Using ambulatory assessments to understand personality-health associations

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Abstract

The assessment of personality is moving beyond typical questionnaire assessments and beginning to rely on repeated assessments where people respond multiple times a day for multiple days. These ambulatory assessments open up new avenues of research directly relevant to understanding healthy aging. In this chapter, two underutilized methods are discussed. First, dynamic metrics of personality, such as variability in behavior, inertia, and synchronicity, are likely to be related to healthy aging over and above standard mean-level trait assessments. These assessments can further allow better tests of personality processes, such as person-situation transactions, given that assessments are collected in situ rather than collapsed across time and context. Second, ambulatory assessments allow personality to be assessed at an idiographic level, where personality is defined not by comparison to others but how each person has a structure of personality unique to them. These idiographic assessments are likely better suited to identify which components of personality are linked to health processes.

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The relationship between personality and health is well established. Assessments of short and simple personality measures are prospectively associated with objective outcomes of health such as stroke, Alzheimer’s, heart disease, cancer, diabetes—just to name a few (Terracciano et al., 2014; Weston, Hill & Jackson, 2015). Personality associations with health outcomes, in turn, help explain the relationship between personality and mortality (e.g., Jackson et al., 2015). Further, personality-health processes extend beyond personality as a prospective risk factor whereby personality also influences perceptions of health and prognoses of disease after onset (Weston & Jackson, 2016). These associations are found regardless of when personality is assessed – from childhood through old age – and across assessment methods (Friedman & Kern, 2014). In short, personality arguably influences all aspects of the health process from cradle to grave.

These well-established associations between personality and health are explained by a number of potential pathways. One of the most studied is health behaviors, such that those high in certain traits are more likely to engage in healthy behaviors, like eating their vegetables, exercising, going to the doctor, and less likely to engage in risky activities such as drug use and driving recklessly (Bogg & Roberts, 2004). Other pathways linking personality with health outcomes are stress mediating processes and interpersonal relationships. For the former, certain traits are linked with experiencing more stress and a greater likelihood of encountering stressful situations (Williams, Smith, Gunn & Ochino, 2011). These stress related processes have well documented relationships with a number of biological mechanisms such as impacting the glucocorticoid system. Interpersonal relationships can also influence health processes such as through stress reduction or providing purpose to one’s life (Park et al., 2013).

Despite these straightforward and sensible pathways linking personality and health, evidence for these pathways are not robust: In general, the overall magnitude of association that mediated pathways explain is relatively small, the mediating processes are not well defined, and the designs of studies typically do not account for reverse causation (i.e. health influences personality; Jackson, Weston & Schultz, 2017). As a result of the lack of strong consistent empirical findings, there are few people outside of personality highlighting the importance of personality traits for health, with no major public policy pushes or discussions of personality interventions to overcome health crises (c.f. Bleidorn et al., in press; Lahey, 2009). The relatively small magnitude of association between health and mediating mechanisms is understandable when considering there are often decades between assessments of personality and health, as well as the cumulative, multi-determined nature of health, not to mention the difficulty of intervening on personality (Jackson, Beck, & Mike, in press).

Personality-health pathways are undoubtably complex. However, these complex pathways linking personality and health are studied relatively simplistically, as most studies tend to look at static markers of personality, health behaviors and health outcomes, often cross-sectionally. However, the processes driving personality-health associations unfold across time and in different situations, calling into question the utility of cross-sectional designs. To truly understand personality-health associations requires broadening when, where, and how personality is assessed. This is accomplished by measuring personality processes repeatedly – in the situations in which they naturalistically occur – and viewing personality through a different lens. We echo the early sentiments of the “father” of personality psychology Gordon W. Allport that “Novel and somewhat daring methods will be required” (Allport, 1937, p. 20) and propose that novel design and assessment methods can open up new possibilities for better understanding the relationship between personality and health processes.

The current chapter describes how Ambulatory Assessments (AAs, also known as Experience Sampling Method (ESM) or Ecological Momentary Assessments (EMA) or intensive longitudinal designs (ILD)), which result in data that can be called multivariate time series data, can move the study of personality and health forward. In these types of designs, a set of variables from a single individual is assessed multiple times within or across days or weeks. While data such as these have been collected since the 1940s or earlier (e.g. Cattell, 1947), there was no coherent framework on how to assess personality and such data were not routinely collected until the introduction of electronic assistants that help “ping” participants throughout the day. Since these electronic assistants has emerged, personality psychologists have used AA to investigate between versus within-person sources of variability in personality (e.g. Fleeson, 2001; Fleeson & Gallagher, 2009; Sherman, Rauthmann, Brown, Serfass, & Jones, 2015) and carryover-effects of personality states (autocorrelative relationships; Beck & Jackson, 2019). However, there has been little discussion about how these types of designs can advance more applied personality questions, such as personality and healthy aging. That said, adjacent fields have routinely used AA methods to better understand health-relevant aging processes within psychopathology (e.g., Trull & Ebner-Priemer, 2013) and emotion (Connor & Barret, 2012).

Ambulatory assessments provide a snapshot of the person as embedded within their lived environment, providing more insight into the processes that connect personality with health, and sidestepping many issues that may arise with retrospective reports and/or generalized trait assessments. Not only do ambulatory assessments allow personality assessments to become contextualized and dynamic, they also allow rich numbers of repeated measures to better assess within-person relationships. Moreover, with the additional time series assessments of health via wearables, such as heart rate and activity, there are a multitude of opportunities to examine novel relationships between personality and health. Below we outline two ways by which AA methods can advance the study of personality and healthy aging.

***Additional (dynamic) metrics of personality traits***

Existing personality-health associations rely almost exclusively on relatively static and simplistic assessments of personality that have important shortcomings with regard to understanding personality processes. Personality assessments are typically self-reported and constitute global evaluations of how a person behaves, thinks, and feels. While alternative rating sources, such as through close associates, provide novel information in the prediction of health (Jackson et al., 2015), broad assessments of personality tend to provide a rough snapshot of a person that do not wholly convey the complexity of a person. Further, a number of personality traits have been implicated in both health promotion and health suppression. For example, neuroticism is generally negatively associated with health outcomes (Weston, Hill & Jackson, 2015). In contrast, there are some potential beneficial aspects of neuroticism, too (Friedman, 2000; Weston & Jackson, 2018; Weston & Jackson, 2016, though see Weston et al., 2018). To disentangle the beneficial and negative aspects of neuroticism, one needs to examine what a person is like *when* they are enacting health behaviors. For that, we need to look at more intensive assessments, often involving a systematic assessment of time to better understand the directionality of association (e.g. do health behaviors better predict neuroticism or vice versa?). Each of these additional types of assessments described below may be related to healthy aging over and above typical mean-level assessments of personality.

*Validating self-reports.* Personality assessments were derived from questionnaires aimed to assess relatively stable attributes. Items are not contextualized within a particular experience, but instead are general descriptors of how someone behaves collapsed across any systematic variability in time and situations. The relatively stable component of personality traits assessed by global reports is likely responsible for the relationship between personality traits and important life outcomes. The cumulative aspects of health processes, where personality-behavior associations add up over time, depends on consistency of personality (e.g., smoking once likely will not have an effect, but it may over a lifetime). However, it is unclear whether global assessments of personality correspond to the lived life of a person as few studies have examined personality manifestations in daily behavior. AA methods can assist in validating self-report and other-report methods of personality to make sure that those who state they are conscientiousness do in fact behave conscientiously (Fleeson & Gallagher, 2009) .

*Variability in personality.* Within-person variability in personality has been discussed since Allport (1937), and figures prominently in many different theories of personality (e.g., CAPS; Mischel & Shoda, 1995). However, few people have looked to see whether or not people are variable, if that variability is systematic, and if variability differs across people (see Beck & Jackson, 2019a for a further discussion) – let alone if that variability is related to health processes. Variability in personality is especially important for personality-health associations given that many health behaviors may occur because of shifts in one’s personality state. For example, I may be generally conscientiousness but sometimes lack self-control due to fatigue or boredom. This, in turn, could lead to a greater likelihood of an unhealthy behavior (Tsukayama et al., 2012). Those that are more variable in personality may be more susceptible to these unhealthy behaviors compared to those that have equal trait standings, but less variability given that those who are more variable will be more likely to experience personality states that depart from their average levels.

Further, variability in personality manifestations may be useful in such that it indexes (usually operationalized through a simple within-person standard deviation in personality states) an ability to respond to the demands of the environment. This ability to shift one’s personality manifestation from situation to situation may be beneficial in keeping with what is expected, whereas rigid behavior regardless of the situation could be seen as maladaptive (Mancini & Bonanno, 2009). For example, there has been some work showing that abstaining from alcohol may be detrimental for one’s health. Here, abstaining may be seen as being inflexible and too rigid in behavior that leads to negative consequences. It is possible that this effect stems from the personality of those that abstain, rather than the act of abstaining (Walton & Roberts, 2004), such that those who abstain may have fewer social contacts due to perceived rigidity. Alternatively, variability from situation to situation has been described as a risk factor for poor mental health and greater distress (Hardy & Segerstrom, 2017; Wichers et al., 2016), presumably resulting from the inability to have a consistent self. Currently, however, the extent that variability in personality states influences health is unknown.

Cattell (1957) broke down within-person variability into *oscillations* (momentary changes) and *fluctuations* (changes over longer time periods, like days or weeks). As applied to personality-health associations, it is likely that stressful times in life prompt people whose personality profiles may put them at risk to engage in less healthy behavior, such as those high on neuroticism, may be more likely to be influenced by outside stressors. The incident can be relatively acute, such as a hectic day at the office that results in poor food choices and a neglect of daily activity, stemming from exhaustion and the need to relax. The result is a temporary oscillation of personality-health behavior associations, one that may or may not have long-term consequences. However, this association could also be prolonged, leading to long term fluctuations in personality states. It is possible that neurotic individuals, to extend the example, may have more of these fluctuation episodes across the lifespan where they demonstrate high levels of neuroticism states. It is the persistence and the accumulation of these episodes that contributes to poorer health down the road – as opposed to what tends to occur day-to-day outside these fluctuations. In such cases, the experience of these fluctuations may be reinforced, for example, by the reduction of negative affect that follows eating unhealthy food or neglecting daily activity, making those behaviors more likely in the future when neuroticism fluctuations (inevitably) occur. That is, a simple oscillation of being stressed out probably isn’t going to have long term ramifications for health. Longer term shifts, fluctuations, may be what is driving the association between personality and health. Examining only general, trait level personality-health associations will thus miss these important personality – health transactions.

Another related concept is *instability*, which is how extreme deviations are when they occur. This captures not just how much a person varies but also how extreme or gradual they are when they do occur. Whereas variability indices like standard deviation captures deviations around the mean, instability reflects the temporal dependency of fluctuations in states over time. Instability is often measured through mean square successive differences (MSSDs) which tallies the squared difference from one time to the next. When considering neuroticism, whose positive pole is emotional stability, a measure of instability is a valuable additional metric in addition to within-person variability alone. For example, two individuals could show identical within-person variability (average scaled difference between an observation and the average observation; SD) but very different MSSDs. If, across 20 observations, one individual gave the same rating (e.g. “1”) to the first half of observations and a different rating (e.g. “2”) to the second half of observations, while the other individual alternated between the two ratings for the whole period, they would have the same within-person variability (*SD* = .51) but different MSSD’s (*MSSD*1 = .05; *MSSD*2 = 1).

Changing states in personality from one situation or time to another, as discussed above, could be beneficial or harmful. There is some evidence that instability influences health, coming from the affective instability literature. Given that negative and positive affect relate closely to neuroticism and extraversion, respectively, it is likely that these findings would extend to personality fluctuations (Ong & Ram, 2016). More research needs to be done to understand if and how personality instability is related to health. For example, is good or poor health that leads to more or less instability or does personality instability influence health? Those that are more variable from time-point to time-point likely are, almost by definition, more susceptible to situational influences. Thus, those people who are high in instability might be prime targets for behavioral interventions as their manifestations appear more labile.

*Inertia.* Like in physics, inertia refers to the tendency to stay consistent within a particular state. Often, inertia is defined as the autoregressive correlation from one time to the next. Similar to instability, inertia involves temporal dependency, though it does not index the magnitude of change from time-point to time-point. Inertia is relatively high within personality panel studies that examine personality from year-to-year, but fewer studies have investigated this within daily or more fine-grain assessments of personality (c.f. Beck & Jackson, 2019a; Eskamp et al., 2018 for exceptions). In these studies, it is relatively unsurprising that state manifestations of personality show modestly high auto-correlations. However, there are large individual differences in the tendency to show high auto-correlations. No personality studies have investigated whether individual differences in inertia are related to different health outcomes. Outside of the trait literature, very few studies have looked at inertia as it relates to health relevant processes (e.g., Kuppens, Allen, & Sheeber, 2010; van de Leemput et al., 2014). One study looked at the inertia of positive affect found that those low in inertia had lower levels of depressive symptoms, indicating that having greater stability in your personality states was positive (Hohn et al., 2013).

Inertia is typically discussed as the autocorrelation of the same variable across time e.g., state levels of extraversion. However, it can be extended to so-called cross-lagged associations – looking at how one’s extraversion predicts future levels of conscientiousness, for example. These cross-lagged associations have not been examined yet either in terms of what is normative or how they relate to health processes. However, inertia across constructs can be viewed in terms of *if…then* associations that are the basis for many process models of personality (Mischel & Shoda, 1995; Wright & Mischel, 1987). For example, if someone was feeling depressed, a facet of neuroticism, then that may make it less likely for them to behave conscientiously, which may manifest in skipping working out to eat junk food. In contrast, someone who has lower levels of inertia across these two constructs may be less likely to exhibit these poor health behaviors because their elevation in neuroticism does not influence conscientious behaviors. These people may be able to shrug off or compartmentalize whatever left the person feeling depressed more so than the person with high inertia. The extent that individual differences exist for cross-lagged inertia in personality is unknown.

*Cyclic trends.* Periodicity, or time dependent patterns in changes in a state over time, of psychological states have been largely unaddressed in personality psychology. Despite that, these cyclic trends, which could operate on the level of minutes and hours to days and months, can be easily examined in AA studies. Moreover, cycles are known to be important for physical functioning, impacting, for example, sleep and eating processes. Separating cyclic trends characteristic from autocorrelative associations is important in understanding both those effects. For example, there are clear diurnal cycles in energy levels, which is often a measure of the activity level facet of extraversion, across the day. If cyclic trends are not accounted for, this may mask patterns of variability *within* a day by not accounting for variability across days. In a demonstration of how cyclical trends are critical. in understanding the processes that underlie personality, Revelle and colleagues (1980) examined arousal levels as a function of extraversion and diurnal cycles, finding that higher levels of arousals among those low in extraversion occurred only in the morning. Indeed, the cyclic trend itself may be an individual difference characteristic (e.g. the periodicity in arousal may be predictive of both personality traits and health outcomes). These issues are especially important in aging context as people’s energy levels and diurnal cycles change with age and health status (Froy, 2013). Combined with the changes in extraversion found in older adulthood (Wortman, Lucas & Donnellan, 2012), there may be large differences in personality-health associations in older adults compared to younger.

*Reactivity.* Outside events are likely to influence one’s personality manifestations, often thought of as person-by-situation interactions. These events, however, may be more or less impactful depending on the person. This idea is sometimes thought of as resiliency when the time frame is longer than moment to moment. But from moment to moment, people may also be more or less susceptible to outside influences, which could directly have implications for health. Reactivity in positive affect in the face of daily pain was associated with vulnerability in fibromyalgia patients (Finan et al., 2009). Similarly, people whose positive affect were impacted more by daily stressors have poorer sleep and elevated inflammation (Ong et al., 2013; Sin et al., 2015). While personality x situation interactions are often discussed. within the personality literature, few empirical studies can reliably show an interaction between the two (e.g. Shermann et al., 2015). It is possible that finer-grained AA studies could shed light on how people react to outside influences.

In sum, few studies have systematically utilized additional AA derived metrics of personality to better understand associations with health. However, merely introducing these ideas into the personality-health literature will not be satisfactory. More systematic research is needed to best design intensive longitudinal assessments, including what and with what frequency. Many of these metrics would change if the time period between assessments changed, for example. For some questions, daily repeated assessments may be more useful than hourly, whereas the reverse may be the case for others. This is further complicated by the potential to assess meaningful health metrics continuously through various wearables (e.g., heartrate). Relatedly, there have been few if any systematic psychometric evaluations of personality or health measures that are used within AA studies. It is not immediately clear that translating a trait questionnaire to a state questionnaire will result in a well validated scale. Moreover, there are additional considerations concerning validating AA indicators (Wright & Zimmerman, 2019), especially when considering that many AA studies address within-person questions compared to standard between person that measures were traditionally validated against.

***Idiographic Assessments***

The time series data collected through AA allows new variables to be created, like those described above, but also allows new opportunities for conceptualizing personality. Traditional personality assessments are nomothetic in nature such that they assume that all people can be characterized by similar constructs -- that is, (1) my extraversion is the same as your extraversion and (2) we can then rank each other on levels of extraversion. An alternative approach to this is idiographic assessment where personality is interpreted as the relative standing of variables within a person, such that not all variables will be important for all people. These assessments are more akin to how you would describe someone after knowing them really well, through discussion of components of their personality that are especially salient to them, not just through listing their relative standings on each of the Big Five traits. The Big Five has been referred to as the “psychology of the stranger” (McAdams, 1994), referring to the rough approximation of personality for someone who barely knows a person. Once two people move past stranger status, a series of predefined constructs such as the Big Five may not be necessary as they are overly coarse. Instead, you can focus on the characteristics that are salient to an individual and how these characteristics are organized specific to an individual. It is likely that this increased precision could open up new insights into personality-health associations.

Idiographic assessment has been discussed since the days of Allport, Cattell, and others (Beck & Jackson, 2019a). Allport, for example, talked about both cardinal traits and individual traits, both of which go beyond typical nomothetic assessments of personality (Allport, 1937). Cardinal traits are traits that are especially relevant for a person in their daily life. The workaholic business executive may list industriousness as their cardinal trait whereas the comedian may feel that humor is the most salient trait that defines her actions. Individual traits go one step further in that both the structure and the content of your personality may only exist within you and not apply to any other person (Allport, 1937). To Allport, personality exists at two levels – at the level of the individual (idiographic) and the level of the population (nomothetic).

Cattell (1957) proposed how to think about these two levels through his databox where persons could be conceptualized into three dimensions that indexed people (P1 to PN), variables (X1 to Xp), and occasions or time (T1 to Tt). Depending how you slice up the data box, you could ask nomothetic questions that applied to all people or idiographic questions that applied to a single person. Nomothetic questions examine the person (P) and variable (X) dimensions and collapse across the occasion (T) dimension either implicitly or explicitly. With this slice, one can examine the nomothetic structure of individual differences within a population of people, which he termed *R-technique.* Instead of collapsing across time, one could slice the data box into variable (X) and occasion (T) dimensions and fix the person dimension. In doing so one can capture the unique structure of individual differences for a single person – that is, the within-person idiographic factor structure of personality. Cattell described this procedure as *P-technique*.

Despite the introduction of analytic tools to examine both between and within-person questions over 60 years ago, few studies have addressed questions of idiographic personality. Some of the progress was limited by the difficulty in collecting the data. Similarly, even with good AA data, computing power limited the types of questions one could address. Finally, the Person-Situation Debate that waged on throughout the latter half of the twentieth century pitted between-person nomothetic perspectives and within person idiographic perspectives against each other. The result is that there were few people interested in crossing party lines to investigate how thinking about personality at these different levels could be adequately addressed. Given this disconnect, it is necessary to connect the two sciences of personality (idiographic and nomothetic) to determine the best level of analysis for a specific question. In terms of aging and health, there may be general processes that drive between person associations such that feeling stressed is associated with worse health outcomes. However, this may not be true for everyone. Stress for some may not be associated with negative health processes but with positive health promoting processes. Only looking for processes at the between person level may thus overlook important within-person (idiographic) processes.

*Distinguishing nomothetic and idiographic processes.* The novel personality metrics discussed above (intertia, instability) that address the dynamics of personality over time are based on between-person models, like factor analysis and most longitudinal models. These models assume that whatever characteristics one is looking at, such as the inertia of extraversion, exists similarly for everyone. However, translating the findings of between person models to individual, idiographic models often provides conflicting results such that the same associations do not hold at the between versus the within person level (Borsboom, Mellenbergh, & Van Heerden, 2003; Molenaar, 2004; Fisher, Medaglia, & Jeronimus, 2018). Mathematically, if within-and between-person processes were equivalent, they would be *ergodic* (Molenaar, 2004)*.* In psychology, this would mean that there would be equivalence between P-technique (X x T, fixing P) and R-technique (X x P, fixing T). Comparisons of between and within person mood processes, sometimes find equivalent structures for most participants – but not all (Zevon & Tellegen, 1982). In a recent demonstration, Fisher et al. (2018) investigated the equivalence of within-and between-person means and standard deviations, finding that the distributions were quite different, which indicates that the time series are non-ergodic and individual-level estimates cannot be made from between-person estimates.

If mismatch between idiographic and nomothetic models is strong, as preliminary data within personality suggest (e.g. Beck. & Jackson, 2019a; Borkenau & Ostendorf, 1998; Molenaar, 2004), then psychologists must turn their attention back to testing idiographic questions posed by Allport and others almost a century ago. This is because, what is considered “conscientiousness” may not exist in (1) all people or (2) in the same way. Which raises issues for using such nomothetic traits as causal explanations. Discussing how conscientiousness predicts mortality could thus be mingling different underlying processes that give rise to similar behaviors. In other words, my conscientiousness may not be the same as your conscientiousness at such a level that it doesn’t make sense to talk about someone having a level of conscientiousness. Recently, for example, Beck and Jackson (2019a) examined the congruence between idiographic and between-person personality structure using well-known (if not oft applied) techniques, like P-factor analysis, as well as newer models that account for timing (see below). Across each method, they found little congruence between the between-person reference structure and idiographic structures, with some people showing strong congruence (a similar factor structure) but many showing weak congruence at best. That is, people differ in the number of personality factors, with the content of those factors not necessarily replicating either. In short, the personality structure of an individual does not necessarily map on to the current taxonomies of personality structure (e.g., HEXACO; Big Five), with some people not having factors that resemble any of the standard traits. People are unique in how their personality is organized, with some components being important for some people but not others.

Although further work is needed to better understand the correspondence between within- and between-person models of personality structure, and how variability can be leveraged to improve our understanding, this study represents the most comprehensive study to date examining methods for assessing congruence. The lack of evidence for such congruence is striking and further highlights the need for devoting more attention to idiographic assessment and modeling. If personality traits are causally influencing distal outcomes decades down the road, then it is necessary to identify the components that are the influencers. The findings from Beck and Jackson (2019a) indicate it is incorrect to label such terms like conscientiousness as distal influences (e.g., Hill & Jackson, 2018; Jackson & Hill, 2019) given that conscientiousness may not “exist” for some individuals.

*Idiographic conceptualization of personality traits.* Theoretically, critical assumptions of the factor model underlying the derivation of nomothetic (common) traits in personality make it unlikely that nomothetic structures can be used to understand individual-level dynamics. Models of the Big 5 were originally extracted using exploratory factor analysis, often with Procrustes rotations that favor its extraction. Less restrictive assessments of the factor structure across the lifespan suggest that the Big Five factor structure do not hold up (Beck, Condon & Jackson, 2019). The factor structure is replicable in early adulthood, the same age that initial validation studies tended to use, but in older ages there was less consistency in the factor structure, suggesting de-differentiation among people. In other words, in older adulthood, personality got more complex with greater links between variables (i.e. cross loadings). What this means is that findings that are based on factor scores of older adults may be either driven by a small subset of people where the trait exists for them and/or that our current estimates for the effect sizes between personality and life outcomes are greatly reduced because our assessments of personality are imprecise. Both possibilities are chilling if personality researchers want to identify the mechanisms between personality and healthy aging. Regardless, these findings suggest that standard factor models of personality may not apply to everyone and that research into healthy aging should utilize idiographic assessment more frequently.

Three important assumptions of the standard *reflective* *model* (or common effect model; see Figure 1) used in nomothetic personality trait studies are that (1) the indicators of these traits are assumed to be interchangeable i.e. that they all measure the same construct, (2) their errors are independent after accounting for the latent variable, meaning that only the latent variable explains variability in these indicators, not other variables, and (3) the latent trait causes variability in the indicators and is not just a data reduction technique. The use of the reflective model in personality has been criticized for violating each of those three assumptions (e.g. Cramer et al., 2012). Although the independence and interchangeability of indicators assumptions can be somewhat bypassed by fitting confirmatory factor models that relax these assumptions (e.g. Hopwood & Donnellan, 2010), the question of the causal nature of latent variables remains. However, there are other models that are mathematically equivalent to the common reflective model that relax all of these assumptions (Kruis & Maris, 2016). Despite their mathematical equivalence, each of the models proposes a different theoretical explanation for the observed associations. Thus, the choice of the model has critical implications for a theory about how personality influences outcomes such as health.

Two other models that are mathematically equivalent to the reflective model – the *formative model* (or common cause model) and an *idiographic* *network* *model* (Figure 1). In a formative model, a latent variable is regressed on its indicators. A classic example of this is socioeconomic status, where indicators like education, household income, and location are indicators of the construct SES. However, there is no assumption that education, income, or location *cause* SES. In personality, in other words, observable manifestations of Extraversion, like being talkative, are not caused by some Extraversion trait that a person has. Rather, their position on the latent construct Extraversion is a function of their tendency to be talkative, as well as a number of other indicators. However, although the formative model relaxes assumptions of the reflective model that often do not hold (perhaps especially the independence of errors), it fails to provide a satisfying explanation for why latent traits emerge at all.

The idiographic network model, though, not only relaxes reflective model assumptions but also suggests explanations for why latent trait dimensions emerge. Based in dynamic systems theory, an idiographic network model asserts that latent traits emerge as emergent properties of interactions among a set of indicators. These emergent properties may appear to be “trait like” but they are only a property of the complex interrelations among lower order components. As a result, these models make none of the assumptions of the common, reflective model. In doing so, these models offer up new perspectives on how to assess and capture personality processes (Beck & Jackson, 2017).

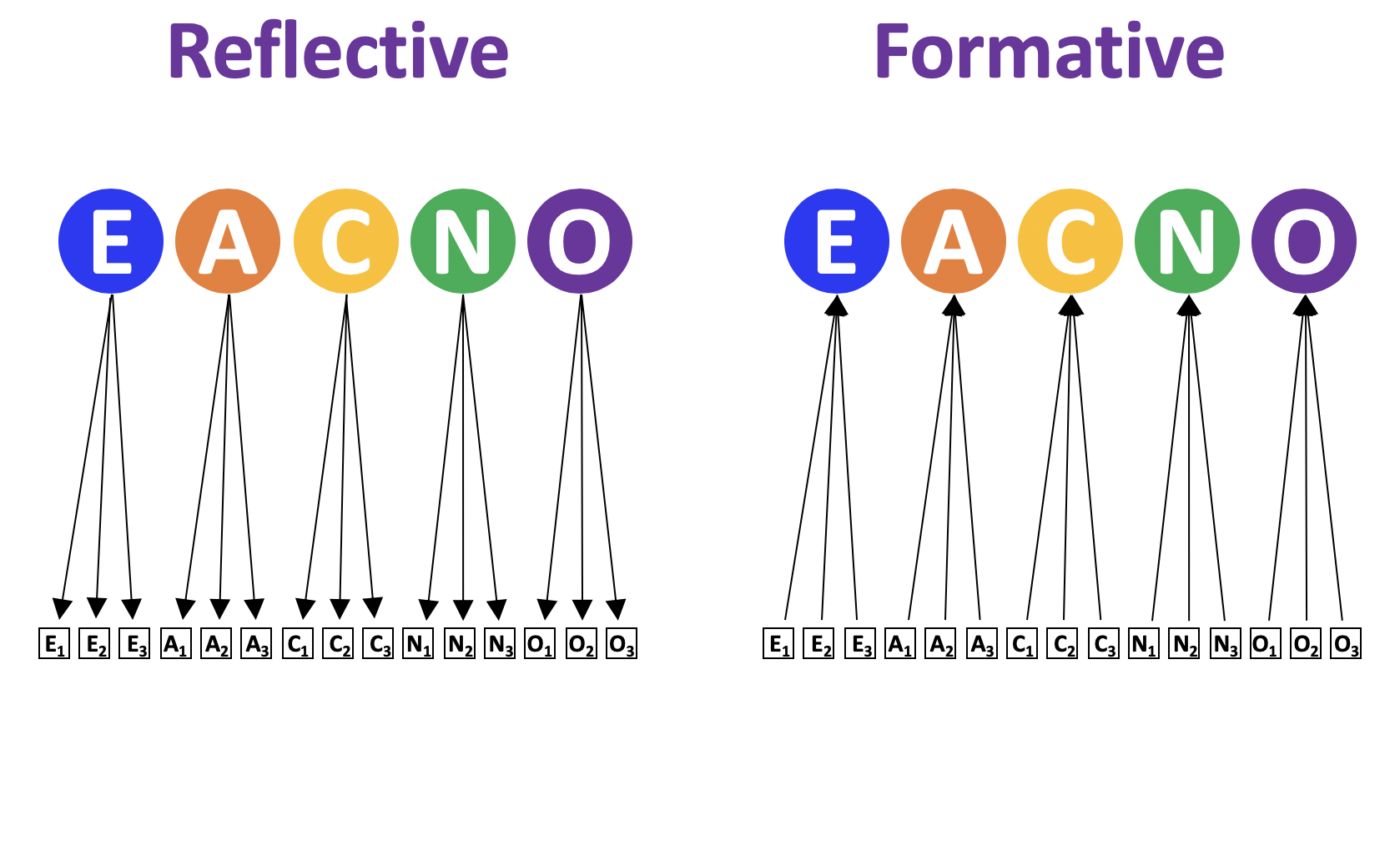
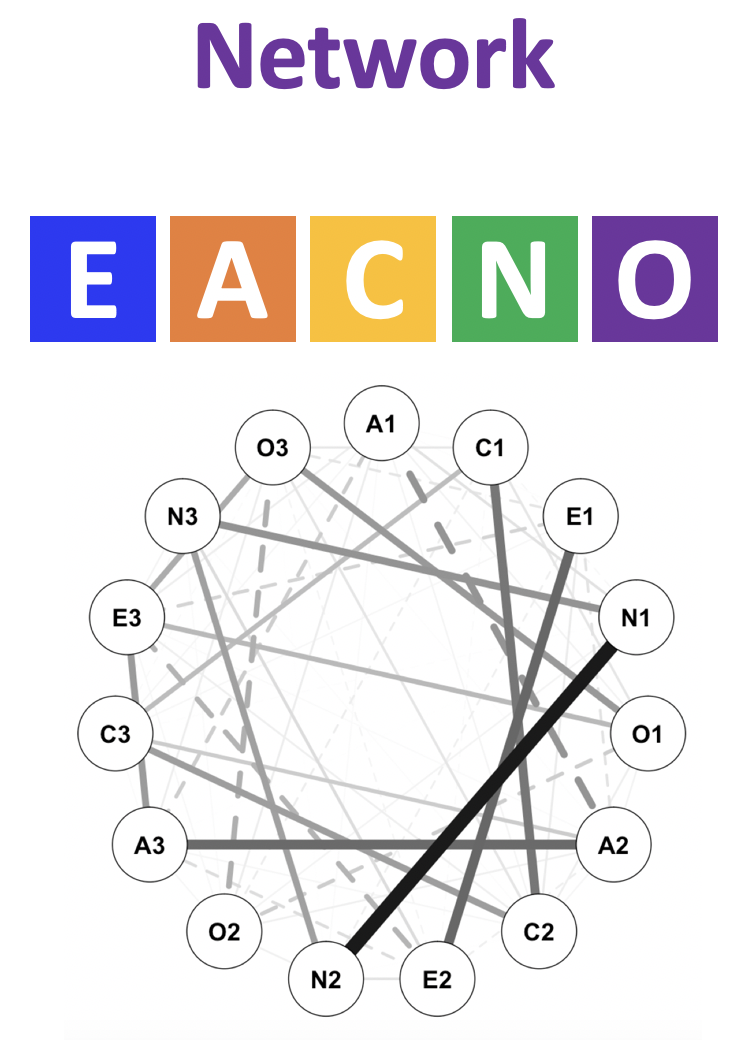
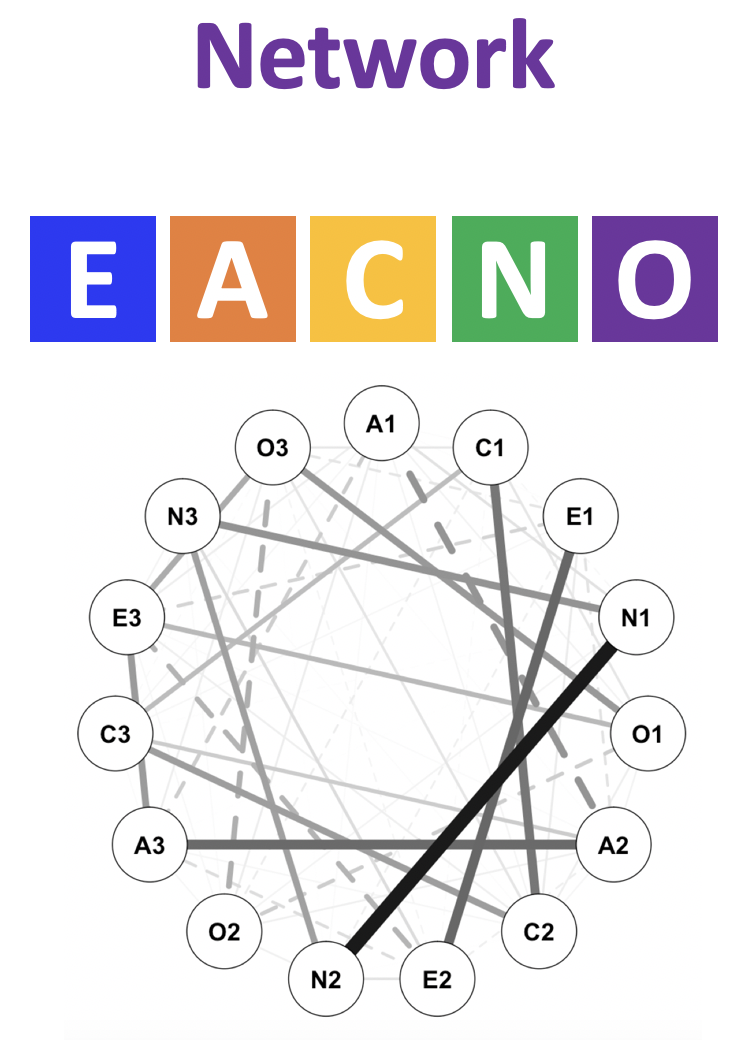


Figure 1. Three Potential Models for Conceptualizing Personality Structure

Instead of focusing on the causal properties of broad traits, lower order components are assumed to be causally responsible for personality-health associations. By looking at these lower order components, compared to standard trait models, idiographic models introduce more unique personality --> health pathways, allowing for more complex models that capture personality-health associations in the complexity that many theories assert. For example, Idiographic network models allow one to systematically estimate the associations between indicators and target behaviors for each person. One can then ask whether (1) properties of the structure of someone’s personality (not their trait standing) is associated with health? Or (2) whether a specific pathway is found (e.g., feeling stressed result in more or less than desired exercise) – and does that association hold for everyone? Currently questions of how idiographic personality structure and network processes relate to health processes is completely unknown.

*Modern idiographic network models.* Idiographic network models of personality differ from standard trait assessments in that they require AA data. They shift the focus from static trait assessments to more dynamic state-level assessments of personality for which AA methods allow. The simplest type of these models is a zero-order correlation among the variables (X) dimension across the time (T) dimension for each person individually, directly echoing Cattell’s slicing of the databox. Called “association networks,” these are the correlation matrices that P-technique factor analysis attempts to reduce. By providing an intuitive visualization of the relationships among indicators, network techniques provide an easy tool for visualizing structural differences in personality traits.

These methods can be expanded to looking at unique relations among indicators and can utilize the time sensitive nature of AA data to looked at lagged associations. However, when examining such within and across (lagged) personality-health relationships in the search for casual relationships strong overlapping variance among indicators can threaten this endeavor, making it important to examine the unique relationships among the indicators using partial correlations or controlling via regression. As with standard regression, the possibility of over-controlling or overfitting goes up as the model increases in complexity (assuming the number of observations remains constant). Recently, there have been a number of proposed models for examining such complex models without overfitting. New techniques for the basic lagged model (e.g. Bringmann et al., 2016; Epskamp et al., 2018; Gates & Molenaar, 2012, Wild et al., 2010), have been proposed and implemented (in a limited manner) to account for (1) bidirectional relationships between lagged predictors, (2) additive relationships among lagged predictors, and (3) the structure of these relationships (Beck & Jackson, 2019a). Together, these novel analytic models allow researchers to address the complex analytics that come with AA data, especially as it applies to idiographic assessment and to tackle questions that have long been of interest.

Modeling personality as cross-lagged idiographic models have several advantages. First, most types of models account both for within-(contemporaneous) and across- (lagged) time relationships. This is important, as personality-health associations likely differ in the time scale of the associations. For example, my anxiety right now may drive my current eating habits whereas my planfulness in the moment will impact future ability to exercise. Second, by including larger set of predictors and using pruning techniques to prevent multicollinearity (e.g. graphical LASSO; Friedman, Hastie, & Tibshirani, 2008), they capture the unique relationships among diverse phenomena that influence manifestations of personality. That is, these models can identify the relevantly salient paths that are most likely causal by accounting for overlapping variance, much like control variables do so in standard regression models. Third, and most simply, they offer a method for testing complex sets of relationships that are a hallmark of many key models of personality (Allport, 1937; Cervone, 2005; Mischel & Shoda, 1995). Such relationships are complex not only in that they can include a large number of predictors but also in what those predictors are.

*Implications for healthy aging*. These newer idiographic models can provide a number of insights about personality structure, personality processes, and personality development (Beck & Jackson, 2017) that may be especially relevant to health processes. For example, while conscientiousness is known to be associated with better health, it is possible that two individuals who have identical levels of Conscientiousness on a nomothetic personality scale obtain better health through different means. Traditionally, from a nomothetic view, this problem has been approached by examining lower-order personality characteristics, such as facets (Jackson et al., 2009; Soto, 2012), aspects (DeYoung, et al., 2007), or items (Mõttus, Kandler, Bleidorn, Riemann & McCrae, 2017; Wood, Nye, & Saucier, 2010) in an attempt to obtain more precision about the pathway. But this still misses unique associations *between* lower-order personality characteristics, such as whether an individual’s sociability is related their impulsivity, which impacts health processes. Allowing for dependencies in idiographic models allows for novel pathways such as these to be tested that are not possible using traditional assessments.

Similarly, idiographic data are inherently temporal. As a result, idiographic models are able to better examine the effects of context and time and to examine so called *if…then* contingencies (Wright & Mischel, 1987) that likely play an important role in personality-health associations (Weston & Jackson, 2016). For example, compared to traditional models of personality, idiographic models incorporate multiple different situations due to repeated responses. As such, situations can be directly incorporated into the same model to see how personality influences health processes while surrounded by and without people, for example*.* It is possible that a someone’s personality could have a completely different structure and thus association with health relevant variables across different contexts. If pathways related to health (risky driving, food choices) predominantly exist in one of those domains, it is important to assess the personality structure in that domain, not average across domains or as assessed in another. In contrast, more traditional approaches to integrating person and situations must statistically interact separate personality and situation terms (e.g. Sherman, Rauthmann, Serfass, & Jones, 2015), which may miss idiosyncratic patterns of person-situation transactions that idiographic network models can address.

*Conclusion*

Personality is a powerful predictor of health, but there are few well-established pathways between personality and health outcomes. The current chapter described two broad techniques to better characterize personality in the hopes of uncovering these pathways. Despite the promise, dynamic metrics and idiographic methods have not been applied to personality and health data. For the former, there is some evidence that mean levels are better predictors of well-being than the more dynamic metrics described above (Dejonckheere et al., 2019 paper); however, it remains unclear whether this is also the case for personality health-related outcomes. For the latter, a common misconception is that it is hard to describe general tendencies or make broad conclusions if every person in your sample is unique. However, both of these perceived limitations are unfounded. No study has examined dynamic metrics of personality to related them to health. Idiographic models can be described as distributions of parameter estimates or as classes of similar people. Together we feel that moving personality assessment beyond simple mean averages can inject new blood into the study of personality and health.

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