



Subjectifying the Personality State: Theoretical Underpinnings and an Empirical Example

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Abstract: Recent developments in personality research highlight the value of modelling dynamic state-like manifestations of personality. The present work integrates these developments with prominent clinical models addressing within-person multiplicity and promotes the exploration of models centred on state-like manifestations of personality that function as cohesive organizational units. Such units possess distinct subjective qualities and are characterized by specific affects, behaviours, cognitions, and desires that tend to be co-activated. As background, we review both theory and research from the fields of social cognition, psychotherapy, and psychopathology that serve as the foundation for such models. We then illustrate our ideas in greater detail with one well-supported clinical model—the schema therapy mode model, chosen because it provides a finite and definite set of modes (i.e. cohesive personality states). We assessed these modes using a newly developed experience-sampling measure administered to 52 individuals (four times daily for 15 days). We estimated intraindividual and group-level temporal and contemporaneous networks based on the within-person variance as well as between-person network. We discuss findings from exemplar participants and from group-level networks and address cross-model particularities and consistencies. In conclusion, we consider potential idiographic and nomothetic applications of subjective states dynamic personality research based on intensive longitudinal methods. © 2020 European Association of Personality Psychology

Key words: personality states; network analysis; idiographic methods; personality dynamics

Recent advances in personality research highlight the importance of attending to dynamic state-like context-sensitive manifestations of personality and of developing models to account for these phenomena (e.g. Rauthmann, Beckmann, Nofle, & Sherman, 2019; Wilson, Harris, & Vazire, 2015; Wright & Simms, 2016). The development of such models involves the building of meaningful bridges between research focused on descriptive (between-individual) differences in traits and research focused on explanatory (within-individual) context-dependent processes of personality functioning (e.g. Baumert et al., 2017; Hopwood, 2018; Jayawickreme, Zachry, & Fleeson, 2019). Some of these models (e.g. Hopwood, Pincus, & Wright's, 2019, Contemporary Integrative Interpersonal Theory) go even further and integrate social, personality, and clinical phenomena into coherent frameworks for research on personality dynamics—both typical and pathological.


In attempting to lay the foundation for such bridges, many studies of personality dynamics have employed the concept of *personality state*. Personality states are typically invoked with reference to the affective, behavioural,

cognitive, or motivational contents, which characterize established (e.g. Big Five) *personality traits*, but appear for brief periods of time rather than chronically (e.g. Fleeson, 2001; Jayawickreme et al., 2019; Rauthmann, Jones, & Sherman, 2016). These personality states provide a lexicon for capturing momentary fluctuations in the extent to which traits manifest in individuals' daily lives.

Other investigations (e.g. Dunlop, 2015; Geukes & Back, 2017; Geukes, van Zalk, & Back, 2018; Revelle & Condon, 2015; Sosnowska, Kuppens, De Fruyt, & Hofmans, 2019) go beyond state manifestations of broad traits and instead address a range of state-like variables (including momentary goals, affects, experiences, behaviours, and evaluations) as well as the dynamic interactions that unfold between these variables. These variables also provide a way of speaking about momentary fluctuations. For example, Zimmermann et al. (2019) developed a Personality Dynamics Diary, which assesses behaviours and situational experiences covering major domains featured in current dimensional models of psychological situations (Rauthmann et al., 2019) and personality pathology (Krueger & Markon, 2014); these are assessed in daily or within-day diaries, which allow researchers to capture within-person variation over time.

For the most part, these accounts of dynamic personality posit momentary or state-like processes but do not propose a structure of (momentary) organizational units. Specifically, they do not point to particular agglomerations of state-like variables that may compose identifiable state units. Thus,

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although these accounts have been very generative of research (e.g. Rauthmann et al., 2019), we believe that they leave out an essential quality: the recognition of cohesive subjective *states of mind* (Siegel, 2012), which involve a clustering of functionally synergistic processes (e.g. motivation, cognition, affect, and behaviour).

Subjective Personality States as Organizational Units

Consider a man who has been through a harsh romantic rejection and is currently reacting to it by enacting avoidant behaviours. We may accurately note that he is currently low in state extraversion, agreeableness, and openness, but this would miss the gist of the situation: namely, that he is *now* in an avoidant *state of being*. In other words, his behaviours, affect, cognitions, motivations/desires (Wilt & Revelle, 2015), and sense of control/authorship (i.e. agency), reflexive functioning (i.e. meta-cognitions), and embodied sense are all activated jointly as part of a cohesive (although contextual and time limited) subjective organizational unit. Seeing his former lover on the street may bring about an entirely different subjective state of being (marked by despair, uncontrollable sobbing, and the wish for reunion), so would the receipt of skilled social support (which may engender a calmer, more regulated state). Thus, within the same person, multiple subjective organizational units become active at different times.

In the present paper, we wish to offer a conceptualization of state-like manifestations of personality that tie together several components into meaningful and lawful (momentary) organizational units. This conceptualization is inspired directly by McAdams (1996) and indirectly by James (1890/1950). Specifically, McAdams contended that personality is best thought of as comprising three levels of psychological individuality—dispositional traits, characteristic adaptations (e.g. goals, coping strategies, values, and skills), and integrative life stories. These elements construct the Jamesian ‘me’—that is, the objective, known part of personality. Like James before him, McAdams (1996, 2013) argued that personality and the self also involve a phenomenological/experiential quality. James (1890/1950) referred to this quality as the ‘I’ and thought of it as the subjective, knowing part of personality. Following James, McAdams argued that the ‘I’ reflexively construes the ‘me’. The ‘I’ can be thought to hold one’s sense of agency, that is, one’s experiential and embodied sense of authorship and ownership over one’s body, action, and mental states (Gallagher, 2012).

For decades, both the ‘me’ and the ‘I’ were seen as unitary; for example, the vast literature on self-esteem was predicated on the idea that people have a unitary self and that a single dimension of esteem can apply to it (e.g. Allport, 1955; Wylie, 1974). However, pioneering psychologists (James, 1890/1950, Kelly, 1955) and sociologists (Mead, 1934) offered a multifaceted view of self and personality, a view highlighting the *variety* of aspects, roles, and perspectives comprising the seemingly holistic self.

Inspired by these theories, developmental and social cognitive models (e.g. Block, 1961; Campbell et al., 1996;

Higgins, 1987; Linville, 1987; Roberts & Donahue, 1994) began investigating self-multiplicity empirically. The majority of this work has focused its sights on the known self, the ‘me’. In doing so, these models demonstrate how multiple ‘me’s—that is, multiple conceptual selves—co-exist within each of us and create individual differences (in self-complexity, self-concept differentiation, self-discrepancies, etc.). At the centre of our Jamesian conceptualization is the idea that a dynamic theory of personhood would benefit from a similarly multifaceted view of the subjective (knowing) self, the ‘I’.

This idea is certainly not new. Indeed, the clinical literature is rife with models (mostly theoretical) addressing the multiplicity of ‘I’s—that is, highlighting the variety of experiential selves. For example, in his seminal work within cognitive therapy, Teasdale (1997) argued that ‘we do not have one mind, but many—at any one time, one of these many minds may be dominant, and can be thought of as the current mind-in-place’. Similarly, from within emotion-focused therapy (EFT), Elliott and Greenberg (2007) noted that ‘humans [are] constituted of multiple parts or voices’. Congruent ideas have been put forward by many other clinical theorists and researchers [e.g. interpersonal meta-cognition: Dimaggio, Semerari, Carcione, Nicolò, & Procacci, 2007; the dialogical-self model: Hermans, 2001; the assimilation model: Stiles, 2006; relational psychoanalysis: Bromberg, 1998; or schema therapy (ST): Rafaeli, Maurer, Lazarus, & Thoma, 2016]. Clinicians working from these perspectives often use the concept of multiplicity of states to account for sweeping short-term fluctuations, to arrive at fruitful tailored formulations of their clients’ experiences, and to help chart possible change courses for these clients (cf. Dimaggio & Stiles, 2007).

This clinical insight guiding theorists from multiple (and often competing) orientations to the same conclusion—that is, that the *subjective* self is multifaceted—is also the main driving force behind our conceptualization. Like these theorists, we wish to put forward the idea that capturing momentary states of personality requires delineating multiple transitory cohesive organizational units—transitory self-states—which can be thought of as both ‘me’s (i.e. collections of traits, goals, and narratives) and ‘I’s (i.e. subjective experiential states).

Investigating Organizational Units of Personality

To date, research exploring transitory self-states as organizational units of personality has been quite scarce. However, work within both social–personality psychology and psychopathology has direct bearing on the topic. In this section, we review such work and highlight some unique contributions of both literatures.

We begin by summarizing work in the social–personality domain. As we will illustrate in the succeeding text, such work provides potent examples of what we mean by subjective experiential states, begins to show the utility of a multi-method approach to investigating them, and offers some clues regarding the identity of frequently occurring states.

In their extensive work on perspectives, Kross and Ayduk (e.g. Kross & Grossmann, 2012; for review, see Kross &

Ayduk, 2017) demonstrated the distinctiveness of experiences marking *self-immersed* (distressed) versus *self-distanced* (reflective) states. In particular, the experiences of these states were shown to be marked by different emotions, emotion regulatory capacities, cognition, pronoun use, narratives, and neural correlates. Dörfel et al. (2014) also examined a self-distanced state but compared it with a *distracted* one, finding that the two recruit different neural networks. Similar ideas undergird the work of Gilbert, Baldwin, Irons, Baccus, and Palmer (2006), who used imagery methods to induce one of two ‘social mentalities’ (a *self-critical* and harsh state versus a *self-compassionate* and reflective one). As these authors argue (p. 187), ‘... the self-critical aspect of the self [... is] personalized like a hostile dominant other with the typical qualities of a hostile dominant [... and] the self-reassuring aspect of the self [... is] personalized like a kind, reassuring other with the typical qualities of a reassuring other’.

The studies noted earlier touch on distinct subjective experiences but stop short of addressing them as stand-alone organizational units. In contrast, the clinical literature on transitory self-states—and in particular, on the phenomena of dissociation—does at times posit such units and illustrates the importance of attending both to the units themselves and to their interrelationships.

The discussion of dissociative states began with Pierre Janet’s (1907) treatment of this phenomenon as a lack of integration among (at least) two different ‘systems of ideas and functions that constitute personality’ (p. 332). A recent revision of Janet’s definition, proposed by Nijenhuis and van der Hart (2011), noted that ‘the division involves two or more insufficiently integrated dynamic but excessively stable subsystems [...]. Each dissociative subsystem [...] minimally includes its own at least rudimentary first-person perspective’. This view of dissociation helped explain the phenomenon of cognitive compartmentalization—that is, a separation of (certain) memory materials from one’s ongoing sense of self (Spiegel et al., 2011).

The recognition of compartmentalization as a common phenomenon has served the clinical literature well in two ways. First, several models of psychopathology highlight the identity of specific distinct states characteristic of individuals suffering from the same disorder. For example, work on social anxiety reveals the ubiquitous presence of a self-critical voice (Shahar, 2014) among socially anxious individuals. Similarly, work on depression reveals the frequent presence of unassimilated mental states of dominance and submissiveness (Osatuke, Stiles, Barkham, Hardy, & Shapiro, 2011). Second, other models of psychopathology address individual differences in the structure and interrelationships among states. In the extreme (albeit controversial) case, dissociative or compartmentalized structure may lead to the phenomenology of dissociative identity (Spiegel et al., 2011). Much more commonly, such structure can play a part in the experience of personality disorders (PDs). For example, individuals with borderline PD were found to have greater compartmentalization in self-concept structure (Vater, Schröder-Abé, Weißgerber, Roepke, &

Schütz, 2015) as well as less coherent narrative identity (Adler, Chin, Kolisetty, & Oltmanns, 2012).

Importantly, other than the social–personality and psychopathology studies reviewed earlier, only limited *empirical* work has explored the phenomenon of multiple subjective experiential states, or the distinct *phenomenologies* of being in such states. The empirical endeavour of capturing multiple ‘I’s has been hindered by several factors. First, individuals’ first-person experiences inherently lose some of their essence when translated into self-reports, a translation that inevitably reduces their experience into symbolic structures (e.g. words), generated by researchers (e.g. Weger, Meyer, & Wagemann, 2016). Second, models of subjective multiplicity often argue for a great multitude of states and avoid providing these states with clear characteristics (e.g. Bromberg, 1998); this can quickly make multiplicity unwieldy to measure in any standard way. Third, when models do pare down this richness to a more manageable set of states, they often rely on one-time cross-sectional self-report instruments (e.g. Lobbestael, van Vreeswijk, Spinhoven, Schouten, & Arntz, 2010), inherently limited in their ability to tap into dynamic experiences. Fourth, and most importantly, the analysis of more appropriate repeated intensive contextual self-state information requires a set of analytic tools—for example, longitudinal or dynamic network models (Epskamp, van Borkulo, et al., 2018)—that only started emerging in recent years.

The Present Study

The present study aims to address the factors that have hindered research on the phenomenology of multiple subjective organizational units. To do so, we start off with one promising clinical model—namely, ST (Rafaeli, Bernstein, & Young, 2011; Young, Klosko, & Weishaar, 2003), which posits a finite set of organizational units as part of its theoretical model. Importantly, the model suggested by ST constitutes only one way of describing the phenomenon of subjective multiplicity. We chose it as our starting point because it offers a relatively straightforward operationalization (see in the succeeding text) and has some proven clinical utility (Bamelis, Evers, Spinhoven, & Arntz, 2014) for patients with a variety of diagnoses. More importantly, it strikes a reasonable compromise between narrower taxonomies of states and ones that are too unwieldy.

To provide preliminary empirical support to the notion of multiple subjective organizational units, we collected intensive longitudinal data (four times daily for 15 days) appropriate for tapping dynamic experiences. We then subjected these data to cutting-edge analytic methods—most notably, network analyses.

Schema therapy’s mode model of multiplicity

Schema therapy’s mode model is an integrative model of personality and psychotherapy centred on a multifaceted view of the self, which is seen as both a clinical challenge in the understanding of psychopathology and distress and as a clinical opportunity for their treatment. When first introduced, ST focused primarily on clients’ schemas (enduring foundational

mental structures that help us represent and interpret the world; Beck, 1976) and particularly on early maladaptive schemas, which were seen as a root cause of clients' distress and disorder. However, it did not take long to recognize that directing clinical attention to trait-like schemas leaves unexplained much of the phenomenology and symptomatology of the clients for whom ST was developed in the first place—individuals with borderline, narcissistic, or other PDs, who manifest quick and often intense fluctuations among various *states* (e.g. Sadikaj, Moskowitz, Russell, Zuroff, & Paris, 2013). This recognition led to the development of the *mode* concept in ST. Importantly, although the mode model was first developed in an effort to address the experience of individuals suffering from personality pathology, it can be (and has been) used to address the existence of multiple subjective states among all individuals, whether suffering from psychopathology or not.

A mode reflects the prevailing schemas, coping or healthy reactions, or emotional states active for an individual at a particular time. By definition, modes are transient states, and at any given moment, a person is thought to be predominantly in one mode. All individuals inhabit various modes over time, but the identity of these modes might differ, and the manner in which they shift from one mode to another—that is, the degree of mode predominance or of separation or dissociation between the modes—appears to lie on a continuum. On the milder end, modes can wax and wane gradually, at times blending together. At the most extreme end, total separation and dissociation between modes can take the form of dissociative identity disorder, in which each mode may present as an entirely different personality. Importantly, all of a mode's components (affective, behavioural, cognitive, and conative) are thought to be co-activated as part of a cohesive (although time-specific and context-specific) organizational unit—a unique 'I'.

A fundamental question pertinent to ST's mode model (as well as to any other model positing multiple transient self-states; e.g. Stiles, 2006) addresses the most appropriate or beneficial partitioning of these states. In a particularly eloquent presentation of this question, Bandura (1999) noted: 'Once one starts fractionating the self, where does one stop? For example, an athletic self can be split into an envisioned tennis self and a golfing self. These separable selves would, in turn, have their subselves [...] How does one decide where to stop fractionating selves?' An honest answer to this question is 'we don't know yet'. But if we see the clinical argument (that multiple experiential selves do exist) as compelling, we have to start with stopping somewhere—and then move further out or further in. Ultimately, the answer will be based on the balance between optimal distinctiveness (of the various indices assessed within the modes) and parsimony (in limiting the number of modes as much as possible).

Schema therapy (e.g. Rafaeli et al., 2011) answers this question in two steps. As a first step, it classifies modes into four categories: *child*, *coping*, *introjected*, and *healthy* modes. As a second step, it further divides each of these categories into several generic modes. *Child modes* include self-states marked by primary emotions, including

sadness/anxiety (*vulnerable child*), anger/protest (*angry child*), impulsivity and whim (*impulsive child*), and playfulness/calmness/contentment (*content child*). These are thought to emerge organically in childhood but to accompany us for the remainder of life. A second and more pernicious category of *introjected modes* echoes one or several negative voices (e.g. *punitive* or *critical parents*) that were implicitly or explicitly learned. In these modes, children begin to treat themselves the way early influential others had treated them, often quite dysfunctionally. The third category includes *maladaptive coping modes*, which coalesce into being due to repeated activation of a growing child's rudimentary psychological survival and adaptation strategies—typically, *flight*, *fight*, and/or *freeze* strategies enacted to withstand whatever deprivation of needs occurred in the child's environment (typically, the same deprivation of needs which continues to echo in the form of one or more introjected mode). Finally, most people also have self-states that are healthy and positive: specifically, alongside the content child noted earlier, we often find a *healthy adult mode*: the self that is reflective, compassionate, and self-coherent.

This pragmatic taxonomy is central to both the theory and practice of ST. In particular, schema therapists work with clients to identify these modes and spell out very distinct strategies vis-à-vis each one, strategies that call for entirely distinct therapeutic stances when any particular mode is predominant. In addition, different patient groups (e.g. those with borderline PD, Arntz, Klokman, & Sieswerda, 2005, versus eating disorders, Pugh, 2015, versus chronic depression, Renner et al., 2018) are thought to differ not only in the manner in which modes shift but also in their content—that is, the specific identity of the modes they tend to inhabit. For example, persons suffering from borderline PD tend to experience abrupt transitions and a strong dissociation among a specific set of characteristic modes (typically, a detached *flight coping mode*, an *angry mode*, a distressed (abandoned/abused) *vulnerable mode*, and a *punitive introjected mode*).

Most studies examining modes have utilized the Schema Mode Inventory (SMI), a retrospective self-report instrument (for reviews, see Lobbestael et al., 2010; Sempértegui, Karreman, Arntz, & Bekker, 2014). Using this measure, modes have largely been found to relate to PDs in theoretically coherent ways (e.g. van Wijk-Herbrink et al., 2018). Additionally, experimental work has begun to validate the theory that modes are state-like experiences that occur in response to triggers in the environment (e.g. Arntz et al., 2005) and do so more strongly for those suffering from certain PDs.

This extant work notwithstanding, better empirical grasp of the mode concept (and through it, of the phenomenon and phenomenology of multiple experiential states) requires additional research. A prominent tool for conducting such research involves intensive longitudinal methods (ILMs; Sened, Lazarus, Gleason, Rafaeli, & Fleeson, 2018), which can tap dynamic changes in schema modes as individuals go about their daily lives. Interestingly, a recent development in the analysis of ILM data—the advent of dynamic network modelling—has made the simultaneous examination of

interrelationships among multiple nodes (or in this case, modes) even more informative.

The analysis of dynamic network models (Borsboom, 2017a; Epskamp, Waldorp, Mottus, & Borsboom, 2018) is premised on the idea that psychological constructs (e.g. psychopathology or personality) emerge from a dynamical interplay between relevant variables. The analyses themselves culminate in models that clarify this interplay, at either the nomothetic (across individuals) or idiographic (within individual) level (Molenaar, 2004). The latter can help establish personalized models of the interrelationships among modes and thus help clarify the person-specific dynamics within an individual's personality (e.g. see the Results section).

An empirical demonstration—schema modes in daily life

To show the validity and utility of a personality conceptualization based on multiple subjective organizational units, we developed a Momentary Schema Modes Questionnaire (MSMQ) aimed at capturing schema modes during daily life, whose repeated administration allows capturing fluctuations in these modes. We then explored the characteristics and predictive validity of this questionnaire in two experience-sampling studies. The first study allowed us to establish the construct validity of our mode scales and to cull out poorer items.¹ The second study (whose results are reported in the succeeding text) allowed us to conduct a range of analyses needed to demonstrate our ideas.

We first sought to examine the psychometric qualities of the MSMQ and the associations between mode values derived from it and scores on a widely used mode assessment tool (i.e. the SMI, Lobbestael et al., 2010). Then, we turned to exploring the additive predictive power of the mode indices derived from the MSMQ vis-à-vis a measure of symptomatic distress and a measure of attachment orientation. We opted to examine the modes' means across the assessment period, but not other dynamic characteristics (i.e. instability and inertia), as such indices have been recently shown to possess limited predictive validity (Dejonckheere et al., 2019).

Finally, we subjected the MSMQ data to network analyses. These allowed us to examine patterns of associations between the measured modes (which function as network nodes). Edges in these networks represent the partial pairwise correlations between modes and are characterized by their weight (i.e. the strength of the associations), their sign (i.e. the positivity or negativity of the association), and their direction across time (only in temporal networks). Importantly, correlations between nodes are obtained while controlling for the effects of other variables included in the network.

In the present study, several kinds of networks were assessed:

Intraindividual temporal networks are based on an individual participant's time series data and address covariation between the modes at both time t and time $t - 1$. Graphically, nodes of the same variables at time t and at time $t - 1$ are combined into a single node. The existence of an edge indicates that a node predicts another node (or itself) at the next time point, while controlling for the effects of all other nodes at time $t - 1$. Thus, edges in temporal networks are *directed*. Temporal networks provide some support for a causal interpretation of pathways as they satisfy the requirement for temporal precedence (Epskamp, van Borkulo, et al., 2018), although such pathways might also result from the effect of unmeasured (third) variables that may present alternative explanations.

Intraindividual contemporaneous networks are also based on an individual participant's time series data but address covariation between the variables at a single time point (time t), while controlling for the effect of the variables measured at the previous time point ($t - 1$) as well as the rest of the (time t) variables in the models. Although contemporaneous networks do not rely on temporal precedence, they are nevertheless informative with regard to potential causal relations between nodes, as in many cases the intervals between consecutive measurements ($t - 1$ and t) do not allow capturing processes that take place over shorter periods of time (Epskamp, van Borkulo, et al., 2018).

Group-level within-person networks are based on time series data from multiple individuals and address the average (i.e. fixed) covariation between participants' deviations from their means (with the covariations among the means themselves modelled in the between-person network, described in the succeeding text). As with the intraindividual networks, group-level within-person networks can be temporal or contemporaneous. Edges in these networks reflect the magnitude of the *average* intraindividual (*temporal* or *contemporaneous*) effect.

Finally, *between-person networks* address covariation between the modes' *means* across different participants. This type of network has gained popularity in psychopathology research (e.g. Borsboom, 2017a) and has also been applied to personality characteristics (e.g. Beck & Jackson, 2017; Costantini et al., 2019). Importantly, unlike more common cross-sectional networks that may reflect both between-individual variance and within-individual variance (due to momentary shifts from individuals' means), between-person networks based on aggregated data can be seen as reflecting purely between-individual variance (Epskamp, Waldorp, et al., 2018). Interpreting edges in between-person networks as reflecting causal relations is controversial (e.g. Bos et al., 2017). The available data will allow us to compare the between-person mode network with the group-level within-person temporal and contemporaneous networks and thus to assess their similarity.

We expect some edges to hold across levels (hypotheses were not preregistered because of the exploratory nature of the study). For example, at the between-person level, we expect individuals with a stronger (average) critical parent mode to also inhabit (some) maladaptive coping modes more frequently. In parallel, at the group within-person level, we

¹Participants in the first study completed up to 30 measurements each; therefore, their data were not appropriate for intraindividual network analyses. For brevity's sake, we have placed this sample's MSMQ's psychometrics in Table S1 in the OSM (<https://osf.io/jkxzn/>).

expect that the activation of the critical parent mode will lead to activation of (some) maladaptive coping mode. In other cases, we expect edges to differ across levels. For example, at the between-person level, we expect edges linking various coping modes to be positive; in contrast, at the group within-person level, we do not expect these edges to emerge as positive.

Besides indicating the presence of links among nodes, the network approach allows estimating the nodes' centrality (Borsboom & Cramer, 2013). Centrality can be calculated in a variety of ways, yet all are aimed at quantifying the importance of specific nodes in the network. One index of centrality—*node strength*—has been found to be particularly stable and is used widely in psychological research (Epskamp, Borsboom, & Fried, 2018). It represents the aggregated magnitude of the node's direct connections with other nodes and will be used in the current study.

In networks of symptoms, centrality indices can help identify targets for intervention (e.g. Fisher, Reeves, Lawyer, Medaglia, & Rubel, 2017). In networks of schema modes or other personality states, centrality indices may not have the same immediate relevance but could convey information regarding the prominence of particular modes in an individual's internal dynamics. This information can be clinically meaningful, aiding the process of case conceptualization (Fassbinder, Brand-de, & Arntz, 2019) and guiding therapists in their choice—and prioritization—of interventions (see our Results section for examples).

In the current demonstration, we begin by presenting the intraindividual (temporal *and* contemporaneous) networks of two individuals, discuss these analyses' utility in generating hypotheses regarding these individuals' personality dynamics, and note some possible clinical implications for these dynamics. We then present group-level temporal and contemporaneous networks based on within-person variance of the entire sample and compare them with a between-person network to assess the extent to which cross-level consistency (i.e. ergodicity) holds. Finally, we discuss insights that can be derived from each of these networks.

METHOD

Participants

Fifty-two undergraduate students at an Urban Israeli university participated in this study for course credit: 88.5% were female, and mean age was 22.2 years ($SD = 2.3$, range = 18–34).

Measures

Momentary Schema Modes Questionnaire

The MSMQ [see the online supplementary material (OSM) —<https://osf.io/jkxzn/>—for the full version] is a 35-item self-report questionnaire developed for the current project. It assesses the present-moment level of 11 schema modes, each with 3–4 items. Participants were asked to rate the

extent to which various statements were true for them during the last hour, on a 5-point Likert scale ranging from '*not at all*' to '*completely*'. Four of the modes included were adaptations of child modes: Distressed mode (e.g. 'I felt lonely, like there was no one I could turn to'), Angry mode (e.g. 'I felt like lashing out or hurting someone for what he/she did to me'), Impulsive/Undisciplined mode (e.g. 'I did things just because I felt like doing them'), and Content mode (e.g. 'I felt spontaneous, curious, and creative'). One of the modes was an adaptation of an introjected mode, namely, a Self-Critical mode (e.g. 'I put myself down'). Five additional modes were adaptations of maladaptive coping modes: Avoidant (e.g. 'I felt empty, numb, as if I don't care about anything'), Self-Soothing (e.g. 'I got lost in doing something soothing/exciting'), Compliant (e.g. 'I subjugated myself to please others'), Perfectionistic (e.g. 'I was very careful to avoid any possible mistake'), and Self-Aggrandizing (e.g. 'I felt special and better than most other people'). Lastly, we included an adaptation of the Healthy Adult mode which we termed Reflective (e.g. 'I was open and accepting of whatever happened to me'). Items were selected from the SMI (Version 1.1, Lobbestael et al., 2010) to include affective, behavioural, cognitive, and motivational facets of modes whenever possible. Additionally, items tapping less extreme experiences/behaviours, which are likely to occur within short time windows, were preferred. Items were revised to refer to recent experience rather than longer-lasting tendencies.

To reduce participant burden, two of the modes identified on the SMI (Enraged Child as well as Bully and Attack) were omitted from the MSMQ. Two SMI child modes (the Impulsive Child and the Undisciplined Child) were combined into one, as were two SMI introjected modes (the Punitive Parent and the Demanding Parent). An additional mode (the Perfectionistic mode) was added, as we expected it to be very pertinent to a high-functioning student sample.

Short Schema Mode Inventory (Version 1.1; Lobbestael et al., 2010)

The Short Schema Mode Inventory (Version 1.1) is a 118-item self-report questionnaire designed to assess 14 schema modes. The SMI has been shown to possess adequate psychometric properties (Lobbestael et al., 2010) and has been translated into multiple languages. In the current study, the average internal consistency (Cronbach's alpha) of all relevant modes was .81 (range .93–.68).

Brief Symptom Inventory (Derogatis & Melisaratos, 1983)

The Brief Symptom Inventory (BSI) is a 53-item measure of psychological distress that contains three global scales and nine subscales. Each item is rated on a 5-point Likert scale from 0 (*not at all*) to 4 (*always*). Participants are asked to respond to each item in terms of 'how they have been feeling during the past 7 days'. The present study employed only the Global Severity Index, which averages all 53 items.

Experiences in Close Relationships—Relationship Structures Questionnaire (Fraley, Heffernan, Vicary, & Brumbaugh, 2011)

The Experiences in Close Relationships—Relationship Structures Questionnaire (ECR-RS) questionnaire is a self-report instrument designed to assess attachment patterns in a variety of close relationships. The same nine items (six for attachment avoidance and three for attachment anxiety) are used to assess attachment styles with respect to four targets (i.e. mother, father, romantic partner, and best friend). We averaged the scores for the four targets across each domain to obtain one avoidance and one anxiety index. Reliability of both the anxiety and the avoidance subscales was excellent (Cronbach's alpha of .90 for both subscales).

Procedure

Participants were invited to take part in a study of daily habits in exchange for course credit. All procedures were completed online through a secure data collection site (www.qualtrics.com). Participants provided informed consent and then completed online baseline questionnaires, which included the SMI, ECR-RS, and the BSI. After completion of the baseline questionnaires, participants were given instructions on how to complete the ecological momentary assessment questionnaires. They were asked to complete the MSMQ four times daily for a period of at least 15 days. A subsample of our participants were orthodox Jews and therefore refrain from using technology on the Sabbath; to accommodate these, we allowed participants up to five additional days to reach 60 complete questionnaires. Four times daily (randomized within four 3-hour windows, between 8:00 and 20:00 hours, with at least 2-hour gaps between consecutive messages), participants received e-mail messages with links to online questionnaires. The links were open for 1 hour; 15 minutes before this hour elapsed, participants received an automatic reminder to use the link if they had not performed so yet. With this 1-hour limit, we assured a minimum of 1-hour difference between two consecutive measurements (mean interval between same-day consecutive measurements was 3:40 hours). On average, measurements took 2 minutes and 45 seconds to complete. A total of 3007 measurements were collected, with a mean of 57.8 measurements ($SD = 5.1$) per participant.

Analytic Approach

Psychometrics and convergent validity of the Momentary Schema Modes Questionnaire

To assess the psychometric quality of the MSMQ, we followed several steps. First, we calculated the reliability of the included modes using methods suggested by Cranford et al. (2006). Specifically, we calculated an index representing the expected between-person reliability in one fixed measurement, which can be thought of as an average of measurement-specific alpha coefficients across all measurements. In addition, we assessed the precision of the estimates of systematic change within participants across measurements (see also Shrout & Lane, 2012); this index represents the within-person reliability of measurement-to-measurement change on each scale (mode). Second, as we

expected the mode scores to vary both within individuals and between individuals, we partitioned the variance of each mode and report the per cent of variance accounted for by each component. Third, we conducted a multilevel confirmatory factor analysis (Hox, 2010) using Mplus and compared a one-factor within-person structure with a within-person structure with one factor for each mode.² To deal with the ordinal and often non-normal distributions of the MSMQ's items, we used robust weighted least squares mean-adjusted and variance-adjusted estimation³ based on the polychoric correlation matrix (Holgado-Tello, Chacón-Moscoso, Barbero-García, & Vila-Abad, 2010). Fourth, we examined the convergent and discriminant validity of the MSMQ by correlating the person-level means of modes across measurements with their respective modes from the SMI.⁴ Finally, we conducted a multilevel exploratory factor analysis of the MSMQ items.⁵

Incremental validity of Momentary Schema Modes Questionnaire modes

To examine the incremental predictive validity of the MSMQ indices, we regressed the BSI as well as the ECR-RS scores separately on each of the corresponding mode indices derived from the SMI and the MSMQ. We expected that the MSMQ indices will be associated both with symptomatic distress (as measured by the BSI) and with important indices of personality (viz. attachment anxiety and avoidance as measured by the ECR-RS) above and beyond the corresponding SMI indices.

Network analyses⁶

To examine the dynamic interrelations among modes, we adopted the network approach and followed guidelines delineated in Epskamp, van Borkulo, et al. (2018) and in Epskamp, Waldorp, et al. (2018). Specifically, prior to network estimation, any significant person-level time trend was removed. Additionally, given our data structure (which included multiple assessments each day), we did not expect the temporal effects of modes to last through the night. Consequently, we did not regress the first response of any day on the last response of the previous day (Epskamp, van Borkulo, et al., 2018).

In all of the network models, each schema mode was represented as a node, with edges (i.e. links between nodes) representing partial correlations between the modes (although each model adjusted for a different set of variables). Additionally, all networks, which were based on time series

²Because of the Level-2 sample size ($N = 52$), we had insufficient data to estimate the between-person factor structure.

³This was performed because regular weighted least squares estimation led to a non-positive definite matrix.

⁴The SMI Impulsive Child and Undisciplined Child modes were combined, as were the Punitive Parent and Demanding Parent modes. The discriminant validity results are available in the OSM (<https://osf.io/jkxzn/>).

⁵The results of the MEFA and a brief discussion of them are available in the OSM (<https://osf.io/jkxzn/>).

⁶The full R code for all network analyses and the data can be found in the OSM (<https://osf.io/jkxzn/>).

data, were estimated using vector autoregression (VAR; Borsboom & Cramer, 2013; Bringmann et al., 2013), which is a statistical method in which each variable in the model is used to predict itself (autoregressive effects) and all other variables at the next time point (cross-lagged effects). The results of each participant's VAR model were used to construct and visualize *intraindividual temporal networks*. The residuals from these models were used to construct and visualize *intraindividual contemporaneous networks* (Epskamp, van Borkulo, et al., 2018). Next, to explore the general (*group-level*) network structure of modes across the entire sample, we used multilevel variations of VAR. In these (temporal and contemporaneous) network models, VAR is estimated using within-person mean-centred data, which results in providing the *fixed* within-person associations among nodes.

All networks were estimated using the graphicalVAR (Version 0.2.2) package (Epskamp, 2017) and were visualized using the qgraph (Version 1.62) package (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012) for R (Version 3.5). Importantly, based on recent developments in network modelling (e.g. Epskamp & Fried, 2018; Foygel & Drton, 2010), we employed a regularization technique (i.e. GLASSO) within the graphicalVAR package when estimating the networks. Such regularization limits the risk of detecting spurious (i.e. false-positive) edges between nodes and enhances the chance of retrieving the true network structure. Specifically, GLASSO allows researchers to set a hyper-parameter (i.e. the extended Bayesian information criterion), which controls the extent to which the estimation may tilt to the side of discovery (i.e. sensitivity) or caution (i.e. specificity; Epskamp & Fried, 2018). In the current

analysis, this hyper-parameter was set to zero to maximize sensitivity.⁷

RESULTS

Psychometrics and Convergent Validity of the Momentary Schema Modes Questionnaire

Within-person and between-person reliability estimates are presented in Table 1. Two of the modes (the Impulsive and Self-Aggrandizing modes) had particularly low within-person reliabilities and were therefore excluded from all following analyses. The rest of the between-person reliability estimates were moderate and varied between 0.54 and 0.75. The within-person reliability scores were also moderate and varied between 0.53 and 0.73. Of note, the average (i.e. not single measurement) between-person reliability estimates were between 0.98 and 0.99 for all modes.

The proportion of between-person variance obtained through variance partitioning is also reported in Table 1. It varied between 0.27 and 0.50, suggesting that all modes had considerable amount of variance at both the between-person and the within-person levels.

A multilevel confirmatory factor analysis revealed that a one-factor model did not provide a good fit for the data ($\chi(350) = 9028.234$, $p < .0001$; CFI = 0.508; RMSEA = 0.092; SRMR = 0.091). In contrast, a model with one factor per mode provided acceptable fit ($\chi(314) = 1868.14$, $p < .0001$; CFI = 0.912; RMSEA = 0.041; SRMR = 0.044).

Correlations between the mean of the MSMQ modes and their respective SMI modes are presented in Table 1 and reflect the MSMQ's convergent validity. The mean correlation across modes was 0.52, indicating moderate convergent validity, with some modes (i.e. Self-Soothing and Compliant) having relatively low correlations and other modes (i.e. the Distressed and Content modes) having relatively high correlations.

Incremental Validity of Momentary Schema Modes Questionnaire Modes

The regression models with SMI and MSMQ mode scores simultaneously predicting symptomatic distress or attachment orientations are presented in Table 2. The Perfectionistic mode was not included in the analysis because there is no corresponding SMI scale with which to compare it. For six out of the remaining eight modes, the MSMQ scores proved to have incremental predictive validity above and beyond the SMI scores in predicting symptomatic distress. Additionally, in four of the eight modes, the MSMQ scores had incremental predictive validity in predicting attachment anxiety and/or avoidance.

⁷Please see <https://osf.io/jkxzn/> for discussion about the hyper-parameter and its influence on the obtained results.

Table 1. Descriptive statistics, reliability, and convergent validity of the Momentary Schema Modes Questionnaire

Mode	Mean [‡]	SD [‡]	B.P. Rel [§]	W.P. Rel [¶]	BPV ^{‡‡}	SMI Corr ^{§§}
Distressed	1.48	0.47	0.75	0.73	0.44	0.68 ^{***}
Angry	1.32	0.36	0.63	0.69	0.35	0.40 ^{**}
Impulsive	1.58	0.41	0.48	0.33	0.38	0.44 ^{**}
Avoidant	1.45	0.46	0.66	0.59	0.44	0.63 ^{***}
Self-Soothing	1.95	0.49	0.54	0.68	0.27	0.36 ^{**}
Compliant	1.57	0.46	0.60	0.57	0.39	0.25 [†]
Self-Aggrandizing	1.65	0.61	0.69	0.20	0.64	0.38 ^{**}
Perfectionistic	2.52	0.63	0.61	0.65	0.35	—
Self-Critical	1.54	0.43	0.63	0.53	0.35	0.60 ^{***}
Content	2.91	0.64	0.65	0.60	0.43	0.74 ^{***}
Reflective	2.91	0.65	0.71	0.67	0.50	0.69 ^{***}

[‡]The mean and the standard deviation are based on participants' means across measurements.

[§]Between-person reliability.

[¶]Within-person reliability.

^{‡‡}Between-person variance.

^{§§}Correlation between the mean of the Momentary Schema Modes Questionnaire modes and their respective Schema Mode Inventory modes.

[†] $p < .1$.

^{*} $p < .05$.

^{**} $p < .01$.

^{***} $p < .001$.

Table 2. Linear regressions of SMI and MSMQ modes predicting symptomatic distress and attachment orientation

Predictor [†]	BSI-GSI		Att. Anx.		Att. Avd.	
	<i>B</i> (<i>SE</i>)	<i>p</i>	<i>B</i> (<i>SE</i>)	<i>p</i>	<i>B</i> (<i>SE</i>)	<i>p</i>
Vulnerable child SMI	0.26 (0.08)	.002	0.26 (0.20)	.205	0.39 (0.19)	.046
Distressed MSMQ	0.52 (0.14)	.001	0.73 (0.35)	.043	0.60 (0.33)	.074
Angry child SMI	0.33 (0.09)	.001	0.38 (0.21)	.074	0.34 (0.20)	.105
Angry MSMQ	0.74 (0.15)	<.001	0.98 (0.37)	.011	0.90 (0.36)	.016
Detached protector SMI	0.38 (0.09)	.001	0.40 (0.22)	.076	0.52 (0.19)	.009
Avoidant MSMQ	0.37 (0.15)	.015	0.67 (0.34)	.052	0.70 (0.29)	.020
Detached self-soother SMI	0.17 (0.07)	.027	0.14 (0.17)	.424	0.25 (0.16)	.116
Self-soothing MSMQ	0.56 (0.13)	<.001	0.58 (0.29)	.056	0.66 (0.27)	.017
Compliant surrendered SMI	0.25 (0.1)	.012	0.29 (0.19)	.133	0.35 (0.18)	.063
Compliant MSMQ	0.33 (0.15)	.032	0.51 (0.30)	.093	0.52 (0.29)	.074
Critical parent SMI	0.25 (0.13)	.07	0.30 (0.28)	.291	0.42 (0.27)	.126
Self-critical MSMQ	0.46 (0.18)	.014	0.54 (0.38)	.164	0.40 (0.36)	.273
Content child SMI	−0.56 (0.1)	<.001	−0.74 (0.22)	.001	−0.62 (0.18)	.001
Content MSMQ	0.27 (0.13)	.051	0.20 (0.28)	.488	−0.27 (0.23)	.250
Healthy adult SMI	−0.5 (0.14)	.001	−0.92 (0.25)	.001	−0.59 (0.23)	.014
Reflective MSMQ	0.1 (0.14)	.483	0.10 (0.25)	.691	−0.41 (0.23)	.081

Note: BSI-GSI, Brief Symptom Inventory–Global Severity Index; MSMQ, Momentary Schema Modes Questionnaire; SMI, Schema Mode Inventory. [†]Intercepts are omitted for the sake of brevity.

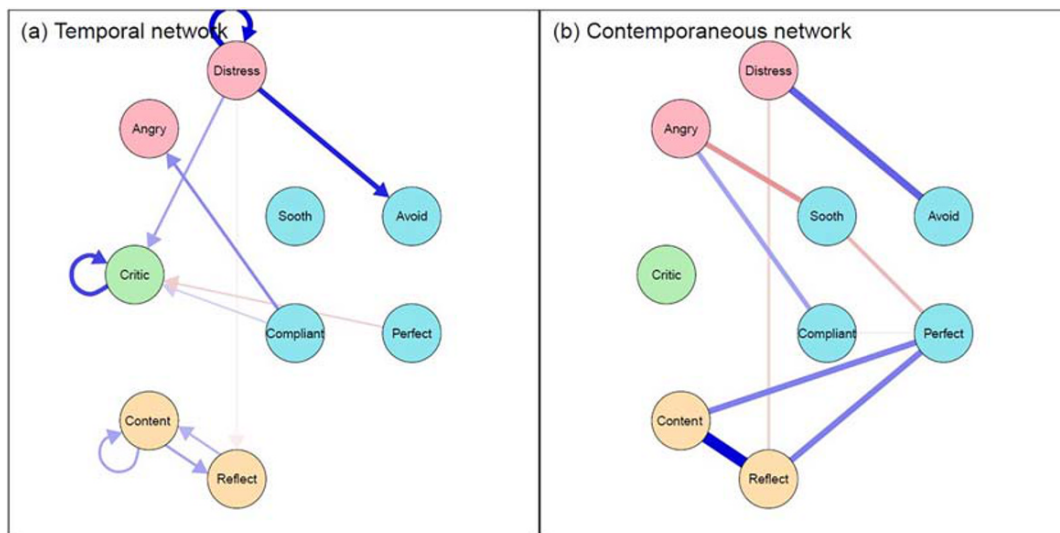


FIGURE 1. Temporal and contemporaneous networks for Participant A. Blue edges indicate positive associations, and red edges indicate negative associations. Thicker edges between nodes represent stronger associations. The location of nodes was predetermined manually to allow for easier comparisons across models. Node label descriptions: Angry = Angry; Distress = Distressed; Critic = Self-Critical; Avoid = Avoidant; Perfect = Perfectionistic; Sooth = Self-Soothing; Compliant = Compliant; Content = Content; Reflect = Reflective. [Colour figure can be viewed at wileyonlinelibrary.com]

Network analyses

Intraindividual networks

Participant A's temporal and contemporaneous networks are presented in Figure 1.⁸ The respective centrality indices and modes' means across the assessment period are presented in Figure 2.⁹ As can be seen in Figures 1(a) and 2, the Distressed mode possessed the greatest out-strength centrality in the temporal network. Beyond having an autoregressive

effect, it predicted the activation of the Avoidant mode (quite strongly) and of the Self-Critical mode (less strongly). Both of these had high in-strength centrality, as the Self-Critical mode also tended to be preceded by low activation of the Perfectionistic mode and by high activation of the Compliant mode. The latter mode also predicted the activation of the Angry mode. Lastly, the Content and the Reflective modes were tied in a positive feedback loop.

Additional information can be drawn from the contemporaneous network, which provides evidence for co-activation of the Perfectionistic, Reflective, and Content modes. Additionally, the Self-Soothing mode was found to be negatively associated with both the Angry and the Perfectionistic modes. Importantly, the activation of the Distressed and

⁸Intraindividual networks for all participants are presented in the OSM (<https://osf.io/jkxzn/>).

⁹Centrality indices of all the intraindividual networks are presented in Table S2 in the OSM.

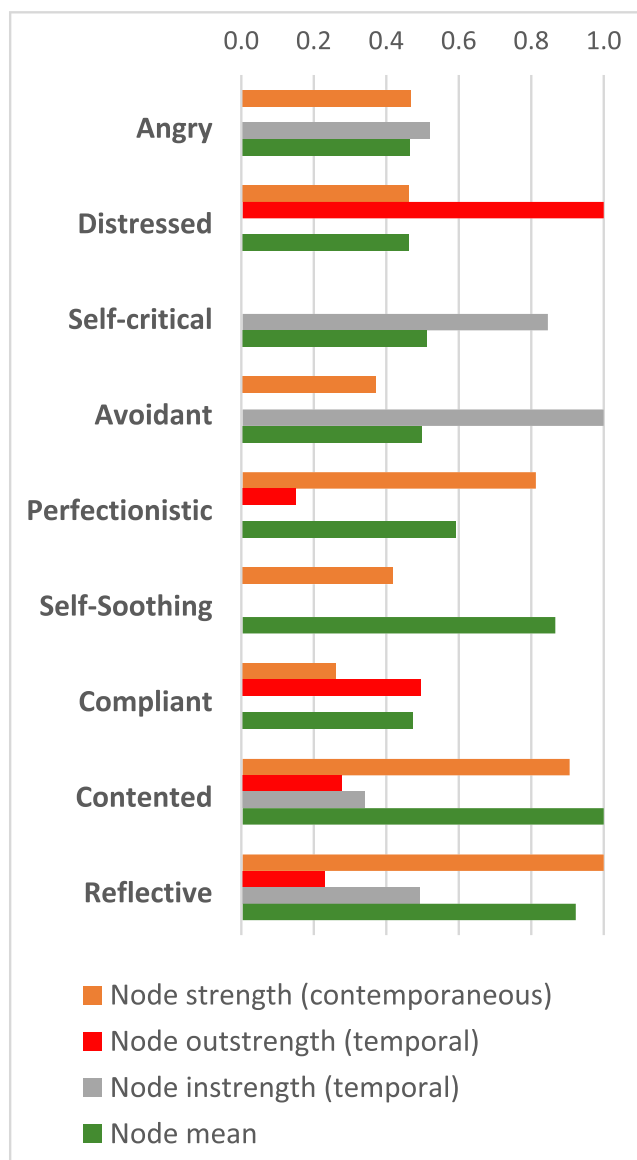


FIGURE 2. Strength centrality for temporal and contemporaneous networks and mode means for Participant A. All values were normalized by dividing them by the maximum value of their category for this participant. [Colour figure can be viewed at wileyonlinelibrary.com]

Angry modes as well as the Self-Critical mode was relatively rare (as evidenced by their mean levels).

Participant B's temporal and contemporaneous networks are presented in Figure 3. The respective centrality indices and modes' means across the assessment period are presented in Figure 4. As can be seen in Figure 3(a), the Distressed mode had an autoregressive effect and predicted lower levels of the Content mode at the consecutive time point. As can be seen in Figure 3(b), the contemporaneous network had much greater density. The Angry mode possessed the greatest centrality—it was positively correlated with three unhealthy modes—the Self-Critical, Compliant, and Avoidant modes—and negatively correlated with the Content mode. The Reflective mode had the second strongest centrality. It was positively associated with the Content and the Perfectionistic modes, and negatively associated with the Avoidant, the Self-Soothing, and the Distressed modes.

Group-level networks

Temporal group-level, contemporaneous group-level, and between-subject networks for the entire sample are shown in Figure 5.¹⁰ The respective centrality indices and modes' means across the assessment period are presented in Figure 6. As can be seen in Figure 5(a), each of the modes showed autoregressive effects. Additionally, several positive feedback loops were observed: between the Distressed and Avoidant modes, between the Reflective and Perfectionistic modes, and between the Reflective and Content modes. Lastly, activation of the Distressed mode also led to activation of the Self-Critical mode.

As can be seen in Figure 5(b), the contemporaneous network comprised stronger associations than the temporal network, with the feedback loops mentioned earlier appearing as relatively strong edges. In addition, negative edges emerged between the Distressed and both the Reflective and Content modes. The latter was also negatively associated with the Avoidant mode and the Angry mode, which was itself positively associated with the Distressed, the Self-Critical, and the Compliant modes. Lastly, the Self-Soothing mode was positively associated with the Avoidant and negatively associated with the Perfectionistic mode. The most central node overall was the Distressed mode, while the most central maladaptive coping mode was the Avoidant mode.

Finally, as can be seen in Figure 5(c), the between-person network shared many of the edges with the contemporaneous network, but did differ in several respects. Specifically, a strong edge that tied the Distressed and Self-Critical modes within individuals was absent from the between-person network. Additionally, the negative edges reported earlier between the healthy and unhealthy (distressed or coping) modes were diminished. Similarly, the negative association between the Self-Soothing and Perfectionistic modes was not present. Finally, an association emerged suggesting that individuals with a stronger Self-Critical mode also tend to have a stronger Perfectionistic mode.

Network accuracy and stability

We used the suggested procedures of Epskamp, Borsboom, et al. (2018) to assess the accuracy and stability of all networks. The group-level networks, particularly the between-person and contemporaneous ones, performed quite well; the same could not be said for the intraindividual networks. This issue is described at length in the OSM (<https://osf.io/jkxzn/>).

DISCUSSION

Personality researchers have recently started to explore the promising field of transient state-like manifestations of personality (e.g. Jayawickreme et al., 2019; Wright & Simms, 2016). We posit that such states can be thought of as subjective organizational units, replete with their own affects, behaviours, cognitions, and desires, which change as

¹⁰The regularization process resulted in a solution with a risk for low specificity. Therefore, weak edges should be interpreted cautiously.

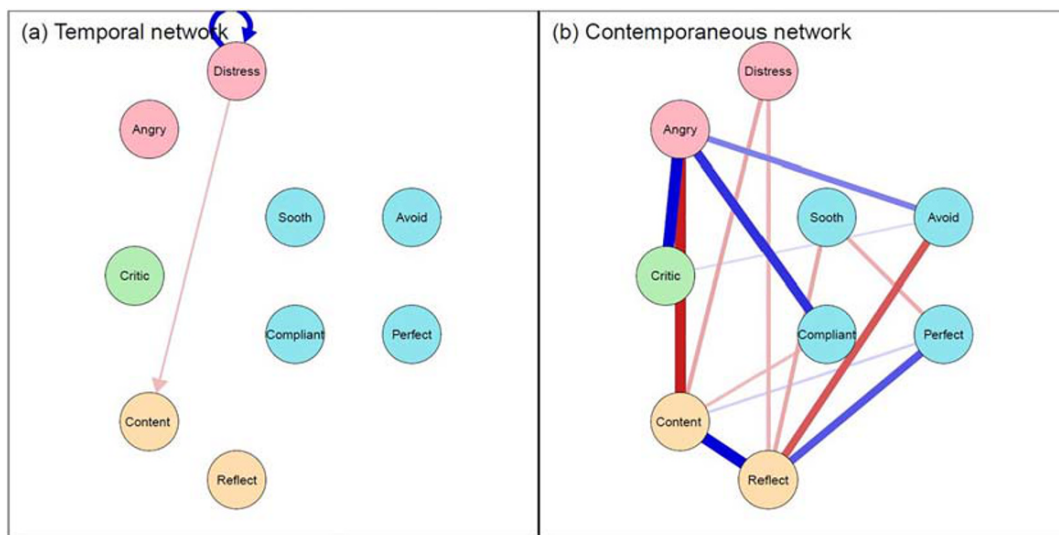


FIGURE 3. Temporal and contemporaneous networks for Participant B. Blue edges indicate positive associations, and red edges indicate negative associations. Thicker edges between nodes represent stronger associations. The location of nodes was predetermined manually to allow for easier comparisons across models. Node label descriptions: Angry = Angry; Distress = Distressed; Critic = Self-Critical; AVOID = Avoidant; Perfect = Perfectionistic; Sooth = Self-Soothing; Compliant = Compliant; Content = Content; Reflect = Reflective. [Colour figure can be viewed at wileyonlinelibrary.com]

individuals go about their daily life. We arrived at this position with inspiration from various social cognitive models (e.g. Gilbert et al., 2006; Kross & Ayduk, 2017) as well as from multiple clinical models (e.g. Stiles, 2006), which highlight the idea of within-person multiplicity. In the present work, we sought to provide an empirical demonstration of this position, based on one such model—namely, the ST mode model (Rafaeli et al., 2016)—using appropriate (intensive and longitudinal) data as well as cutting-edge (network) analytic methods.

The following sections are devoted to a (ST-inspired) theoretical discussion of the empirical results obtained. We begin with some brief notes about the MSMQ measure itself. After discussing our illustration of intraindividual network models, which were based on two participants' intensive longitudinal data, we consider the aggregation of all participants' intraindividual networks into group-level (temporal and contemporaneous) within-person models and compare these with the between-person model, noting both similarities and differences between the three. We then move to a discussion of the limitations that characterize this work, as well as to its broader implications for the study of personality dynamics (Figure 6).

The Momentary Schema Modes Questionnaire

The MSMQ was designed to assess schema modes as they fluctuate during individuals' daily life. It was based on a longer cross-sectional measure (i.e. the SMI) of schema modes and was designed to be as short as possible to reduce participants' burden. The reliability of changes across assessments (i.e. within-person reliability) was only moderate (see the Limitations and future directions section), which indicates a need for some further development. Still, and as expected, modes were found to vary both within and between individuals and to have incremental predictive validity over the

corresponding SMI-based indices vis-à-vis general symptomatic distress and common personality measures. Encouragingly, the multilevel confirmatory factor analysis supported the hypothesized factor structure; similarly, a multilevel exploratory factor analysis suggested that most items load on their intended factors (see <https://osf.io/jkxzn/>).

Intraindividual Networks

Participant A's mode data suggest a relatively healthy personality state profile, marked by elevated levels of the Reflective and the Content modes, which were tied together in a positive feedback loop. Her most visible coping mode, the Self-Soothing, appeared not to be contingent on (or predictive of) any of the distressed or introjected modes (e.g. Distressed, Angry, or Self-Critical Parent). The next most visible coping mode, the Perfectionistic, was actually co-activated with her two healthiest modes and negatively tied to the Self-Critical mode and to other coping modes; this raises the possibility that Perfectionistic coping may actually be an adaptive mode for this particular person. The relatively infrequent activation of the Distressed mode tended to lead (as it also does nomothetically; see the Group-level Networks section) to the activation of the Self-Critical and the Avoidant modes.

We contrast this relatively healthy profile seen in Participant A's data with that emerging from Participant B's data. One striking difference in the latter is the strong negative edges linking pleasant modes (i.e. the Reflective and Content modes) and unpleasant ones (e.g. the Distressed mode). This pattern may be indicative of a rather high level of compartmentalization in this participant's personality dynamics. Specifically, for her, activation of states characterized by anger or detachment was associated with simultaneous *deactivation* of states marked by contentment or compassionate self-regard. These rapid shifts hold clinical importance and may signify

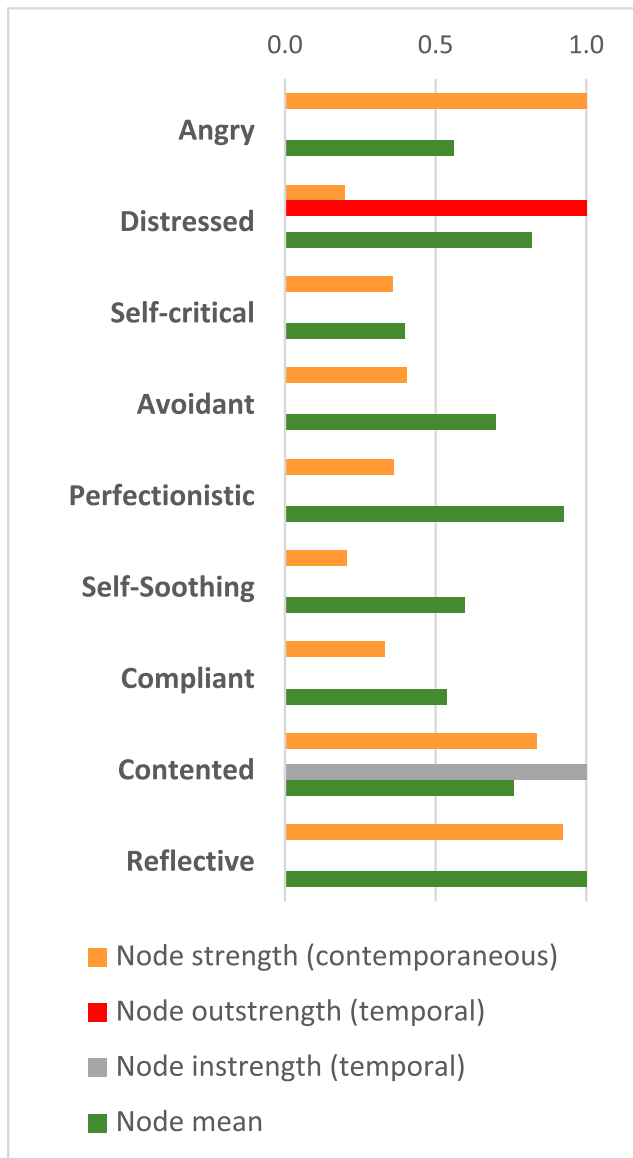


FIGURE 4. Strength centrality for temporal and contemporaneous networks and mode means for Participant B. All values were normalized by dividing them by the maximum value of their category for this participant. [Colour figure can be viewed at wileyonlinelibrary.com]

disturbance in how the world is experienced, particularly some difficulty in holding to a stable self. Furthermore, the Angry mode was associated with both the Self-Critical and the Compliant modes, associations that provide vital information with regard to how anger is experienced. Specifically, it appears that for this person, anger is directed both inwardly and outwardly and is often accompanied by a sense of submissiveness. If this person were in therapy, this pattern might suggest an important target for intervention (e.g. helping her recognize ways in which her anger blends with other experiences and making the experience of anger more distinct and its expression more effective).

It is important to acknowledge that the obtained intraindividual networks may not be very robust or stable (see <https://osf.io/jkxzn/>; Epskamp & Fried, 2018). Still, the two examples of such networks provided earlier offer a glimpse into the world of intraindividual (i.e. idiographic)

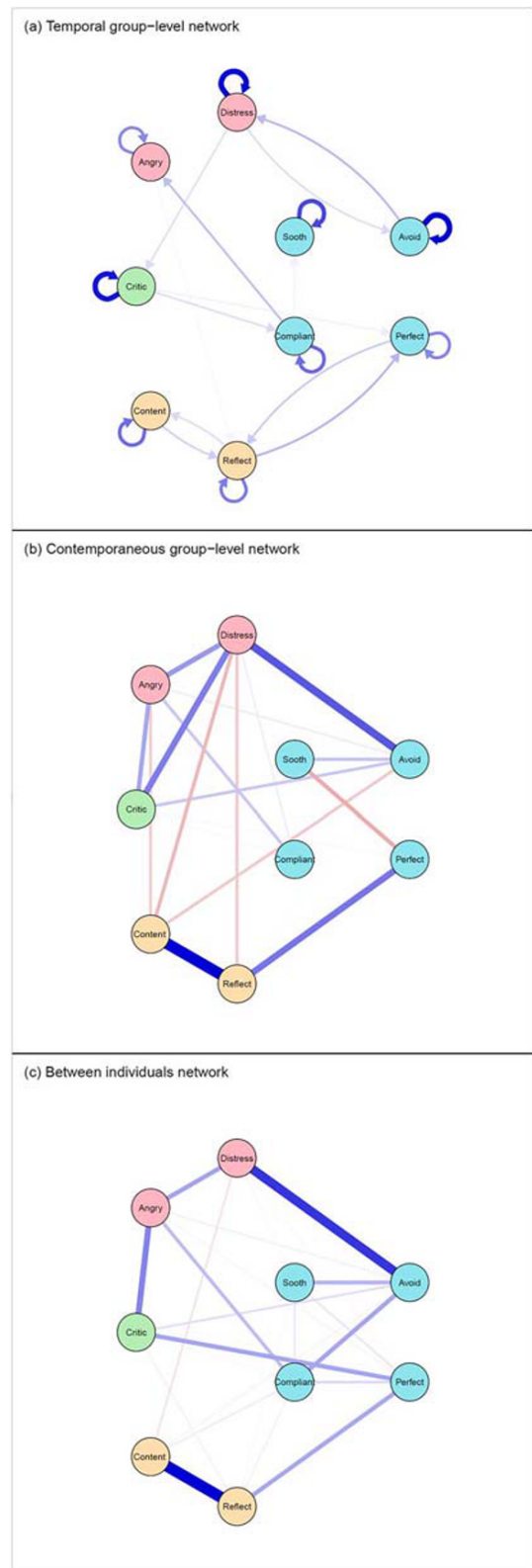


FIGURE 5. Temporal and contemporaneous group-level within-person networks and between-person network for the entire sample. Blue edges indicate positive associations, and red edges indicate negative associations. Thicker edges between nodes represent stronger associations. The location of nodes was predetermined manually to allow for easier comparisons across models. Node label descriptions: Angry = Angry; Distress = Distressed; Critic = Self-Critical; Avoid = Avoidant; Perfect = Perfectionistic; Sooth = Self-Soothing; Compliant = Compliant; Content = Content; Reflect = Reflective. [Colour figure can be viewed at wileyonlinelibrary.com]

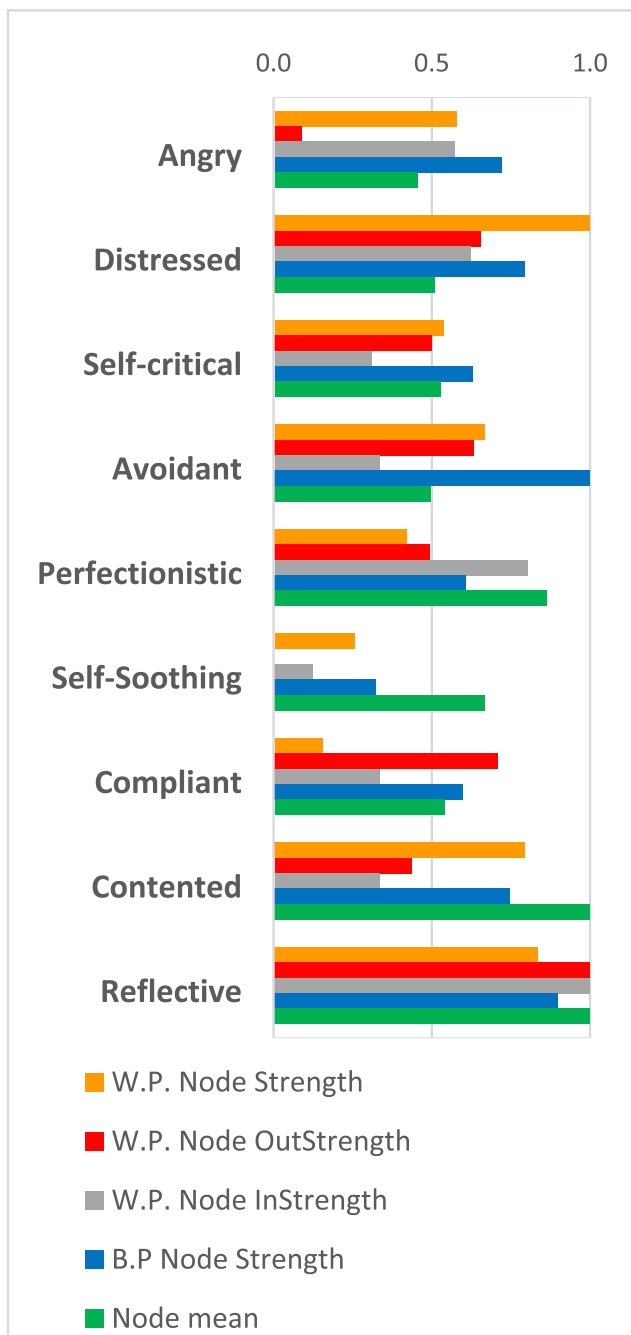


FIGURE 6. Strength centrality for temporal and contemporaneous group-level networks and between-person network, as well as mode means for the entire sample. All values were normalized by dividing them by the maximum value of their category for the entire sample. [Colour figure can be viewed at wileyonlinelibrary.com]

personality dynamics and, at the very least, provide a launch pad for generating idiographic hypotheses. As the patterns of these two individuals begin to illustrate, we found considerable variability across individuals. This idiosyncrasy in psychological processes points to the importance of tailoring possible psychological interventions to the characteristics of the specific person (e.g. Fisher et al., 2017; Hofmann & Hayes, 2019; Piccirillo & Rodebaugh, 2019). Indeed, recent years have witnessed growing attempts to employ ILM-based idiographic assessment of maladaptive

intraindividual *symptom* dynamics for the purpose of disrupting these (e.g. Fisher et al., 2019; Levinson, Vanzhula, & Brosch, 2018; van der Krieke et al., 2015).

More importantly, our results (and the case examples described) demonstrate how dynamic assessment can go beyond symptoms and be applied to subjective units of personality—that is, to distinct experiential states, each replete with its own moods or emotions, behavioural tendencies, cognitive contents/processes, and goals/motives. A taxonomy of such states adds an important feature to dynamic assessment—namely, the ability to think about how these states of being unfold over time, preceding or succeeding each other in meaningful ways.

The clinical appeal of idiographic research in the form of dynamic assessment is quite evident. In contrast, the basic-research implications of such an endeavour for the field of personality may not be as straightforward. Specifically, to the extent that idiographic research stays solely ‘within person’ (i.e. without allowing comparisons across individuals or groups and/or comparisons with some established standard), it remains limited in its utility (Wright & Zimmermann, 2019). Thankfully, this limitation can be overcome, as our aggregate and group-level analyses, to which we turn now, illustrate.

Group-level Networks

The simultaneous analysis of group and individual data raises the question of consistency across levels: to what extent do the aggregated findings from the individual level (e.g. the average within-person associations) agree with those from the between-person models (e.g. Fisher, Medaglia, & Jeronimus, 2018)? This question of ergodicity becomes even more pressing when causal relations are inferred from observed associations (e.g. Bos et al., 2017). The ergodicity of networks linking schema modes (or any other operationalization of cohesive states) has yet to be examined empirically and thus was a central goal of the present work. Indeed, several associations were observed in both the group-level within-individual networks and the between-person network.

First, on the more pleasant side of the mode networks, a consistent association emerged between the Reflective mode on the one hand and the Content as well as Perfectionistic modes on the other. The associations (both within-person and between-person) between the Reflective and the Content modes are easy to understand: moments in which one positive mode is active are likely to be tied, both contemporaneously and over time, with moments in which the other is active; similarly, individuals blessed with an abundance of one are likely to have an abundance of the other, as well. In contrast, the associations between the Reflective and Perfectionistic modes were more surprising, as the latter is considered (theoretically, at least) to be a *maladaptive* coping mode. It may be that within a sample of generally well-adjusted and high-achieving college students, instances of ‘push[ing] myself to do the best possible job on something’ (as one of this mode’s MSMQ items states) are experienced as part and parcel of *adaptive* functioning.

Second, on the more unpleasant side of the mode networks, a consistent association emerged between the Distressed and the Avoidant modes. This association is a central tenet of the ST model and of the therapy based on it. Specifically, the activation of the Distressed mode (in whatever idiosyncratic manifestation it takes across different individuals) involves the strongest instances of primary negative emotions; not surprisingly, it (in counter-point to the Reflective mode) was among the most central modes in all of the networks. In many occasions, the activation of this mode generates psychological pain, which motivates the need for relief. Detachment, which is the cardinal feature of the Avoidance mode, can provide such relief (at least temporarily) although, at times, may fail to do so (leading to more psychological pain).

Another edge found consistently across networks links the Angry and Compliant modes. In this case, the temporal network results suggest that it is the Compliant mode that comes first, such that compliance serves as an antecedent of anger. In other words, the coping response of submission, compliance, or surrender often backfires and culminates in expression (or at least feelings) of anger or even rage.

Focusing the attention on the temporal network, it is notable that the average cross-lagged associations between modes were relatively weak—possibly because of relatively long lags between consecutive measurements (indeed, many of the temporal intraindividual networks had no edges). This suggests a need for caution in interpreting the presence of these temporal edges. Nonetheless, the edge leading from the Distressed mode to the Self-Critical mode was one also seen (as an undirected edge, of course) in the contemporaneous network. A link between vulnerability and self-criticism is recognized and discussed extensively in the ST literature and also in other evidence-based approaches (including EFT; Elliott, Watson, Goldman, & Greenberg, 2003). These models posit that the two modes are often hard to distinguish: both involve powerful negatively valenced content such as feelings of defectiveness, unlovability, or failure, and they are often experienced in rapid succession or oscillation. Alongside these similarities, both ST and EFT accentuate the dissimilarities between the modes—in particular, the distinct perspectives or stances that these modes inhabit vis-à-vis psychological pain. Whereas the Distressed mode embodies it and experiences it in the first person (e.g. ‘I’m no good’), the Self-Critical typically *causes* the pain, by judging, punishing, or criticizing the person harshly, often referring to herself or himself in the second person (e.g. ‘You are no good’). Clinicians often invite patients to enact each of these modes in a dialogue (e.g. EFT’s two-chair technique; Pos & Greenberg, 2012) to help underscore this distinction. Of course, the sampling rate in our data is likely to mask such instantaneous dynamics, but the contemporaneous association found may (at least in part) reflect these.

The contemporaneous network was marked by several negative edges linking distressed modes with healthier ones (see our account of this issue within the discussion of Participant B’s network earlier). The emergence of these edges in the group-level network, alongside their absence from the between-person network (where only one very weak

negative edge was present), suggests that these associations reflect within-individual processes and not between-individual differences. In other words, although distress or vulnerability on the one hand, and a healthy or playful stance on the other hand, may partly exclude each other at the momentary level, they can co-exist at the person level.

Lastly, the between-individual network included a positive edge linking the Self-Critical and the Perfectionistic modes. Interestingly, the latter was tied only to the Reflective mode in the within-person networks, a link that we interpreted as suggestive of an adaptive role for this mode, at least in the present sample. The finding from the between-individual network seems to shed less positive light on this mode and suggests that individuals with a perfectionistic stance are more likely to also inhabit a harsh self-critical (introjected) mode.

The aggregation of within-person personality dynamics can be a very productive area of research. Specifically, researchers can compare groups according to predetermined characteristics such as demographics (e.g. Costantini et al., 2019) or the diagnosis of specific psychopathology (e.g. PD). The *top-down* identification of condition-specific within-person network structures can aid in elaborating our understanding of certain conditions and in improving treatment protocols for these conditions.

Alternatively, groups of individuals can emerge from the data itself using sophisticated clustering methods (e.g. Gates, Lane, Varangis, Giovanello, & Guiskewicz, 2017) based on common within-individual personality dynamics. A *bottom-up* approach of this sort can aid in the discovery of transdiagnostic processes that cut across current diagnostic systems (e.g. Wigman et al., 2015). Here again, the extent to which a clustering based on dynamic processes will resemble a clustering based on traditional single measurements is, for the time being, unknown.

All in all, as our discussion has shown, some of the associations hold across the levels of analysis, and others appear to be level specific. In other words, ergodicity cannot be assumed for the entire set of modes examined here, but further research with bigger samples (in terms of both participants and time points) may help clarify which components or association are characterized by this quality.

Limitations and Future Directions

The present work comes with several notable limitations. First, the modes assessed in the current investigation were ones drawn from the ST model. This model is only one of the several conceptualizations that posit distinguishable organizational units in individuals’ experience. We chose to employ this particular model in the current work because of its relatively finite and definite account of such units. This model (and others like it) emerged from clinicians’ experience and is thus mostly *theory driven*. It is likely that additional modes exist, and possibly, that the modes can be organized in a different manner, a possibility that should be examined in future work. Moreover, recent advances in the analysis of multilevel data (e.g. in clustering methods, some based on machine learning; e.g. Dwyer, Falkai, &

Koutsouleris, 2018) hold great promise for obtaining *data-driven* accounts for more valid segmentation of these units.

Second, the sample we examined was a community sample with relatively well-adjusted participants. If we were to examine clinical samples, we would expect maladaptive modes to be decidedly more prominent. Even more importantly, we would expect the transitions between modes in such samples to be more abrupt, which would be manifested by stronger edges between nodes in both the intraindividual and the group-level networks.

Third, some of the obtained reliability estimates for the MSMQ modes were moderate at best. In part, this had to do with scale length. To reduce participant burden to a minimum, we chose to measure each mode with only three to four items. Yet, if a mode is expected to encompass a person's full and nuanced subjective experience (replete with its own affects, behaviours, cognitions, and desires), the conceit of capturing it reliably with only three items appears to be a formidable challenge. Four-item scales fared a bit better; indeed, the Distressed and Reflective modes (both assessed using four items) were found to be the most reliable. Future research attempting to tap the complexity of momentary experiences could attempt to assess a greater number of items, while staying mindful of participant burden.

Fourth, the sample was limited in size and in number of assessments per participant. The required sample size for estimating network models depends on the true network characteristics, and no simple rules of thumb exist for determining this (Epskamp & Fried, 2018). Additional complexity is added when data are multilevel. As the MSMQ was first used in the current study, a simulation-based sample size calculation was not possible. Notably, although larger sample sizes are always helpful, more frequent, intensive, or prolonged assessments come at a price of participant burden, which may exceed acceptable levels, or of more prolonged data collection periods, which would raise the risk of stationarity violations (i.e. changes in nodes' means and variances across time; Bringmann et al., 2017). Another upshot of the frequency of our assessments—and even more so, of the instruction to complete these with reference to the past hour—is that even if modes are truly discrete, the (somewhat retrospective) responses may reveal co-activation merely because different modes were activated within that hour. Future studies would benefit from instructing participants to focus exclusively on momentary experience.

Fifth, in many of the temporal networks, absolutely no edges were obtained. While this pattern might have several explanations (including insufficient within-person measurements), one possibility might be our choice of inappropriate intervals between measurements (Dorman & Griffin, 2015). In particular, assessments might have been too sparse to allow for accurate estimation of causal links between modes. Researchers who want to further investigate similar constructs may consider shorter intervals, even at the cost of limited coverage of significant parts of the day; importantly, with an instrument as long as the MSMQ, we would expect more than 4–5 assessments per day to be excessive.

Sixth, the analytic approach we adopted is still a work in progress (Epskamp, van Borkulo, et al., 2018; Epskamp,

Waldorp, et al., 2018). Some issues, such as the estimation of random effects in multilevel data networks or the clustering of nodes and individuals, have yet to be worked out. Recent work by Bastiaansen et al. (2019) demonstrates how far we still are from consensus in choosing methods for identifying core processes in idiographic longitudinal data. One sticky issue involves the usage of nodes' means as an additional source of information. Our work did take the means into account, but did so only in the intraindividual models, where these means seemed most relevant. We expect ongoing work in the field to help identify the most efficient and reliable methods to fully utilize the richness of within-individual data, but are aware of the ongoing debate in the field regarding the current robustness of these methods (e.g. Epskamp, Fried, et al., 2018; Forbes, Wright, Markon, & Krueger, 2017). One future direction that may help establish the case for robustness would be increased use of multi-burst designs (e.g. Ram & Diehl, 2015).¹¹

Broader Considerations

One of the driving forces for the development of clinical or personality models centred on the idea of within-person multiplicity has been individuals' experience that they possess diverse and often inconsistent thoughts, emotions, and desires, which often translate into inconsistent behaviour. Subjectively, such inconsistencies in one's phenomenology often involve distinct and intermittent holistic experiences. For example, in a subjective state of distress/vulnerability, one is likely to have certain emotions (e.g. fear), cognitions (e.g. perceived danger), desires (e.g. a need for safety), and behaviours (e.g. reassurance seeking); in another subjective state (e.g. that of detachment), these elements would be quite different (e.g. numbness, distracted thoughts, a need for stimulation, and sensation seeking, respectively). In other words, these states are unique organizational units.

Various clinical theorists (e.g. Bromberg, 1998; Stiles, 2006) have proposed models that encompass such dynamic state-like context-sensitive organizational units. For the most part, these models—including ones that serve as the basis for effective therapeutic approaches, such as ST (Bamelis et al., 2014)—have received little empirical attention in their own right. Our goal in this project was to extract one such model—namely, ST's mode model—from the clinical literature in which it germinated and bring it into contact with contemporary trends—both theoretical and analytic—in personality research. By doing so, we hoped to demonstrate possible means to investigate such a model that makes use of intensive longitudinal data and of network analytic methods.

Recent work by Jacobs, Lenz, Wollny, and Horsch (2018) explored the latent factor structure underlying the retrospective report of ST modes in a large sample of inpatients. Their findings help situate these aggregated modes into the emerging hierarchical dimensional organization of personality pathology (Hierarchical Taxonomy of Psychopathology; Kotov et al., 2017) and ultimately to broader trait dimensions such

¹¹For further discussion of this issue, please see the OSM at <https://osf.io/jkxzn/>

as the Big Five traits (e.g. Krueger & Markon, 2014) and join other work helping identify dimensions that may underlie various schemas as modes (e.g. Bach & Bernstein, 2019). Importantly, these efforts differ from our work in several respects. First, they are explicitly concerned with personality pathology, rather than the full scope of personality organization. Second, they rely on cross-sectional data (e.g. the SMI) rather than on dynamic assessment. Third, and most importantly, they break away from the very idea of discrete states (or modes) by highlighting the shared variance accounted for by traits such as internalization, externalization, or compulsivity.

Notably, our work was not aimed at establishing empirical support for the ST mode model or for any particular model of subjective personality states. However, we clearly see the need for future work on the validation of personality states as cohesive organizational units. Such work could help solidify the empirical foundation of the ST model (or models like it), for example, by employing experimental designs in controlled environments to explore the characteristics of such states and examine the extent to which they are indeed composed of typical cohesive components and indeed experienced as distinct from other states. Such research could utilize a variety of measures that go beyond self-reports and include psychophysiological (Schäfflein, Sattel, Schmidt, & Sack, 2018), neuroimaging (e.g. Longe et al., 2010), and implicit measures (Han, Olson, & Fazio, 2006). What is crucial, in our view, is that future study of dynamic personality models should take into account individuals' phenomenology and, particularly, attend to the way individuals experience themselves as composed of multiple individualized parts. A useful benchmark for any such model would be its ability to provide an intelligible language or lexicon with which individual could describe their own multiplicity and understand their own complex (and often inconsistent) behaviour.

Clinical models of multiple self-states start with the assumption that such states are, at least to some extent, distinct (e.g. Bromberg, 1998; Stiles, 2006; Young et al., 2003). In the present work, we wanted to relax this assumption for both methodological and theoretical reasons, as we are currently agnostic about whether the 'real' picture of involves discrete categories (or profiles), prototypes, or continuous dimensions. Theoretically, most clinical models assume individual differences in the 'discreteness' of states—that is, they recognize that some individuals move more easily and less abruptly between different self-states, whereas others may be predominantly in one state at a time, making any move between them quite dramatic. Methodologically, even if self-states are entirely discrete entities, measuring their presence over periods that are longer than an instant (e.g. 'over the last hour', as was the case in our sample) would mean that various self-states might co-exist. This too calls for dimensional scores for each of the states. A benefit of such scores is that they allow for both discreteness and possible continuity.

Positing the existence of multiple subjective personality units requires a consideration of how they relate to each other. In the present work, we did so by examining simple linear associations between units, which were used to construct networks of associations. Such an approach provides information regarding the strength and direction of these

associations and, by proxy, regarding the extent to which they are experienced as distinct. However, it ignores other possible aspects of these associations. For example, the relations among these within-individual units (and possibly, even their identity) may be better understood using non-linear complex systems methods (as has been suggested by Borsboom, 2017b) or by adopting top-down conceptual frameworks such as the interpersonal circumplex model (which help situate specific behaviours and possibly states along the cardinal axes of agency and communion; e.g. Hopwood et al., 2019).

Conclusion

The present work joins several other recent attempts to conceptualize within-person personality dynamics (e.g. Geukes & Back, 2017; Hopwood et al., 2019; Wright et al., 2019). Its distinction comes in part from the inspiration it draws from widely used clinical models, which converge on the idea of multiple subjective personality 'states' as separable organizational units. This idea has considerable intuitive appeal and richness, and has led to clinical utility, but has rarely been examined empirically. By using ILMs and network analyses, we were able to explore these states and to further refine a model tying them together. We believe that this model (and others like it) can serve as meaningful bridges between the fields of personality and clinical psychology, increasing the relevance of personality research for clinicians on the one hand and strengthening the empirical foundations of clinical conceptualizations on the other.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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