Editor’s choice

The dynamics, processes, mechanisms, and functioning of personality: An overview of the field

Niclas Kuper†*, Nick Modersitzki†*, Le Vy Phan†*, and John F. Rauthmann†
Abteilung Psychologie, Universität Bielefeld, Germany

Personality psychology has long focused on structural trait models, but it can also offer a rich understanding of the dynamics, processes, mechanisms, and functioning of individual differences or entire persons. The field of personality dynamics, which works towards such an understanding, has experienced a renaissance in the last two decades. This review article seeks to act as a primer of that field. It covers its historical roots, summarizes current research strands – along with their theoretical backbones and methodologies – in an accessible way, and sketches some considerations for the future. In doing so, we introduce relevant concepts, give an overview of different topics and phenomena subsumed under the broad umbrella term ‘dynamics’, and highlight the interdisciplinarity as well as applied relevance of the field. We hope this article can serve as a useful overview for scholars within and outside of personality psychology who are interested in the dynamic nature of human behaviour and experience.

Explaining individual differences in what people think, feel, and want, and how they behave is at the core of many psychologists’ research and the central object of investigation of personality dynamics. Personality dynamics is an active research area in personality psychology that has seen a surge in empirical publications in the recent decade (Revelle & Wilt, 2020). It concerns the investigation of intra-individual personality processes, mechanisms, and functioning, as well as inter-individual differences therein. Contrary to the descriptive study of trait structures, the study of personality dynamics aims to provide an explanatory account of an individual’s thoughts, feelings, motivations, and behaviours and their patterning (Baumert et al., 2017; Cervone & Little, 2019).

Despite the popularity of a more dynamic understanding of personality in the last years, the topics and research questions studied are anything but new. The conceptual foundation for personality dynamics has been discussed as early as in the 1870s by experimental psychologists in France (Lombardo & Foschi, 2003). In 1930, Allport and Vernon published a detailed review about the field of personality dynamics up to this
point. Moreover, the themes and research questions relevant to personality dynamics have been discussed by several eminent psychologists such as Freud (1958), Lewin (1951), Allport (1937), Kelly (1955), and Rogers (1959) – with varying degrees of scientific rigour and legitimacy. Importantly, interest in personality dynamics has been present throughout the existence of psychology as a science.

However, the empirical investigation of personality dynamics has long been hindered by both technological hurdles and a prevailing focus on individual differences taxonomies in the personality–psychological landscape since the 1960s (Cervone & Little, 2019). With the rise of new technologies (e.g., enabling experience sampling studies or passive sensing; see Csikszentmihalyi & Larson, 2014; Harari, Müller, Aung, & Rentfrow, 2017; Wiernik et al., 2020) and statistical methods (e.g., multilevel modelling, network analysis, dynamic system models) that allow for the collection and analysis of (high-density) longitudinal data, the empirical study of personality dynamics has found a revival in interest (Cervone & Little, 2019; Hamaker & Wichers, 2017). Furthermore, current personality dynamics researchers can draw on the amassed knowledge of other relevant disciplines such as cognitive, experimental, social, and developmental psychology, or neuroscience, which are critical to understanding the causal systems underlying personality expressions (Cervone & Little, 2019; Quirin et al., 2020). This makes contemporary personality dynamics a highly integrative and transdisciplinary science that informs both basic psychological research and domains of applied psychology.

The purpose of this paper is to introduce the field of personality dynamics into mainstream psychology, provide a primer for scholars interested in a more dynamic understanding of personality, and thereby facilitate the study of dynamics across disciplines. To this end, we provide a brief overview of the past, present, and future of the field. First, we highlight the relevance of the field and introduce central concepts to ensure conceptual clarity and consistency. We then briefly outline the history of the field and provide an overview of contemporarily dominant dynamic models and theories of personality. We next describe the principles of empirical research and briefly highlight the applied relevance of personality dynamics. We conclude with suggestions for future directions.

Given the broad scope of this article and its limited length, this work cannot represent a comprehensive review of the literature on personality dynamics. We focus more on the conceptual underpinnings of theoretical models and methodological approaches rather than on specific empirical findings. Further, we mainly refer to short- and middle-term dynamics since most of the research reviewed here deals with processes and mechanisms occurring in shorter time frames. Of course, we acknowledge the importance of long-term dynamics (e.g., personality development) and their study (Asendorpf, 2020; Wrzus, 2020). However, this research area can be included only very selectively in this article, and readers are referred to the extensive personality development literature instead (Bleidorn et al., 2020). For an extensive account of diverse perspectives on current research in personality dynamics, the reader is referred to the recently published *Handbook of Personality Dynamics and Processes* (Rauthmann, 2020b).

**Relevance of the field**

From a basic research perspective, the study of personality dynamics is important because it strives for an understanding of the causal principles that govern the ways humans navigate through life and seeks to explain how personality ‘works’. Given this explanatory
claim, the examination of processes, mechanisms, and functioning has to be inherent to
the study of personality (Baumert et al., 2017). That is, to understand a person affords
studying the dynamic patterning of their thoughts, feelings, motivations, and behaviours
(Revelle & Wilt, 2020). Personality psychology has been dominated by nomothetic
perspectives (i.e., generalizing across individuals) in the past and neglected idiographic
perspectives (i.e., individual-specific). One strength of the study of personality dynamics
is that it combines nomothetic and idiographic approaches (Revelle & Wilt, 2020). Due to
its holistic and complex nature, the field of personality dynamics affords and enables
interdisciplinary research and theory-building. Many existing theories, models, and
frameworks in the field draw on knowledge from other psychological disciplines (see
Contemporary theoretical dynamics-focused approaches in personality science). At the
same time, insights gained from personality dynamics research can inform neighbouring
disciplines that are concerned with individual differences or within-person variability in
experiences and behaviour. Such insights are also relevant for applied psychology (see
Personality dynamics in applied settings). By moving across disciplinary borders,
personality dynamics research facilitates interdisciplinary (i.e., synthesized) or transdis-
ciplinary (i.e., unified) perspectives on personality.

Central concepts

To increase conceptual clarity and consistency of terms used in personality dynamics
research, we compiled a list of central terms, working definitions, and corresponding
references (Table 1). Additionally, Figure 1 provides an illustration of the key terms ‘dynamics’, ‘processes’, ‘mechanisms’, and ‘functioning’. We chose working definitions
that are broad enough to be inclusive and applicable for most of the approaches discussed
here. However, different authors may use these terms differently than they are defined in
Table 1, and we decided not to alter their terminology when discussing their work in later
sections (e.g., Table 2). The practice of using the same terms for different phenomena
(jingle fallacy) and different terms for the same phenomena (jangle fallacy) is unfortu-
nately widespread in personality dynamics research which impedes the integration of
different lines of work. Furthermore, we modified some definitions with the goal of
circumventing conceptual circularities (i.e., to distinguish between explananda – the
phenomena to be explained – and explanantia – the phenomena explaining them; Uher,
2016, 2017). Of course, we do not claim that the definitions chosen here are all-
encompassing, commonly accepted, or represent the ground truth. Defining concepts in
personality psychology is exceptionally difficult given the plurality of models and
resulting jingle-jangle fallacies in the field as well as the origin of many terms in natural
language (Cervone & Little, 2019). Nevertheless, we believe that by providing explicit
definitions, we can increase clear and consistent communication.

The first term that should be defined is personality dynamics itself. Personality
dynamics is an umbrella term that encompasses all processes, mechanisms, and changes
that are involved in the development and manifestation of personality (Figure 1). It
includes normative dynamics (e.g., average contingencies between situation variables and
states) and individual differences therein. Personality dynamics can be understood in a
broad sense, covering dynamics in all psychological phenomena that show individual
differences (i.e., most psychological phenomena). In a narrow sense, personality
dynamics could be restricted to the study of dynamics in content domains represented
in taxonomies of personality (e.g., Big Five / HEXACO traits and states, but also broader
| Term                          | Working Definition                                                                                                                      | Reference                                  | Notes                                                                                                                                 |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| (Personality) Change         | Differences between states or traits from one time point to another.                                                                      | Baumert et al. (2017)                      | Usually change is only tracked in single variables.                                                                                   |
| Causality                    | 'A cause is . . . an insufficient but non-redundant part of a condition which is itself unnecessary but sufficient for the result.' (p. 525) | Mackie (1965)                              | The following criteria must be met to establish causality (Cook, Campbell, & Day, 1979):                                              |
|                              |                                                                                                                                              |                                            | - Causes anteced their effects.                                                                                                |
|                              |                                                                                                                                              |                                            | - Cause and effect covary.                                                                                                       |
|                              |                                                                                                                                              |                                            | - The relationship between cause and effect must be non-spurious.                                                             |
| Development                  | ‘The progressive series of changes in structure, function, and behavior patterns that occur over the lifespan of a human being or other organism.’ | American Psychological Association (n.d.-a) |                                                                                                                                       |
| Dynamics                     | Pertain to:                                                                                                                              | American Psychological Association (n.d.-b) |                                                                                                                                       |
|                              | - The complexities of force and interaction in dynamic (i.e., changing, fluctuating) systems.                                           |                                            |                                                                                                                                       |
|                              | - The study of dynamics (see above).                                                                                                      |                                            |                                                                                                                                       |
| Explanation, explanatory     | ‘An explanation articulates a causal or functional relation, or a linked series of them, that can act or do(es) act to bring about some phenomenon.’ (p. 526) | Baumert et al. (2017)                      | In contrast to descriptive accounts of personality. Enables understanding of the causal mechanisms and processes in personality dynamics. |
| Function                     | Pertain to:                                                                                                                              | Baumert et al. (2017)                      | The mathematical definition of function is not meant here.                                                                     |
|                              | - Function of: Causal relations between momentary states and past and present situations as well as past state levels of the person.     |                                            |                                                                                                                                       |
|                              | - Function for: States being adaptive for the organism.                                                                                     |                                            |                                                                                                                                       |
|                              | - Function as a goal: An organism's goal (conscious or unconscious) to produce a consequence.                                               |                                            |                                                                                                                                       |
| Term                        | Working Definition                                                                                                                                                                                                 | Reference                        | Notes                                                                                                                                                                                                 |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mechanism                  | ‘A system of components, operations, and their organization that together produce a phenomenon’ (p. 526)                                                                                                              | Baumert et al. (2017)             |                                                                                                                                         |
| Person–Environment Relations | Relations between person and environment variables  
  – Interactions: Person and environment variables moderate each other’s effects on outcomes.  
  – Correlations: Person and environment variables are concurrently associated.  
  – Fit: Person and environment variables match with each other.  
  – Transactions: Person and environment variables affect each other across time.                                                                 | Rauthmann (2020a)                |                                                                                                                                         |
| Personality                 | A person’s stable characteristic pattern of thoughts, feelings, motivations, and behaviours.                                                                                                                        | Baumert et al. (2017)             | This definition has been criticized as vague and circular: Patterns of thoughts, feelings, motivations, and behaviours cannot be the explanandum of personality if they are defined as part of it (Uher, 2017). |
| Personality architecture    | ‘The overall design and operating characteristics of those psychological systems that comprise a person’ (p. 2)                                                                                                       | Cervone and Little (2019)         |                                                                                                                                         |
| Personality development     | ‘Relatively enduring change, including (i) decrease or increase in a person’s trait level; (ii) relatively enduring change in trait expression; (iii) relatively enduring change in personality structure.’ (p. 525)  
  Pertains to continuity, stability, and change.                                                                                       | Baumert et al. (2017)             |                                                                                                                                         |
|                            |                                                                                                                                                                                                                                                                               | Wrzus and Roberts (2017)         |                                                                                                                                         |
| Term                  | Working Definition                                                                                                                                                                                                 | Reference                           | Notes |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|
| Personality dynamics  | Pertains to:                                                                                                                                                                                                     |                                     |       |
|                       | – Umbrella term for all dynamics involved in the development and manifestation of personality; encompassing psychological processes, mechanisms, and changes.                                                                                                                                                      |
|                       | – In a broad sense: Dynamics in all psychological phenomena that show individual differences; in a narrow sense: dynamics related to content domains of personality taxonomies.                                                                                                                                                |
|                       | – The study of personality dynamics (see above).                                                                                                                                                                  |                                     |       |
| Process               | 'A series of steps ... through which some phenomenon takes place or emerges. ... necessarily makes reference to the passage of time and implies changes or development during the referenced period.' (p. 527)                                                                                                       | Baumert et al. (2017)               |       |
| – Biophysiological     |                                                                                                                                                                                                                  |                                     |       |
| – Cognitive            |                                                                                                                                                                                                                  |                                     |       |
| – Affective            |                                                                                                                                                                                                                  |                                     |       |
| – Motivational         |                                                                                                                                                                                                                  |                                     |       |
| – Behavioural          |                                                                                                                                                                                                                  |                                     |       |
| Situation              | 'A set of fleeting, dynamic, and momentary circumstances that do not lie within a person ... but in their surroundings. The situation consists of objectively quantifiable stimuli, so-called cues ... that may be perceived and interpreted by a person, yielding psychological situation characteristics' (p. 4)                                                                                     | Rauthmann and Sherman (2020)        |       |
| Term                        | Working Definition                                                                                                                                                                                                 | Reference              | Notes                                                                                                                                 |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| State                       | Quantitative dimension describing the degree of coherent momentary thoughts, feelings, motivations, and behaviours at a particular time. a Intra-psychological state: Momentary phenomena that primarily occur within a person (e.g., affective, cognitive, and motivational states). Extra-psychological state: Momentary phenomena that are externalized by a person (e.g., behavioural states). | Baumert et al. (2017)  | The broad distinction between intra- and extra-psychological states is proposed by the authors.                                    |
| System                      | ‘Any collective entity consisting of a set of interrelated or interacting elements that have been organized together to perform a function.’                                                                                                              | American Psychological Association (n.d.-c) |                                                                                                                                      |
| Trait                       | Quantitative dimension describing relatively stable inter-individual differences in the degree of coherent thoughts, feelings, motivations, and behaviours.a                                                                                      | Baumert et al. (2017)  |                                                                                                                                      |

Note. Terms are ordered alphabetically.

a definitions have been modified by the authors.
conceptualizations, e.g., McAdams & Pals, 2006). Personality dynamics is also the term used to describe the field dedicated to the study of personality processes, their causes, and outcomes. As the term already implies, the field examines dynamic phenomena (as opposed to static phenomena such as trait structures). Dynamics-focused theories can be viewed in a narrow sense where time is considered and modelled explicitly (e.g., Read et al., 2010; Revelle & Condon, 2015) or in a broad sense where time-dependent processes are at least implied (e.g., Fleeson & Jayawickreme, 2015).

As the passage of time is either explicitly or implicitly important, three other concepts are central: change, development, and situations. First, change and development always require a passage of time. Changes represent differences in a variable from one time point to the other, and development represents a series of changes across time. Second, time passing also means that situations vary. Personality dynamics do not occur in a vacuum but in specific situations. Situations are defined as momentary circumstances outside the person (i.e., in a person’s surroundings) that are also inherently dynamic (Table 1). They contain objectively quantifiable stimuli that can be subjectively perceived and interpreted by persons to yield a psychological situation (Rauthmann, Sherman, & Funder, 2015). The relations between person variables (i.e., states and traits), environment variables (i.e., momentary situations and stable niches), and relevant outcomes are subsumed under the term person–environment relations. Person–environment relations encompass interactions, correlations, fits, and transactions (Rauthmann, 2020a).

In personality dynamics, mechanisms and processes are central objects of investigation. Mechanisms are systems of components and operations that are organized to produce certain phenomena (Table 1). The mechanistic view is adopted from physics and is concerned with the function (‘why?’) and causality (‘how?’) of psychological phenomena (Casadevall & Fang, 2009). Mechanisms can be processes, but unlike processes, they do not have to precede the phenomenon they produce (Baumert et al.,

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**Figure 1.** Overview of Key Terms. Two focal variables, A and B, vary across time (and possibly also situations) and are thus changing. In this example, B varies as a consequence of changes in A. B varies as a function of A via an underlying mechanism (which can be another variable, process, or system). The sequence of A to B (via a mechanism) is a process. The concrete links of A to B (via a mechanism) across time describe the functioning of the variable system. Processes, mechanisms, and functioning can be subsumed under the umbrella term of dynamics.
| Approach / Work | Brief Description | Relevant References |
|-----------------|------------------|---------------------|
| **Broad Approaches** | | |
| Behavioural process model of personality (BPMP) | Adaptation of the reflective-impulsive model (RIM; Strack & Deutsch, 2004). Posits that actual social behaviour results from reflexive (deliberate) and impulsive (associative, motivational) processing of situational cues via behavioural schemata. Typical functioning of these processes condenses into an explicit and an implicit self-concept, respectively. | Back et al. (2009) |
| Complex-system approach to personality (C-SAP) | Posits that personality is a complex system that is hierarchically organized into three levels which are (L+1) behaviours and actions, (L) structures, and (L-1) mechanisms and processes. Within this system, upward integration provides stability and downward regulation preserves homeostasis. The personality system may be coherent or incoherent. The System of Regulation and Integration Stimulation controls activity, activation, and arousal. | Fajkowska (2013, 2015) |
| Cybernetic big five theory (CB5T) | Conceptualizes personality as an evolved cybernetic (i.e., goal-directed, adaptive) system. Genetic and environmental effects influence individual differences in cybernetic mechanisms (cybernetic parameters; e.g., individual differences in behavioural exploration, cooperation, and defensive responses to threats) which directly cause personality traits. Finally, personality traits and the environment causally predict life outcomes and characteristic adaptations which, in turn, affect the environment and cybernetic parameters. | DeYoung (2015) extension of Van Egeren (2009) |
| Domain-general personality process model | Integrates reinforcement sensitivity theory (RST; see elsewhere in this table), the response modulation model (RMM; Patterson & Newman, 1993), and the context-appropriate balanced attention model (CABA; MacCoon, Wallace, & Newman, 2004) into a neurobiologically based personality process model. | Collins et al. (2017) |
| Functionalist approach | Emphasizes the functionality of people's thoughts, feelings, and behaviours. Highlights the role of process variables (e.g., goals, efficacies, expectancies, and values) and proposes functional field models as formalizations of functionalist accounts of behaviour. | Wood, Gardner, and Harms (2015) Wood et al. (2017) Wood, Spain, Monroe, and Harms (2020) |
| Approach / Work                                                                 | Brief Description                                                                                                                                                                                                 | Relevant References |
|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Foundations for a unified theory of motivation, personality, and development   | Highlights the importance of needs (basic needs: predictability, acceptance, competence; compound needs: combinations of basic needs) which give rise to goals. Goal pursuit results in mental representations (beliefs, representations of emotions, action tendencies) guiding future goal pursuit. Personality is defined as characteristic acts and experiences accompanying goal pursuit as well as characteristic mental representations guiding goal pursuit. | Dweck (2017)        |
| Knowledge-and-appraisal personality architecture (KAPA)                          | Proposes that personality consists of enduring knowledge structures as well as dynamic cognitive and affective appraisal processes. Mental states may be intentional or unintentional. Contents of intentional cognitions can be distinguished into beliefs, goals, or evaluative standards based on their directions of fit (i.e., how they relate to the world). | Cervone (2004, 2008, 2020) |
| Network perspective on personality                                              | Conceptualizes personality as a network of connected cognitive, affective, and behavioural components. Dependencies between components can be causal, homeostatic, or logical. Person–environment feedback loops sustain typical patterns of behaviour (i.e., idiosyncratic behavioural equilibria). Traits are descriptors of average state activations that emerge as a result of the connectivities between components. | Cramer et al. (2012) |
| Personality dynamics approach (PDA)                                              | Based on the commonalities of multiple models of personality dynamics. Emphasizes three psychological functions (cognition, motivation & emotion, volition) which are relevant in different phases of self-regulation (selection, planning, action, evaluation). 20 tenets of the PDA are delineated. | Quirin et al. (2020) |
| Personality dynamics (PersDyn) model                                             | Conceptualizes personality as a dynamic system. Emphasizes three individual difference parameters describing changes in personality states: baseline (set point), variability (fluctuation), and attractor force (how quickly people return to their baseline). | Sosnowska et al. (2019) Sosnowska et al. (2020a) |
| Approach / Work | Brief Description | Relevant References |
|----------------|-------------------|---------------------|
| **Personality systems framework** | Divides personality into four functional areas termed energy development, knowledge guidance, action implementation, and executive management. Emphasizes dynamics of self-control and dynamics of action as processes of personality expression. | Allen, Sylaska, and Mayer (2020) Mayer (2015) |
| **Personality systems interactions (PSI) theory** | Assumes seven levels of personality functioning: (L1) low-level cognition (habits), (L2) temperament, (L3) affect, (L4) coping, (L5) motives, (L6) high-level cognition (cognitive styles), and (L7) agency. Behavioural and experiential systems exist at each level, and personality systems interact dynamically. People differ in the contents, reactivities, and connectivities of their personality systems. | Baumann and Kuhl (2020) Kuhl (2000) Kuhl, Quirin, and Koole (2020) |
| **Whole trait theory (WTT)** | Proposes a descriptive and an explanatory side of traits which together form the ‘whole trait’. The former is conceptualized as individual differences in within-person density distributions of (Big Five / HEXACO) personality states. The explanatory side refers to social-cognitive mechanisms underlying expressions of personality states. | Fleeson and Jayawickreme (2015, 2020) |
| **Person–Environment Approaches** | | |
| **Bottom-up model of personality** | Posits that social roles (as classes of situations) activate short-term goals which in turn influence momentary personality states. Suggests that aggregated personality states affect personality trait development. | Heller et al. (2009) |
| **Cognitive-affective personality system (CAPS) approach** | Suggests a system of cognitive-affective units (CAUs: encodings, expectancies and beliefs, affects, goals and values, competencies and self-regulatory plans) which mediate the relationship between features of situations and behaviours. Individual differences in the chronic activation levels but also the interrelations of CAUs (with each other and with features of the situation) are hypothesized. CAPS accounts for individual differences in average behaviour but importantly also for individual differences in if-then patterns (i.e., situation-behaviour relations). | Mischel and Shoda (1995) |
| Approach / Work                                      | Brief Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Relevant References                                      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Nonlinear interaction of person and situation      | Conceptualizes behaviour as having lower and upper limits and proposes a nonlinear modelling approach using logistic functions. Integrates ideas about persons and situations associated with high versus low behavioural variability (e.g., 'strong situations'). Four types of processes underlying behaviour are distinguished: activation, tendency, inhibition, and predictability. These processes modulate four different parameters of the logistic curve.                                                                                       | Blum et al. (2018) Blum, Baumert, & Schmitt (2020)       |
| (NIPS) process model                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Person–environment relations model (PERM)          | Systematizes different types of relations between person, environment, and outcome variables both on short-term and long-term timescales. Emphasizes four types of relations: interactions, correlations, fits, and transactions.                                                                                                                                                                                                                                                                          | Rauthmann (2020a)                                        |
| SORKC model-based framework                         | Adaptation of the SORKC (Stimulus-Organism-Response-Contingency-Consequence) model (e.g., Kanfer & Saslow, 1969). Aspects of the internal and the external situation give rise to an internal representation of the situation (i.e., psychological situation) that elicits internal and external responses. Personality moderates these normative causal effects and directly influences the psychological situation and how the individual responds. Internal and external responses bring about internal and external consequences of personality. | Wessels et al. (2016)                                   |
| Trait activation theory (TAT)                       | Interactionist perspective suggesting that traits should be most strongly linked to behaviour in situations that activate the respective trait (i.e., have high trait relevance).                                                                                                                                                                                                                                                                                  | Tett and Guterman (2000)                                 |
| Computational Approaches                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Cues-tendency-action (CTA) model                    | Conceptualizes personality traits as rates of state change in response to environmental cues. Builds on the dynamics of action model (Atkinson & Birch, 1970) and uses differential equations to model the temporal dynamics between cues, action tendencies, and actions.                                                                                                                                                                                                                                 | Revelle and Condon (2015)                                |
|                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Approach / Work                           | Brief Description                                                                                                                                                                                                 | Relevant References                        |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Personality space framework (PSF)       | Proposes that individuals can be represented as points (i.e., coordinates) or vectors in a multidimensional personality space spanned by orthogonal feature dimensions (i.e., traits). Influences (internal or external) on the person can be represented as force vectors that transact with person vectors moving them towards an equilibrium state. | Mottus et al. (2017)                       |
| Virtual personalities (VP) model        | Implemented as a neural network. Specific motives are nested in an Approach and an Avoidance system. Individuals differ in their sensitivities of these motivational systems and the baseline activation of motives. Motives are activated by situational features and the bodily state of the individual. The resulting behaviour changes the situation (Consummation) and the bodily state (Satiation). | Read and Miller (2002)                     |
|                                         |                                                                                                                                                                                                                  | Read et al. (2010)                         |
|                                         |                                                                                                                                                                                                                  | Read et al. (2017)                         |
|                                         |                                                                                                                                                                                                                  | Read et al. (2020)                         |
| Developmental Approaches                |                                                                                                                                                                                                                  |                                            |
| GLIDE-STRIDE theory                     | Concerns within-person variability in personality states. Proposes five distal mechanisms (GLIDE: Genetics, Learning, Identity, Developmental regulation, Environment) that affect behaviour via six proximal mechanisms (STRIDE: Stabilizing forces, Temporal trends, Resource availability, Interpretations of situations, Drives and Desires, Error). | Noftle and Fleson (2015)                   |
|                                         |                                                                                                                                                                                                                  | Fleeson and Jolley (2006)                  |
| Integrative state process model of personality development | Process-based approach conceptualizing personality as individual differences in levels of and relationships (contingencies) between state processes. Distinguishes three types of state processes: goals and strategies, actions and experiences, and evaluations and reflections. Personality trait development is reflected in changes in the dynamic state network over time (e.g., due to environmental and biological factors, social roles, and developmental tasks). | Geukes, van Zalk, and Back (2017)         |
| Neo-socioanalytic model of personality development | Distinguishes four domains of personality (traits, motives and values, abilities, and narratives) which manifest themselves in identity (assessed via self-reports) and reputation (assessed via observer reports). Emphasizes social roles as relevant drivers of personality development and suggests eight principles to describe and/or explain personality change and consistency. | Roberts and Nickel (2017)                  |
|                                         |                                                                                                                                                                                                                  | Roberts and Wood (2006)                    |
| Approach / Work | Brief Description | Relevant References |
|----------------|-------------------|---------------------|
| (Revised) Sociogenomic model of personality traits | Highlights that biological underpinnings of personality are dynamic (e.g., the expression of DNA can be modified in response to the environment via epigenetic mechanisms). Presents a model of personality development by delineating the relationships between environment, DNA, pliable (long-term epigenetic) and elastic (short-term epigenetic) systems, states, and personality traits. | Roberts (2018) Roberts and Jackson (2008) |
| Triggering situations, expectancy, states/state expressions, and reactions (TESSERA) framework | Posits that long-term personality development occurs due to repeated momentary TESSERA sequences (Triggering situations → Expectancy → States → Reactions) via associative processes (e.g., habit formation) and reflective processes (e.g., self-reflection). Is a generic model which applies to different levels of personality as well as implicit and explicit aspects of personality. | Wrzus and Roberts (2017) Wrzus (2020) |

**Selected Domain-Specific Approaches**

| Classification system for dynamic self-processes | Organizes key self-related terms (e.g., self-awareness) and processes (e.g., self-talk) into a coherent classification system and postulates conceptual links between them (e.g., self-awareness initiates self-talk). Self-talk is involved in most self-related processes (e.g., in self-reflection, self-regulation). | Morin (2017) Morin and Racy (2020) |
| Contemporary integrative interpersonal theory (CIIT) | Socio-affective meta-theory that integrates personality structure and dynamic processes in relation to interpersonal functioning. States that the most important personality and psychopathology expressions occur in interpersonal situations (i.e., phenomena involving more than one person). Interpersonal situations occur both between proximal interactants and within their subjective experiences, and they are conceptualized alongside the dimensions of agency and communion. Interpersonal behaviour is guided by interpersonal complementarity. | Dawood, Dowgwillo, Wu, and Pincus (2018) Pincus (2005) Pincus and Ansell (2003) Wright et al. (2020) |
| (Cybernetic) Control theory | Suggests a hierarchy of self-regulatory feedback loops. At each level, (perceptual) input is compared against a standard (i.e., reference value; goal). If a discrepancy is detected, output is generated to change the current environment which, in turn, changes the input. The output of higher-level systems constitutes standards for the respective next lower level. At the lowest level, the output constitutes behaviour. | Carver and Scheier (1981, 1982, 2003) |

*Continued*
| Approach / Work | Brief Description | Relevant References |
|----------------|------------------|---------------------|
| Dynamic self-regulatory processing framework | Conceptualizes personality as intrapersonal and interpersonal self-regulatory processes aimed at constructing and maintaining a desired self. These processes unfold in social interaction, particularly in defining social relationships. Self-knowledge drives and is shaped by self-processes. Self-components are interconnected systems, coherently organized by personal goals and motives. | Mischel and Morf (2003) Morf (2006) |
| Interpersonal situation model of personality dynamics | Focuses on personality manifestations in interpersonal situations. Proposes that four interacting personality systems are involved: (1) the self-system (goals, motives: agency and communion); (2) the affect system, (feelings: valence and arousal); (3) the interpersonal behavioural field (interpersonal behaviour: dominance and warmth); (4) the perception system (person perception and self-insight). Maladaptive personality involves dysregulation/distortion in these systems. | Hopwood (2018) |
| Personality affect construal theory (PACT) | Integrates the ABCD (i.e., affect, behaviour, cognition, desire) model (Wilt & Revelle, 2015) and Russell’s (2003) model of emotion: Core affect (i.e., valence and arousal), behaviours (i.e., instrumental action), cognitions (i.e., perception of affective quality, attribution of affect to its perceived cause, appraisals), and goals/desires (i.e., goals, motives, emotion regulation) interact with each other and the situation to produce discrete state-level emotions. | Thapa et al. (2020) |
| PERSonality and SOCial Relationships (PERSOC) framework | Integrative framework for the relations between social relationships and personality. Emphasizes four principles: (1) relationship and individual dispositions as constituents of personality relationship interplay on a trait level; (2) relationship and individual dispositions affect each other over time, mediated by social interactions; (3) social interactions consist of interpersonal perceptions and social behaviours; (4) processes concerning disposition expression, disposition development, and social interactions are to be distinguished. | Back (2020) Back et al. (2011) |
| Reinforcement sensitivity theory (RST) | Defines personality by three brain-behavioural systems: the Behavioral Activation System (BAS), the Behavioral Inhibition System (BIS), and the Fight-Flight-(Freeze)- | Corr (2004, 2008) Gray (1982) |
| Approach / Work                      | Brief Description                                                                                                                                                                                                 | Relevant References                  |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| 1982), Revised RST (2000)           | System (FFS or FFFS; in different versions of RST). BAS is sensitive to appetitive stimuli (approach; reflects reward sensitivity), FFS/FFFS to aversive stimuli (avoidance), and BIS resolves goal conflict (both FFS/FFFS and BIS reflect punishment sensitivity). | Gray and McNaughton (2000)           |
| Reversal theory (RT)                | Proposes that reversal between four pairs of opposite (meta-)motivational states (i.e., goal-oriented–activity-oriented, conforming–rebellious, mastery–sympathy, self-oriented–other-oriented) are induced by situational changes, satiation, or frustration. Individual differences may exist, for example, in the dominance of certain states, the interconnectedness of states, or the ease of reversal. | Apter (1982, 1984, 2001, 2013)       |

Note. Theoretical approaches are theories, models, and frameworks. The list is not comprehensive. Approaches have been roughly categorized by theme or subject for the sake of clarity. Broad Approaches concern short-term dynamics relating to a wide range of personality phenomena; Person–Environment Approaches focus on the interplay between persons and environment variables; Computational Approaches use mathematical formalization and computational modelling; Developmental Approaches emphasize long-term developmental processes; Selected Domain-specific Approaches focus on dynamics in specific domains, namely, social situations (PERSOC; interpersonal situation model; CIIT), self-processes (Control Theory; dynamic self-regulatory processing framework; classification system for dynamic self-processes), motivational processes (RT; RST), or emotion construal (PACT).

We have taken great care to accurately describe the main contents of each approach and avoid personal interpretation. Therefore, we have often adopted the vocabulary used in the source literature. In some cases, this may have resulted in wordings that are similar to those used by the authors of the original work. Within each category, theoretical approaches are ordered alphabetically.
Processes refer to series of steps through which a phenomenon takes place and thus imply the passage of time (Table 1). Processes are, therefore, inherently dynamic. Processes are central to personality dynamics because they have the potential to explain inter- and intra-individual differences in personality expressions. Processes can be biophysiological, cognitive, affective, motivational, or behavioural and can co-occur sequentially or in parallel (e.g., DeYoung, 2015; Quirin et al., 2020). Biophysiological processes include processes pertaining to brain function (e.g., action potentials, brain waves, neurotransmitter activity) and the body in general (e.g., heart rate, skin conductance, pupil dilation). Cognitive processes are involved in all forms of information processing and the processing of sensory input (Neisser, 1967) and can include sensory, perceptual, and regulatory processes. Affective processes are involved in subjective experiences of pleasure/displeasure and activation (Baumert et al., 2017). Motivational processes are involved in the selective approach/avoidance of certain situations or features thereof (Baumert et al., 2017). Lastly, behavioural processes are motoric and usually externalized by a person; that is, they occur outside the body of a person (Uher, 2016).

Personality processes may constitute or result in momentary thoughts, feelings, motivations, and behaviours that are manifested by a person and are referred to as states. States can be associated with traits, other concurrent and past states, and the current and preceding situation. We further draw the distinction between intra-psychological and extra-psychological states to distinguish internal momentary phenomena that primarily occur within a person (e.g., cognitive, affective, and motivational states) from momentary phenomena that are mostly externalized (e.g., behavioural states). In the field of personality dynamics, personality states—often treated as the units that are dynamic or that underlie more static units—are a fundamental concept. These can be differentiated from psychological states in general as they are intimately linked to personality traits (Horstmann & Ziegler, 2020). However, personality states are defined differently in the literature. According to Fleeson (2007), personality states are dimensions with the same scale and content as their corresponding personality traits but refer to how a person is at the moment. Others view personality states as states that are indicative for personality traits (Horstmann & Ziegler, 2020) and argue that personality states must serve a specific trait-congruent function (Schmitt, 2009). This means that although the content of a state (e.g., being talkative) might match a specific personality trait in terms of content (e.g., extraversion), it is not indicative of this trait—and hence not a state expression of the trait—if its function corresponds to another trait (e.g., conscientiousness due to a networking situation at work).

As alluded to in the example above, another common theme of dynamic personality models is functions or functioning of processes. Function can pertain to three meanings here (Baumert et al., 2017). First, functionalistic dynamic approaches (e.g., Wood, Spain, & Harms, 2017) assume that a person’s individual patterning of thoughts, feelings, and behaviours is influenced by a person’s goals, values, motives, or interests. Second, function is also used to describe the causal relations of a momentary state to past states or

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1 Additionally, there can also be intra-biophysiological states (e.g., heartbeat) and extra-biophysiological states (e.g., pupil dilation, transpiration).

2 Personality states are usually conceptualized as reflective manifestations of corresponding personality traits (e.g., Baumert et al., 2017; DeYoung, 2015; Fleeson & Jayawickreme, 2015; Funder, 2001; Horstmann & Ziegler, 2020, Wrzus & Mehl, 2015). However, some researchers assume a formative trait conceptualization (i.e., that states make up the trait; e.g., Buss & Craik, 1983; Cramer et al., 2012).
past and present situations. Lastly, a state can be functional for a person if that state is adaptive (i.e., serving a certain purpose).

Finally, several dynamic theories of personality assume and examine underlying personality systems. Systems are collective entities of interrelated elements that together perform a function. Indeed, personality itself is often conceptualized as a complex system (e.g., DeYoung, 2015; Kuhl, 2000; Mayer, 2015; Mischel & Shoda, 1995).

The terms introduced in this section emerged from a long line of research on personality dynamics and are as central to personality science today as they have been in the past. In the next section, we provide a selective overview of historical accounts before we delve into current theoretical and empirical work on personality dynamics.

A (very brief) history of personality dynamics

In this section, we briefly review three selected dynamic accounts that have been historically influential. For excellent and more comprehensive historical overviews, we refer to Revelle and Wilt (2020) and Cervone and Little (2019). As mentioned earlier, personality dynamics research has been around for as long as the field of scientific psychology itself. Allport, one of the founding fathers of personality psychology, emphasized personality dynamics throughout his career. In his view, personality is ‘the dynamic organization within the individual of those psychophysical systems that determine his unique adjustments to his environment’ (Allport, 1937, p.48). He stressed processes and functioning within a person (Allport, 1937) and highlighted the importance of idiographic approaches and how nomothetic and idiographic perspectives complement one another (Allport, 1968).

In 1946, Cattell introduced his ‘covariation chart’ which depicts the organization of data on three axes: persons, variables, and occasions. Much personality–psychological research examined correlations of variables across persons at one time point (but also correlations of persons across variables to identify types with similar profiles). Including a temporal dimension (i.e., occasions) allowed for a dynamic approach where variables could be examined within persons (or a single person) across multiple occasions. This laid the foundation for the analysis of longitudinal data and research concerning continuity, stability, and change (e.g., Caspi, Roberts, & Shiner, 2005; Roberts & DelVecchio, 2000; Roberts, Walton, & Viechtbauer, 2006).

Perhaps the most influential among historical dynamic approaches has been Kurt Lewin’s field theory (1936, 1951). In his famous equation $B = f(P, E)$, Lewin expressed behaviour as a function of a person’s momentary mental states and the momentary environment. Lewin viewed the person and environment states as interdependent, and he highlighted the dynamic nature of behaviour and its changes over time and space. Furthermore, he emphasized the importance of integrating idiographic and nomothetic approaches (Lewin, 1935). Field theory draws on topological principles and posits a ‘life space’ representing all intra- and extra-psychological and environmental factors influencing a person’s behaviour at any given time. Lewin’s focus on the whole situation, a person’s goals, and on causal explanations of a person’s behaviour has been visionary, and modern personality dynamics research can still build on his ideas.

The approaches mentioned above – but also other historical approaches emphasizing, for example, constructivist idiographic perspectives (e.g., Kelly, 1955), motivation in the context of dynamics (e.g., Atkinson & Birch, 1970), or the capacity for personality development (i.e., persons as agentic operators interacting with their environment; e.g.,
Contemporary theoretical dynamics-focused approaches in personality science

To truly advance our understanding of personality dynamics, it will be necessary to zoom in on processes (Baumert et al., 2017; Quirin et al., 2020). To this end, various dynamics-focused theoretical approaches have been proposed. For a selective overview of contemporary approaches, see Table 2. We use ‘theoretical approaches’ as an umbrella term to encompass theories, models, and frameworks. Most approaches listed in Table 2 are contemporary in that they have been proposed in the last two decades, although we also included selected earlier approaches that have remained influential in the field. These approaches have in common that they emphasize the role of processes and mechanisms underlying inter-individual and intra-individual variability rather than being restricted to describing trait structures. Several prominent approaches attempt to integrate personality dynamics and structure. Whole trait theory (WTT; Fleeson & Jayawickreme, 2015, 2020), for example, posits that individual differences in Big Five personality traits can be understood as between-person differences in density distributions of personality states and proposes explanatory social-cognitive mechanisms underlying trait manifestations. As another example, cybernetic big five theory (CB5T; DeYoung, 2015) links individual differences in the Big Five traits to different cybernetic parameters.

While theoretical approaches emphasize the role of explanatory processes, they differ with respect to the specificity of the proposed processes. For example, WTT and the cognitive-affective personality systems (CAPS) model include relatively broad sets of social-cognitive processes (e.g., goals, self-regulatory plans, situation interpretations; Fleeson & Jayawickreme, 2015; Mischel & Shoda, 1995), while reinforcement sensitivity theory arguably proposes more specific processes such as punishment sensitivity (Corr, 2008; Gray & McNaughton, 2000). Some more trait-specific models not included in the table postulate even more specific processes (e.g., perception of status gain or loss in narcissism dynamics: Back, 2018; Grapsas, Brummelman, Back, & Denissen, 2020).

Several common themes of the theoretical approaches can be identified. First, many approaches explicitly emphasize cybernetic concepts such as goal-directedness, feedback processes, and (self-)regulatory aspects (e.g., Carver & Scheier, 1981; DeYoung, 2015; Dweck, 2017; Fajkowska, 2015; Kuhl, 2000; Mischel & Shoda, 1995; Morf, 2006; Quirin et al., 2020; Revelle & Condon, 2015; Wood et al., 2017), although not all of these classify themselves as ‘cybernetic approaches’. For example, cybernetic big five theory links traits to individual differences in cybernetic functions (e.g., extraversion to behavioural exploration; openness to cognitive exploration; agreeableness to cooperation; DeYoung, 2015).

Second, several approaches include concepts related to a ‘dynamic self’ (Markus & Wurf, 1987), such as the implicit and explicit self-concept (Back, Schmukle, & Egloff, 2009), self-regulation (e.g., Carver & Scheier, 1981; Fajkowska, 2015; Kuhl, 2000; Morf, 2006; Quirin et al., 2020; similar concepts are covered in additional approaches in Table 2), and other self-processes (Morin, 2017). In addition to the self-related approaches included in Table 2, narrative identity (e.g., Adler, 2012; Dunlop, 2017; Lilgendahl & McLean, 2019; McAdams & McLean, 2013; McLean, Pasupathi, & Pals, 2007; Pals, 2006),
which concerns a person’s internalized life story and its development, constitutes another approach worth noting. However, the self, identity, and personality literatures appear to be operating mostly in parallel with only occasional cross-cuttings. Further, apart from the specific and more circumscribed approaches referenced above, there does not seem to be any coherent model or framework of dynamic self-processes that underlie personality as a whole.

Third, multiple approaches highlight the importance of environmental variables such as situations for the understanding of dynamics (e.g., Blum et al., 2018; Heller, Perunovic, & Reichman, 2009; Mischel & Shoda, 1995; Rauthmann, 2020a; Tett & Guterman, 2000; Wessels, Zimmermann, & Leising, 2016). For instance, Rauthmann (2020a) has systematized four types of person–environment relations (correlations, interactions, fits, transactions), and studying them has been facilitated by recent empirical and conceptual advances in the area of psychological situation research (e.g., Rauthmann, Horstmann, & Sherman, 2020; Rauthmann & Sherman, 2020).

Fourth, a large number of theoretical approaches focus on long-term dynamics pertaining to personality development (e.g., Geukes, van Zalk, & Back, 2018; Noftle & Fleeson, 2015; Roberts, 2018; Roberts & Nickel, 2017; Wrzus & Roberts, 2017). As an example, the TESSERA framework posits that repeated momentary sequences (Triggering situations → Expectancy → States → Reactions) affect personality development through associative and reflective processes, such as habit formation and self-reflection (Wrzus & Roberts, 2017).

Fifth, another important family of models are computational approaches which can be implemented as mathematical models in computer simulations (e.g., Motts, Allerhand, & Johnson, 2017; Read et al., 2010; Revelle & Condon, 2015). Importantly, given their high degree of formalization, these approaches allow for specific predictions that could be tested with empirical data (e.g., Read, Smith, Droutman, & Miller, 2017, see also Robinaugh, Haslbeck, Ryan, Fried, & Waldorp, 2020).

Finally, Table 2 includes selected approaches that focus on personality dynamics in specific domains (i.e., social situations: Back et al., 2011; Hopwood, 2018; Pincus, 2005; Wright, Pincus, & Hopwood, 2020; self-processes: Carver & Scheier, 1981; Morf, 2006; Morin, 2017; motivational processes: Apter, 1982; Gray & McNaughton, 2000; emotion construal: Thapa, Beck, & Tay, 2020).

Importantly, many of the intra- and interpersonal processes that are of interest to personality dynamics researchers are also studied in other psychological disciplines (e.g., cognitive, experimental, biological, social, developmental, clinical, work, and organizational psychology). Thus, personality dynamics may build on research from different areas such as social cognition (e.g., Back et al., 2009; Cervone, 2004; Fleeson & Jayawickreme, 2015; Mischel & Shoda, 1995), interpersonal theory (Hopwood, 2018; Pincus, 2005), or biopsychology and neuroscience (e.g., Collins, Jackson, Walker, O’Connor, & Gardiner, 2017; DeYoung, 2015; Gray & McNaughton, 2000; Read et al., 2010; Roberts, 2018).

In sum, multiple relevant theoretical approaches for the study of personality dynamics have been proposed. Many of these are complementary and can to some degree be integrated (e.g., Quirin et al., 2020), but they still each emphasize different aspects, serve different purposes, and sometimes use different terminology. Next, we will delve into superordinate principles of empirical research in personality dynamics which allow the examination of propositions derived from these theoretical approaches.
Principles of empirical research on personality dynamics

As the field of personality dynamics is inherently concerned with changing rather than static phenomena, empirical research typically uses longitudinal (i.e., multi-occasion) data. Importantly, multi-occasion data can be used to examine processes (e.g., reinforcement learning) or other dynamic phenomena without drawing conclusions about the processes involved (e.g., intra-individual state variability). However, processes may also be inferred from their end products on the basis of single-occasion data (e.g., in laboratory experiments manipulating a process of interest once). In this overview, we will focus largely, but not exclusively, on multi-occasion studies given their suitability to more directly capture dynamic phenomena. A variety of viable study types and data sources exists, and they often make use of recent technological and methodological advances. When conducting dynamics-focused studies, it is vital to pay attention to measurement issues (e.g., psychometric properties of state measures) and appropriate sampling procedures (i.e., sampling of persons, situations, and state variables). Finally, various statistical approaches have been utilized or specifically developed for the analysis of dynamic data. In the following, we give a brief overview of these different methodological aspects and illustrate them with concrete empirical studies.

Study types

For an excellent overview of different study types suitable to capture personality processes, see Wrzus and Mehl (2015). Such studies can be distinguished along at least three dimensions: (1) context (laboratory vs. field), (2) design (observational vs. quasi-experimental vs. experimental), and (3) duration (e.g., single-occasion vs. several days, weeks, or years of measurements). Different realizations of these dimensions can be combined and yield various study types, some of which are more frequently used than others. Moreover, even studies with different realizations regarding the same dimension can be combined in a larger research project and may in fact facilitate more generalizable conclusions about dynamic phenomena (e.g., investigating reactivity to situational stimuli with the same participants in both experimental laboratory settings and in everyday life using experience sampling). In the following, we go into detail about three broad classes of frequently used study types: (1) ambulatory assessment, (2) laboratory studies, and (3) long-term panel studies.

Ambulatory assessment (Conner & Mehl, 2015; Fahrenberg, Myrtek, Pawlik, & Perrez, 2007; Wright & Zimmermann, 2019), also referred to as ecological momentary assessment (Shiffman, Stone, & Hufford, 2008), comprises multiple study designs that are defined by the assessment of psychologically relevant variables in participants’ everyday lives. Prominent examples include continuous passive sensing (e.g., physiology or mobile sensing data; Ebner-Priemer & Kubiak, 2007; Harari et al., 2017; Wiernik et al., 2020), repeated momentary assessments of participants’ experiences (experience sampling; Csikszentmihalyi & Larson, 2014), daily and weekly diary (Bolger, Davis, & Rafaeli, 2003), and the day reconstruction method (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004; Lucas, Wallsworth, Anusic, & Donnellan, 2020). Experience sampling methodology (ESM) is used particularly often as it allows the momentary assessment of participants’ (usually self-reported) states as they occur or shortly after their occurrence in everyday life. For instance, Fleeson (2001) conducted ESM studies with multiple daily assessments for several days to examine within- and between-person variation and density distributions of momentary personality states (e.g., state extraversion). When conducting ESM
studies, multiple methodological choices need to be made that allow tailoring the study design to the research questions of interest (for an overview, see Horstmann, 2020).

Contrary to studies using ambulatory assessment, laboratory studies do not capture participants in their natural everyday environments (although some may seek to create ‘naturalistic’ environments). While this may result in decreased generalizability to people’s daily lives, laboratory studies provide a more controlled setting, allow rich multivariate assessments (including data sources that are currently difficult or impossible to tap in everyday life), and facilitate causal inference if experimental manipulations are introduced. A wide range of study designs can be realized in the laboratory, including, for instance, social interaction studies (e.g., round-robin designs; Warner, Kenny, & Stoto, 1979), behavioural tasks (e.g., learning tasks, decision-making tasks, economic games; see, e.g., Bódi et al., 2009; Buelow & Suhr, 2009; Forsythe, Horowitz, Savin., & Sefton, 1994), and experimental designs (Revelle, 2007; e.g., randomized presentation of certain situations or situational features). Laboratory studies can be specifically designed to capture a personality process of interest in a more controlled and potentially more fine-grained manner than is possible in everyday life. For instance, Blain, Sassenberg, Xi, Zhao, and DeYoung (2019) examined the association between behavioural reward sensitivity and extraversion using a probabilistic reward task. Jach and Smillie (2020) used a novel laboratory task to examine whether openness/intellect is associated with information seeking as proposed by DeYoung (2013). As another example, Hyatt, Weiss, Carter, Zeichner, and Miller (2018) examined whether the relationship between narcissism and a measure of aggression differed between two experimental conditions: competitive or non-competitive interaction with a confederate (given the potential relevance of competitive contexts for narcissism manifestations).

Finally, long-term panel studies (e.g., Scherpenzeel, 2011; Taylor, Brice, Buck, & Prentice-Lane, 1993; Wagner, Frick, & Schupp, 2007) can be used to examine longer-term personality dynamics such as personality development and its sources (e.g., Denissen, Luhmann, Chung, & Bleidorn, 2019; Roberts et al., 2006). While long-term panel studies are often limited to repeated self-report assessments, they can include other data sources and can be combined with other study types. For instance, the Personality Change Consortium explicitly highlighted the importance of frequent multi-method assessments of traits, states, and environments for understanding personality development (Bleidorn et al., 2020). One example of a partial realization of this approach is a study by Borghuis et al. (2018) which combined yearly personality assessments with daily diary measurement bursts to examine associations between positive daily experiences and personality trait change.

**Data sources**

Research on short-term personality dynamics requires the assessment of relevant state variables. Many studies assess affective and emotional states (e.g., Schimmack, 2003; for an overview, see Brose, Schmiedek, Gerstorf, & Voelkle, 2020) or personality states with Big Five or HEXACO content (e.g., Fleeson, 2001; Sherman, Rauthmann, Brown, Serfass, & Jones, 2015; for an overview, see Horstmann & Ziegler, 2020). However, research in this area is not limited to these constructs and it may be necessary to assess more specific state variables tailored to the personality process of interest (e.g., interest and confusion in response to specific stimuli when examining openness dynamics; Fayn, Silvia, Dejonckheere, Verdonck, & Kuppens, 2019). Importantly, state measures are not limited to self-report questionnaires. In fact, the
study types described above can be combined with multiple data sources for the assessment of dynamic personality phenomena (Wrzus & Mehl, 2015). Rauthmann (2017) proposed the BIOPSIES data sources: behaviour and its traces (objectively measured), indirect measures, observations, physio-biological measures (including neurobiological, imaging, and genetic data), strangers’ impressions, informant knowledge, experience sampling, and self-reports. A combination of multiple appropriate data sources is likely to yield a more comprehensive and accurate picture of a person’s momentary states and enduring traits. In a notable example, Geukes et al. (2019) combined ambulatory and laboratory assessments and included a variety of data sources (e.g., behavioural observation in the laboratory, implicit personality tests, experience sampling with self- and partner-reported behaviours and interpersonal perceptions, informant reports, and other-reports in a zero acquaintance round-robin design).

In general, the field of personality dynamics has considerably profited, and will continue to do so, from advancements in innovative technologies. Beyond experience sampling and related methods, novel technologies create the possibility of collecting data in daily life from various other sources (Wiernik et al., 2020), such as passively sensed psychophysiological data (Ebner-Priemer & Kubiak, 2007); phone usage, GPS, and accelerometer data (Harari et al., 2017); microphone data (Mehl, 2017); or wearable camera data (Blake, Lee, De La Rosa, & Sherman, 2020). For instance, van Halem, Van Roekel, Kroencke, Kuper, and Denissen (2020) used wearables to examine the relations between skin conductance and affect in everyday life. In another study, Harari et al. (2020) used smartphone sensing (capturing conversation behaviour from microphone sensors, calls, text messages, and social media messaging app usage from phone logs) to study predictors and personality correlates of daily social behaviours.

To gain a fuller picture of human functioning, it is important to assess not only variables pertaining to the person but also to the environment (Rauthmann, 2020a). The assessment of situational variables has made substantial progress over the last decade (Horstmann, Rauthmann, & Sherman, 2018; Rauthmann et al., 2020; Rauthmann & Sherman, 2020). Same as for the assessment of states, different types of information and data sources are relevant for the assessment of situations. For instance, Rauthmann (2015) distinguishes multiple types of situational information (cues = physically existing, nominal objects in the situation; characteristics = subjective perceptions and meanings of cues along psychologically relevant continuous dimensions; classes = groups or types of situations with similar levels or profiles of cues and/or characteristics) and informants (in situ = directly in the situation and affected by it; juxta situm = bystander to the situation of someone else; ex situ = external coder). For example, Sherman et al. (2015) investigated the relations between subjectively perceived situation characteristics and HEXACO personality states using experience sampling. Further, situational information can also be assessed using novel technologies such as mobile sensing methods (Harari, Müller, & Gosling, 2018). In an exemplary study, Müller (2019) used GPS sensors to examine the places where participants spent time in their everyday lives. In sum, a variety of data sources can be combined with multiple study designs to provide an integrated assessment of a person’s states and situations.

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3 Several intensive longitudinal studies use self-reported experience sampling data and thus mix BIOPSIES data sources.
**Measurement issues**

The measurement of dynamic variables is associated with several challenges that require attention. The psychometric properties of the personality state measures used are often unclear (for an overview and considerations on the construction of state measures, see Horstmann & Ziegler, 2020). Such personality state measures are typically created ad hoc by rephrasing personality trait measures without further validation. This can lead to potential problems such as the limited applicability of certain items in certain situations (e.g., being quiet vs. talkative may not be relevant or have a different meaning in situations where no interaction partners are present). Moreover, it is crucial that the reliability (computed within and between persons) and validity (content, structural, convergent, discriminant, and criterion validity) of personality state measures are investigated and ensured (e.g., Horstmann & Ziegler, 2020; for a good example, see Halvorson et al., 2020). The psychometric properties of measures from other data sources should be evaluated as well. For instance, the reliability of individual differences in some behavioural task measures (e.g., Dang, King, & Inzlicht, 2020) and physiological measures (e.g., task-based fMRI; Elliot et al., 2019) has been questioned. In general, the psychometric properties of variables from novel data sources are often unknown, and terminological ambiguities across disciplines pose additional complications. Given these issues, it is important that researchers pay attention to the psychometrically rigorous measurement of states and situations across all data sources.

**Sampling**

For dynamics-focused studies, it is crucial to pay attention to the sampling of persons and situations (e.g., Wrzus & Mehl, 2015) as well as relevant state variables. Concerning the sampling of persons, sufficient variability in the measure of interest is required to examine between-person associations. Representatively drawn samples of persons are preferable to maximize diversity and generalizability, albeit not always feasible. Additionally, it may be desirable to specifically target certain groups of participants (e.g., extreme groups or clinical samples) for a given research question. For instance, Ringwald, Hallquist, Dombrovski, and Wright (2020) examined affect and interpersonal behaviour variability using ambulatory assessment in individuals meeting the criteria for borderline personality disorder. Finally, it should be noted that a sufficiently large number of participants needs to be sampled to obtain precise parameter estimates.

Regarding the sampling of situations, the types of situations assessed, the number of occasions for each participant, and the timing of assessments have to be considered. First, the importance of representative sampling of situations has been emphasized (e.g., Blum et al., 2018; Horstmann, Ziegler, & Ziegler, 2018; Judd, Westfall, & Kenny, 2012). Selective sampling of situations may lead to biased results and yields an incomplete picture of person–environment relations (Rauthmann, 2020a). When sampling situations, researchers should specify the population of target situations (e.g., daily life situations, interpersonal situations, work situations), and situations sampled should be representative of this population. When focusing on specific types of situations (e.g., interpersonal situations), targeting the situations of interest can be facilitated, for example, by conducting event-contingent experience sampling studies (e.g., Geukes et al., 2019) or by

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4 The sampling of relevant trait variables is important as well, but here we focus on states given their particular importance for dynamics-focused studies.
employing specifically designed laboratory studies. For example, when sampling situations that not everyone encounters, researchers can attempt to experimentally create these situations in the laboratory or using virtual reality. Systematic taxonomies of situational cues or classes (e.g., Rauthmann et al., 2015) could aid researchers in determining whether their sampled situations have situation cue/class frequency distributions similar to the population of interest. Second, a sufficient number of situations per person as well as sufficient situational variability are necessary for the precise estimation of effects of interest (e.g., individual differences in within-person associations; Neubauer, Voelkle, Voss, & Mertens, 2020). Third, the timing of assessments needs to be tailored to the research question of interest. For instance, when examining changes or transactions over time, it is crucial to sample data at the appropriate frequency (i.e., number of assessments per time unit; e.g., Bleidorn et al., 2020; Wrzus & Mehl, 2015). While passive sensing (e.g., Harari et al., 2017) is continuous and often unobtrusive, sampling intervals have to be specified for self-report data. For example, Rauthmann, Jones, and Sherman (2016) examined cross-lagged associations between self-reported situation characteristics and personality states, each at least an hour apart from each other, and reported only very small cross-lagged effects. Given that causal transaction effects are very likely (people’s states likely change in response to changes in perceived situations), these findings may be attributable to the low sampling frequency (i.e., hours rather than minutes). In a similar vein, research on long-term dynamics (i.e., personality development) has emphasized the importance of examining effects on relevant timescales to accurately measure and distinguish various forms of change (e.g., anticipatory change, post-event change, reversible change; Denissen et al., 2019; Luhmann, Orth, Specht, Kandler, & Lucas, 2014). Thus, appropriate study designs should be implemented that allow investigating processes of interest on the timescales on which they actually occur.

Researchers also need to decide on the sampling of relevant state variables. This includes decisions pertaining to the breadth vs. narrowness of assessed dependent and independent state variables (see bandwidth-fidelity trade-off; Cronbach & Gleser, 1957; e.g., Big Five domain states vs. Big Five facet states vs. specific, narrower state variables). Moreover, researchers need to decide which types of state variables to include (e.g., cognition, emotion, motivation, behaviour) and which data sources to use (e.g., self-report, passive mobile sensing, physiological measures). The number of relevant variables assessed can be increased without undue participant burden through the use of passive measures (e.g., Harari et al., 2017; Wiernik et al., 2020) and using planned missingness designs (e.g., for self-reported states; Horstmann, 2020; Silvia, Kwapił, Walsh, & Myin-Germeys, 2014).

Another crucial topic concerning sampling in dynamics-focused studies is the issue of statistical power. Researchers should design their studies to yield sufficient power for testing their hypothesis—which can have different implications depending on the type of hypothesis (e.g., between- vs. within-person). Power analysis for intensive longitudinal studies is more complex than for simple statistical tests such as t-tests and correlations. For example, in multilevel models that are typically fitted in ESM studies, statistical power depends on many parameters such as the number of persons and assessments, random slope variance, intraclass correlation, and fixed effects. For relevant guides and tools, see, for example, Arend and Schäfer (2019), Scherbaum and Pesner (2019), and Lafit et al.

Of course, in research examining person-environment relations, one also needs to pay attention to sampling relevant situational variables (e.g., specific situation characteristics).
(2020). Generally, power analyses should be tailored to the type of effect of interest. Power for between-person effects and cross-level interactions depends more strongly on the number of participants than power for within-person effects. For examples of recent ESM studies on personality dynamics reporting power analyses, see Horstmann, Rauthmann, Sherman, and Ziegler (2020), Kritzler, Krasko, and Luhmann (2020), and Kroencke, Geukes, Utesch, Kuper, and Back (2020).

**Statistical approaches**
The typically longitudinal data suitable to investigate personality dynamics requires appropriate statistical tools during analysis. Various approaches such as multilevel modelling (e.g., Hox, Moerbeek, & van de Schoot, 2010), structural equation modelling (e.g., Kline, 2016), network models (e.g., Epskamp, Waldorp, Mõttus, & Borsboom, 2018), and dynamic system models (e.g., Sosnowska, Kuppens, De Fruyt, & Hofmans, 2019) have been proposed and applied. Table 3 gives a selective overview of relevant statistical approaches, sample work introducing or discussing these approaches (e.g., methodological articles) as well as sample studies applying them.

The various analysis techniques fulfil different goals and sometimes map onto corresponding theoretical approaches (see Tables 2 and 3). However, they have in common that they allow the modelling of nested data (i.e., measurement occasions nested in participants). One key difference between analysis techniques is the treatment of time. Some analysis approaches model variability across measurement occasions but conceptualize occasions as independent within persons (e.g., in multilevel modelling, although autocorrelated residuals can be estimated). On the other hand, certain analysis approaches specifically model change over time (e.g., dynamic system models; Sosnowska et al., 2019; the computational cues-tendency-action model; Revelle & Condon, 2015). Despite the differences between analysis techniques with respect to the treatment of time, it should be emphasized that the presented approaches are often highly flexible and many of them allow for the modelling of time. For instance, lagged effects representing associations or transactions over time can be included in several of the presented approaches (e.g., multilevel modelling, structural equation models, temporal network models). Some authors have emphasized the centrality of explicitly modelling time-dependent processes when seeking to investigate dynamics (e.g., Revelle & Wilt, 2020).

One issue worth mentioning is to which degree different analysis techniques truly model or capture dynamic phenomena. Some may argue that the term ‘dynamic’ should be reserved for studies modelling time-dependent processes, while others may, for instance, also regard intra-individual associations of variables as dynamic. This issue becomes particularly apparent when multi-occasion data is reduced to individual difference indices (e.g., Dejonckheere et al., 2019; Wendt et al., 2020): While individual differences in autocorrelations between states and even state variability may be considered dynamic, extracting a person mean of states could be considered a different method to capture a static phenomenon. Future work may benefit from more terminological precision in this respect (see also Future Directions and Desiderata).

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6 Another noteworthy family of models are variance partitioning approaches (generalizability theory; Cronbach et al., 1972), which Furr (2020) emphasized for the analysis of variability and consistency in behaviour. While variance components are frequently estimated in personality dynamics research (e.g., using multilevel modelling), classical generalizability theory is currently only infrequently applied. Therefore, this approach is not included in Table 3.
Table 3. Common methodological approaches in personality dynamics

| Approach                  | Brief Description                                                                 | Pertinent Work                      | Sample Studies                                                                 |
|---------------------------|-----------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------|
| Computational approaches  | Computer simulations based on mathematical models to study complex phenomena. Specific systems can be modelled, and parameters can be adjusted to examine the resulting changes. Theoretical frameworks that are used in psychological computational approaches are, for example, predictive coding or neural networks. Examples include the virtual personality model and the cues-tendency-action model. | Mischel and Shoda (1995) Read et al. (2010) Revelle and Condon (2015) | Read et al. (2010) implemented the virtual personalities model in a neural network which simulates personalities, situations, and resulting personality states. Dynamic phenomena such as intra-individual variability and person × situation interactions were simulated. |
| Dynamic system models     | Examine changes of states over time and model phenomena such as equilibria, attractors, and repellers. Thus, they allow the estimation of novel types of individual difference variables (e.g., attractor strength). They are typically investigated using change-as-outcome models or differential equations. | Danvers, Wundrack, and Mehl (2019) Oravec, Tuerlinckx, and Vandekerckhove (2011) Oravec, Tuerlinckx, and Vandekerckhove (2016) Sosnowska et al. (2019) | Sosnowska, Hofmans, and De Fruyt (2019a) and Sosnowska et al. (2019) examined state neuroticism fluctuations in a work context. They investigated individual differences in (1) baseline neuroticism state levels, (2) variability in state neuroticism, and (3) attractor strength (i.e., how quickly people return to their baseline level of neuroticism after deviations from it). |

Continued
| Approach          | Brief Description                                                                                                                                                                                                 | Pertinent Work                                                                 | Sample Studies                                                                                                                                                                                                 |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Factor analyses** | Multiple analysis techniques examining the factor structure or measurement model of state data are available. This includes P technique factor analysis, dynamic factor analysis, multilevel confirmatory factor analysis, and more recent techniques such as latent Markov factor analysis. These techniques are relevant for the examination of substantive questions pertaining to personality dynamics as well as the determination of structural validity and reliability of (personality) state data. These factor-analytic approaches are at the intersection between personality process and structure. | Cattell, Cattell, and Rhymer (1947)                                                                                                 | Borkenau and Ostendorf (1998) used P-technique factor analysis to examine the within-person factor structure of daily Big Five state items. Both individual and averaged within-person factor structures were investigated. |
| **Machine learning (ML)** | An umbrella term encompassing a broad variety of algorithms that can be used on data. Three main tasks of ML algorithms are prediction, classification, and clustering. Learning methods are generally distinguished into supervised, unsupervised, and reinforcement learning. In personality science, most research using ML focuses on the prediction of personality traits using supervised learning and prediction models. Idiographic and dynamic approaches afford person-dependent algorithms (requiring multiple measurement occasions per person). Person-dependent algorithms are trained using data of a single individual. | Bleidorn and Hopwood (2019)                                                                                                      | Stachl et al. (2019) used ML prediction models (random forest, elastic net) to automatically and accurately predict personality factors and facets from smartphone sensing data.                                                                 |
|                   |                                                                                                                                                                                                                   | Mehta, Majumder, Gelbukh, and Cambria (2019)                                                                                      | Jacobson and Chung (2020) used personally weighted machine learning models to predict momentary depressed mood from passive sensor data.                                                                       |
|                   |                                                                                                                                                                                                                   | Montag and Elhai (2019)                                                                                                           |                                                                                                                                                                                                           |
| Approach                                  | Brief Description                                                                                                                                                                                                 | Pertinent Work                                                                                                                                  | Sample Studies                                                                                                                                                                                                 |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Multilevel modelling (MLM)               | Regression analyses allowing modelling of hierarchically structured data (e.g., measurement occasions nested in participants) using random effects (e.g., random intercepts and slopes). Can be used to disentangle between- and within-subjects effects. Various extensions such as multilevel generalized linear models and multivariate multilevel models are available. | Hox et al. (2010) Nezlek (2008) Raudenbush and Bryk (2002)                                                                                      | Sherman et al. (2015) used MLM to examine the within-person effects of subjective situation characteristics on personality states in everyday life using experience sampling data. |
| Multilevel structural equation modelling (MSEM) | Integrates SEM and MLM and facilitates the modelling of nested data structures in the SEM framework. It has multiple advantages over classical MLM, including the possibility of multiple outcome variables and the examination of measurement models within and between persons. | Heck and Thomas (2015) Preacher, Zyphur, and Zhang (2010) Rabe-Hesketh, Skrondal, and Pickles (2004) Sadikaj, Wright, Dunkley, Zuroff, and Moskowitz (2020) Costantini et al. (2019) | Sharpe, Simms, and Wright (2020) used MSEM to examine the within-person associations between daily stress, impulsivity, and affect in patients with personality disorder diagnoses. Between-person differences in these within-person associations (stress-reactivities) were correlated with other level 2 variables. |
| Approach                  | Brief Description                                                                                                                                                                                                 | Pertinent Work                                 | Sample Studies                                                                 |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------|
| Network models           | A family of modelling approaches where nodes (often individual items or sum scores) are connected via edges which denote the strength of an association. Different types of models can be estimated including undirected (e.g., partial correlation) vs. directed (e.g., lagged) networks, contemporaneous vs. temporal networks, and between-subject vs. within-subject networks. A related modelling approach is the group iterative multiple model estimation (GIMME) approach in which general, subgroup-specific, and person-specific effects can be examined in intensive longitudinal data. | Epskamp et al. (2018)  
Gates and Molenaar (2012)  
Wright et al. (2019) | Beck and Jackson (2020) implemented graphical vector autoregressive models (one type of network model) to examine individual within-person networks of personality state measures using experience sampling data. The stability of these idiographic personality networks (both contemporaneous and lagged) across two experience sampling waves was investigated. |
| Person-specific dynamic indices | Using intensive longitudinal data, researchers may extract a variety of person-specific dynamic indices. This includes: state mean levels, state variability, inertia, mean square successive difference (MSSD, instability), network-density, individual differences in within-person correlations, random slopes (e.g., individual differences in contingencies between states and situations using MLM), and many more. | Dejonckheere et al. (2019)  
Jahng, Wood, and Trull (2008)  
Liu, Kuppers, and Bringmann (2019)  
Wendt et al. (2020) | Wendt et al. (2020) examined the structure, reliability, and personality correlates of various person-specific dynamic affect indices on the daily and momentary level. |
Table 3. (Continued)

| Approach                        | Brief Description                                                                                                                                                                                                                                                                                                                                 | Pertinent Work                                                                                                                                                                                                                                                                                                                                 | Sample Studies                                                                                                                                                                                                                                   |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Structural equation modelling   | Very flexible and broad framework for the examination of relations between latent and observed variables. Specific SEMs relevant to personality dynamics include growth curve models, latent change score models, cross-lagged models, latent state-trait (LST) models, multi-method as well as multi-situation models, and many more. Various extensions such as continuous time SEM (ctSEM), dynamic SEM, and multilevel SEM (MSEM; see above) are available. Various approaches in this table can be implemented as or subsumed under SEM. | Asparouhov, Hamaker, and Muthén (2018)                                                                                                                                                                                                                                                                                                                                                                       | Borghuis et al. (2017) used latent growth curve models to examine mean levels of and individual differences in longitudinal change of personality traits during adolescence and early adulthood.                                           |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                           | Geiser, Hintz, Burns, and Servera (2020a)                                                                                                                                                                                                                                                                                                                                                               | Judge et al. (2014) used SEMs including cross-lagged effects to examine the relationships between daily personality states and daily work variables.                                                                                       |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                           | Geiser, Hintz, Burns, and Servera (2020b)                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                           | Kline (2016)                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                           | Usami, Murayama, and Hamaker (2019)                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                           | Voelkle, Oud, Davidov, and Schmidt (2012)                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                |

Note. Shown are selected statistical approaches suitable for the analysis of dynamic personality data. We provide brief descriptions, pertinent—often methodological—work, and examples of studies applying these approaches in the area of personality dynamics. Methodological approaches are ordered alphabetically.

Individual differences in dynamics (i.e., dynamic indices) do not represent one coherent statistical approach but are nonetheless included in the table given their relevance to the analysis of dynamic data.
Multiple statistical approaches allow distinguishing inter-individual effects (between-person: e.g., extraverted individuals report higher typical or average momentary well-being) from intra-individual effects (within-person: e.g., momentary deviations from one’s typical state extraversion are associated with momentary deviations from one’s typical well-being). For instance, multilevel modelling allows the examination of within-person associations between variables as well as individual differences therein (i.e., random slopes). Individual differences in within-person contingencies have been emphasized in various theories (e.g., Fleeson & Jayawickreme, 2020; Mischel & Shoda, 1995). When these are predicted by personality traits, this represents so-called cross-level interactions (i.e., the level 2 variable, a personality trait, moderates the level 1 association between two state variables). For example, Sherman et al. (2015) examined whether links between situation characteristics and personality states were moderated by personality traits and found only few interaction effects.

Beyond the specific statistical approaches presented in Table 3, it should be mentioned that the intensive longitudinal data gathered in personality dynamics research allow both idiographic (i.e., individual-specific) and nomothetic modelling (i.e., generalizing across individuals). Multiple authors have noted the importance of idiographic approaches in psychology (e.g., Allport, 1937, 1962; Beck & Jackson, 2020; Molenaar, 2004), and some have emphasized the viability of combining idiographic and nomothetic work (e.g., Beltz, Wright, Sprague, & Molenaar, 2016; Revelle & Wilt, 2020; Wright & Zimmermann, 2019). Thus, various suitable statistical approaches exist and, together with other methodological advances, facilitate the study of dynamic phenomena.

**Personality dynamics in applied settings**

In the following paragraphs, we selectively showcase some applications to briefly illustrate the benefits of a dynamic approach to individual differences and refer to relevant publications. We focus on research and practice in clinical psychology/psychotherapy and work/organizational psychology as major applied disciplines in psychological science. Studies on dynamic personality phenomena in educational settings also exist (e.g., Cervone, Mercurio, & Lilley, 2020; Zhang, Beckmann, & Beckmann, 2019) but remain sparse.

**Clinical psychology**

Contemporary theories and models of psychopathology generally emphasize the relevance of dynamic processes underlying maladaptive functioning (e.g., DeYoung & Krueger, 2018; Hopwood, 2018; Pincus, 2005; Pincus & Hopwood, 2012; Ringwald, Woods, Edershile, Sharpe, & Wright, 2020; Wright et al., 2020). For example, Carver, Johnson, and Timpano (2017) suggested a process-based, functional interpretation of the recently proposed general factor of psychopathology (p factor; e.g., Caspi et al., 2014). Also, psychotherapy centres on the premise that psychopathology is dynamic by nature and that dysfunctional patterns of experience and behaviour can be disrupted or modified to achieve higher levels of functioning. We believe personality dynamics theory and research can inform the study and treatment of all psychopathologies (e.g., DeYoung et al., 2020), but we will focus on personality disorders (PDs) which constitute an obvious link between personality and psychopathology.
The dynamics of PDs can be examined at different time scales, nomothetically or idiographically, and across or within situations (Hopwood, 2018; Hopwood, Zimmermann, Pincus, & Krueger, 2015; Ringwald, Woods, et al., 2020). First, the long-term development of PDs, for example, the stability of pathological traits and symptoms, is of theoretical and practical relevance (e.g., Hopwood et al., 2013; see also Hopwood & Bleidorn, 2018 for a review). Second, some PDs can be defined by dysfunctional patterns of within-person variability across situations. Narcissistic PD, for instance, can be characterized by alternating states of idealization and devaluation (e.g., Cain, Pincus, & Ansell, 2008). Third, PDs can be nomothetically examined in terms of their characteristic contextualized response patterns or situational contingencies. For example, in narcissists, antagonistic behaviour and negative affect may often be triggered by perceiving others as dominant (Wright et al., 2017). Fourth, practitioners can idiographically explore patients’ unique dysfunctional dynamics and symptom triggers and tailor interventions accordingly (Hopwood et al., 2015; Wright & Zimmermann, 2019; Zimmermann et al., 2019). Fifth, in psychotherapy, insights gained by zooming into the moment-to-moment dynamics that unfolded within a single relevant situation in the patient’s life may be beneficial (Hopwood, 2018; Hopwood et al., 2015). Finally, a process-oriented conceptualization of personality may also enable the integration of the clinical and personality psychological literatures (Ringwald, Woods, et al., 2020).

**Work and organizational psychology**

A dynamic perspective on personality offers great potential for work and organizational psychologists (Beckmann & Wood, 2020) and has been applied to study, for example, job satisfaction (Ilies & Judge, 2002), work motivation (Judge, Simon, Hurst, & Kelley, 2014), emotions at work (Fisher, Minbashian, Beckmann, & Wood, 2013; Thapa et al., 2020), or the influence of work experiences on personality trait change (Li et al., 2020; Wille & De Fruyt, 2014). Here, we illustrate the utility of dynamic approaches by focusing on the personality–performance link.

Predicting performance is especially relevant in personnel selection, and considering dynamic personality phenomena may have practical benefits (see Sosnowska, Hofmans, & Lievens, 2020). For example, recent empirical studies suggest that assessing stable inter-individual differences in within-person contingencies (Mischel & Shoda, 1995; see CAPS in Table 3) between personality states and situational demands (i.e., state levels changing systematically with task demand) may improve predictions of work outcomes beyond traditional personality trait assessments (Minbashian, Wood, & Beckmann, 2010; Wood et al., 2019). Moreover, several studies have investigated relations between personality state fluctuations and job performance (e.g., Debuschker, Hofmans, & De Fruyt, 2014, 2016a, 2016b, 2017; Sosnowska et al., 2019b). Guided by Whole Trait Theory (Fleeson & Jayawickreme, 2015; see WTT in Table 3), Lievens et al. (2018) used situational judgement tests to examine people’s hypothetical states in response to different work situations and found that intra-individual variability incrementally predicted job performance beyond traditional trait measures. Importantly, variability in situational judgement test responses was correlated with (i.e., validly generalized to) personality state fluctuations in everyday life.

In sum, if these findings prove replicable, dynamic within-person phenomena, such as situational contingencies and state fluctuations, may be relevant individual difference variables and predictors in work settings. Further, existing personnel selection methods
may be well suited or could easily be adapted to study these phenomena (Lievens, 2017; Sosnowska, Kuppens, Kuppens, De Fruyt, & Hofmans, 2020).

**Future directions and desiderata**

Although a dynamic understanding of personality goes back to the beginnings of psychology itself, interest in personality dynamics has been reinvigorated in the recent two decades and the field has experienced a renaissance. Thus, personality dynamics is still actually a nascent field where multiple desiderata can be identified. Here, we formulate some future directions that could help the field move forward.

First, a pervasive issue in personality psychology — and thus also in personality dynamics research — is the over-reliance on self-report data and the narrow focus on traits, often in the form of the Big Five. Many studies purport to have examined personality change or fluctuations in personality states with such data. However, what these studies may really have examined were changes in explicit self-concepts (e.g., self-reported extraversion) across time, or momentarily activated construals or self-schemata (e.g., self-reported extraverted behaviour), often even retrospectively assessed from memory. While such studies provide valuable insights into how people construe themselves and how self-concepts may be malleable, it is overstretching to equate explicit self-concepts with personality traits or personality as a whole. Moving forward, different data sources (e.g., actual and observed behaviour, indirect measures, biophysiological measures, other-reports) should be used, ideally simultaneously, to tease apart generalizable patterns from more data source-specific ones.

Second, personality states are an integral concept to studying personality dynamics. However, most personality state measures have been developed in an ad hoc fashion by abridging trait measures, and their psychometric properties are often unknown. It will be important to create psychometrically validated personality state measures, ideally using multiple data sources (e.g., self- and other-reports, actual behaviour sensed by wearables, etc.). Additionally, the applicability of state measures in the situations sampled needs to be evaluated (e.g., some states cannot be enacted in certain situations). Finally, state measures should allow both nomothetic and idiographic analyses to be useful for dynamics-focused research endeavours.

Third, not only the measures assessing traits, states, and situations need great care, but also the sampling of persons and situations that yield data on those measures. There are two issues that should be considered: variability and generalizability. A comprehensive sampling of persons and situations is needed to ensure sufficient variability for statistical analyses (e.g., variance partitioning or multivariate analyses). Moreover, we often want observed effects to generalize beyond the specific sample of persons and situations and the methods used, or at least understand their constraints on generality (Simons, Shoda, & Lindsay, 2017). Hence, future research should carefully attend to the diversity and potential generalizability of the samples of persons and situations, and of the methods used.

Fourth, within-person dynamics (e.g., within-person variability or within-person contingencies) as individual difference variables or personality units require further examination. Some parameters of within-person dynamics have demonstrated low to moderate between-person reliabilities (e.g., Jones, Brown, Serfass, & Sherman, 2017; Neubauer et al., 2020; Wendt et al., 2020; Wood et al., 2019). However, further work is needed to establish which within-person dynamics constitute stable and consequential
individual differences, and under which conditions. For one, it remains to be seen when and to what extent within-person parameters add information beyond person mean levels. This pertains to their incremental validity, for example, in the prediction of trait levels, well-being, and important outcomes such as job performance (see *Personality dynamics in applied settings*). So far, research suggests that individual differences in within-person dynamics, as currently assessed, may add only limited predictive value beyond person mean levels (e.g., Dejonckheere et al., 2019; Wendt et al., 2020; cf. Wood et al., 2019).

Fifth, we have restricted this review to short- and middle-term dynamics. However, as mentioned above, there is ample work on long-term dynamics, most notably in recent research on the processes underlying personality development (Bleidorn et al., 2020; Wrzus, 2020), including trait change following interventions (Hudson, 2020). An integration of dynamics in the origins, expressions, outcomes, and development of personality *at different timescales* (see also the discussion of timescales in *Sampling* above) can move us towards a more holistic understanding. There is already promising research attempting such integration (e.g., longitudinal multi-burst designs: Borghuis et al., 2018; Quintus, Egloff, & Wrzus, 2020) and there are proposals for future research (e.g., longitudinal experience-wide association studies: Bleidorn et al., 2020). For instance, Quintus et al. (2020) examined in one study (1) how traits are related to situation characteristics and states, (2) how states and situation characteristics are related at the momentary within-person level, and (3) how aggregated state changes are related to trait changes across longer time scales. Innovations in optimizing and automating longitudinal intensive data collection and analysis will likely advance the study of personality dynamics at different timescales.

Sixth, future research needs to put a stronger emphasis on conceptual clarity, terminological accuracy and consistency, and operationalization to move towards formulizable theories. We compiled key concepts and terms in Table 1, but we do note that there is considerable heterogeneity in the literature of how exactly the terms are used. For example, some authors lump different phenomena under the term ‘process’ (jingle fallacy), while others use different labels for ‘process’ (jangle fallacy). This impedes clear and consistent communication as well as a cumulative synthesis of the literature. Further, unclear or fuzzy concepts are often difficult to translate into a coherent operationalization. For example, operationalization issues can occur when a concept is not properly identified conceptually or is not well implemented into a corresponding measure to tap it. Problematic operationalization, in turn, hampers the testing and formalization of theories. Integrated theory formation that cuts across literatures will be vital to the field of personality dynamics (which is currently rather fragmented with several different theoretical approaches; see Table 2), and thus, more terminological precision, operationalization, and formalization will be key goals to pursue.

Lastly, dynamics-focused research will also benefit from best practices in open science to ensure transparency, reproducibility, and replication. This includes attending to high statistical power for detecting also subtle effects with sufficient precision and being able to replicate research. Moreover, it includes the wider use of pre-registration as well as registered reports.

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7 Further, to complicate matters even more, the measures may be used in inappropriate designs (e.g., problematic sampling of persons and/or situations) and inappropriate statistical procedures may be applied to the data.
Conclusion
The study of personality dynamics is a vibrant field that has enjoyed increasing interest and advances in the last decades. Further progress in this field will complement other psychological research that also seeks to understand the mechanisms and processes underlying human experience and behaviour – one of the main goals of psychological science. As we have shown in this primer, personality dynamics research covers a staggering range of concepts, theories, and methods which may have to be integrated better moving forward. We hope this review is not only a serviceable overview of the field but can also entice scholars interested in personality dynamics to delve into this fascinating field and contribute to it.

Conflicts of interest
All authors declare no conflict of interest

Author contributions
Niclas Kuper (Conceptualization; Writing – original draft) Nick Modersitzki (Conceptualization; Writing – original draft) Le Vy Phan (Conceptualization; Writing – original draft) John Rauthmann, Ph. D. (Conceptualization; Supervision; Writing – review & editing).

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