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Dynamics of personality: The Zurich model of motivation revived, extended, and applied to personality

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Abstract

Personality researchers are increasingly interested in the dynamics of personality, that is, the proximal causal mechanisms underlying personality and behavior. Here, we review the Zurich Model of Social Motivation concerning its potential to explain central aspects of personality. It is a cybernetic model that provides a nomothetic structure of the causal relationships among needs for security, arousal, and power, and uses them to explain an individual's approach-avoidance or "proximity-distance" behavior. We review core features of the model and extend them by adding features based on recent behavioral and neuroscientific evidence. We close by discussing the model considering contemporary issues in personality science such as the dynamics of personality, five-factor personality traits and states, and personality growth.

KEYWORDS

dynamics of personality approach, five-factor model of personality, intra-individual systems, personality neuroscience, Zurich model of motivation

1 | INTRODUCTION

Personality researchers are increasingly interested in the proximal causal dynamics underlying personality and behavior, that is, the dynamics of personality (Baumert et al., 2017; Jayawickreme, Fleeson, et al., 2021; Quirin et al., 2020). This research is significant because "psychological and biological phenomena are organized within persons over time" (Fisher et al., 2018, p. 1), and intra-individual variance is much larger than between-subjects variance (Fisher et al., 2018). Accordingly, conceptualizing personality as a static description on a few personality scales does not do enough justice to the personality functioning of an individual.

We reconsider the Zurich model of social motivation (ZM; Bischof, 1975, 1985, 1993), which is a functionally elaborated theory of motivation we believe harbors significant potential for personality psychology. ZM was developed from the 1970s to the 1990s by psychologist, mathematician, and philosopher Norbert Bischof, who was formerly a scientific assistant of Konrad Lorenz. Specifically, based on a cybernetic framework (e.g., Wiener, 1948), ZM postulates a nomothetic, causal structure of motivational process variables (e.g., security, arousal, power, and coping strategies). These variables interact linearly or nonlinearly to determine approach versus avoidance behavior toward a conspecific. Accordingly, ZM uses needs and motivation as primary constructs to explain behavior and experience

and integrates aspects of theories of attachment, optimal arousal, self-determination, emotion regulation, and coping.

Given the frequency of citations to date, the ZM seems to lack international visibility in the contemporary international communities of personality and motivation psychology. This may be due to two circumstances at least. First, the ZM might have been too complex during an epoch where psychology ironically preferred to explain complex relationships with simple models. Second, the relationships postulated lacked empirical support during the time of its development. In our eyes, the low visibility is in stark contrast to the relevance of Bischof's contribution to our discipline.

Revisiting, extending, and applying ZM to personality is particularly important for personality research because elaborate, dynamic models of personality are scarce (but see Kuhl, 2000; Morf & Rhodewalt, 2001; Quirin & Kuhl, 2022; Read, Droutman, et al., 2017; Revelle & Condon, 2015). Rather, most existing personality theories provide frameworks for how personality processes and their eventual relationships may be conceptualized in general (DeYoung, 2015; Mischel & Shoda, 1995) or how frequently they appear (e.g., Fleeson, 2001). However, they often do not make assumptions about how process and trait variables causally relate to each other to produce behavior and experience (e.g., how states of security, arousal, and power interact; but see e.g., Kuhl, 2000; Read, Smith, et al., 2017).

The goals of the present paper are multifold. First, we resketch ZM regarding its central assumptions about the causal relationships among process variables. Second, we connect the theoretical assumptions of ZM, such as psychoanalytic assumptions or other assumptions based on qualitative observations of mammal behavior, to contemporary behavioral and neuroscientific concepts and empirical evidence. Most of these concepts were created and discussed independent of the ZM, and much evidence supporting its assumptions about causal relationships of process variables were collected only after its publication. We rename the original by contemporary terminology wherever adequate and helpful to counteract misunderstandings and foster theoretical integration. Third, we will complement ZM with additional assumptions based on research of the last decades, which we will refer to as ZM-E (extended) in what follows (see Table 1). Fourth, we apply this ZM-E to personality psychology.

We start by outlining the core features of ZM such as its general cybernetic framework, need-related situational features, need states and reference values/setpoints, activation, behavioral programs, and forms of coping, as well as extensions. We then discuss how ZM relates to some contemporary issues within personality science, namely the Dynamics of Personality Approach (DPA), cognitive-volitional variables as components of personality, five-factor personality traits and states, and personality growth.

2 | THE EXTENDED ZURICH MODEL OF SOCIAL MOTIVATION (ZM-E)

ZM can be considered a specific DPA model (for other models, e.g., see DeYoung, 2015; Kuhl, 2000; Kuhl et al., 2015; Read, Smith, et al., 2017; Revelle & Condon, 2015; Tops et al., 2010). ZM has been developed to explain the regulation of distance of a mammal (incl. humans) to its conspecifics via approach-versus-avoidance behavior that is instigated whenever social needs are unsatisfied. This way, this model uses social needs rather than temperament (and related individual differences) to explain behavior and experience.

Non-satisfaction of a need is conceptualized in a cybernetic model by the discrepancy between (subtraction of) an actual need value and its specific setpoint (reference value). Specifically, states of security, arousal (excitement), and power are compared with the need for security, arousal, and power, respectively. Discrepancies cause the subject to approach or avoid the object at hand. If this is not readily possible, that is, in the presence of problems, the subject implements assimilative coping strategies as an "effortful" way to solve the problem. If there is still no progress, in a second step, setpoint change occurs as a form of accommodative coping; for example, need standards are relinquished (the interpretation in terms of assimilation vs. accommodation is already part of ZM-E).

ZM can also be understood as a cybernetic extension of attachment theory integrated with theories of optimal arousal and coping theories. ZM analyzes how attachment, arousal, power, and coping systems dynamically interact based on cybernetic principles such as homeostasis and feedback loops. ZM does not apply only to children's distance regulation to their parents, but also to adults' approach–avoidance tendencies and behaviors in romantic partnerships (Bischof, 1985; Schönbrodt, 2010), and in general.

Figure 1 illustrates the causal network structure of ZM-E. The notes in Figure 1 summarize the extensions that we made, which we explain later. To provide a brief sketch of the model, sensory systems ("detectors") perceive aspects of objects. In a broad sense (as used here), "objects" refer to all kinds of stimuli including creatures, humans, situations, environments, or even ideas. In the original ZM, objects refer to a social (conspecific) interaction partner. Objects (conspecifics) vary in at least three features, familiarity, salience ("relevance"), and

proximity, each of which can vary relatively over time and contexts (there can even be more features, such as sexual attractiveness, e.g., Bischof, 1985). These features and the subject's actions (e.g., successful approach toward or avoidance of a conspecific) differentially influence the subject's *actual values* of security, arousal (excitement), and power. Each of these actual values, which can vary from moment to moment, is compared with its corresponding setpoint. Discrepancies elicit activation, which facilitates affective-behavioral programs that feed back to and change the actual need states in the direction of the setpoints. However, a protracted irresolution of the discrepancies and concomitant accumulation of activation instigates coping as an auxiliary, more effortful resource.

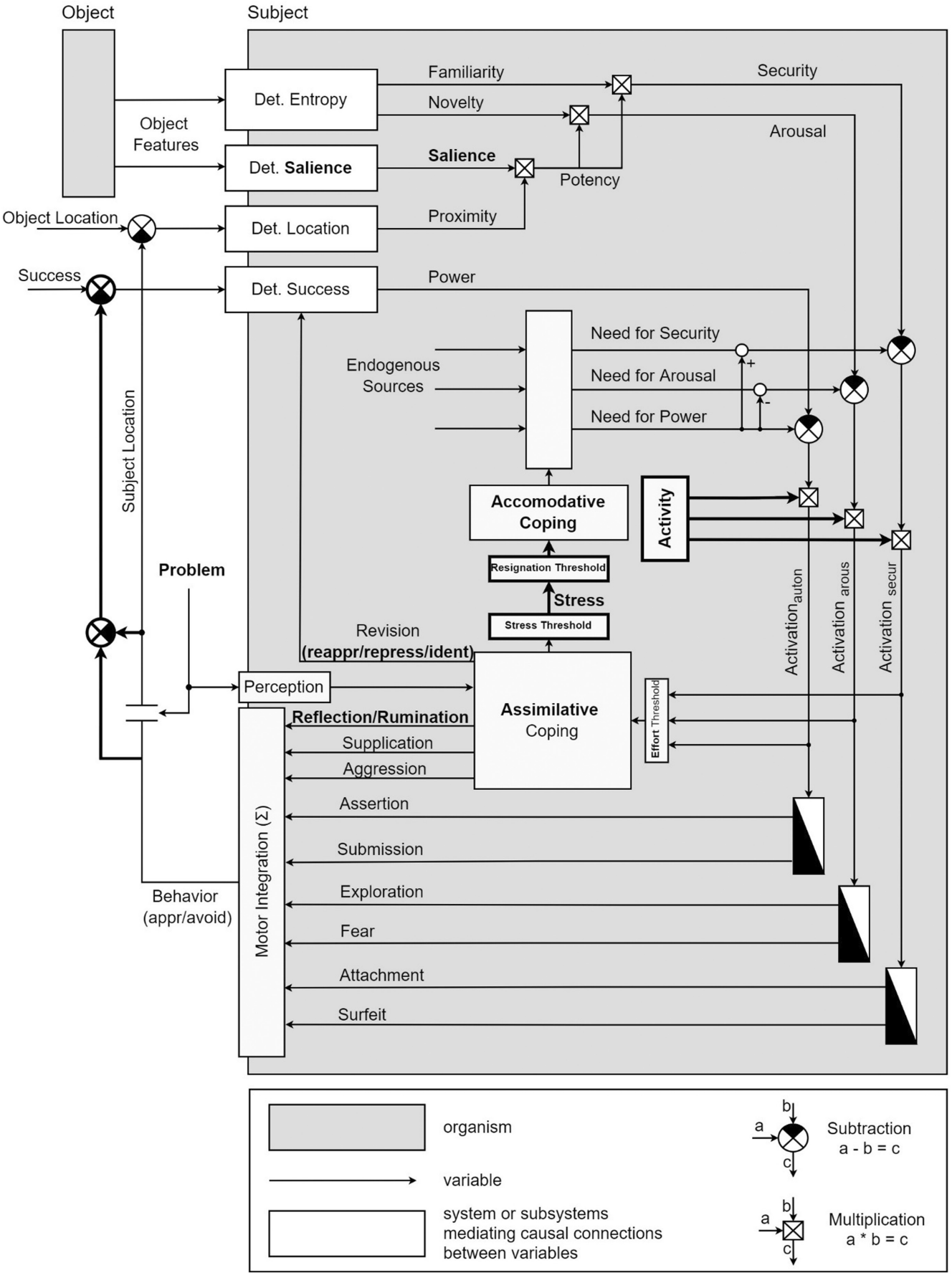
For example, examine security by supposing the actual value of security falls below its setpoint (need for security). A specific motivational program such as attachment approach behavior becomes activated to increase proximity to the attachment figure. By contrast, if an actual value of the security exceeds the setpoint, another motivational program is activated to increase the distance from the object (i.e., "surfeit" in the case of attachment, e.g., when a teenager feels overprotected by her or his mother).

In the next sections, we describe central ZM and ZM-E elements in some detail, elaborating on empirical evidence from contemporary research on human personality and motivation relevant to the model. We also complement the original model with a few causal relationships among the process variables (see Table 1, and Figure 1 in

TABLE 1 Modifications to the extended Zurich model of social motivation (ZM-E)

Extension	Explanation
1. Activity	Encompassing energetic sources other than need dissatisfaction (e.g., trait activation level, circadian rhythms)
2. Behavior threshold	Behavior is not elicited under a certain threshold of activation
3. Assimilative versus accommodative coping	We introduce these terms to emphasize two forms of need satisfaction and personality growth. Accommodative coping = acclimatization in the ZM
4. Reappraisal, repression, and identification	We explicitly spell out that revising one's interpretation of success ("revision") encompasses reappraisal, repression, and identification, central processes of emotion/self-regulation theories
5. Maturity of coping strategies	Coping strategies (incl. Defense mechanisms) vary in the degree to which they utilize high-level cognitive and volitional processes
6. Stress	Failure in assimilative coping diminishes perceived control and elicits stress
7. Regression	Stress diminishes accessibility of mature (high-level) coping as a major source of intraindividual variability
8. Distance change as success	Interpretation of desired, self-induced change in the distance to an object (i.e., goal approach/ avoidance), including successful attainment, routing, and escape as indicators of success
9. Terminology	A number of terminological changes to link the model to contemporary research (see text and bold print in Figure 1)

FIGURE 1 Extended Zurich model of social motivation. The graph shows central aspects of ZM, along with our suggested extensions (depicted in bold). Features of an object (novelty/familiarity, salience, and location/distance) and indications of the subject's success are identified by specific detector networks of the subject, and influence actual values of security, arousal, and power (resp. power) in specific ways. Actual values are compared with their corresponding setpoints (desired states) need for security, need for arousal, and need for power, respectively. Discrepancies lead to activation, which is multiplied by (temperamental) activity, to facilitate behavior. If actual values fell short at their setpoints, specific affective-behavioral approach programs are elicited, whereas specific avoidance programs are elicited if they exceeded them. These programs function to regulate the distance to the (social) object and thus to bring actual values in line with need setpoints, that is to meet the subject's desires. If difficulties and barriers ("problems") thwart immediate approach or removal, assimilative coping mechanisms become activated. If assimilative coping does not suffice to change the situation (here: the distance to the object and according need satisfaction), the organism reacts with stress (allostatic load, if chronic), or it may resign and adapt the setpoint into the direction of the actual value (and thus toward the situation).


Object
Subject
Det. Entropy
Det. Salience
Det. Location
Det. Success
Object Features
Object Location
Success
Familiarity
Novelty
Salience
Potency
Proximity
Power
Security
Arousal
Need for Security
Need for Arousal
Need for Power
Endogenous Sources
Subject Location
Accomodative Coping
Activity
Resignation Threshold
Stress
Stress Threshold
Problem
Revision (reappr/repress/ident)
Activation auton
Activation arous
Activation secur
Perception
Reflection/Rumination
Supplication
Aggression
Assimilative Coping
Effort Threshold
Assertion
Submission
Exploration
Fear
Attachment
Surfeit
Motor Integration (Σ)
Behavior (appr/avoid)
organism
variable
system or subsystems mediating causal connections between variables
Subtraction a - b = c
Multiplication a * b = c

bold print). As the model integrates motivational process variables and relatively stable setpoints for these variables, it can be used as a theoretical framework that integrates personality processes and traits.

2.1 | Situational features and corresponding detectors

Individuals get in touch with the environment via sensory organs that feed forward information to specialized brain areas that function as detectors for specific features of objects and situations. Many situational aspects can be relevant to elicit a human's behavior and can vary from moment to moment (Rauthmann et al., 2014), but ZM focuses on aspects that are immediately relevant to basic psychological needs: familiarity, salience, and proximity (as immediate aspects of objects), as well as success (positive and negative incentives obtained by one's own efforts). Regarding the brain, detectors can be considered to not only comprise primary-sensory but also higher-level association areas, including those of the prefrontal cortex that provide top-down feature interpretation. In Figure 1, detectors are located at the relative intersection with the environment.

2.1.1 | Entropy

Entropy refers to the degree to which aspects (or the total) of an object, a person, an event, or a situation are uncertain. Accordingly, novel objects or situations are entropic, for example, objects for which the organism is uncertain about their classification. Moreover, unpredicted objects or situations are entropic, such as a familiar object occurring in an unusual context, as well as unpredictable objects or situations, for instance, a situation in which one does not know what to expect. By contrast, one's family (and their typical behavior) or one's safe home are prime examples of "objects" that encompass high levels of familiarity (i.e., the opposite of novelty).

Furthermore, unpredictability can promote not only the acquisition of knowledge (Barto et al., 2013) but also competence acquisition (Mirolli & Baldassarre, 2013). Indeed, unpredicted neutral stimuli are thought to drive the acquisition of actions that produce those stimuli (Redgrave & Gurney, 2006), just as biological reinforcements are thought to drive the learning of how to maximize rewards (Mirolli et al., 2013). Hence, entropic inputs are needed to increase the likelihood to gain reinforcements and avoid punishments in the future. In sum, entropy stimulates curiosity and exploration, which is vital for the organism to learn and adapt to its specific environment.

Detectors of entropy can be found in various parts of the brain. In particular, the inferotemporal cortex (Ranganath & Rainer, 2003), the perirhinal cortex (Brown & Aggleton, 2001), and the prefrontal cortex (Asaad et al., 1998) have all been shown to be sensitive to stimulus novelty. Meanwhile, the hippocampus is well known to be sensitive to various forms of novelty in the context of spatial, temporal, or stimulus–stimulus associations (Kumaran & Maguire, 2007). Another area that is essential for novelty processing is the amygdala (e.g., Schwartz et al., 2003; Weierich et al., 2010; Wilson & Rolls, 1993; Wright et al., 2006). Still other areas have been implicated in the processing of contextual novelty, which is the perception of a familiar stimulus in a novel context. Contextual novelty might also depend on unpredictability (the individual knows the stimulus but cannot predict its occurrence in the present context), which includes regions in the prefrontal cortex, anterior insula, cingulate gyrus, temporoparietal cortex, medial temporal cortex, and the hippocampal formation (Ranganath & Rainer, 2003).

2.1.2 | Salience

"Salience" is the degree of the pertinence of an appetitive or aversive stimulus to a need perceived or expected by an individual (Berridge & Robinson, 1998; Bromberg-Martin et al., 2010; DeYoung, 2013). Although stimuli can be salient in various aspects (i.e., to satisfy needs for nutrition or intellectual curiosity), in a model of social motivation such as this study, salience refers to the *social relevance* of an object in question. An object is socially relevant when it has the potential to satisfy basic social needs of the subject, such as those for security, arousal, or power. Conspecifics are typically more salient than non-conspecifics, but differences also exist within conspecifics. For example, parents have high social relevance for their child concerning all three social needs, functioning as attachment figures (security), authorities (power), and playmates (arousal). Later in life, however, the relevance of parents for the subject substantially drops, typically for each need.

Generally, the perceived status of objects in a social hierarchy is of particular social relevance in that it can relay a reduction or increase in the subject's power. For example, a high social status would (implicitly or explicitly) enable a superior to impose duties or a teacher to evaluate intellectual abilities (Rauthmann et al., 2014) or to let the subject shine in their shadow. Objects of high status at the same time qualify as granters of security or attachment figures. The central brain areas of salience processing (not

only of social salience) are the anterior insula and the dorsal anterior cingulate cortex (Menon & Uddin, 2010). Additionally, the thalamus (Zhou et al., 2021) and the amygdala (Davis & Whalen, 2001; Garavan et al., 2001) provide fast evaluations of stimulus salience.

2.1.3 | Proximity

The proximity of (vs. distance from) an object is yet another variable that influences the subject's motivational states, which has been shown in early behavioral studies on animal motivation (Miller, 1959; see also Louro et al., 2007 for a review). "Proximity" is defined by subtracting the object's location (i.e., the spatial coordinates) from the subject's location, either of which can vary from moment to moment and proportionally affect their internal states. In an adult subject, proximity to the object not only connotates objective distance (i.e., whether the partner is visible or invisible, in the room, in the house, or easily reachable by train) but also subjective distance conveyed by symbolic behaviors (e.g., a partner not responding to a question, averting eyes, or reducing an intimate connection). Detection of a location and thus the physical distance of an object is strongly supported by the occipitoparietal cortex (Ungerleider & Pasternak, 2004). Higher-level areas, by contrast, are recruited to interpret symbolic indicators of subjective distance (e.g., when an interaction partner turns away his head or does not answer).

2.1.4 | Success

Another situational variable that critically influences the subject's need state is success. In ZM, "success" concerns positive cues of social rank (power) or competence such as outdoing somebody (i.e., winning a fight or competition), signals of prestige, others' appreciation or obedience, as well as mastering a task or achieving a goal (Bischof, 1985; see also Schönbrodt et al., 2009; Schneider, 2001). In ZM-E, we explicitly connect success to all kinds of experiences that result from the desired and self-induced approach toward or withdrawal from an object, situation, or goal (i.e., perceived approximation toward incentives and distancing from a threat are conceived of as success). Accordingly, even desired increases in security (e.g., receiving the love or proximity of a beloved person or attachment figure) add to success when they are self-induced (e.g., via social manipulation; see Figure 1). Evidence shows that successful attainment of a goal or related subgoals is reinforced by the phasic release of midbrain dopamine (Berridge & Robinson, 2016; Wilkinson et al., 2014).

2.2 | Need states

Need states—namely security, arousal, and power—constitute the central variables in ZM, which are continuously compared with their specific setpoints. The variables are influenced by the detected input variables described above. Whereas object features of low entropy (familiarity) determine the actual value of security, object features of high entropy (novelty/unpredictability) determine the actual value of a different variable—arousal. By contrast, success cues increase the organism's feeling of power. We describe these need states in the following sections.

2.2.1 | Security

Security is a state of (relative) relaxation that results from high levels of familiar objects and aspects. The presence of attachment figures, primary caregivers, or adult romantic partners considerably contributes to a state of security (Holmes & Johnson, 2009; Shaver & Mikulincer, 2002). By contrast, their absence or distance from the subject proportionally reduces security. Findings from brain morphometry research indicate that attachment security is related to larger gray matter density in the superior temporal sulcus and gyrus, temporo-parietal junction, precentral gyrus (Leblanc et al., 2017), and the hippocampus (Quirin et al., 2010).

2.2.2 | Arousal

In ZM, arousal is used in the meaning of "excitement" and is a response to entropic (i.e., novel, unpredicted, and unpredictable) sensory input (see also Pribram & McGuinness, 1975; Thayer, 1978b). Similar to security, salience and proximity multiply ("potentiate") entropy's effect on arousal (*potency* in Figure 1; see also Berlyne, 1971; Fiske & Maddi, 1961). Arousal is strongly related to the release of noradrenaline (DeYoung, 2013).

2.2.3 | Power

In ZM, as a predominantly mammal model, power ("autonomy" in the original ZM) is inextricably related to the rank order within the social hierarchy of a subject's group (and in relation to the interacting object), and thus with social power. On the one hand, high status (or rank, prestige) bestows more liberties (i.e., autonomy) and the implicit privilege to influence and exert control over others, which restrains their liberties. Accordingly, signs of others' obedience constitute strong indicators of success. On the other

hand, the appearance of a conspecific of a higher rank can immediately reduce one's sense of power (e.g., authorities such as parents, teachers, older siblings, superiors, or group leaders). If these conspecifics are experienced as friends rather than authorities, they can alternatively raise one's power ("shining in someone's shadow").

The concept of power is not restricted to social power in ZM but also extends to "personal power" (Lammers et al., 2009). Accordingly, power has also been related to perceived competence as success makes subjects feel capable of attaining goals through their own efforts, that is, autonomously. In this manner, the concept of power in ZM may also be linked to states of (i.e., momentary) effectance (White, 1959), self-efficacy (Bandura et al., 1999), self-determination (Deci & Ryan, 2000), self-directedness (Cloninger et al., 1993), and self-esteem (Rosenberg, 1979). We explicitly expressed these links in ZM-E.

As a consequence, power should not only increase in response to social-rank-related experiences of success but also in response to each self-induced approach toward (or avoidance of) objects that afford a change in any need-related state, such as security or arousal. Hence, we added an excitatory path from the variable "difference between attempted location (i.e., behavior) and desired location (i.e., preferred distance to the object)" to "success" (Figure 1). Note that in humans and certain contexts, "power" can be subdivided into related but distinct concepts such as social power, autonomy, prestige, or achievement-related feelings of competence (Bischof, 2009; see also Schönbrodt et al., 2009).

2.3 | Setpoints, activation, and homeostatic feedback

In the ZM, actual values of security, arousal, and power are compared with (subtracted from) their corresponding setpoints (reference values). In cybernetic models, setpoints aim to keep an organism's behavior in relative balance (homeostasis) and thus contribute to stability. Specifically, a *deviation* (discrepancy or "error") between actual and reference values activates process variables, which result in actions. This cascade of processes functions to realign actual and reference values via feedback loops (e.g., the outcomes of actions influence proximity and success).

Setpoints constitute one major source of interindividual differences (traits) in a cybernetic system, and in ZM they reflect relatively stable optimal values of specific need states (Atkinson & Birch, 1970; McClelland, 1987). Therefore, ZM can be considered a personality-situation interaction model (Mischel, 1968; see also Rauthmann, 2020), which may be traced back to early incentive-drive models as precursors (Hull, 1943; see also Read & Miller, 2002). Specifically, security, arousal, and power each carry their specific setpoints coined *need for security*, *need for arousal* (or "excitement seeking"), and *need for power*, respectively (see Bischof, 1985, but using different terminology: dependency, enterprise, and autonomy claim, respectively).

When states of security, arousal, or power deviate from their setpoints, momentarily or chronically, the subject is set into a state of *activation*. The level of activation (or "tension") corresponds with the amount of deviation and functions to move the actual value closer to its setpoint (e.g., by changing the current situation via actions). In line with some traditional theories on activation and arousal (Pribram & McGuinness, 1975; Tucker & Williamson, 1984; Thayer, 1967, 1978a, 1978b), these two concepts have also different meanings and functions in ZM: Whereas arousal reflects a response to novel input and increases perceptual receptivity, activation (as an effector variable) reflects output excitation (motor readiness; see also Kuhl et al., 2021). ZM thus incorporates the two functions of sensory stimulation postulated by Hebb (Hebb, 1955; see also Fajkowska, 2013): a cue function, which gives direction to a behavior (i.e., approach vs. avoidance; here depending on the sign of the discrepancy) and an "arousal" function, which activates the behavioral system (here: "activation"). Whereas arousal is strongly related to the release of noradrenaline, activation is more strongly related to dopamine (and adrenaline) activity (Tucker & Williamson, 1984).

Here, we extend ZM by considering an additional input variable, *activity*. "Activity" in this work is considered the sum of all other sources of activation that are independent of the amount of activation produced by immediate need discrepancies. Such sources may encompass neurotransmitter activity due to circadian rhythms and sleepiness, effects of ingested nutrition and substances, and particularly, relatively stable trait individual differences in activation. Similar to the variable "activity" postulated by Hull (1943), we suggest a multiplicative connection to boost the effect of discrepancies on behavioral-emotional programs. This variable also reflects Hebb's (1955) notion that the cue function does not (entirely) determine activation and that this function cannot operate properly below a minimum threshold level of preexisting temperamental activation. In ZM-E, "cannot operate properly" means that no affective-behavioral program is elicited below a particular threshold. Accordingly, a person with a trait of low activity (e.g., a melancholic individual) may not react behaviorally although they experience elevated levels of discrepancy (e.g., Fajkowska, 2013).

Revising ZM by adding a need-independent component of activation ("activity") integrates a motivational

(need-based) with a temperamental approach toward personality as activity is considered a defining variable of infant personality in most developmental theories (Shiner et al., 2012; Shiner & DeYoung, 2013) and has been postulated as a component of temperament in influential theories (Strelau & Zawadzki, 2012).

2.3.1 | Need for security

The need for security (or "dependency" in the original ZM) indicates the amount of emotional warmth an individual desires from attachment figures (e.g., a parent or romantic partner). This need can be considered the critical process variable underlying individual differences in anxious (preoccupied) attachment or dependent personality accentuation (Ainsworth et al., 1978; Bowlby, 1982; Shaver & Mikulincer, 2002). Whenever the security state falls short at the need for security, the subject shows attachment behavior (Figure 1). Accordingly, individuals with a high need for security typically show security deficits and concomitant separation anxiety; thus, they tend to maximize proximity to attachment figures. By contrast, whenever security exceeds its setpoint, the subject shows surfeit and attempts to increase the distance to the object (see Figure 1; Bischof, 1985). Accordingly, objects or environments that provide excessive levels of security can become aversive. Typical phenomena of providing too-much security are "helicopter" parents or clingy romantic partners. However, appropriate levels of security in matches of actual-setpoint values are related to feelings of relaxation, and (social) warmth. These feelings are also related to the release of (endogenous) opiates, serotonin, and oxytocin (e.g., Machin & Dunbar, 2011; Tops et al., 2014).

2.3.2 | Need for arousal

The setpoint for arousal is the *need for arousal* (or "excitement seeking"). The need for arousal alludes to novelty-seeking tendencies, that is individual differences in the need to explore novel things and environments (Cloninger et al., 1993), or briefly, the "need for stimulation" (Raju, 1980). Individuals with a high need for arousal are considered to show lower levels of arousability (Eysenck, 1964; Strelau, 2008). In the original ZM, as a model of social motivation, the need for arousal is confined to adventurousness in a social context, that is, to approach or avoid strangers.

ZMAs a cybernetic model, ZM is in the tradition of optimal arousal theories, according to which the organism seeks to align actual arousal with a setpoint (i.e., need) for arousal (Berlyne, 1960; Hebb, 1949). Hence, setpoint comparison in ZM integrates two types of historical drive-reduction theories. The one views arousal as an annoying perturbation that should be reduced (e.g., Hull, 1943), and the other views arousal as an integral and adaptive aspect of life that motivates humans to explore the environment to continuously acquire knowledge and competencies (e.g., Berlyne, 1966; Eysenck, 1993).

Specifically, when the level of arousal is lower than the need for arousal, the organism becomes activated to explore the environment, looking for adventures and sensations. Here, two states can be distinguished, depending on the presence or absence of an interesting stimulus: Whereas the presence of stimulation amounts to curiosity, its absence amounts to boredom. Accordingly, boredom is a state of an activated (tense) state of appetence for stimulation and arousal in an uneventful environment (Bench & Lench, 2019; Bischof, 1985) that drives the subject toward a diversive exploration of the environment (Berlyne, 1966). The reader may think of a cat (or a child in kindergarten) starting to hit somebody unexpectedly. This scenario might refer to a case of appetence for arousal with the function to induce unpredictable behavior as a social play or fight (similarly, think of action movies, hooligan fights, or toy destruction by children).

By contrast, if arousal exceeds the need for arousal (e.g., when an object or its behavior is too strange or unfamiliar, or when the individual has a low need for arousal), arousal becomes aversive, which results in fear. This situation elicits an avoidance or flight program to increase the distance from the object at hand (Berlyne, 1960, 1966). If escape is impossible, however, the subject has no choice but to fight or explore (or even befriend) the threatening object in the hope that the novel object will prove to be harmless ("specific" or "inspective" exploration, according to Berlyne, 1966). In the latter case, the individual shows a behavioral approach that is still characterized by cautiousness and fear. This conflictual motivational state has been termed "behavioral inhibition" in reinforcement-sensitivity theory (Gray & McNaughton, 2000; see also Corr, 2008), for which ZM provides a functional, cybernetic explanation. Concerning neurotransmitter functioning, noradrenaline and dopamine have been qualified as neural correlates of fear and curiosity, respectively (DeYoung, 2013; Lisman & Grace, 2005; Ranganath & Rainer, 2003).

The need for arousal is closely, yet inversely, related to the concept of arousability (Gray, 1964; Strelau, 2008). "Arousability" refers to the degree to which individuals differ in how strongly they are activated by a stimulus of

the same intensity. In ZM, incoming arousal from a perceived stimulus is compared with the need for arousal. Hence, this tends to result in fear in individuals with a low need for arousal (i.e., high arousability). However, the model is silent about the mechanisms underlying arousability, whereas other models assume stimulus-reducing mechanisms (e.g., Strelau, 2008). Additionally, or alternatively, arousability might be modeled as a property (i.e., the sensitivity) of the detectors for entropy or salience (not in the ZM).

2.3.3 | Need for power

In the original ZM, *need for power* (or "autonomy claim"), which is the setpoint for power, regulates assertive and submissive behaviors toward establishing one's status in the social hierarchy. Accordingly, it may particularly reflect individual differences in the power motive (see Schönbrodt et al., 2009), that is, the tendency to exert influence on others (Winter, 1973). As such, less-than-optimal levels of power (i.e., levels lower than the individual need for power) result in assertion, whereas more-than-optimal levels result in submission (e.g., states of embarrassment in response to receiving unreasonable compliments or when employees are promoted to a position they do not feel competent for). As outlined above, ZM-E strongly relates power to self-effectance (self-efficacy). Correspondingly, the setpoint may also be coined self-directedness as an important personality trait (Cloninger et al., 1993).

We described above that power in mammals is inextricably related to social power. This relationship exists because mammal needs are related to communion in a way that success and failure experiences center around increasing versus decreasing social rank, respectively. Therefore, researchers' use of the need for power or self-directedness as a setpoint depends on modeling the exact stimulus-behavior interaction (e.g., self-determined engagement with challenges and tasks in general versus competition with conspecifics).

2.3.4 | Interaction of need systems

Need systems of security, arousal, and power do not operate independently but rather interact in specific ways, with a central role of the power system (see Figure 1). In particular, the power system controls the other need systems in a way that its activation dampens the need for security (negative weight) and promotes the need for arousal (positive weight). For example, evidence suggests that a momentary decline in power renders individuals more dependent (i.e., more "needy" of security) and less adventurous (i.e., less needy of arousal; Keltner et al., 2003). Developmental studies show that with increasing power during early childhood, the need for security becomes reduced, and explorative behaviors increase (Marvin & Britner, 2008). The ZM also includes a central aspect of the dynamics of action theory (Atkinson & Birch, 1970; see also Revelle & Condon, 2015), namely that the strength of each need varies over time and contexts (e.g., presence of objects) and that the strongest need finally determines behavior.

2.4 | The coping system

In the absence of difficulties, the alignment of actual and reference values via approach and avoidance behaviors occurs smoothly and naturally, without the recruitment of additional resources or "effort". However, disturbances often compromise smooth goal advancements (e.g., when a beloved person or attachment figure is eluding). Further, the organism musters more effort by employing the coping system to obtain need satisfaction and corresponding goal (object) attainment in that case (or "effort system"; Sanders, 1983). Two processes can indicate the necessity of this engagement (see Figure 1): Activation exceeds a particular *threshold* (such as the psychohydraulic model to explain aggression; Lorenz, 1950) and/or the organism (consciously) perceives the problem (disturbance) at hand.

Generally, organisms have two possibilities to cope with obstacles (Brandtstädter & Rothermund, 2002; Heckhausen et al., 2010): They may bring situations or experiences (i.e., the perception of situations) in line with their standards (i.e., need setpoints in ZM). Alternatively, they may adapt their standards (reference values) to the existing circumstances. Whereas the former process may be referred to as *assimilative coping*, the latter may be referred to as *accommodative coping*. Although the concepts of assimilation and accommodation have traditionally been introduced to describe adaptations between novel cognitive experiences and existing cognitive schemata (e.g., Piaget, 1977), they may be applied to the realm of emotion, motivation, and personality as well (Quirin & Kuhl, 2022; see also Hanfstingl et al., 2021). Here, in our extended ZM, they refer to the alignment of situational conditions in terms of perceived stimuli and contexts with one's need setpoints. Changes of need setpoints reflect an accommodative process because need setpoints can be considered acquired memory schemata (expectations) of typically gained amounts of incentives (Crespi, 1942; Helson, 1964; McClelland et al., 1953), which may involve corresponding neurotransmitter receptor densities in affect-related areas (e.g., hypothalamus, nucleus accumbens). While the original ZM did not use the terms assimilation and

accommodation, we use them to build a conceptual bridge to coping and personality growth, versus the development of psychological disorders (see Quirin & Kuhl, 2022).

2.4.1 | Assimilative coping

Typically, organisms try hard to keep their standards and worldviews rather than to revise them immediately. Therefore, individuals engage in assimilative coping long before they start revising their standards and worldviews (accommodative coping). In assimilative coping, individuals actively deploy resources to attain their goals to meet their needs (i.e., to reduce or increase the distance to a conspecific in the present model). To illustrate the broad types of assimilative coping postulated by ZM, imagine a rudimentary goal barrier (problem) such as a wall, literally or metaphorically, that keeps the subject from the target (e.g., an attachment figure, a delicious food, or any kind of a problem; cf. Bischof, 1985). To overcome this barrier, individuals can cope via supplication (i.e., asking or crying for help; "victimhood"), aggression (i.e., destroying the wall; which comes with the recruitment of additional activity), revision (i.e., denying, repressing, or reappraising the existence or relevance of the wall: Gross, 2014; or identifying with a goal alternative: Deci & Ryan, 2000), or reflection (i.e., creatively thinking about how to circumvent or overcome the wall). In Figure 1, the different forms of coping are illustrated by the arrows exiting the coping system.

The term *reflection* (originally "invention") is here used to encompass all kinds of logic and creative cognitive processes that help solve a problem (incl. Planning and volition). Excessive reflection, when losing its creative components, turns into rigid, and non-productive rumination (Nolen-Hoeksema et al., 2008). Reflection already occurs in apes, at least in a rudimentary form (and inventive trial-and-error behaviors can already be found in non-mammals). Accordingly, what appears as a tiny box in ZM, is probably the major subject addressed by psychologists (see later, for limitations of ZM as a comprehensive model of personality). Please note that two types of aggressive behaviors or "fight" need to be distinguished functionally in that only one of the two types reflects assimilative coping. Specifically, aggression as coping (i.e., an emergency reaction when escape is not possible, such as in the presence of a clinging partner) differs from aggression as a power-regulating behavior (i.e., assertion; see above). Aggression as coping more so than the latter reflects the fighting behavior postulated in reinforcement-sensitivity theory to derive from the "fight-flight system" (Gray & McNaughton, 2000; see also Corr, 2008). It occurs with a reduced assessment of one's chances of winning (i.e., regressively).

The coping strategies may hierarchically be distinguished by their cognitive-emotional maturity (vs. "primitivity"). Specifically, aggression and supplication can be seen as rather primitive strategies. By contrast, whereas revision and invention can be seen as relatively mature strategies because they involve more complex (human-like) cognitive processes. However, the subtypes of the latter, including defense mechanisms, can further be differentiated concerning their level of maturity (Vaillant, 1992). Thus, coping strategies differ in the matter of their adaptivity in pursuing long-term goals and social norms.

Here we postulate that the application of hierarchically lower strategies is, among others, a function of activation. More precisely, excessive levels of activation render the application of elementary strategies more likely (but individuals differ in the turning point of switching from mature to elementary strategies). This mechanism may be referred to as "regression," defined as the deficiency to access complex cognitive processes in extreme levels of tension and negative affect (see Kuhl, 2010; Quirin & Kuhl, 2022). Accordingly, ZM-E postulates two different mechanisms for suboptimal performance at both low and high (but not moderate) levels of activation, respectively (i.e., the inverted u-shaped function often postulated between activation and performance, e.g., Yerkes & Dodson, 1908). Specifically, a suboptimal performance at low activation levels may be attributed to a lack of motivation (no behavior below a certain threshold, see above). On the other hand, a suboptimal performance at high activation levels may be ascribed to a stress-related regression of complex cognition (Lupien et al., 2007; Radtke et al., 2020; Schwabe et al., 2012). The concept of regression used here is compatible with the concept of overarousal, according to which a direct energetic overflow occurs from the arousal to the activation system that provokes immediate action without cognitive control (cf. Sanders, 1983; see also Fajkowska, 2013). In the case of "reflection", however, these two systems become uncoupled (Kuhl, 2000; Quirin & Kuhl, 2022).

2.4.2 | Accommodative coping

Prolonged phases of failing to assimilate the actual to the reference value and concomitant stress may finally urge the individual to adapt their schemata or standards/expectations, that is, to change the reference value in the direction of the actual value. In humans, this typically involves the disengagement from several life goals (Brandstätter & Schüler, 2013). The term "accommodative coping" is used here to denote this functional adaptation after resignation ("acclimatization" in the mechanical terminology of ZM; see McFarland & Houston, 1981, for the concept of

acclimatization). Accordingly, ZM includes two cybernetic principles, *homeostasis* in terms of attempting to meet a setpoint, with assimilative coping constituting an auxiliary mechanism and *heterostasis* in terms of adapting to the environment via setpoint change. This differentiation provides a cybernetic reconciliation for the debate about personality stability versus change (Ormel et al., 2017).

We deem it important to further differentiate accommodation into *phasic* (short-term) and *tonic* (long-term) accommodation—a distinction that is not explicitly spelled out in the original ZM, as far as we know. An example for a phasic accommodation is the momentary reduction of the need for power in response to a lost physical or intellectual competition or its expectation (which might even result in submissive behavior). An example for a tonic change (e.g., Denzinger & Brandstätter, 2018) is the stabilization of adaptive personality changes (e.g., a reduction in the need for security) as a reflection of personality growth (Jayawickreme & Blackie, 2014; Ormel et al., 2017; Quirin & Kuhl, 2022).

Often, tonic setpoint changes cannot readily be achieved because of the solid or even obsessive tendency to inflexibly satisfy one's needs (and keep one's need standards) rather than to adjust them. This urge may engender a prolonged state of activation and reduced perceived control, which puts the organism under *stress* (see Figure 1) or even chronic allostatic load (McEwen & Stellar, 1993). Consequently, it brings about dysfunctional behaviors reflected in psychological disorders, psychosomatic illness, or even suicide. Neurobiological correlates of such reduced control and resources can be seen, among others, in a chronic increase of hypothalamus-pituitary–adrenal axis activity encompassing increased cortisol release (Foley & Kirschbaum, 2010). Alternatively, or after a longer while (but often stimulated by professional psychological intervention, critical life events, and deep self-insights, or combinations thereof), the constant state of despair may push the individual toward tonic accommodation of setpoints (Joseph & Linley, 2005; Quirin & Kuhl, 2022; Tedeschi & Calhoun, 2004). To implement this, we introduced a *resignation threshold* in the ZM-E (Figure 1). Practical examples refer to changes in the need for security (i.e., dependency) after a breakup or changes in the need for power after the loss of status (e.g., forced resignation of an influential politician).

3 | RELEVANCE OF THE ZURICH MODEL FOR PERSONALITY RESEARCH

We would now like to link aspects of ZM more closely to personality processes and traits to evaluate the model's capacity for personality science in general. We start by discussing (a) the degree to which ZM encompasses features that can be considered important for investigating the dynamics of personality (Quirin et al., 2020), (b) its limitations with respect to cognitive-volitional personality processes, (c) its potential to explain five-factor personality traits and states, (d) its potential to systematize and explain personality growth, and not least, the issues concerning assessment of psychological variables and computational modeling.

3.1 | The Zurich model as a dynamics of personality approach

Personality science is rapidly advancing to investigate the proximal causal mechanisms underlying behavior and personality (Baumert et al., 2017; Jayawickreme, Fleeson, et al., 2021; Kuper et al., 2021; Quirin et al., 2020). Recently, Quirin et al. (2020) used the umbrella term *dynamics of personality approach* (DPA) to refer to models and research that analyze inter- and intra-individual differences in the causal network of dynamically interacting personality processes such as affect/motivation, low and high-level cognition, and volition. Such a functional, process-oriented approach toward personality complements descriptive, aggregative (e.g., factor-analytic) approaches with explanatory elements. While the investigation of these mechanisms has a long tradition that roots in early traditions of personality psychology (e.g., Allport, 1961; Lewin, 1935), it has more recently been experiencing a resumption and refinement in contemporary research (e.g., Back et al., 2011; Cervone et al., 2001; DeYoung, 2015; Fajkowska, 2013, 2015; Fleeson, 2001; Kuhl, 2000; Miller & Read, 1991; Mischel & Shoda, 1995; Nowak et al., 2005; Read & Miller, 2014).

Quirin et al. (2020) discussed twenty features of the DPA: those that many DPA theories have in common and that the authors consider indicatory for a future-oriented personality science. ZM comprises most of them, for example,

- the investigation of the proximal causes of personality-related phenomena,
- action-perception feedback loops as an integral mechanism of dynamics of personality models,
- the consideration of nonconscious processing,
- the adoption of a personality-by-situations perspective by considering moment-to-moment transactions between individuals and situations,
- an exact description of the characteristics of these situations,
- the investigation of interactions among personality processes (within-person variables) and individual differences in them,

- the underlying assumption that all humans share an evolutionarily developed, nomothetic structure of functional variables and operations,
- the possibility that the same kind of overt behavior may stem from different underlying personality (e.g., motivational, cognitive) processes, and, not least,
- a degree of specification of the model that renders it able to be submitted to the computational modeling.

Another DPA tenet for a future-oriented personality science (Quirin et al., 2020) is that the model is subject to a comparison with neuroscientific evidence. In the present article, we attempted a cautious step into this direction. However, another important aspect of the DPA is its consideration of high-level cognitive and volitional (self-regulation) processes, besides basic affective-motivational processes to thoroughly explain human personality, which ZM needs to provide in its current form. We turn to an extended discussion of this aspect in the next section. Later, in yet another separate section, we elaborate on the mentioned aspects of objective assessment (e.g., of implicit processes) and computational modeling.

3.2 | Cognitive-volitional personality variables

ZM has been developed to describe motivational dynamics of mammals, humans included. As such, it includes emotional-motivational process variables and very basic cognitive variables (e.g., detectors for relevance, familiarity, proximity, and success). As a mammal model, it largely disregards higher personality levels concerning cognitive or volitional processes (see Quirin et al., 2020; Wilt & Revelle, 2015). This is not a limitation in itself (as the model was not developed to explain this), but a limitation with respect to explaining human personality and behavior thoroughly.

Yet, a prototypical form of cognition is reflected in the coping mechanism of "invention" reflecting creative problem solving. Volitional (or "self-regulation") processes, which support the prioritization of nondominant goals or action alternatives (or the coordination of actions necessary to solve complex tasks), are not included in ZM. As a consequence, the agent always choses an action that is expected to reduce the strongest (i.e., the most urgent) actual-reference value discrepancy (like in some other computational models of motivation as well: Atkinson & Birch, 1970; Read et al., 2010; Revelle & Condon, 2015). As volitional processes are not considered, which otherwise could regulate motivational impulses, approach and avoidance as outcomes of ZM refer to motivational strength rather than their manifestations in behaviors itself. Accordingly, ZM may best predict behaviors in conditions where self-regulation of the human subject is limited (e.g., impulsive or spontaneous behavior under strong emotions, stress, or in private/non-public contexts; McClelland et al., 1989). To more comprehensively model human behavior and personality (e.g., conscientiousness), ZM should be extended by volitional processes. Another factor that would necessitate an integration of volitional mechanisms is the addition of more than one object that the model can interact with. This would require decision-making processes such as cognitive dissonance reduction or "affective consonance production" (Quirin, Tops, et al., 2019).

3.3 | Relationship to personality traits and states

The present paper attempts to link ZM closer to personality science. We therefore changed some concepts and terminology that have been used to date. In general, ZM variables that can perhaps be most closely related to personality traits are the need setpoints, the newly added "activity" variable, preferences for coping strategies, and individual differences in the thresholds. For concrete illustrations, we concentrate on points of contact between ZM and factors or components of the five-factor model of personality (FFM), because of its popularity (DeYoung et al., 2007; Goldberg, 1990; McCrae & Costa, 2004), and related personality state variables (e.g., Fleeson, 2001; see below). The FFM is based on factor analyses of between-subject covariation in self-reports of typical (i.e., trait-like) behavior and experience, which usually results in the five superfactors of neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness ("Big Five"). The items aggregated to express one of these factors form subclusters of functionally heterogeneous personality components (domains, aspects, facets).

We think that ZM(−E) variables are linked to the personality factors or their facets in specific ways. For example, the need for security is strongly related to neuroticism (Mongrain, 1993), and appears to be identical (or at least strongly overlaps) with attachment anxiety (Noftle & Shaver, 2006; Shaver & Brennan, 1992). Note that despite its importance in developmental and clinical psychology, the need for security is not directly addressed by most FFM inventories as a potential component of neuroticism (but see Lee & Ashton, 2004). Probably, this is the case because individuals can hardly self-report their own need for security (Main et al., 1985). Instead of a need for security, most personality models consider emotional arousability a causal mechanism underlying neuroticism (e.g., Eysenck, 1967), or even more specifically,

arousability by negative stimuli (e.g., DeYoung, 2013; Gray & McNaughton, 2000).

The need for arousal seems largely equivalent to "excitement seeking" or "novelty seeking" (Cloninger, 1987). Need for arousal may underlie both traits, extraversion, and openness to experience (Gocłowska et al., 2019), with extraversion referring to a tendency to socially interact and explore corresponding incentives (e.g., communion, power, sex), and openness referring to a tendency to explore things, situations, and ideas to acquire experiential or intellectual knowledge (DeYoung, 2013). In that extraversion and openness to experience have been subsumed under the meta-trait "plasticity" (e.g., DeYoung, 2006), the need for arousal may constitute a major mechanism underlying plasticity. The new variable "activity," as an additional input to activation, can be considered another component of extraversion (Costa & McCrae, 1992a).

A tendency to use non-assertive coping strategies in ZM might reflect a major mechanism underlying agreeableness (e.g., politeness is negatively correlated with assertiveness; DeYoung et al., 2007). Additionally, agreeableness may derive from a trait form of empathy and altruism (Song & Shi, 2017), which, however, is not considered in ZM. Note that assertiveness is considered a facet of extraversion (e.g., Costa & McCrae, 1992b; DeYoung et al., 2007) that likely derives from a high need for power (e.g., Engeser & Langens, 2010). Accordingly, assertive behavior may be an expression of agreeableness or extraversion. Specifically, assertiveness is an immediate, effortless reaction in individuals with a high need for power (i.e., or power in extraverts), while assertiveness in agreeable individuals is a socially desirable preference for coping forms other than assertion. This variability is compatible with evidence (Kammrath et al., 2015) demonstrating that introversion goes with deficiencies to assert oneself, and agreeableness goes with an ability to be non-assertive (i.e., to be flexible concerning coping forms).

Perhaps no ZM variable or mechanism is directly linked to conscientiousness because conscientiousness is strongly related to volitional processes such as focus and persistence in the pursuit of goals, which reflect uniquely human(oid) qualities (McCrae & Löckenhoff, 2010). Note, however, that individual differences in conscientiousness could be observed in chimpanzees (Gosling & John, 1999).

In that the need setpoints can be considered to strongly comprise trait variance, it might be questioned how they are related at the population (between-subjects) level. Although the need for power regulates needs for arousal and security at the individual level, relationships at the individual level do not allow hypotheses about relationships at the population level (e.g., Fisher et al., 2018). Nevertheless, evidence from studies on self-reported traits shows that the need for security (or "dependency") is uncorrelated with the need for arousal (or "excitement seeking"; Mongrain, 1993; Schönbrodt et al., 2009). This finding corresponds with the relative orthogonality of neuroticism and extraversion—the two factorial traits that comprise these variables as facets, respectively.

ZM may also add to research that compares trait and state variances of behavior and experience. For example, whole-trait theory linked the Five personality trait factors to "personality states," that is, states during which behavior and experience are exhibited that are typical for a five-factor personality trait (Fleeson, 2001; Fleeson & Jayawickreme, 2015). Specifically, this research compared density distributions of within-person variance (i.e., of personality states) and between-person variances (i.e., of personality traits), finding that within-person variance was about twice as large as between-person variances (e.g., Fleeson & Gallagher, 2009). These results are of enormous significance because they demonstrate that situations interact to a strong degree with personality traits to elicit behavior. In the ZM(−E), personality states are reflected in need process variables (i.e., states of security, arousal, and power) along with state variables of activation and coping.

ZM(−E) proposes the precise causal way personality process ("state") variables interact from moment to moment with situational variables and among each other. To define personality states (i.e., manifestations of process variables), ZM draws on specific, functional variables (e.g., security and need for security) rather than on broad factors, which subsume and aggregate the former as facets. The usage of specific, functional variables enables not only description but also explanation of the appearance of strong within-subject variability of personality states found in previous research. Accordingly, a next step in empirical research on the dynamics of personality may be to sample experiences (i.e., momentary assessments) and setpoints (i.e., traits) of need states, coping strategies, and behavior, and use a computational implementation of ZM-E to predict the empirical pattern of dynamics of these variables.

Future research may also use such an implementation to explain the static factorial pattern of personality traits, such as the five-factor model. Note, however, that ZM makes assumptions regarding personality states and traits, whereas the five-factor model is based on research about self-reports of these characteristics. The validity of self-reports of traits and states is limited by cognitive and motivational biases, and this has been shown to be particularly the case for social need traits (Malekzad et al., 2021), which are the pivot of ZM. An adequate compromise might be to assess these traits with indirect procedures (Quirin et al., 2018; Runge et al., 2016; Schönbrodt et al., 2021; Schultheiss & Pang, 2007), while assess the dynamics of states with economical samples of (self-reported) experiences.

3.4 | Personality growth

"Personality growth" might broadly be conceptualized as adaptive changes in personality traits (including Needs). These adaptations might encompass the integration of negative experiences as well as improvements in needs and goal attainment, which are typically considered as a basis for enhancements in happiness and morality. Conceptualizing personality growth in terms of cybernetic mechanisms may feel outlandish at first because cybernetic (or control systems) theory has more typically been applied to machine engineering than to modeling personality processes.

Nevertheless, cybernetics is merely a method to explain the behavior of complex systems (humans included) in a clear, logical, or mathematical way (Wiener, 1948; see also DeYoung, 2015). Accordingly, cybernetics might have the potential to concretely conceptualize and explain personality growth. Generally, adaptive changes in cybernetics can be seen in the reduction of discrepancies between actual and reference values.

The existence of reference values or "needs" in ZM already provides the basis for the possibility of growth. Specifically, the need for arousal constitutes the basis for an organism's intrinsic motivation to be curious, and thus to acquire knowledge and grow as a person. Likewise, the setpoint for power (need for power) constitutes the basis for managing tasks self-efficiently and thus growing by strengthening one's competences and skills. Accordingly, seemingly mechanistic cybernetic models that include homeostatic principles can be conciliated with a humanistic view of growth regarding organisms as active and self-enhancing rather than purely passive and reactive (Baldassarre et al., 2014; Bischof, 1985).

As explained above, an organism can attempt to change the actual value to reduce discrepancies (e.g., by changing the environment or one's perception) or change the corresponding reference value. Accordingly, two broad forms of personality growth might be differentiated: assimilative and accommodative growth (e.g., Quirin & Kuhl, 2022), which are reflected in ZM as adaptive changes in assimilative and accommodative coping, respectively. Specifically, *assimilative coping strategies or abilities* may be improved or substituted to enhance adaptation to the social and nonsocial environment (e.g., using nondefensive coping such as reappraisal/revision or invention instead of aggression or supplication).

In a narrow sense, personality growth might be recognized in accommodation (i.e., deep, substantial transformations in personality) rather than in changes in strategies or abilities (Quirin & Kuhl, 2022). Regarding accommodation, ZM postulates *long-term (developmental) increases* in the need for power as a function of the acquisition of knowledge and experiences of self-efficacy. This accommodation is considered a nomothetic developmental process and a key mechanism of healthy personality growth, which is compatible with several developmental and clinical theories (e.g., Deci & Ryan, 2000).

Moreover, ZM postulates that such an increase in the need for power engenders a decrease in an (infantile) need for security and an increase in the need for arousal, which can be considered additional manifestations of personality growth (Bowlby, 1982). This relationship is compatible with empirical research showing that personality growth has been found, among others, in reductions of neuroticism, increases in extraversion (e.g., Roberts et al., 2017), and more recently, in increases of perceived control (Asselmann & Specht, 2022). Accordingly, ZM would consider need changes as mechanisms underlying such modifications rather than temperamental factors. Alternatively, improvements in adaptive assimilative coping strategies or "emotion regulation abilities" might be considered as underlying mechanisms (Quirin et al., 2020).

4 | CONCLUSION

Elaborated models are scarce regarding how personality processes interact to produce behavior and experience as well as relatively stable patterns. We reviewed and extended the Zurich model of social motivation, discussing it in light of more recent literature. In addition, we evaluated the model's potential to explain the mechanisms and functioning of underlying personality dynamics. We hope to stimulate personality scientists to extend this work to advance our understanding of the complexity of human personality.

AUTHOR CONTRIBUTIONS

Markus Quirin wrote the draft the paper. Marco Mirolli, Farhood Malekzad, Dinesh Paudel and Alois C. Knoll revised it.

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