ADVANTAGES OF A DEVELOPMENTAL PSYCHOPATHOLOGY APPROACH

Advantages of a Developmental Psychopathology Approach to Studying the Antecedents of Physical Health

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Abstract

Although the field of developmental psychopathology has traditionally focused on mental health, there has been increasing interest in exploring how psychological and developmental factors are associated with physical health. I argue that the principles of developmental psychopathology may be particularly useful for understanding physical health across development. I discuss how researchers can apply the following developmental psychopathology principles to the study of physical health: 1) dimensional measurement of stress exposure, 2) the multifaceted nature of risk and resilience, 3) focus on processes and pathways, and 4) lifespan development and intergenerational effects. I provide several future directions and considerations for work in this area, many of which are consistent with the new goals of *Infant and Child Development*.

Advantages of a Developmental Psychopathology Approach to Studying the Antecedents of Physical Health

Research on physical health in childhood has traditionally focused on risk factors such as health behaviors, genetics, lack of medical care, structural barriers to health, racism, and other forms of discrimination. However, there is a growing understanding that psychosocial and developmental factors such as early life stress, loneliness, and psychopathology are fundamental to physical health. As more developmentalists study the risk and protective factors and sensitive periods for predicting physical health, we must reflect on strengths that we might bring to interdisciplinary collaborations to inform research in fields such as medicine or public health.

The developmental psychopathology approach is used by many developmentalists to understand both normative and non-normative psychological processes that contribute to psychological disorders and wellness across the lifespan (Cicchetti, 2006). Some developmentalists, who can come from many disciplinary backgrounds, use developmental psychopathology principles to understand the development and maintenance of psychopathology. Other developmentalists may focus on questions surrounding basic processes or clinical outcomes not directly related to psychopathology (e.g., physical health or academic outcomes) and typically do not use a developmental psychopathology framework. Although developmental psychopathology principles have been primarily used to explain psychological processes and outcomes, it is time to utilize the principles in the study of physical health across development. With substantial training in theory and lifespan methodology,

researchers trained in developmental psychopathology are particularly suited for formulating important research questions and improving methods to inform the study of physical health across the lifespan. Our understanding of the complexity of development enriches prevention and intervention efforts for improving physical health. This understanding includes how risk and resilience factors during specific early periods, such as in utero, infancy, childhood, or adolescence affect risk for chronic diseases that may not typically emerge until middle or late adulthood (e.g., cardiovascular disease). In addition, risk for both mental and physical health problems operate under several shared mechanisms, including those that are biological (e.g., inflammation; dysregulated hypothalamic-pituitary-adrenal axis activity), psychosocial (e.g., poor social support; emotion dysregulation), and behavioral (e.g., low inhibitory control; disrupted sleep). Given that developmentalists come from a wide range of disciplines and often have expertise in the complexity of ecological systems affecting an individual (e.g., family, socioeconomic, cultural, or other environmental contexts), we are well-situated to study the interplay of risk and resilience factors for physical health. In addition, we are ideally positioned to study and address factors that contribute to health disparities, which are most commonly studied in relation to race/ethnicity and socioeconomic status.

The first goal of the current paper is to encourage developmentalists to incorporate measures of physical health into existing work in developmental psychopathology given shared predictors and mechanisms underlying both mental and physical health. The second goal is to motivate researchers focused on physical health outcomes to adapt developmental psychopathology principles in their own research.

Ultimately, it will be ideal if researchers who typically study mental and physical health as separate outcomes integrate both outcomes into their work while incorporating the developmental psychopathology framework into their research. Below, I will illustrate the advantages of using the following developmental psychopathology principles to inform the study of physical health across the lifespan: 1) dimensional measurement of stress exposure, 2) the multifaceted nature of risk and resilience, 3) focus on processes and pathways, and 4) lifespan development and intergenerational effects.

Dimensional measurement of stress exposure

One of the most well-replicated findings in psychology is that greater exposure to psychosocial stress is associated with higher likelihood for mental and physical health problems (Anda et al., 2006; Hammen, 2005; Steptoe & Kivimäki, 2013). Although there has been an increase in studies incorporating multiple psychosocial factors to predict physical health, in many studies there is often a) only one measure of stress exposure (if any) that is collected in adulthood as a retrospective report, or b) a focus on cumulative stress exposure (e.g., number of adverse childhood experiences) predicting physical health outcomes. These approaches are problematic as they obscure a more nuanced understanding of how type, timing, severity, and chronicity of stress exposure may predict pathways to various physical health outcomes. Although researchers in developmental psychopathology have long recognized that different types of stress may have different associations with developmental outcomes, more recent theoretical work addresses the underlying characteristics of stress that may be measured dimensionally (Humphreys & Zeanah, 2015; McLaughlin et al., 2014). This move away from the traditional cumulative stress approach of measuring overall stress exposure to

measuring more individualized experiences such as type, timing, chronicity, and severity of stress is consistent with developmental psychopathology principles. Recent theoretical work has examined the separate dimensions of threat and deprivation as predictors of differential psychological outcomes (Humphreys & Zeanah, 2015; McLaughlin et al., 2014). Similarly, unpredictability in the environment has been identified as another stressor that may impact brain development and behavior in a unique manner (Baram et al., 2012). Effects of stressors characterized by threat (e.g., abuse), deprivation (neglect), or unpredictability (unpredictable maternal signals or lack of routine) may be different than effects of broader stressors such as economic hardship, which may include components of each of these types of stress. As each of these stressors may be associated with different psychological processes or outcomes, they may predict different profiles of physical health or pathways with implications for physical health. Instead of measuring the sequelae of cumulative stress exposure, a dimensional approach incorporating type, timing, severity, and chronicity of stress exposure may yield more nuanced understanding of physical health outcomes (Brumbach et al., 2009; Johnson et al., 2017; Mayer et al., 2019). This dimensional approach (McLaughlin et al., 2014) may also help us to target interventions based on profiles of risk to reduce health disparities for those experiencing higher burdens of stress exposure.

Multifaceted nature of risk and resilience

Another benefit of the developmental psychopathology approach is the focus on resilience and a strengths-based approach to examining individual-, family-, and community-level factors. This emphasis on strengths and assets is especially important

when considering disease prevention as many chronic diseases (e.g., cardiovascular disease, diabetes, cancer) do not typically emerge until adulthood and often co-occur with psychopathology. This transition to focusing more on health and well-being is reflected in the American Heart Association's goal of increasing ideal cardiovascular health (Folsom et al., 2011), which is positive cardiovascular health based on seven health and behavior metrics, such as physical activity, diet, and blood pressure. An understudied area of research is uncovering what assets individuals possess that might lead to ideal health. Instead of focusing on risk and disease, a strengths-based approach incorporating principles of resilience may be a more helpful approach to promoting health. One example of centering on strengths involves recent research focusing on positive or benevolent childhood experiences—as opposed to adverse childhood experiences—and their associations with improved health (e.g., Crandall et al., 2019, 2020; Narayan et al., 2018). Positive or benevolent childhood experiences are not necessarily out of reach for many families to implement even if a child has experienced several adverse experiences, which is in line with Masten's concept of "ordinary magic" (Masten, 2001). For example, having at least one safe caregiver, having one good friend, and having at least one teacher who cared are each considered to be positive or benevolent childhood experiences (Narayan et al., 2018) that may have direct implications for future physical health.

At the core of the developmental psychopathology approach is a focus on multiple levels of analysis (Cicchetti & Blender, 2006). Most research on physical health examines factors at a single level (e.g., biological or environmental), often driven by medical and epidemiological research on prominent risk factors for physical health

problems. Research studying multiple levels of analysis, including structural, social, environmental, and biological factors that contribute to health disparities simultaneously is needed. For example, when studying cardiovascular health, research groups in public health may focus on environmental factors, such as air pollution or noise, as contributing to cardiovascular risk (Daiber et al., 2019). Physicians may focus on health behaviors (e.g., sleep, physical activity, diet), while geneticists target genetic and family-level risk, and psychologists focus on personality factors or psychosocial stress exposures that may increase later cardiovascular risk. Studies integrating factors from each of these areas of inquiry will provide the best evidence for which factors will be the most important to target in interventions to improve cardiovascular health. Evidence is growing that factors such as air pollution, noise, health behaviors, genetics, personality, and stress are related are also related to mental health (Biddle & Asare, 2011; Buoli et al., 2018; Sygna et al., 2014). As many biological, behavioral, and psychological pathways that lead to physical and mental health problems are shared, targeting these pathways simultaneously may reduce the burden of both disease and psychopathology. Ideally these multi-pronged interventions will consider individual strengths and adaptations while also addressing environmental and structural barriers to health. Although challenging to implement, these types of interventions will have the greatest likelihood for success in reducing health disparities.

When including multiple levels of analysis, it is important to consider proximal factors such as children's individual characteristics in addition to broader structural/environmental factors. For example, factors that influence children's physical health, such as poverty, are often discussed as external factors that influence the child

without consideration of what capacities children bring to the table in interacting with these factors or in shaping their own environments. This concern is especially important when considering child health in contexts of adversity where children must navigate multiple risk factors while also harnessing resilience factors. An important question remains in understanding how children develop abilities to effectively cope with challenges and what factors may lead to failures in coping (Pollak, 2015). How do differences in children's coping capacities emerge in contexts of adversity, and what role do these capacities have in shaping children's biology, behavior, and ultimately their physical health?

Considerations of children's capacities and interactions with their environment must integrate whether these capacities and interactions are *adaptive within the context*. For example, there is growing evidence that behavioral and physiological adaptations children make to adverse environments may have short-term benefits but lead to long-term consequences if the environment is chronically adverse. For example, low self-control or inhibition of impulsive behavior has been documented as a correlate of early adversity and a predictor of poorer mental and physical health outcomes (Meldrum et al., 2020; Miller et al., 2011). However, it may not be advantageous to have high inhibition in unpredictable environments where you may need to act quickly to obtain scarce resources, such as food-insecure environments. Similarly, physiological adaptations that have been associated with chronic childhood adversity and poorer mental and physical health outcomes may act protectively in the short-term but lead to long-term dysregulation in stress biology (Gunnar & Vazquez, 2001). It is impossible to

understand a behavioral or biological response—and certainly incorrect to assume a response is negative or maladaptive—without considering the context.

Combining the principle of multiple levels of analysis with the focus on resilience, there is an increasing realization that risk in one domain of functioning does not necessarily translate to other domains of functioning. Instead, risk and resilience may be multifaceted, where an individual may demonstrate positive outcomes in certain domains but more negative outcomes in others. This concept of multifaceted resilience is somewhat in line with the developmental psychopathology principle of multifinality (Cicchetti & Rogosch, 1996), where the same environmental factor may predict different outcomes for different individuals (e.g., chronic childhood abuse leading to depression for some and cardiovascular disease for others). One example of multifaceted resilience, where individuals may be functioning well in some domains but not others, is *skin-deep resilience*. The concept of skin-deep resilience suggests that for some individuals, there may be a cost to physical health for succeeding in psychosocial or academic domains. For example, for African American youth from low-socioeconomic status backgrounds, persisting to succeed and maintaining high self-control may increase academic success and improve mental health but come with a cost to physical health (Brody et al., 2020). Future work assessing why individuals may show resilience in the face of adversity in certain domains but risk in others will be important for more personalized interventions tailored to individuals that will ideally reduce health disparities.

Focus on processes and pathways

Another strength of the developmental psychopathology approach is the focus on processes and pathways rather than solely focusing on specific outcomes (Pollak, 2015). As a result, we can understand risk and protective factors influencing why an individual progresses along one pathway towards poorer physical health versus another leading to more ideal health. Likewise, we can understand whether similar pathways lead to multiple outcomes, such as cardiovascular disease, diabetes, depression, and anxiety. Pathways that may be unique to each of these outcomes can be teased apart using a process-oriented approach rather than only focusing on risk factors and distal outcomes. Though processes like the development of glucocorticoid resistance, enhanced inflammatory signaling, and decreased self-regulation capacities have been implicated in the development of both mental and physical health problems (Evans & Kim, 2013; Miller et al., 2002), few studies incorporate assessment of both mental and physical health. Understanding what adaptive or maladaptive processes underlie multiple outcomes may allow us to understand mental and physical health more broadly than focusing on one diagnosis.

Lifespan development and intergenerational effects

Finally, developmental psychopathology focuses on lifespan development and intergenerational effects of factors such as childhood trauma and attachment. Given increased recognition of prenatal and intergenerational transmission of risk and resilience for physical health outcomes (Bowers & Yehuda, 2016; Entringer et al., 2010), future work must focus on the earliest developmental periods and lifespan health. This focus is also consistent with *Infant and Child Development's* newly expanded focus on the prenatal period through young adulthood.

Inherent to a lifespan approach is the understanding that risk for adult disease begins long before adulthood and that individual risk can be traced to childhood, the prenatal period, and even to previous generations. An increased focus in psychology, medicine, and public health has been placed on prevention of adult disease, which has led to interdisciplinary fields such as prevention science or more specific disciplines such as pediatric preventive cardiology. Lifespan approaches to both mental and physical health allow us to think about risk and resilience in biology and behavior long before disease emerges, which gives us a better chance to reduce the human suffering associated with adult disease *and* reduce health disparities by intervening early. As discussed above, interventions that harness the strengths and assets of families early in life may lead to even more effective preventive interventions (Sapienza & Masten, 2011). Intergenerational strengths within families that may be applied to interventions may be a particularly fruitful area for future research.

Future directions

1. Focus on adaptation at multiple levels

Future studies should focus on adaptation to adversity at multiple levels by measuring both mental and physical health in the same studies, although this is rarely done. Incorporating multiple levels of health will allow us to better understand the multifaceted nature of resilience to inform prevention and intervention. Some examples of minimally invasive measures of physical health that researchers who primarily focus on mental health can include in studies are height and weight to calculate body mass index, waist circumference, and questionnaires that assess physical health. My colleagues across pediatrics, public health, and psychology and I recently published a

review paper of methods to assess cardiometabolic health in pediatric populations experiencing high levels of stress (see Doom et al., 2020). Incorporating multiple levels of mental and physical health assessment in studies using developmental psychopathology principles may allow us to target individuals for intervention who might be more at risk for *both* mental and physical health problems following chronic adversity.

2. Interdisciplinary research across the lifespan

In order to study adaptation at multiple levels, there must be interdisciplinary crosstalk with researchers in public health, medicine, and clinical, developmental, and health psychology, among other fields. To make sure that research-informed interventions serve their target audiences in an effective way, practitioners and policy makers must also be a part of the process. It will be important to have developmentalists at the table for these conversations to ensure a lifespan and intergenerational approach to physical health.

3. Focus on health rather than risk

Future studies should shift the focus from just reducing risk for poor health to actively promoting ideal health. A focus on identifying individual strengths or protective factors will be important in addition to promoting programs that actively incorporate protective factors such as increasing positive childhood experiences and prevent risk factors like adverse childhood experiences.

4. Reducing health disparities

There are stark health disparities that exist in the United States due to a multitude of factors, including high socioeconomic inequality, unequal access to healthcare,

racism, and discrimination due to gender, sexual identity, or disability status. In addition to fixing underlying structural causes of health disparities to achieve health equity (Braveman et al., 2011), researchers need to focus on including populations that have typically been excluded or understudied in future research studies. This recommendation is consistent with the push in *Infant and Child Development* for more inclusive science, encouraging more diversity in research participants. In particular, understanding protective factors and strengths of individuals from groups experiencing health disparities will be crucial. In line with future direction 3 above, rather than focusing on only risk, assessing and harnessing strengths for groups that have experienced discrimination and exclusion to create more effective interventions will be vital.

As part of understanding how the type/nature, timing, chronicity, and severity of stressors may lead to different outcomes, stressors that are more unique to populations who have experienced health disparities will be increasingly important (Lewis, Cogburn, & Williams, 2015). For example, a better understanding of how experiences of discrimination or racism may lead to changes in biology and behavior will be important for reducing health disparities. It has been proposed that racism and discrimination should be considered as additional adverse childhood experiences given their associations with poorer mental and physical health (Cronholm et al., 2015). This proposal is an excellent idea for advancing research and policy on health disparities. Further, removing structural barriers that lead to health disparities, and studying whether such changes lead to greater health equity will also be important. Given the

current sociopolitical context in the United States and increasing health disparities due to the COVID-19 pandemic, this research could not be more vital.

Conclusion

In closing, there exist many promising opportunities to guide research, prevention, and intervention efforts bringing together developmental psychopathology and physical health. Now is the time for a renewed commitment to interdisciplinary efforts to promote ideal health and health equity using principles of developmental psychopathology.

References

- Anda, R. F., Felitti, V. J., Bremner, J. D., Walker, J. D., Whitfield, C. H., Perry, B. D., Dube, S. R., & Giles, W. H. (2006). The enduring effects of abuse and related adverse experiences in childhood. *European Archives of Psychiatry and Clinical Neuroscience*, 256(3), 174–186.
- Baram, T. Z., Davis, E. P., Obenaus, A., Sandman, C. A., Small, S. L., Solodkin, A., & Stern, H. (2012). Fragmentation and unpredictability of early-life experience in mental disorders. *American Journal of Psychiatry*, 169(9), 907–915.
- Biddle, S. J., & Asare, M. (2011). Physical activity and mental health in children and adolescents: A review of reviews. *British Journal of Sports Medicine*, 45(11), 886–895.
- Bowers, M. E., & Yehuda, R. (2016). Intergenerational transmission of stress in humans. *Neuropsychopharmacology*, 41(1), 232–244.
- Braveman, P. A., Kumanyika, S., Fielding, J., LaVeist, T., Borrell, L. N., Manderscheid, R., & Troutman, A. (2011). Health disparities and health equity: The issue is justice. *American Journal of Public Health*, 101(S1), S149–S155.
- Brody, G. H., Yu, T., Chen, E., & Miller, G. E. (2020). Persistence of skin-deep resilience in African American adults. *Health Psychology*.
- Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies. *Human Nature*, 20(1), 25–51.

- Buoli, M., Grassi, S., Caldiroli, A., Carnevali, G. S., Mucci, F., Iodice, S., Cantone, L., Pergoli, L., & Bollati, V. (2018). Is there a link between air pollution and mental disorders? *Environment International*, 118, 154–168.
- Cicchetti, D. (2006). Developmental psychopathology. In D. Cicchetti & D. Cohen (Eds.), *Developmental psychopathology: Vol. 1. Theory and method* (2nd ed., pp. 1–23). Wiley.
- Cicchetti, D., & Blender, J. A. (2006). A multiple-levels-of-analysis perspective on resilience: Implications for the developing brain, neural plasticity, and preventive interventions. *Annals of the New York Academy of Sciences*, 1094(1), 248–258.
- Cicchetti, D., & Rogosch, F. A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*, 8(4), 597–600.
<https://doi.org/10.1017/S0954579400007318>
- Crandall, A., Broadbent, E., Stanfill, M., Magnusson, B. M., Novilla, M. L. B., Hanson, C. L., & Barnes, M. D. (2020). The influence of adverse and advantageous childhood experiences during adolescence on young adult health. *Child Abuse & Neglect*, 108, 104644.
- Crandall, A., Miller, J. R., Cheung, A., Novilla, L. K., Glade, R., Novilla, M. L. B., Magnusson, B. M., Leavitt, B. L., Barnes, M. D., & Hanson, C. L. (2019). ACEs and counter-ACEs: How positive and negative childhood experiences influence adult health. *Child Abuse & Neglect*, 96, 104089.
- Cronholm, P. F., Forke, C. M., Wade, R., Bair-Merritt, M. H., Davis, M., Harkins-Schwarz, M., Pachter, L. M., & Fein, J. A. (2015). Adverse childhood

- experiences: Expanding the concept of adversity. *American Journal of Preventive Medicine*, 49(3), 354–361.
- Daiber, A., Lelieveld, J., Steven, S., Oelze, M., Kröller-Schön, S., Sørensen, M., & Münzel, T. (2019). The “exposome” concept—how environmental risk factors influence cardiovascular health. *Acta Biochimica Polonica*, 66(3), 269–283.
- Doom, J. R., Reid, B. M., Nagel, E., Gahagan, S., Demerath, E. W., & Lumeng, J. C. (2020). Integrating anthropometric and cardiometabolic health methods in stress, early experiences, and development (SEED) science. *Developmental Psychobiology*.
- Entringer, S., Buss, C., & Wadhwa, P. D. (2010). Prenatal stress and developmental programming of human health and disease risk: Concepts and integration of empirical findings. *Current Opinion in Endocrinology, Diabetes, and Obesity*, 17(6), 507.
- Evans, G. W., & Kim, P. (2013). Childhood poverty, chronic stress, self-regulation, and coping. *Child Development Perspectives*, 7(1), 43–48.
- Folsom, A. R., Yatsuya, H., Nettleton, J. A., Lutsey, P. L., Cushman, M., Rosamond, W. D., & Investigators, A. S. (2011). Community prevalence of ideal cardiovascular health, by the American Heart Association definition, and relationship with cardiovascular disease incidence. *Journal of the American College of Cardiology*, 57(16), 1690–1696.
- Gunnar, M. R., & Vazquez, D. M. (2001). Low cortisol and a flattening of expected daytime rhythm: Potential indices of risk in human development. *Development and Psychopathology*, 13(03), 515–538.

- Hammen, C. (2005). Stress and depression. *Annu. Rev. Clin. Psychol.*, 1, 293–319.
- Humphreys, K. L., & Zeanah, C. H. (2015). Deviations from the expectable environment in early childhood and emerging psychopathology. *Neuropsychopharmacology*, 40(1), 154.
- Johnson, W. F., Huelsnitz, C. O., Carlson, E. A., Roisman, G. I., Englund, M. M., Miller, G. E., & Simpson, J. A. (2017). Childhood abuse and neglect and physical health at midlife: Prospective, longitudinal evidence. *Development and Psychopathology*, 29(5), 1935–1946.
- Masten, A. S. (2001). Ordinary magic: Resilience processes in development. *American Psychologist*, 56(3), 227.
- Mayer, S. E., Prather, A. A., Puterman, E., Lin, J., Arenander, J., Coccia, M., Shields, G. S., Slavich, G. M., & Epel, E. S. (2019). Cumulative lifetime stress exposure and leukocyte telomere length attrition: The unique role of stressor duration and exposure timing. *Psychoneuroendocrinology*, 104, 210–218.
- McLaughlin, K. A., Sheridan, M. A., & Lambert, H. K. (2014). Childhood adversity and neural development: Deprivation and threat as distinct dimensions of early experience. *Neuroscience & Biobehavioral Reviews*, 47, 578–591.
- Meldrum, R. C., Champion Young, B., Soor, S., Hay, C., Copp, J. E., Trace, M., Smith-Darden, J. P., & Kernsmith, P. D. (2020). Are adverse childhood experiences associated with deficits in self-control? A test among two independent samples of youth. *Criminal Justice and Behavior*, 47(2), 166–186.

- Miller, G. E., Cohen, S., & Ritchey, A. K. (2002). Chronic psychological stress and the regulation of pro-inflammatory cytokines: A glucocorticoid-resistance model. *Health Psychology, 21*(6), 531. <https://doi.org/10.1073/pnas.1118355109>
- Miller, H. V., Barnes, J. C., & Beaver, K. M. (2011). Self-control and health outcomes in a nationally representative sample. *American Journal of Health Behavior, 35*(1), 15–27.
- Narayan, A. J., Rivera, L. M., Bernstein, R. E., Harris, W. W., & Lieberman, A. F. (2018). Positive childhood experiences predict less psychopathology and stress in pregnant women with childhood adversity: A pilot study of the benevolent childhood experiences (BCEs) scale. *Child Abuse & Neglect, 78*, 19–30.
- Pollak, S. D. (2015). Developmental psychopathology: Recent advances and future challenges. *World Psychiatry, 14*(3), 262–269.
- Sapientza, J. K., & Masten, A. S. (2011). Understanding and promoting resilience in children and youth. *Current Opinion in Psychiatry, 24*(4), 267–273.
- Steptoe, A., & Kivimäki, M. (2013). Stress and cardiovascular disease: An update on current knowledge. *Annual Review of Public Health, 34*, 337–354.
- Sygna, K., Aasvang, G. M., Aamodt, G., Oftedal, B., & Krog, N. H. (2014). Road traffic noise, sleep and mental health. *Environmental Research, 131*, 17–24.