Challenges with Latent Variable Approaches to Operationalizing Dimensions of Childhood adversity – a Commentary on Sisitsky et al. (2023)

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Abstract

Childhood adversity is a common, powerful risk factor for future mental and physical health problems. Appropriately aggregating and categorizing discrete adverse experiences into cumulative indices remains an active area of research and debate in the field of developmental psychopathology. In a recent article by Sisitsky et al. (2023), they report using confirmatory factor analysis and latent profile analysis to categorize participants into "profiles" of childhood adversity. In this commentary, we argue that categorizing dimensions or profiles of childhood adversity based on the tendency of adversities to co-occur is misaligned with dimensional models of adversity, which derive underlying dimensions from their tendency to cumulatively predict certain outcomes rather than adversity co-occurrence. We summarize the history of theories and methods of operationalizing childhood adversity that led to the development of the dimensional model of adversity and psychopathology. We then explain why latent variable approaches, which simply reflect the tendency of adverse experiences to co-occur, are inappropriate for validating any given approach.

Keywords Dimensional model · Childhood adversity · Deprivation · Threat · Factor analysis

Childhood adversity is a common, powerful risk factor for future mental and physical health problems. However, moving beyond this overarching pattern to characterizing the precise nature of the associations between constellations of adverse experiences and their developmental sequelae remains an active area of research and a challenge to the field of developmental psychopathology. Sisitsky et al. (2023) addressed this challenge by combining two factor-analytic approaches—confirmatory factor analysis and latent profile analysis—to categorize participants into 8 "profiles" of adversity and compare their relative associations with psychopathology and biological aging (telomere length). This approach is attractive for its intuitive appeal in suggesting that natural categories or profiles of adversity exist in the real world and that these profiles may have unique associations with developmental outcomes. However, categorizing

dimensions or profiles of childhood adversity based on their tendency to co-occur is misaligned with dimensional models of adversity, which instead derive underlying dimensions from their tendency to cumulatively predict certain outcomes. In this commentary, we outline existing theories and methods of operationalizing childhood adversity and explain why latent variable approaches are inappropriate for validating any given approach.

One approach to operationalizing childhood adversity has been to focus on the outcomes associated with a single type of adverse experience (e.g., physical abuse, institutional rearing). However, children frequently experience multiple different types of adversity, and isolating samples that have only experienced a single type of adversity is therefore both challenging and lacking in ecological relevance. Because adverse experiences both tend to co-occur and can have a cumulative impact on physical and mental health, counts of adverse experiences—termed cumulative risk or adverse childhood experiences (ACEs) scores—can be strong predictors of later life outcomes (Evans et al., 2013). However, if the goal of the research is not merely to predict the likelihood of later physical and mental health

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problems, but also to understand the mechanisms linking adversity with later health and to thereby identify targets for intervention, the ACEs approach is too imprecise. Because it implicitly assumes common mechanisms for the impact of diverse adverse experiences, it has led to an overemphasis of perceived stress and the physiological stress response as the primary mechanisms linking childhood adversity with later health (Evans et al., 2013).

Dimensional models propose that complex environmental experiences can be distilled into underlying dimensions of adversity (McLaughlin et al., 2014). Two initial dimensions proposed are threat—experiences involving harm or threat of harm, and deprivation—a reduction in environmental inputs that the brain has evolved to expect during development, such as social and cognitive stimulation. Unpredictability in the environment has also been proposed to influence development in distinct ways, but is more difficult to measure and has not been studied as thoroughly as threat and deprivation (McLaughlin et al., 2021). Based on the dimensional model of adversity and psychopathology, experiences of threat lead children to adapt by developing greater behavioral and neural sensitivity to potential cues of danger. Children who grow up in environments characterized by deprivation experience fewer social and cognitive inputs to guide the development of the brain's language and cognitive control circuitry (McLaughlin et al., 2014). Indeed, in our systematic review of the literature on childhood adversity and neural structure and function, we found evidence supporting distinct associations of threat and deprivation with structure and function of the fronto-amygdala and cognitive control network, respectively (McLaughlin et al., 2019). Similarly, and of particular relevance to Sisitsky et al.'s analyses, in a recent meta-analysis, threat-related adversity tended to be associated with accelerated biological aging across both pubertal timing and cellular aging, while deprivation was unrelated to the pace of biological aging (Colich et al., 2020). Importantly, the dimensional model of adversity argues, and these systematic reviews and meta-analyses support, that discrete measures of threat- and deprivation-related adversity are linked by their associations with certain neurodevelopmental outcomes, not by their tendency to co-occur.

Sisitsky et al. (2023) used confirmatory factor analysis to create latent factors for (1) threat experienced at home and (2) in the community, as well as two forms of deprivation: (3) lack of stimulation and (4) neglect. They then conducted latent profile analysis to derive 8 different profiles, representing different combinations of these experiences. This analysis creates profiles based on the specific adversities that tended to co-occur in their sample. Using this person-centered approach, they identified profiles that were at higher and lower risk for developing psychopathology.

These analytic decisions seem to be intuitive approaches to understanding dimensional profiles of adverse experiences, but in our view, the construction of latent constructs representing dimensions of adversity based on their correlational structure is misguided. With constructs like personality (e.g. extraversion) or psychopathology (e.g. depression), we assume that there is an unmeasured characteristic that causes individuals to respond in a convergent ways to the items and subscales that evaluate that characteristic. The shared variance of those items therefore reflects that unmeasured latent variable. This is sometimes referred to as a reflective measurement model (Hanafiah, 2020). However, dimensions of adversity are not bound together by their tendency to co-occur. Rather, we hypothesize that they are linked by their cumulative influence on particular outcomes (McLaughlin et al., 2014). For example, experiencing corporal punishment at home and violence in one's neighborhood need not be correlated for those two experiences to contribute in similar ways to a greater likelihood to engage in aggressive or delinquent behavior. The validity of dimensions of deprivation and threat therefore emerge from the tendency of their indices to relate to specific mechanisms and outcomes consistently and cumulatively (McLaughlin et al., 2021). This is sometimes referred to as a formative construct. Formative measurement models can also be estimated within a structural equation modelling framework, although their application in psychology is far less common than reflective, latent variable models. The specific technical and mathematical details of formative models are beyond the scope of this commentary, but importantly, they do not require that indices of the formative construct be highly correlated, or even positively correlated with each other (Hanafiah, 2020).

If correlations among measures of childhood adversity do not necessarily validate underlying dimensions of adversity, what might they indicate? In Sisitsky et al.'s analyses, it appears the convergence of particular items and indicators is based primarily on how the data was collected. Items from the conflict tactics scale tended to correlate with one another, as did the four parent-report items about cognitive stimulation, and the two indices of neighborhood crime; however, the four factors were also weakly but significantly correlated with one another. There are likely historical, sociological, and economic reasons for this co-occurrence. In particular, racial and socioeconomic inequality contribute to residential segregation and financial scarcity, both of which may lead to exposure to myriad adversities. While identifying the broad structural characteristics that drive exposure to multiple adversities is an important area for further investigation, it is a distinct question that should not be confounded with identifying dimensions of adversity that contribute cumulatively to distinct outcomes. Indeed, doing so may lead to misleading conclusions. When a latent construct

is defined based on the shared variance of its indicators, the variance in those indicators that is not shared is assigned to the residual and does not contribute to the latent factor. The relative contributions of indices of childhood adversity to a latent measure of a reflective latent construct of childhood adversity is therefore likely determined more by how much it corresponds to an underlying structural source of adversity (e.g. poverty, racism) than by the extent to which it causes stress or triggers a particular form of adaptation. This mathematical reality is at odds with the theoretical basis for dimensional models.

Better alignment between theory and analytic methodology is needed in studies attempting to validate and operationalize dimensional models of childhood adversity. For studies attempting to identify underlying structural sources of co-occurring adversities, reflective, latent variable approaches may have some utility. However, such an endeavor is independent of dimensional models of adversity. Indeed, measures of threat, deprivation, harshness, or unpredictability (McLaughlin et al., 2021) derive their validity formatively, from the extent to which they cumulatively predict certain outcomes. Some approaches to aggregating measures of dimensions of adversity—including counts of the number of different adverse experiences or standardizing scores across multiple measures—therefore require a priori categorization of measures along the dimensions of interest. Alternatively, network analysis can be leveraged as a data driven approach to identify dimensions of adversity by including not only measures of adversity experiences but also the hypothesized developmental correlates into the same network model. This approach has been used to evaluate the predictions of dimensional models in numerous recent studies (Carozza et al., 2022; Sheridan et al., 2020). Within a structural equation modeling framework, formative measurement models are a statistically rigorous but underutilized approach to modeling dimensions of adversity (Hanafiah, 2020). Regardless of the approach, the extent to which indices of a dimension of adversity are correlated with one another is not pertinent to the validity of that dimension as conceptualized within dimensional models of adversity. Reflective, latent variable approaches are an appropriate tool for estimating adversity co-occurrence but should not be used in work attempting to operationalize dimensions of adversity.

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