original article

# Within-person indicators of health

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With healthcare costs increasing in many nations, a better understanding of risk factors and health treatment effects is needed to enhance health prevention and treatment efficacy. Individuals are not affected similarly by risk factors, nor do they respond uniformly to treatment (overall or day-to-day). Further, some research questions do not lend themselves well to experimentation or traditional longitudinal research (e.g., stress-induced alcohol consumption), thereby complicating measurement. In particular, many variables (e.g., pain, mood, perceived control) are dynamic, with substantial fluctuation (within-person variability), and thus differentially predict outcomes (e.g., Eizenman, Nesselroade, Featherman, & Rowe, 1997). Given the importance of estimating variability in a phenomenon, single time-point measurements are insufficient in assessing the full range of within-person experiences (as opposed to the mean levels). To address these issues, some interventions (e.g., psychotherapy, weight-loss programs) employ journaling or daily surveys to capture within-person reactivity to internal and/or external cues and immediate treatment effects.

Whereas single variable fluctuation is interesting, many research questions concern relationships between multiple fluctuating variables. Researchers have turned to daily process or experience sampling methods combined with multilevel modeling to examine within-person associations among psychosocial variables and health behavior/outcomes, such as one's psychological mood reactivity to stressors or behavioral responses to a positive or negative experience. Results emerging from multilevel modeling analyses, then, involve an intercept and slope of a given person's relationship (such as stress-negative mood), which equates to each individual's own regression equation. The resulting slope provides an estimate of the extent to which people typically respond in a particular way when certain internal or external events occur. Thus, some people may have a more exaggerated or more reactive negative mood response to a given stressor than other individuals, as indicated by significant slope variance. Likewise, some people may have a more positive boost from an intervention activity or stimulus than others. For example, Erica might experience a significant increase in positive mood compared to her typical level of positive mood following supportive interactions. However, Amelia might not experience much change in positive mood, or indeed may actually experience decreases in positive mood. What this approach captures is the dynamic, day-to-day fluctuations that happen within the individual (i.e., some days may be more reactive than others), which is reflected in a positive, negative or neutral slope estimate.

Simultaneously, this approach also measures differences between individuals in that some people may show greater reactivity or responsiveness than others, as depicted in the example with Erica and Amelia. Indeed, this approach is conceptually similar to Mischel and Shoda's (1995) formative work, wherein they define personality as a series of stable but

distinctive if-then situation-behavior signatures, as opposed to previous work conceptualizing individual differences as cross-situationally consistent (Mohr et al., 2013). According to Mischel and Shoda, rather than predicting cross-situational consistency, one should look for reliable patterns of expected behavior within a particular context. So, for example, Amelia might not respond favorably to all socially supportive exchanges, but rather only those that she perceived as helpful or wanted.

Recently, however, researchers have begun to model within-person associations as predictors, rather than outcomes, as they represent potent indices of treatment responsiveness or health-risk reactivity. This addresses a conceptually similar question to one posed by Nesselroade and colleagues, who examined whether intra-individual variability in dynamic and fluctuating factors, (e.g., pain or moods), are powerful predictors of critical health outcomes over and above mean levels, including mortality (e.g., Eizenman et al., 1997). This approach (i.e. slopes-as-predictors) offers a significant advance for health psychologists to predict longer term health and well-being outcomes that contribute above and beyond mean levels of a given variable, such as stress or drinking. It also offers an assessment of the implications of these within-person associations that many of us have been studying for some time; for example, what does it mean that people have a more reactive response to negative events in terms of their well-being over time? What the slopes-as-predictors approach contributes is a unique and more objective measure of how variables that are naturally dynamic and fluctuating relate to longer-term outcomes, compared to more subjective, one-time measures. In particular, information gleaned from within-person associations assessed by repeated measures over time involves contingencies (e.g., stressor-mood; stress-drinking) that are likely outside the awareness of individuals. Indeed, the mechanism by which within-person slopes affect health outcomes is distinct from that by which mean levels influence the same outcomes, akin to the theoretical distinction of stressor exposure and stressor reactivity (Almeida, 2005). Similarly, slopes can predict in the opposite direction from what one might predict based on mean levels, as will be shown below. Although variations exist in this approach, one simple, straightforward method involves extracting individual person-level slopes from a multilevel modeling program, and then employing those as predictors of longer-term outcomes in linear regression equations (while controlling for baseline levels of the outcome; see Mohr et al., 2013).

Much of the existing work using the slopes-as-predictors method has focused on affective reactivity. One set of studies considering these relationships examined within-person negative affect reactivity, measured as same-day and next-day negative affect response to daily stressors, to predict responsiveness to cognitive therapy (Cohen et al., 2008; Gunthert, Cohen, Butler, & Beck, 2005). Results revealed that those who had greater next-day affect spillover responded less quickly to therapy compared to those with lower spillover. Negative event reactivity has also been linked to higher subsequent levels of depression (Parrish, Cohen, & Laurenceau, 2011). Another set of studies demonstrated that those with higher levels of affective reactivity experienced higher levels of general affective distress and likelihood of affective disorder after ten years (Charles, Piazza, Mogle, Sliwinski, & Almeida, 2013), as well as enhanced risk of chronic physical health conditions ten years later (Piazza, Charles, Sliwinski, Mogle, & Almeida, 2012).

My colleagues and I have also recently employed this approach in exploring consequences of behavioral reactivity (i.e. alcohol consumption) to daily positive and

negative mood experiences. In particular, our work has examined outcomes related to within-person mood-drinking relationships in a sample of moderate-to-heavy drinkers (Mohr et al., 2013). We revealed that negative mood-related solitary consumption was associated with lower levels of drinking-to-cope motivations twelve months later. This finding is particularly revealing in that it contradicts the prediction based on mean levels of consumption (i.e., greater consumption predicted stronger motives) and research examining self-reported alcohol use motivations. Although self-reports of drinking as a coping strategy typically predict negative health outcomes, such as alcohol abuse, our assessment of the relationship between negative mood-drinking slopes and follow-up drinking-to-cope motivation indicated a different (and less detrimental) outcome. Our conclusions support that daily mood-drinking associations are a distinct measure from self-reported coping motives. One explanation for our pattern of results may be that, consistent with the work recovery literature (Repetti, 1992), our participants socially withdrew on more stressful days to rejuvenate, which reduced coping motives for drinking over the longer term (at least among moderate drinkers). In contrast, participants who drank more alone on days with increases in positive mood actually demonstrated higher coping motives and lower social motives a year later. Although further research is needed to establish a firm understanding of this result, the positive mood-drinking alone relationship could serve as an index of relationship deficits, whereby these individuals may not have others with whom to share or capitalize on positive experiences (one potential byproduct of social, experience-enhancement drinking). In employing this approach, then, we may have uncovered a new behavioral risk factor for subsequent health problems, such that consistently drinking alone following increases in positive moods is consequential to health over time. Thus, we conclude that how and when people consume alcohol may be at least as important as how much they consume -information that cannot be gleaned from traditional self-report/survey methodology.

In sum, the slopes-as-predictors approach holds much promise for health psychologists striving to gain a better understanding of the interrelationships between psychosocial factors and health outcomes over time. It also affords a new tool for psychologists already interested in dynamic and fluctuating phenomena measured as within-person associations in their short-term context, in relation to longer-term outcomes. Lastly, the benefit of considering individual differences in within-person reactivity processes facilitates better prediction of longer-term health and well-being outcomes, which ultimately should improve prevention efforts.

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