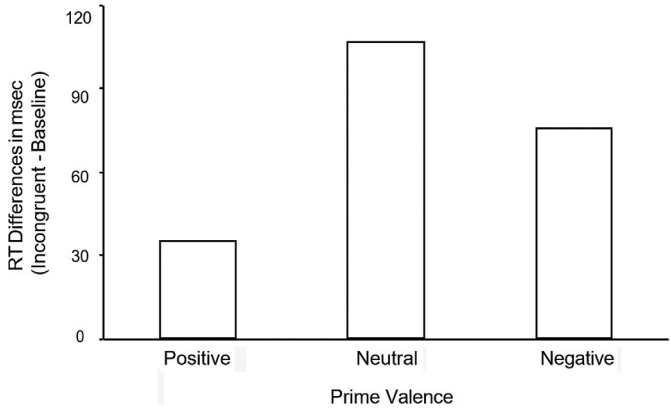

Fig. 2 Differences in Mean Reaction Times (in ms) Between Incongruent Minus Baseline Trials as a Function of Prime Valence at a Modified Stroop Task. *After Kuhl, J., & Kazén, M. (1999). Volitional facilitation of difficult intentions: Joint activation of intention memory and positive affect removes stroop interference.* Journal of Experimental Psychology: General, 128, *382–399, table 4.*

the switchboard model of motives (i.e., in positive social interactions intention memory is deactivated with the effect that positive primes cannot facilitate difficult intentions).

The experimental support for the volitional facilitation assumption is complemented by findings showing that prospective action orientation, an individual difference variable that is related to the ability to generate positive affect, is associated with volitional facilitation, that is improved enactment of behavioral intentions under demanding conditions (Jostmann & Koole, 2007; Kaschel, Kazén, & Kuhl, 2017; Kazén, Kaschel, & Kuhl, 2008). For instance, in work settings, people who are more (rather than less) action-oriented display better work performance in non-routine situations (Diefendorff, Richard, & Gosserand, 2006). Notably, action orientation provides no performance advantage in non-demanding routine situations, where enactment of behavioral intentions does not require self-management competencies. Similar effects of prospective action orientation had been found in standardized laboratory tasks (e.g., Jostmann & Koole, 2006, 2007) and other important real-life behaviors, including academic performance (Schlüter et al., 2018), athletic performance (Heckhausen & Strang, 1988), and health behavior (Palfai, 2002). Importantly, the effects of prospective action orientation hold up even after controlling for other trait factors, such as conscientiousness (e.g., Schlüter et al., 2018) and cognitive ability (Diefendorff, 2004).

The counterpart of action-oriented people are state-oriented people. State-oriented individuals that have problems to restore positive affect that is reduced under demanding conditions (Koole & Jostmann, 2004) show impaired volitional facilitation (i.e., an increase in Stroop interference) and this impairment can be repaired by a mental contrasting procedure (Friederichs, Kees, & Baumann, 2020). This method encourages participants to alternate between the positive feelings associated with anticipated goal attainment and the dampening of positive affect presumably associated with focusing on the difficult and unpleasant steps to be taken toward the goal (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011).

2.2 Self-growth: Integrating errors and painful experience into the self

According to PSI theory, self-growth and profound learning from errors or other aversive events requires the interaction between a system explicitly focusing on unexpected or painful details (objects) and the self as an extended experiential network (i.e., *extension memory*) that has the capacity

to integrate error correction and ways to cope with aversive events (Fig. 1). The former system (i.e., *object recognition*) is useful for detecting errors and pain- or fear-arousing cues. Focusing attention on an error or any other mismatch or source of pain can be considered a requirement for learning from mistakes and for subsequent integration of painful experience into extension memory with its large experiential basis for problem-solving and coping. In the context of PSI theory an "object" is a perceptual detail (visual, auditory, emotional etc.) that has been extracted from its context. This extraction implies sharpening a relevant detail against its contextual background (Cassidy, 2004) or separating a detail from its surrounding perceptual field (Brincat & Connor, 2006; Jia, Zhang, & Li, 2014). High-level integration of an unexpected and aversive experience requires both explicitly focusing on the experiential detail (object) to be integrated and, as a second step, making contact between the aversive object and the extended memory base of relevant personal experience (i.e., the self) that provides various ways of dealing with the problem at hand.

According to the *self-growth assumption* (also known as the second modulation assumption) of PSI theory, the transition from focusing on isolated details such as fear or pain-arousing objects toward their integration into the extended experiential system (i.e., self-integration) is difficult when negative affect or stress exceeds a critical threshold (Fig. 1). Conversely, non-defensive downregulation of negative affect (see also "integrative emotion regulation; Roth, Vansteenkiste, & Ryan, 2019, "constructive coping"; Epstein & Epstein, 2016) facilitates the interaction between object recognition and extension memory, which is considered the functional basis for integrating a hitherto isolated experience into extension memory. Evidence supporting the relationship between constructive downregulation of negative affect and extension memory was reported by Bledow and associates using various measures of creativity as a dependent variable (Bledow, Schmitt, Frese, & Kühnel, 2011). The extended experiential knowledge base of extension memory can be regarded as a basis for creativity because this system provides an implicit overview of possible solutions that is not available to explicit systems such as object perception or intention memory. As predicted by the self-growth assumption, creativity went up for participants as a function of effective downregulation of negative affect (Bledow, Rosing, & Frese, 2013; Bledow et al., 2011).

Our own search for experimental evidence examining the self-growth assumption started with experiments on semantic coherence as a functional component of the integrated (coherent) self. The term *extension memory*

describes an extended associative network facilitating the detection of remote associations (Ferstl, Neumann, Bogler, & Von Cramon, 2008). One task that has been used to assess remote associations as a prerequisite for achieving semantic coherence is the Remote Associates Task, that has been frequently used to operationalize one component of creativity (RAT; Beeman & Bowden, 2000; Mednick, 1968): Do the three words "pass, goat, high" have something in common? Most participants easily find the correct answer (i.e., "yes"—because those three words are connected by the concept of "mountain"). How about the following word triad: "stick, maker, point"? The last word triad "stick, maker, point" also belongs to the coherent group of items and some people can feel that coherence even without being able to tell the reason why: The three words have in common the meaningful relation to the word "match": match stick, match maker, match point. Discrimination between incoherent and coherent word triads has been used as an index of associative intelligence as a cornerstone of creativity (Beeman et al., 1994; Bowden & Jung-Beeman, 2003).

In our research, we have used the semantic coherence task to operationalize access to extension memory because this extended experiential network should facilitate the identification of remote associations. As predicted by the self-growth assumption, impaired discrimination between coherent and incoherent word triads was observed among state-oriented participants who reported to be in a negative mood (Baumann & Kuhl, 2002). Note that, in this research, a second type of state orientation was assessed that is characterized by difficulties to disengage from negative mood once aroused (i.e., failure- or threat-related state orientation). A second experiment replicated this finding for word triads describing personal attributes of two personal friends. Participants reported three positive and three negative adjectives for either friend. Coherent word triples contained one positive and two negative adjectives (or vice versa) reported for one of the friends. Incoherent triads consisted of word triples that contained one item from the other friend (Baumann & Kuhl, 2002). Again, threat-related action orientation (but not low neuroticism) prevented the impairment of coherence judgments observed under negative mood conditions in state-oriented participants.

The results from Baumann and associates confirmed the hypothesis that negative affect, unless combined with non-defensive emotion regulation abilities (i.e., action orientation), would impair coherence judgments. According to the self-growth assumption, superior performance should be associated with negative affect when the task requires error detection:

Reduction of attentional breadth, or "tunnel vision," supposedly associated with perseverating negative affect should facilitate the detection of details, especially when they relate to errors (cf. Easterbrook, 1959). As expected, state-oriented individuals outperformed action-oriented individuals in a spelling task (discriminating between correctly and incorrectly spelled words) at high levels of negative affect (Kazén, Kuhl, & Quirin, 2015). Notably, mood effects were more reliable in this study when mood changes were assessed with an implicit measure of affect (Quirin, Kazén, & Kuhl, 2009; Quirin et al., 2018). One possible reason for the sometimes better predictability of implicit mood measures may be the fact that, compared to explicit self-report measures, implicit measures are less subject to distortions toward social desirability or defense.

The experiments exploring mood effects on semantic coherence assessed by the semantic coherence task confirm the holistic processing basis of extension memory with its extended associative networks (Beeman et al., 1994). However, this research did not test the hypothesis that the effects obtained for uncontrollable and persevering negative affect can be generalized to the personal level (e.g., self-awareness, self-access). Experiments on self-infiltration, as operationalized by false self-ascriptions of external demands, were conducted to address this matter.

In one of the first experiments, participants rated various tasks of an office administrator (Kuhl & Kazén, 1994) and were next asked to choose 9 tasks from a list of 27 routine tasks to gain a realistic impression of some of the tasks. Subsequently, the experimenter, who played the role of the boss, informed them about nine other activities that he or she would have liked them to finish. In all experiments, task attractiveness was controlled to make sure that self-chosen and experimenter-chosen tasks were equally unattractive tasks. After a distracter task, participants received the list of activities once more and were to indicate which tasks of the list they had chosen. The number of false self-ascriptions of tasks that had actually been chosen by the experimenter was interpreted as a measure of (impaired) self-access. Self-other discrimination was considered a pivotal component of self-growth because the latter involves checking the self-compatibility of external demands which in turn depends upon the ability to discriminate between internal and external determinants (i.e., self versus other). On the basis of the self-growth assumption, it was predicted that self-other differentiation should be impaired under conditions of persevering negative affect, that is when participants reported to be in a negative mood and could not easily disengage from it (i.e., state-oriented participants).

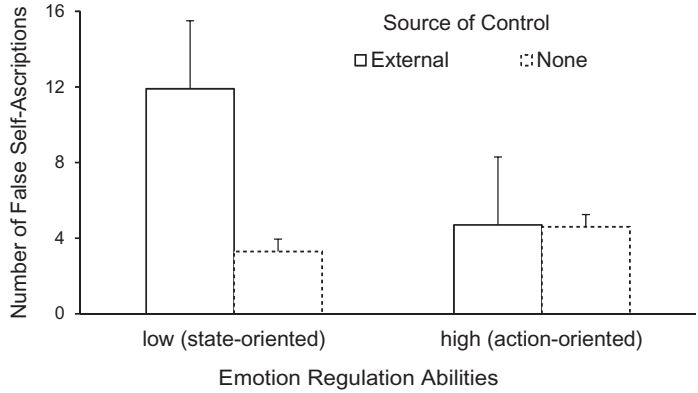

Fig. 3 Number of False Self-Ascriptions of Assigned (External) as Compared to Remaining Goals for High vs. Low Emotion Regulation Abilities *After Kuhl, J., & Kazén, M. (1994). Self-discrimination and memory: State orientation and false self-ascription of assigned activities.* Journal of Personality and Social Psychology, 66, *1103–1115.*

The results (Fig. 3) showed that false self-ascriptions of tasks that were actually preferred by the "boss" occurred significantly more often in a group of state-oriented participants that reported to be in a negative mood, for example, helplessness (Kuhl & Kazén, 1994). Specifically, state orientation was measured here by a subscale that taps the ability to downregulate negative affect once it is aroused. It was concluded that the increase in false self-ascriptions of external demands was consistent with the self-growth assumption according to which uncontrollable negative affect impairs self-access (Fig. 1). According to this interpretation, self-access is a prerequisite for discriminating self-chosen from externally imposed or suggested activities.

In subsequent experiments, conceptual replications of those findings were obtained, for example, when participants were to discriminate between own preferences and recommendations putatively made by experts or when negative mood was experimentally manipulated (Baumann & Kuhl, 2003; Kazén et al., 2003; Quirin, Koole, Baumann, Kazén, & Kuhl, 2009). Confirming evidence for the intuitive and holistic processing characteristics of the self presumably supported by the right hemisphere (Beeman et al., 1994; Jung-Beeman et al., 2004) were obtained in experiments showing that self-infiltration could be removed by activating the right hemisphere through left-hand muscle contractions (Baumann, Kuhl, & Kazén, 2005).

3. The procrastination paradox: Focusing on a goal may interfere with enacting the goal

In the research summarized in the preceding sections, state-oriented participants were described as perseverating and ruminating on uncontrollable thoughts about future intentions (i.e., prospective, demand-related state orientation) or about aversive events in the past (i.e., retrospective, threat-related state orientation). There is a paradox involved in this conception of state orientation: State-oriented people, compared to their action-oriented counterparts are expected to focus on goals and behavioral intentions. This assumption (Section 2) was confirmed (Goschke & Kuhl, 1993). Shouldn't this enhanced goal focus facilitate state-oriented participants' goal-oriented behavior? In fact, the opposite has been found: state-oriented participants suffered from volitional inhibition and procrastination rather than benefiting from volitional facilitation (Beswick & Mann, 1994; Blunt & Pychyl, 1998; Fuhrmann & Kuhl, 1998; Jostmann & Koole, 2007; Kaschel et al., 2017; Kazén et al., 2008).

The shift from dampened positive toward moderate or high positive affect facilitates the transition from intention maintenance to behavioral implementation. Presumably, prospectively action-oriented individuals have the ability to generate positive affect when it is needed for implementing an intention. This capacity to self-generate positive affect when needed has been called *self-motivation* (Kuhl, 2000c). The prefix "self" refers here to the source of self-motivation: Presumably, it is the operation of an extended associative network of personal experiences (i.e., the self), which has the capacity to recruit energy from positive images, anticipated incentives, etc., for volitional facilitation. As an extended parallel-processing network of personal experiences, possible actions, personal needs and values as well as abilities, most of the self's operations are unconscious.

The self-motivation hypothesis has been tested directly in an experiment by Koole and Jostmann (2004). They operationalized self-motivation through savings in response times when people were to detect a happy face hidden in a crowd of angry faces (face discrimination task) or respond in a positive response format when confronted with a negative stimulus word (affective Simon task). As predicted, time savings in favor of positive responses were obtained for action-oriented participants, but not for state-oriented participants in an experimental condition in which a prospective task was announced that entailed the chance to earn money depending

on their future achievement in a subsequent simple arithmetic task. Note that either method for assessing self-motivation was based on response time effects in the range of a few hundred milliseconds, which are beyond conscious control.

Notably, the findings discussed in the preceding paragraph not only confirmed the implicit nature of self-motivation, but also the mediating role of the self, the hypothetical origin of self-motivation: The significant relationship between the self-motivation measure (accelerated detection of the happy among angry faces) and experimental activation of prospective memory (announcing a future task to be finished or, in Koole and Jostmann's third experiment, visualizing a demanding person) was mediated by an implicit reaction time measure of self-access (Koole & Jostmann, 2004; Fig. 1). In sum, the experiments by Koole and Jostmann confirm three hypothesized components of action control expected when action-oriented individuals are exposed to a prospective demand (presumably activating intention memory): Action-oriented participants showed (1) down-regulation of an emotional concomitant of volitional inhibition (subjective tension, Koole & Jostmann, 2004; Table 1) that was anticipated in Lewin's seminal papers on uncompleted systems as "tension systems" (Lewin, 1935) and Zeigarnik's famous findings on superior recall for uncompleted compared to completed tasks, (2) implicit upregulation of positive affect (self-motivation) as operationalized, for example, by accelerated detection of happy faces among a crowd of angry ones, and (3) mediation of self-motivation as a response to demanding conditions through facilitated self-access.

Assuming that the implicit self is the source of self-motivation, we can explain the procrastination paradox: Volitional inhibition is associated with a strong focus on goals and uncompleted intentions when this focus involves *explicit* rather than implicit processing; when explicit goals or intentions strongly control behavior, implicit self-determination literally deteriorates; under explicit control, it is more difficult for behavior to be guided by the implicit self with its capacity to recruit emotional support for enactment. We use the term *self-control* when behavior is guided by explicit goals or intentions. In this case volitional action does not only lack self-motivational support, but it may even deplete motivational energy (Baumeister, 2014): In contrast to the implicit self, the explicit ego does not seem to have the privileged access to emotional resources that we attribute to the self (Kazén, Kuhl, & Leicht, 2015; Tice, Baumeister, Shmueli, & Muraven, 2007).

To conclude, by discussing the procrastination paradox, we identified analytical, unidirectional, monocausal thinking as the source of this paradox. When people are asked to explain why some individuals procrastinate, they sometimes tend to establish one static factor rather than dynamic interactions among various mental capacities or systems. A common example is the listlessness explanation. Listlessness, as a state of low positive affect (level 3; recall the example of the "lazy" students in the beginning), can be a determinant of procrastination. It appears logical that the opposite of listlessness, for example, joy or other forms of positive affect, would be the ideal remedy against listlessness and procrastination. However, according to the dynamic view, overly positive people run the risk of procrastinating as well because they can barely tolerate frustration and dampening of positive affect, which is associated with maintaining an unpleasant intention in mind until completion.

Recalling our introductory reflection about many possible reasons for impaired motivation, our dynamic approach to personality provides several possible reasons why individuals fail to enact their intentions. In fact, besides personality types biased toward high or low positive affect, several possible determinants exist. For example, negative affect is at times helpful to enact an intention and accomplish a goal (Elliot, 2008; Fishbach, Eyal, & Finkelstein, 2010; Higgins, 1997). The fear of failing at an exam can spur enormous behavioral efforts, a motivational phenomenon called *active avoidance* in learning theory (Mazur, 1990). In fact, superior performance sometimes associated with anxiety has been a target of psychological research for several decades (e.g., Broen & Storms, 1961; Weiner & Schneider, 1971). For example, in a longitudinal study high state-oriented preoccupation with fear of failure predicted superior performance, even when compared to low-anxiety students, provided preoccupation was associated with high perceived control (Perry, Hladkyj, Pekrun, & Pelletier, 2001). Paradoxical positive effects of anxiety and state orientation on performance can be explained when performance is observed under task conditions that require a narrow attentional scope: According to the self-growth assumption, performance at tasks requiring the narrow attentional scope associated with discrepancy-sensitive object recognition should be facilitated by negative affect (Kazén, Kuhl, & Quirin, 2015).

Despite those positive sides of negative affect, excessive reliance on prevention or avoidance motivation can interfere with performance and well-being (Elliot & McGregor, 2001; VandeWalle, Cron, & Slocum, 2001). This relationship is consistent with the notion of an inverted-u

shaped relationship between negative affect and stress on cognitive performance (Arent & Landers, 2003; Salehi, Cordero, & Sandi, 2010; Sullivan & Bhagat, 1992; Yerkes & Dodson, 1908). Debilitated performance can be attributed here to the fact that fear avoidance involves phylogenetically old prewired mechanisms, which may weaken high-level cognitive involvement (Robinson, Vytal, Cornwell, & Grillon, 2013).

In contrast to volitional facilitation through active avoidance, volitional facilitation through self-motivation activates the self (i.e., the source of self-motivation) with its extended experiential networks and their vast associative networks that provide many possible solutions to a problem and the ability to understand even remote relationships between various pieces of knowledge (Baumann & Kuhl, 2002). Here the costs and benefits of more automatic ways of performing intended behavior such as avoidance motivation (Elliot & McGregor, 2001) or implementation intentions (Gollwitzer, 2018) become obvious: They are of use whenever high-level systems are not available (e.g., under stress) or do not support an important, but highly unpleasant activity. However, their limitations become apparent when flexibility and creativity is required (Masicampo & Baumeister, 2012; Ruigendijk & Koole, 2014).

4. The motivational paradox: Striving for unpleasant goals

Earlier, we reported on the case that individuals sometimes mistake others' expectations for their own (chosen) goals and pursue them, albeit with low enthusiasm. We have referred to this unconscious form of introjection as self-infiltration. But why should people strive for such unpleasant goals? A start toward unraveling this paradox is made when we realize that people are social animals who could not survive without their social environment. Living and prospering entails an inherent conflict between any individual's needs and preferences and the needs and preferences of significant others. In their efforts to find a balance between self-determination and external control, people run the risk of overly indulging in either pleasing or neglecting others. Although the latter alternative might be more successful from the perspective of an overly self-centered person, it entails prompt disadvantages for his or her social environment and those adverse effects can, at least in the long run, backfire on the egomaniac. As a dynamic approach, PSI theory explores the diverse phenomena that may result from the interplay of the processes underlying self-concern and external control.

A case in point is self-infiltration. Recall that, in self-infiltration experiments, a conflict between external control and personal choice is induced by limiting participants' choice to rather unpleasant activities (Kuhl & Kazén, 1994). An adaptive strategy in this situation would be to have a clear representation of which activities one did choose and which was suggested by somebody else. Self-other differentiation provides the basis for dealing with conflicts between self-chosen and externally controlled options. As mentioned, action-oriented people can be moved to commit themselves to unpleasant activities, but they keep track of their own choices and external suggestions, even when negative mood may interfere with efficient self-other differentiation.

Conversely, state-oriented people mistake external choices for their own choices (Fig. 3). How can this self-infiltration paradox be resolved? Recall that false self-ascriptions of controlled activities happened only when state-oriented participants were in a negative mood. That this effect was attributable to the fact that negative mood impairs self-access, was confirmed by findings showing that self-infiltration was removed when self-access was restored either by inducing positive mood (Baumann & Kuhl, 2019) or by activating the right hemisphere (Baumann, Kuhl, et al., 2005), which seems to support the implicit self (Kuhl et al., 2015; Molnar-Szakacs, Uddin, & Iacoboni, 2005). Note that the research cited demonstrates removal of self-infiltration especially in those participants that reported being in a negative mood or leaning toward a negative primary response (e.g., anxiety) before positive mood or self-access was experimentally supported. In fact, high sensitivity for negative affect can, despite its maladaptive effects on mental health (Ormel et al., 2013), turn into a protective factor and a motor for self-growth under conditions facilitating self-access and non-defensive downregulation as a secondary emotional response (e.g., action orientation). For example, a personal style approximating one of the known personality disorders (e.g., social anxiety and avoidance) is associated with a paradoxical *reduction* of psychosomatic complaints even below the low level observed in emotionally less sensitive participants, provided participants are exposed to conditions facilitating emotional recovery, as, for example, action orientation, secure attachment, or autonomy support (Baumann, Kaschel, & Kuhl, 2007). In a similar vein, children having a genetic marker predisposing them for psychological symptoms such as aggression, depression or hyperactivity have a paradoxically lower risk to develop the respective symptoms compared to children without those genetic risk markers, if the former group (i.e., those having genetic risk markers) is exposed to developmental

conditions supporting autonomy and/or secure attachment (Belsky & Pluess, 2009). Again, the paradox can be resolved by taking a dynamic view (Fig. 1): High emotional sensitivity facilitates the first step toward self-growth (e.g., non-defensive focusing on an aversive experience using the object recognition system). This initial exposure to negative affect promotes self-growth and its protective capacity if the primary sensitization stage is followed by a secondary stage of non-defensive downregulation of negative affect and self-access associated with it.

The discrepancy between explicit goals and implicit motives is another example for the paradox that people sometimes pursue unpleasant goals. When people report explicit goals that do not match their spontaneous need-related fantasies (i.e., their implicit motives) volitional strength and subjective well-being decrease and the risk of psychosomatic symptoms increases (Job, Oertig, Brandstätter, & Allemand, 2010; Kazén & Kuhl, 2011; Kehr, 2004; Schüler, Job, Fröhlich, & Brandstätter, 2008). As mentioned before, motives can be conceptualized in terms of that component of the self that comprises implicit associated networks providing experiential knowledge about context-adequate behavioral options to satisfy the respective need whenever a need-relevant cue is detected. Thus, the ability to generate explicit goals that are compatible with implicit motives should be facilitated by valid self-perception, intact self-access, and self-determination. The relationship between self-determination and goal-motive congruence has been replicated across different cultures (Hofer et al., 2010). Conditions that impair self-access, notably excessive and perseverating negative affect, reduce congruence between explicit goals and implicit motives and increase psychological symptoms (Baumann, Kaschel, & Kuhl, 2005).

There is another example of paradoxical pursuit of unpleasant goals. In an earlier section, we mentioned the distinction between two modes of self-management, the narrow, strict and conflict-prone self-control mode and the more democratic self-regulation mode that is guided by the implicit self rather than by explicit ego control. According to PSI theory, implicit self-regulation is more integrative than coercive and it works with rather than against emotions. Working according to the principles of parallel processing (Engel & Kuhl, 2015; Read, Droutman, Smith, & Miller, 2019), the self-regulatory mode prevents or resolves conflicts by exploring an extended scope of behavioral options to find some behavior that might satisfy multiple constraints such as one's own goals, needs, emotions, values, abilities and identity features, as well as others' goals, needs, emotions, abilities, etc. These processing features predestine self-regulation as a remedy against

the self-control paradox, the latter being tantamount to coercing oneself to strive for unwanted goals: When people are able to modify external goals in a way that they can be integrated into the self, they can pursue those goals in a conflict-free way with emotional support and the creativity of the self (see Ryan & Deci, 2019, for a similar view). The link between intrinsic motivation and creativity can be interpreted as an example of the creative side of self-involvement (Amabile, 1996).

A striking experimental illustration of the self-control paradox stems from a diary study aimed at improving personal nutrition (Fuhrmann & Kuhl, 1998). In this study, participants who sought to improve their nutritional habits maintained a diary for about 15 days. Each day they rated 8 "eat-more" foods and 8 "eat-less" foods according to the difficulty to change their intake (half of each item group was self-chosen and the other half was recommended by experts). At the end of each day (or the next morning) they had to indicate for each food item whether there had been an opportunity to behave according to their change intention and whether they had actually tried to eat more or less of the respective food item on that day. Volitional efficiency was operationalized by the ratio between the number of actual attempts toward change divided by the number of opportunities during the respective day.

The two modes of self-management were experimentally manipulated. In the *self-control group* the instruction directed attention toward difficulties in goal-striving**.** It used the wording "discipline" in referring to self-management and reminded participants of the negative consequences of shortcomings and even little failures within the first week of trying to change one's behavior (self-punishment focus). Conversely, in the *self-regulation group* an instruction was used that emphasized a self-determined way of goal-striving in conjunction with downplaying possible failures and weaknesses and rewarding oneself even for small, unchallenging steps toward goal attainment (self-reward focus). In addition to this manipulation, we also assessed the two self-management styles using relevant scales from the Volitional Components Inventory (Kuhl & Fuhrmann, 1998): Self-control was assessed by summing up the scores for planning (e.g., *Before I begin to work on a task I think about all the details*) and active avoidance (e.g., *My fear of failure often motivates me to work especially hard*). The self-regulation style was assessed by summing across the scales of self-determination (e.g., *Most of the time I feel in tune with myself*), self-motivation (e.g., *I can usually motivate myself quite well when my perseverance subsides*), and self-relaxation (e.g., *I can reduce my tension level when it becomes disturbing*).

The findings were surprising, as the relaxed self-regulation instruction with its self-reward focus did not always show volitional facilitation as one might expect from a simple resource-oriented point of view. Specifically, the self-regulation instruction (i.e., encouraging self-reward for small steps toward success) led to impaired volitional efficiency in the group that leaned toward a self-control style. The self-reward instruction facilitated volitional efficiency only in the group leaning toward a self-regulation style (Fig. 4). The results were reversed for participants leaning toward a self-control style. Within this group, self-punishment led to superior enactment, whereas self-reward had a negative effect. This pattern of findings is consistent with the regulatory fit phenomenon, that is, superior performance when a prevention focus (which is conceptually similar to the self-control style described here) is combined with a controlling instruction or a promotion focus is combined with an approach oriented instruction (Higgins, 2005).

However, the term *regulatory fit* is more descriptive than explanatory. Within the framework of PSI theory, we suggest the following explanation of disordinal interactions between self-management style and regulatory conditions. Our explanation focuses on the perhaps most paradoxical effect:

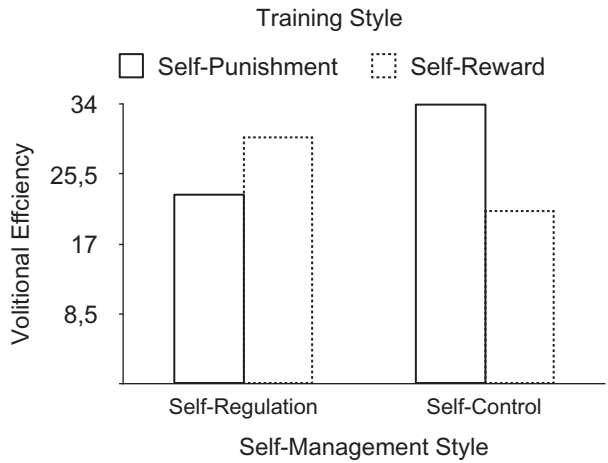

Fig. 4 Volitional Efficiency in Initiating Healthy Nutritional Behavior (Percentage of Planned Activity From Total Number of Possible Activities) as a Function of Dispositional Self-Management Style (i.e., Self-Control vs. Self-Regulation). *After Fuhrmann, A., & Kuhl, J., Maintaining a healthy diet: Effects of personality and self-reward versus self-punishment on commitment to and enactment of self-chosen and assigned goals.* Psychology and Health 13, *1998, 651–681.*

Why does a relaxed self-reward instruction, that is to promote the self-regulation mode, *impair* volitional efficiency in self-controlled participants? According to the self-growth assumption of PSI theory, a relaxing self-reward instruction should facilitate self-access. However, we cannot expect self-controlled people to have their goals or intentions integrated into their selves (the more accurate term for self-control would be *ego-control*). In this case, opening the self through self-reward may activate a variety of behavioral tendencies including more or less tempting ones except for the explicit intention that is maintained in the memory for *explicit* intentions as a result of an explicit self-control style.

This explanation has some interesting implications for training and therapy: If one is looking for fast answers regarding the right intervention for people who suffer from the negative side-effects of an excessive self-control style, one might be tempted to say that people should be warned against the negative side-effects of positive thinking and self-reward for them, which would be tantamount to recommending them to utilize their best regulatory fit condition (i.e., self-punishment or avoidance motivation). PSI theory suggests an alternative long-term route toward developing the ability to benefit from self-reward. Toward this end, a multi-level systems theory like PSI suggests many opportunities for self-development. For example, overly self-controlled individuals may be encouraged (1) to learn to distinguish between their own self-congruent choices and external demands, (2) to practice self-integration (e.g., how to modify an external request in a way that it can be integrated or feels at least a bit more self-congruent than before), (3) to learn to reject external demands unless they can be modified toward more self-compatibility, (4) to learn self-relaxation for improving self-access even under stress, (5) to learn self-motivation for recruiting positive energy in support of difficult intentions (see Storch & Kuhl, 2011; Storch, Morgenegg, Storch, & Kuhl, 2018, for a variety of methods recommended for training and therapy). Focusing on the highest (self-management) level of personality, those five avenues for interventions aiming at strengthening the relaxed and creative self-regulation style are well-suited to solve the various motivational paradoxes emanating from a more static approach to personality.

5. Implicit motives as switch boards

As mentioned before, motives can be conceived of as providing implicit intelligence for context-sensitive need satisfaction. In this section,

we further elaborate this functional approach to motives. In PSI theory, motives are conceived of as switch boards that arrange need-specific configurations of cognitive functions and their underlying systems (Kuhl, 2001). For example, motivation theorists have assumed (McClelland, 1975, 1985; Winter, 1996) that to satisfy the need for power, a useful system configuration would be one that supports instrumental activities providing the means toward an aspired end state ("having an impact on others"). Among the motivational systems specified in PSI theory, intention memory (along with analytical thought as a supporting function) is well-suited for means-end efforts: When a manager would like to convince his team to adopt a new strategy, he or she may form an explicit intention to prepare a presentation in order to attain his or her goal. In contrast, to satisfy the need for affiliation, intuitive behavior (emotional expression, synchronization of motor movements, etc.) may be more useful than explicit intentionality (Kuhl, 1994). For example, when a woman recognizes a colleagues' friendly behavior as part of his plan to make her vote for his proposition at a department meeting, his explicit intentionality may disrupt the smooth flow of intuitive social interaction and may be perceived as instrumental rather than an expressing his emotional involvement in the relationship.

Kuhl and Kazén (2008) conducted a study to test the hypothesis that affiliation and power motives elicit divergent system configurations. Because explicit intentions to influence others typically have an instrumental means-end format (Winter, 1996), it was hypothesized that arousing the power motive activates the left hemisphere of the brain (i.e., the more instrumental hemisphere; Levy & Trevarthen, 1976), whereas arousal of the affiliation motive activates the right hemisphere that seems to support intuitive processing (Beeman et al., 1994; Jung-Beeman et al., 2004; see also Santarnecchi et al., 2019). The results confirmed this prediction (Kuhl & Kazén, 2008): Verbal or pictorial arousal of the power motive facilitated target detection in the right visual field (indicating left-hemispheric processing), whereas verbal or pictorial primes arousing the affiliation motive facilitated target detection in the left visual field (indicating right-hemispheric processing). Note that these results relate to the primary response only (covering a time window of a few hundred milliseconds) and do not exclude the possibility that other (even contralateral) systems can be activated in subsequent stages of processing if the context would require such a shift.

The role of the right hemisphere for the affiliation motive was additionally supported by a later resting-state EEG study that was able to identify the

right ventromedial prefrontal cortex as a source of frontal alpha asymmetry associated with high affiliation needs (Quirin, Gruber, Kuhl, & Düsing, 2013). Hemisphere asymmetries in affiliation vs. power motives were also supported by an fMRI study showing that the affiliation motive predicted activation of the right basal ganglia while participants watched romantic love scenes, and that the power motive predicted activation of a region in the left dorsolateral prefrontal cortex while watching scenes related to assertive behavior by a positive hero (Quirin, Gruber, et al., 2013). In yet another study, we conceptually replicated the finding that the affiliation motive predicted correct coherence judgments about remotely associated words (Quirin, Düsing, & Kuhl, 2013), adding indirect evidence to the notion that affiliation motivation associated with positive affect facilitates switching toward intuitive cognition.

In contrast, for satisfying achievement needs, intention memory should be important as it presumably is for the need for power, albeit for a different reason: Mastering difficulties is the target of the need for achievement. Intention memory helps maintain difficult intentions until they are completed. The difficulty aspect is even more relevant for need achievement compared to the need for power because the latter can be fully satisfied even when it happens to be easy to find a way to have an impact, whereas solving an easy task has little incentive value for the achievement motive (Atkinson, 1957). The difficulty focus of the achievement motive poses a special challenge to maintain motivation during repeated attempts to succeed at a difficult task. In an earlier section, we discussed the ability to enhance or restore motivation in terms of external incentives or an internal self-competence (i.e., "self-motivation). In a study by Kazén and Kuhl (2005), the modified Stroop paradigm mentioned in Section 2.1 was investigated for primes related to achievement, affiliation, and power. As it turned out, volitional facilitation (i.e., reduction or removal of prolonged response times for incongruent color words) was observed for positive achievement primes only.

At first glance, these findings seem to suggest that the volitional facilitation assumption is valid for the achievement domain only. However, in the original research (Kuhl & Kazén, 1999), removal or reduction of Stroop interference was found despite the fact that most primes were not specific to achievement (*child, hero, friend, happiness, fun, pleasure*). Moreover, a closer look at the action control assumption reveals that positive affect is assumed to facilitate the *interaction* between intention memory and intuitive behavior control rather than any single system per se. This interaction-focused

assumption implies that positive affect is *not* expected to facilitate the intention-behavior relationship unless intention memory is loaded. According to the switchboard model of motives outlined above, intention memory is particularly relevant for achievement contexts. Thus, a higher likelihood that intention memory is loaded with a difficult intention would be expected for achievement in contrast to affiliation or power motives. Empirical evidence for this hypothesis was reported by Kazén and Kuhl (2005) using the modified Stroop task: When positive primes reminded participants of positive social interactions, behavioral rather than volitional facilitation was observed. The obvious interpretation of this finding holds that a behavioral intention cannot be facilitated unless it is first loaded into intention memory. Without an active intention in intention memory, positive affect cannot facilitate implementation of an intention. In other words, whenever an individual does not have an uncompleted intention in mind, positive affect should generate behavioral rather than volitional facilitation (which would result in prolonged rather than reduced response times at the Stroop task).

6. Biological foundations of PSI theory

As we have seen, PSI theory proposes a taxonomy of seven levels of motivation and personality functioning, and assumptions about specific interactions between personality systems located at these levels. These levels encompass systems and processes that have been well investigated in the cognitive and affective neurosciences. To describe neural mechanisms of the processes and systems operating at these levels, we confine ourselves to list regions that are central to these processes, rather than to the wealth of regions that play an additional role. Next, we will describe some neural mechanisms that may be assumed to underlie interactions between levels of motivational and personality functioning. Because of the centrality of the motives-as-switchboards hypothesis in the present work, we will close with a section on the neuroendocrinology of social motives.

6.1 Neural mechanisms of motivation levels and their systems

As outlined in the beginning, PSI theory postulates a hierarchy of lower levels (e.g., object recognition and intuitive behavior) to higher levels (e.g., thinking and self-management) of motivational and personality functioning. This hierarchy follows phylogenetic and ontogenetic development, and has also been applied to discuss the topic of free will vs. determinism. Specifically, Kuhl and

Quirin (2011) suggested that personal freedom increases from the lowest degrees of freedom on the most basic level of processing (i.e., automatized habits) to the highest degrees of freedom at the level self-determination. This hierarchy of processing levels can be mapped to the neural anatomy that is considered to constitute the levels of motivation. For example, object recognition and behavior control can be found in rudimentary form in all vertebrates, whereas self-management ("will"; forming the highest [seventh] level) can be considered to be specific for primates, especially humans. However, this hierarchical order should be understood, both with respect to aspects of development and causal information flow, as a coarse rather than a strict arrangement ("partial heterarchy"; Kuhl & Koole, 2008, for more detailed discussion of levels of processing).

At level 1, object recognition has been linked to the operation of the ventral visual stream including large parts of the inferotemporal cortex that represents the conceptual meaning of an object (Brincat & Connor, 2006; Goodale & Milner, 1992). By contrast, intuitive behavior control may be linked to the dorsal visual stream including large parts of the parietal cortex (Goodale & Milner, 1992), as well as to the premotor and motor cortices (including mirror neurons), the basal ganglia, and the cerebellum. Habit formation, which draws on linking object recognition with behavior control (i.e., a stimulus with a response), is strongly supported by the dorsal striatum (as a part of the basal ganglia) and regions of the cerebellum (Malvaez & Wassum, 2018). An intriguing neurobiological finding supporting the role of habit formation was reported by Lengfelder and Gollwitzer (2001). They found that merely associating in a learning phase a future action with a specific location and time (i.e., forming an *implementation intention* such as "after lunch at home I will do my homework") led to a higher rate of intention enactments even in individuals suffering cognitive control deficits following lesions in the prefrontal cortex (levels 6 and 7). The authors interpreted this finding in terms of those patients' overreliance of automatic control.

Temperamental processes such as activation and arousal (level 2) are modulated by the ascending reticular activating system (ARAS), which is composed of a number of interconnected nuclei extending from the brainstem to the cortex (Edlow et al., 2012; Moruzzi & Magoun, 1949). Via dopaminergic, noradrenergic, cholinergic, and other neurotransmitter pathways, temperamental processes can thus intensify processes at higher motivational levels such as affect or cognition. Individual differences in the baseline activity of this ascending system are considered a major neural basis of extraversion (Eysenck, 1967; for an elaborated recent view on the

ARAS, see Horn, Němcová, Hans, & Overeem, 2020). Our distinction between arousal and activation has been known since long (Thayer, 1978): Within the ARAS, separate pathways can be distinguished for sensory arousal versus motor activation (Pribram & McGuiness, 1975; Waterhouse & Navarra, 2019).

At level 3, affect and approach-avoidance motivations are supported by areas of the limbic system. Specifically, negative affect (e.g., fear) is associated with amygdala activation (Aggleton, 1992) and the release of noradrenalin. By contrast, positive affect in terms of incentive motivation (wanting) is linked to the activity of the nucleus accumbens and the release of mesocorticolimbic dopamine (Peciña & Berridge, 2005). These two areas are involved in the conditioning of stimulus-response associations and thus facilitate (albeit are not necessary for) the formation of habits.

With respect to level 4, stress is regulated by the hypothalamic pituitary adrenal axis, including the hippocampus as a central regulatory area (Jacobson & Sapolsky, 1991). When situations are evaluated by the amygdala as stressors or potential dangers, the hypothalamus starts a cascade of neurotransmitters to prompt the adrenal glands to release cortisol. Presumably, low levels of cortisol enhance complex cognitive processes (e.g., analytical and holistic thought of level 6) mediated by parts of the hippocampus and the prefrontal cortex. By contrast, high levels of cortisol attenuate the impact of high level on low-level processes (Vogel, Fernández, Joëls, & Schwabe, 2016). This stress-dependent hippocampal facilitation versus inhibition of top-down control suggests the hippocampus as a possible neurobiological basis for pro- versus regression. That this hippocampal mechanism may have a long phyologenetic history is suggested by animal research demonstrating a similar role of the activation versus (stress-dependent) inhibition of the hippocampus in mediating complex versus simple cognition, respectively (Schmajuk & DiCarlo, 1991). Moreover, stress-dependent hippocampal inhibition of top-down control may provide the functional basis of the well-known inverted u-shaped function between complex cognition and stress or arousal level (Eysenck, 1967; Lindsay, 2020; Yerkes & Dodson, 1908). With respect to individual differences, the position of the peak of these inverted u-functions (i.e., shifted to the left vs. right) is likely to be different for individuals high vs. low in emotion regulation abilities, respectively (Radtke, Düsing, Kuhl, Tops, & Quirin, 2020). Insecure attachment styles, which typically go with impaired emotion/stress regulation, showed alterations in circadian and acute-stress cortisol release (Quirin, Pruessner, & Kuhl, 2008), as well as reduced gray matter cell densities in the hippocampus (Quirin et al., 2010).

Motives, as allocated to level 5 processes, have been found to be supported by parts of the prefrontal cortex (e.g., the right ventromedial prefrontal cortex for the affiliation motive; Quirin, Gruber, et al., 2013) and activity in areas of the reinforcement system in the limbic brain (Quirin et al., 2011). This is consistent with the switchboard model of motives because the orchestration of a motive-adequate system configuration should require executive control (notably from a right-hemispheric prefrontal network) and the energizing function attributed to motives should involve limbic participation.

Higher-level cognition such as analytical and holistic thought (level 6) are strongly supported by parts of the prefrontal and temporal cortices. With respect to holistic cognition, right fronto-medial networks and the right anterior temporal pole appear to be linked to the understanding of metaphors and language in context, whereas left frontal areas are more concerned with reducing uncertainty by building and testing logical explanations (Turner, Marinsek, Ryhal, & Miller, 2015). There is also evidence that brain areas supporting creativity and insight, which strongly depend on holistic thought, may be lateralized to the right cortex (Bowden, Jung-Beeman, Fleck, & Kounios, 2005; Mihov, Denzler, & Förster, 2010; Santarnecchi et al., 2019), but recent meta-analyses suggest a more differentiated view (Boccia, Piccardi, Palermo, Nori, & Palmiero, 2015; Ferstl et al., 2008; Shen et al., 2018; Sunavsky & Poppenk, 2020; Turner et al., 2015). As most creativity tasks require both intuitive and analytical processing, it comes as no surprise that the coordination of both hemispheres is required unless a task is chosen that requires intuitive-holistic processing only.

Neural underpinnings of self-management (level 7) can be seen in the interplay between many areas and neurotransmitter functioning. For the contents presented in this article, the role of different parts of the prefrontal cortex is particularly instructive. For example, with respect to planning (recall the student having difficulties to plan when and how to learn), the left dorsolateral prefrontal cortex may structurally analyze propositional information about the hierarchical goal structure in order to come up with a plan, whereas the right dorsolateral prefrontal cortex may monitor the concrete sensorimotor-spatial feasibility of and integration of information about consecutive, here-and-now actions (e.g., Grafman, Spector, & Rattermann, 2005; Kaller, Rahm, Spreer, Weiller, & Unterrainer, 2010). These findings suggest the left prefrontal cortex to support a rigid and constraining form of self-management (i.e., self-control or "ego-driven"), whereas the right

dorsal prefrontal cortex to support an internally-driven (intrinsic), flexible, and context-sensitive form of self-management (i.e., self-regulation or "self-directed"). Nested within left-lateralized rigid vs. right-lateralized flexible forms of regulation, promotion-focused (reward-driven) and prevention-focused (punishment-avoidant) have been linked to the dorsal vs. ventral parts of the prefrontal cortex, respectively (Quirin et al., 2019; Tops, Montero-Marín, & Quirin, 2016; Tops, Quirin, Boksem, & Koole, 2017).

As self-management at level 7 strongly interacts with level-6 cognitive processes and those from other levels (e.g., self-control capitalizing on combinations of analytical thought, object recognition, and sometimes negative affect), empirical dissociation of brain regions and their causal interaction is a difficult yet not impossible endeavor. In fact, such research is needed to test central assumptions on the neurobiological basis of interactions between cognitive systems, especially and as described above, their modulation by affective systems. Therefore, we will report on studies investigating such interactions in the following section.

6.2 Neural mechanisms of interactions between levels and systems

An important neurobiological mechanism that may underlie the affective modulation of personality processes may be seen in neuromodulator functioning (e.g., dopamine, norepinephrine, serotonin) connecting low-level systems related to arousal, activation, affect, and incentive motivation (e.g., brain stem, ventral tegmentum) with higher levels of processing (e.g., basal ganglia, neocortex). The relevance of these neuromodulatory pathways across the brain for understanding motivation, volition, and personality was recognized several decades ago (Derryberry & Tucker, 1991; Tucker & Williamson, 1984), and has been elaborated recently (e.g., Aston-Jones & Cohen, 2005; Petersen & Posner, 2012; Tops et al., 2017). Temporal changes and individual differences in the connectivity and dissociation between those pathways running across the "vertical" axis of the brain provide a plausible model for the neurobiology underlying incentive motivation, planned behavior (as illustrated by the interaction between intention memory and intuitive behavior control) and sustainable, constructive coping and self-growth as illustrated by learning from mistakes. Recall that "learning from mistakes" presumably involves the interaction between error-detection and error-prevention or perception of pain and its integration into the extended experiential knowledge system of the self.

Two neuroimaging studies offer direct support for the assumption that positive affect modulates the interaction between intention memory and intuitive behavior control (i.e., the volitional facilitation assumption). Diekhoff and Gruber (2010) found that structures involved in behavioral facilitation through midbrain dopamine activity such as the nucleus accumbens interact with a dorsal frontal network when participants are exposed to a long-term goal or intention. Specifically, successful maintenance of an (unpleasant) long-term goal was associated with an inhibitory connectivity between a left prefrontal network and NAcc activity. From the perspective of PSI theory, this pattern is expected on the basis of the antagonistic relationship between intention memory and intuitive behavior control (see Fig. 1, dashed arrow from IM to IB).

Building on this work, Herrmann, Baur, Brandstätter, Hänggi, and Jäncke (2014) found that this pattern was reversed in a way that the nucleus accumbens was connected with rather than inhibited by regions of the left frontal cortex when participants entered an action crisis, that is when they experienced a decisional conflict between sticking to the goal or switching to a more attractive one. Moreover, action orientation scores were negatively related to the intensity of an action crisis, which in turn was positively related to connectivity between the left frontal network and activity in the nucleus accumbens. Finally, a mediation model showed that, in the pursuit of unpleasant long-term goals, action orientation dampens the connectivity between the left frontal network (which presumably supports intention memory and maintains the goal in focus) and impulsive action (which would increase the risk of switching from that goal to more attractive activities). According to the action control assumption of PSI theory (Section 2) the inhibitory relationship observed in action-oriented participants who were not likely to enter an action crisis helps them to shield their intention against tempting alternative behaviors. Research demonstrating volitional facilitation in action-oriented participants when the right time for the enactment of an intention is approaching (e.g., Kazén et al., 2008; Koole & Jostmann, 2004) leads us to predict increased rather than decreased connectivity between the left frontal network and the nucleus accumbens under conditions allowing for the implementation of an intention. An empirical test of this implication of the action control assumption awaits future research.

Interactions between limbic and prefrontal cortex structures in the context of volition, that is volitional facilitation vs. inhibition, are likely to be associated with the mesocortical dopamine pathway (Engert & Pruessner, 2008; Malenka, Nestler, & Hyman, 2009). By contrast, behavioral facilitation

(e.g., including impulsive false positive reactions) are likely to be produced by the mesolimbic or nigrostriatal dopamine pathways, which are more related to relatively uncontrolled, automatic reactions to incentives (Level 3: Affect) or to cues associated with habitual behavior (Level 1), respectively. Experimental evidence for volitional facilitation (i.e., reduction of Stroop interference through positive primes) suggests that positive affect supports the mesocortical dopaminergic pathway (Kuhl & Kazén, 1999). Note that volitional facilitation requires that intention memory is loaded with an explicit intention.

As mentioned before, the likelihood that intention memory is loaded should increase when more than one intention is active (with one intention in mind enactment does not necessarily require explicit intentionality because one imminent intention might still be accomplishable by intuitive control). With at least two explicit intentions in mind, the agent has to decide which one should be enacted first and this decision should result in an explicit intention. This reasoning implies that, unless an individual has actually formed an intention, behavioral rather than volitional facilitation should occur (indicated by an increase rather than a decrease of Stroop interference). This renders the modified Stroop paradigm as a possible method to assess whether or not an individual has actually formed an intention.

There is also evidence on the modulatory effect of negative affect on object recognition vs. extension memory and self (i.e., the reverse of the self-growth assumption). The self, conceptualized here as a high-level system providing an overview of motives, goals, and values on the basis of autobiographical experiences, is assumed to be linked to the ventromedial prefrontal cortex (Northoff et al., 2006), and supported by the hippocampus in its function of providing associative connections of memory traces during both encoding and retrieval (Lepage, Habib, & Tulving, 1998). In a neuroimaging study, negative affect induced via images enhanced activity of the amygdala to strengthen item memory, but at the same time reduced hippocampal activity to weaken memory for associations with the image (Bisby, Horner, Hørlyck, & Burgess, 2016). Accordingly, activity of the object recognition system may become enhanced while hippocampal input, which supports extension memory, may become reduced under conditions of negative affect. This also suggests that the amygdala interacts with visual areas to promote attention and encoding of emotionally relevant stimuli (see also Vuilleumier, Richardson, Armony, Driver, & Dolan, 2004).

Indirect evidence supports the assumption that the effect of negative affect on object recognition is stronger for individuals with low levels of action orientation (state-oriented rumination). Specifically, Düsing, Tops,

Radtke, Kuhl, and Quirin (2016) found that cortisol increase in response to social evaluation threat (negative affect) predicted a shift toward left prefrontal activity as indicated by relative asymmetry of reduced power in the electroencephalographic alpha band. This effect was stronger among people low in action orientation (rumination). This EEG study did not allow specification of which exact region of the left frontal cortex was more strongly (or which region of the right frontal cortex was less strongly) activated. This would be important, as parts of the object recognition system are considered to be more strongly supported by the left ventral than by the left dorsal prefrontal cortex, which plays a strong role in consciously integrating novelties into existing schemes (Quirin, Kent, Boksem, & Tops, 2015; Tops et al., 2017) and rumination (Andrews & Thomson, 2009), which may be considered an inefficient attempt of integration. According to PSI theory, this attempt toward extending existing self-schemes may become dysfunctional when areas related to object perception and areas supporting extension memory and the integrated self (which provide broadly connected, integrated memories of previous experiences and contextual information), are not active simultaneously. The latter idea needs to be tested in future research.

6.3 Neuroendocrinology of social motives

Brain areas related to motives may partially be lateralized (e.g., Kuhl & Kazén, 2008; Quirin et al., 2011; Quirin, Gruber, et al., 2013). Moreover, there is much evidence that links motives to neuroendocrinological functioning, especially to neurotransmitters elicited by the hypothalamus, a region of the limbic brain (Mehta & Josephs, 2010). For example, the power motive has been linked to both baseline levels and reactivity of testosterone in men (for an overview, see Schultheiss, 2013). While the relationship between the power motive and baseline testosterone is relatively weak, effects of the power motive on testosterone reactivity to successful competitive situations (i.e., winning) are moderate to high, which is compatible with the notion that motives constitute a latent personality variable that manifests itself in current motivation and physiological and behavioral correlates. By contrast, estradiol turned out to be a correlate of the power motive in women, similarly to testosterone in men. For example, women with a high (rather than low) power motive who won a contest against another woman showed increases in estradiol (e.g., Stanton & Schultheiss, 2007). Also, the stress hormone cortisol increased in both

men and women with a high as compared to low power motive after having lost a competition (Wirth, Welsh, & Schultheiss, 2006).

With respect to the affiliation motive, progesterone appears to play a critical role. For example, both affiliation scores and progesterone levels increased in response to watching a romantic movie clip (Schultheiss, Wirth, & Stanton, 2004). Higher levels of progesterone in women's luteal cycle phase were related to the affiliation motive (Schultheiss, Dargel, & Rohde, 2003). Conversely, increases in progesterone over the period of watching a movie were associated with an increase of affiliation motivation (Wirth & Schultheiss, 2006). The research on relationships between the power and affiliation motives with testosterone, estradiol, and progesterone used a broadly validated version of the picture-story exercise as an indirect measure of motives (Schultheiss, Liening, & Schad, 2008), corroborating the assumption that self-representations stored in a pictorial format may be more strongly linked to spontaneous behavioral and physiological reactions than self-reported motives or "goals" (McClelland, Koestner, & Weinberger, 1989).

Other research relying on motive measures different from the picture story exercise established links between motives and other neurotransmitters. A well-documented link exists between oxytocin regulation and attachment, as a major component of affiliation (Carter, 1998). Specifically, oxytocin is typically elicited in reaction to intimate interactions between romantic partners (sexual intimacy included) and the child and their mother. Also, baseline plasma oxytocin has been linked to the level of self-reported attachment in adults (Tops, van Peer, Korf, Wijers, & Tucker, 2007). Similar to oxytocin, opioid regulation appears to be linked to affiliation as well (e.g., Depue & Morrone-Strupinsky, 2005; Schweiger, Stemmler, Burgdorf, & Wacker, 2013).

Despite the remarkable research demonstrating the relationship between hormones and motive measures there is still little evidence on the psychological mechanisms that might be supported by hormones. Since hormones, like catecholamines, are active across the brain, they may facilitate connectivities across levels of brain functioning. Moreover, Pribram and McGuiness (1992) proposed that certain neuropeptides may work as "meta-modulators" orchestrating task-specific combinations of neurotransmitters (e.g., dopamine and norepinephrine). This function of hormones is consistent with our switchboard hypothesis of motives. We hope that the switchboard hypothesis will stimulate future work into the interface between hormonal and psychological mechanisms of implicit motives.

7. Conclusions and outlook

Throughout this chapter, we have highlighted PSI theory as an integrative framework for motivation science. We began by laying out how PSI theory distinguishes seven levels of motivational functioning which integrate major motivation-theoretical traditions. After this, we discussed the principles that govern the interaction between motivational (and personality) systems, and how these principles can explain paradoxical motivational phenomena, specifically, why people often fail to enact their intentions and why people often choose goals that oppose their intuitive needs and references. We also showed how PSI theory invites a new look on motives as switchboards and considered how PSI theory is grounded in biobehavioral and neuroscientific evidence.

7.1 PSI theory in the context of motivation science

As a comprehensive framework for human motivation and personality functioning, PSI theory is more abstract than most other contemporary approaches in the field, which have centered on isolated mechanisms and phenomena. In our view, such mini-theoretical approaches are perfectly compatible with the macro-theoretical approach of PSI theory. Fine-grained theoretical analyses can offer indispensable insights into specific domains that complement and extend PSI theory in important ways. For instance, in studying volitional facilitation, we as PSI theorists (Kuhl & Kazén, 1999) have made ample use of the extensive scientific knowledge base that was available in cognitive psychology on the Stroop interference task and its relevance for high-level, executive processing (Cohen, Dunbar, & McClelland, 1990; MacLeod, 1991). Without the latter domain-specific knowledge, we would not have been able to conduct a rigorous test of PSI theory's volitional facilitation assumption.

At the same time, we believe that PSI theory has something important to add to motivation science. As noted before, motivation science has long remained a highly fragmented discipline (Austin & Vancouver, 1996; Braver et al., 2014). PSI theory helps overcome this problem by offering a theoretical integration that combines multiple theoretical traditions into a coherent analysis of the person's motivational functioning.

The added value of the integrative theoretical analysis that PSI theory affords is perhaps nowhere clearer than in everyday applications of motivation science. This is presumably because motivational problems in everyday

life do not adhere to neatly pre-defined conceptual categories. Instead, everyday motivational problems tend to be messy, ill-defined, and complex. Resorting to simple formulas in such cases is unlikely to yield enduring solutions. The framework of PSI theory, though admittedly more complex, seems better suited to provide a more scientifically grounded approach to people who struggle to motivate themselves in everyday situations (see Storch et al., 2018, for an easily understandable introduction to PSI theory and its applications in everyday life).

To stimulate applications of PSI theory, we have developed a general logic, along with assessment tools, which can be used for motivational counseling (Kuhl, Kazén, & Koole, 2006). The first set of tools consist of an encompassing assessment of motivational and personality variables across all seven levels of personality (Kaschel & Kuhl, 2004; Kuhl & Henseler, 2003). This "Evolvement Oriented Systems" assessment (EOS) permits an in-depth individualized (i.e., idiographic) evaluation of a person's psychological capacities and processes including personality disorders (DSM V; American Psychiatric Association, 2013) and related personality styles (Kuhl, 2000b). Using PSI theory, practitioners can interpret the pattern of results in the EOS. Oftentimes, this involves the discovery of a "leitmotiv" (i.e., a guiding theme) that helps to interpret the complete pattern of results. Once the leitmotiv is established, it is interpreted in terms of the systems postulated by PSI theory. The coaching intervention will then focus on strengthening or weakening these systems or their interactions, through targeted interventions. Finally, the effectiveness of this intervention is subsequently tested using differentiated measures that are derived from PSI theory.

7.2 Using PSI theory to address motivational deficits among students

Using this general logic and the framework of PSI theory, we conclude with another look at the students that were described in the opening of this article. For each of the seven levels of personality functioning, PSI-based intervention involves the steps outlined in Table 2. First, the nature of the motivational problem that students have at various levels can be described by referring to the functional characteristic of each level specified in the first section of this paper. Second, the degree to which any of the levels is involved can be identified during interviewing, behavior observation (column 2 in Table 2), and by using standardized tests (see column 3 in Table 2).

Table 2 Example items for the assessment of resources or problems on each of the seven levels of personality functioning: items from self-report scales (EOS; Kaschel & Kuhl, 2004; Kuhl & Alsleben, 2009); targets for behavior observation or interviewing.

Level of processing	Targets for interviewing, behavior observation	Evolvement-oriented systems assessment (EOS) (example items)	Intervention (examples)
(1) *Habits* (Compound of Object/Cue and Intuitive Behavior)	Explore habits relevant for critical life domains (e.g., habit diary) and promote habit change.	Being with other people, I usually follow my heart	Habit change (Behavior Therapy); if-then plans; and intuitive behavior through modeling.
(2) *Global Arousal* (Sensory Arousal and Motor Activation)	Which activities require more (less) sensory arousal (motor activation) than currently available?	Compared to others, I get nervous (active) quite quickly	Autogenic training or sensory stimulation (with over vs. underarousal, respectively); physical exercise or "wait-and-think" (with under- vs. hyperactivity, respectively)
(3) *Specific Affect* (Positive and Negative Affect/Reward and Punishment)	Which objects, persons or activities elicit (reduce) positive (negative) feelings (→ incentive diary)?	There are many things in my life that make me happy	Expand the number of positive incentives, reduce negative incentives; change subjective appraisal (reframing).
(4) *Stress-Dependent Regression*	How does stress affect the impact of motives, goals, and self-management on experience and behavior?	When something really gets me down: (A) I have trouble doing anything at all. (B) I find it easy to distract myself by doing other things.	Train hippocampal efficiency: episodic memory, spatial orientation, stress-reduction

(5) *Motives* (Affiliation, Achievement, Power, Autonomy)	Which fantasies or spontaneous behaviors come up in motive-relevant situations?	Once I have solved a difficult task I am on to the next challenge.	Emotional grounding of goals (ZRM); motivational counseling (Alsleben & Kuhl, 2011); disengagement from problem goals (Brandstätter & Herrmann, 2018)
(6) *Complex Cognition* (Concepts/Constructs and Associative Semantic Networks)	What concepts or goals have an impact on experience or behavior (e.g., in the family or at the workplace)	I often contemplate how to improve my relationship with my partner or friends.	Specify personal goals; clarify and extend personal constructs (Kelly, 1955) search for meaning (Frankl, 1973); discover the intelligent unconscious (e.g., through hypnosuggestive methods).
(7) *Self-Management* (Self-Control and Self-Regulation)	Explore self-management: Planning, goal shielding, self-motivation, self-relaxation, self-determination etc.	Before I begin to work on a task, I first think about all the details.	Teach self-management strategies (e.g., emotion regulation, proactivity; mental contrasting)

Third, we suggest possible interventions for this motivational problem by pointing to appropriate approaches in training or therapy.

At Level 1, the students have not developed suitable habits that are conducive to learning. This problem can be identified by asking students about their study habits in an interview. Also helpful may be standardized tests that tap into students'chronic reliance on automatic behavior patterns. Suitable interventions that target habits are implementation planning exercises (e.g., Gollwitzer & Sheeran, 2006) and presenting students with successful role models that they can imitate (e.g., Richards, Heathfield, & Jenson, 2010). Implementation planning is a procedure inviting participants to specify conditions and behavioral consequences (e.g., "If distracting thoughts come up, I immediately return to my homework"). This procedure can be interpreted in terms of establishing a habitual connectivity between a cue and the desired behavior.

At Level 2, the students suffer from energy or arousal problems. This kind of problem can be diagnosed by determining how much sensory arousal or motor activation is required for the students' activities, and by observing if the students are able to meet these demands. Self-report measures may further provide an indicator of students' chronic arousability at sensory and motor processes. Different interventions may be used depending on whether students suffer from underarousal or over-arousal. Underarousal, which is, for example, associated with externalizing behavior (Baker et al., 2018), may be tackled by increased sensory stimulation or enhanced disciplinary consequences (Beauchaine et al., 2015). Over-arousal problems may be overcome by autogenic training, which includes systematic exercises for learning to perceive relaxation of body parts and autonomic activity (Stetter & Kupper, 2002).

At level 3 (Table 2), incentives associated with scholastic learning may be lacking. Here, it could be useful to collect information about objects, persons, and activities that elicit positive or negative feelings. Again, interviewing, behavior observation, and self-report scales (e.g., EOS) will provide information about the availability of relevant incentives. A variety of incentives contribute to task motivation and academic performance (Wilson & Corpus, 2001). Despite the partial antagonism between extrinsic and intrinsic rewards (Cameron, Banko, & Pierce, 2001; Deci, Ryan, & Koestner, 2001), providing extrinsic incentives may have an impact on performance and even long-term improvement of intrinsic motivation (Davis, Winsler, & Middleton, 2006). Parents and teachers can increase incentives for learning by creating reward systems (e.g., suggest an attractive activity

after a less attractive task has been finished). Additionally, parents may increase the positive valence of learning through participation in the learning process and by providing encouragement and support when needed (Steinberg, Lamborn, Dornbusch, & Darling, 1992).

At level 4, students are incapable of inhibiting unwanted habits or emotional impulses, especially when they are under stress, such as important life changes or rejection from peers. This problem relates to regression, defined as stress-dependent impairments of the influence of high-level systems (e.g., goals, motive, self-determination) on low level systems (e.g., for inhibiting unwanted habits or emotional impulses). Interviewing, behavior observation and self-report scales can reveal the extent to which normally available high-level processes deteriorate under stress (Table 2). Recall that the hippocampus mediates top-down regulation from high to low levels of processing (Schmajuk & DiCarlo, 1991). Therefore, any task that activates the hippocampus, such as autobiographical interviewing activating episodic memory or memory games involving spatial orientation, may reduce stress-dependent regression. Moreover, strengthening levels 5, 6 and 7, that is, the development of motives, goals, and self-management skills (Table 2, column 4), should improve resistance against regression.

At level 5, motives are not sufficiently recruited in students' behavior. Recall that motives facilitate context-sensitive and creative need satisfaction. For example, without the support of a well-developed achievement motive, students may miss many opportunities that would give them a chance to advance their learning and performance. The degree to which motives (i.e., level 5) support the context-sensitive satisfaction of needs can be estimated by exploring a person's fantasies and spontaneous behavior and by applying standardized tests that infer motives from spontaneous imagery (Alsleben & Kuhl, 2011; Baumann, Kazén, & Kuhl, 2010; Kuhl & Scheffer, 1999; Schüler, Brandstätter, Wegner, & Baumann, 2015; Schultheiss et al., 2008). Because motive development starts early in childhood, increasing the influence of motives is not a trivial endeavor. However, a training program strengthening the connectivity between personal goals and positive imagery and somatic markers successfully addresses core elements of motive development: The Zürich Resource Model (ZRM; Storch, 2004; Storch et al., 2018) combines the emotional support provided by motives with their broad attentional vigilance for need-relevant cues and context-sensitive behavior (Table 2). Motivational counseling can help improve the ways individual motives can be taken into account both at the workplace and in the family (Alsleben & Kuhl, 2011; Kaschel & Kuhl, 2004). Note that

motive development is not the only way to reduce incongruence between explicit goals and implicit motives. Another possibility toward aligning explicit goals with implicit motives is to help people disengage from goals that are not supported by implicit motives or that do not match constraints any longer (Brandstätter & Herrmann, 2018).

At level 6, students are not capable of forming personal goals. Goal formation requires complex cognition that is based on general concepts, and personal constructs about how the world works. Kelly's (1955) role repertory grid can be used for a better understanding of the constructs an individual uses to make sense of the social world (Montesano et al., 2015). From a motivational point of view it makes a great difference whether people are guided by specific or by global goals. Our discussion of this distinction within level 6 focused on the implicit nature of global goals (cf. Jung's "feeling" process as a form of high-level, rational intuition) in contrast to specific goals that focus on a concrete outcome. Interviewing, behavior observation, and self-report measures can reveal the subsystems an individual prefers for satisfying his or her motives. For example, frequently thinking about how to improve one's relationships with friends (cf. the respective EOS item in Table 2, level 6), might interfere with spontaneous enjoyment of positive interactions with them. Repeatedly thinking about improvement of one's relationships is likely to involve intention memory more than intuitive behavior when the need for social interaction is aroused. In contrast, extension memory (i.e., the cognitive basis of the self in PSI theory) provides global constructs that help in perceiving the inner world of others (e.g., their likes and dislikes). Compared to pondering about difficult improvement intentions enjoyable personal relationships may be better facilitated by gaining access to the intelligent unconscious, that is one's *felt sense* (Gendlin, 1978), for understanding others. This training focusing on global feelings can be complemented by supporting students in their efforts toward finding meaning in their lives, for example, by exploring personal values, needs, and feelings that provide a positive perspective on a difficult or painful experience (Frankl, 1985).

Finally, at level 7, students are struggling to manage themselves across a broad range of situations. These problems with self-management pose perhaps the most complex challenge for assessment and intervention. A broad assessment of self-regulatory competences may reveal the specific self-regulatory processes that can benefit from counseling and training (Table 2). The long version of the Volitional Components Inventory (VCQ; Kuhl & Fuhrmann, 1998) comprises up to 40 specific self-regulatory

competences, such as planning (e.g., thinking about the details of a task before starting with it), self-motivation (e.g., knowing how to make a boring task interesting), and many more. Fortunately there are effective intervention methods for improving self-regulation, for example, for emotion regulation (Beaumont & Sofronoff, 2008; Jazaieri et al., 2014; Southam-Gerow, 2013), initiative and proactivity (Mensmann & Frese, 2016), and mental contrasting between the positive sides of attaining a difficult goal and the difficult steps to be taken toward it (Duckworth et al., 2011). Moreover, on the basis of PSI theory, context-adequate switching between contrasting emotional states and/or macrosystems such as intention and extension memories, error-sensitive object perception or intuitive behavioral imagery has turned out to provide an effective set of tools for motivational counseling and coaching (Storch et al., 2018). Some self-management programs provide broader sets of self-regulatory strategies (Cleary & Zimmerman, 2004; Storch & Kuhl, 2011; Storch et al., 2018). A particular challenge in self-management training relates to improving the balance between effortful and easy forms of self-management (i.e., strict self-control vs. integrative self-regulation). In our discussion of the findings by Fuhrmann and Kuhl (1998) we addressed some relevant elements for interventions aiming at a better balance between self-control and self-regulation.

Students often have problems at several levels simultaneously. In most cases, the various problems detected across levels and within levels are connected through a 'leitmotiv' that connects some or all problem areas. For example, a student seeks counseling because, in stressful competitions, his basketball performance on the college team is far under his training level. At first glance, the problem seems to be at level 4, because stress is an obvious problem and the student's low action orientation score suggests an impaired ability to downregulate negative affect. However, instead of prematurely identifying stress regulation as the intervention target, the scope of attention was expanded by the EOS assessment. The student's affiliation motive score was considerably higher than average (level 5) which seems a bit paradoxical in light of the student reporting that his team play falls short of the coach's expectations. Since the student's VCI score for self-control was two standard deviations above the self-regulation score (level 7), it was not surprising that he admitted perceiving his coach's instructions as controlling and undermining his motivation, including his affiliation motive (which would otherwise be a valuable resource for team play). Finally, mood assessment (Quirin et al., 2009) showed an incongruence between explicit and implicit

anger, that is, the student's score for implicit anger is significantly above average, whereas explicit anger ratings are much lower.

This seemingly "complex" pattern of problems is not atypical and often the interview reveals even more problems (as in this case). However, the counselor's task becomes easier by taking the interconnectedness of those problems into account. In this particular case, the first hypothesis derived from the EOS profile and additional information from the interview lead to assuming the imbalance between the student's very strong self-control and his weak self-regulation as this student's pivotal problem ('leitmotif'). Instead of treating his elevated degree of implicit anger directly, the student might be better helped with training to find a better balance between self-control and self-regulation. Specifically, the student learned to sometimes replace self-control - which is energized by negative affect (i.e., avoidance motivation)—with self-regulation with a positive emotional basis (i.e., approach motivation). This treatment focus turned out to be sufficient for normalizing the student's problems across all levels of processing. Thus, implicit anger could be identified as an indicator of an inner resistance against the coach's instructions that were perceived as controlling, which in turn prevented this student from utilizing positive affect and the integrative power of self-regulation.

7.3 Concluding remarks

At the outset of this article, we described how underperformance by students was attributed to laziness by their parents. In subsequent sections, we tried to explain how PSI theory affords a much richer and multi-faceted view of people's motivational dynamics. We hope that this work will stimulate motivation scientists to develop this work further, so that our discipline will be able to provide scientifically grounded solutions to the pressing motivational problems that people are facing in everyday life.

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