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HUMAN DEVELOPMENT, BIRTH TO DEATH

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Concept Paper Form

Provisional Paper Title: Developing a p-factor screening questionnaire
Proposing Authors: Renate Houts, Ethan Whitman, Kathy Xie, Matt Hanna
Authors' Emails: renate.houts@duke.edu, ethan.whitman@duke.edu, kathy.xie@duke.edu, matt.hanna@duke.edu
P.I. Sponsor: Avshalom Caspi (if the proposing author is a student or colleague of an original PI)
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Please describe your proposal in 2-3 pages with sufficient detail for helpful review.

Objective of the study:

Mental disorders tend to co-occur, and this significant overlap between diagnoses has prompted the development of the 'p-factor', a general factor of psychopathology. This factor, repeatedly described in datasets spanning from childhood to adulthood (Caspi et al., 2020; Calkins et al., 2016), represents an underlying vulnerability toward developing any type of psychopathology. P-factor is associated with poor psychosocial outcomes and brain impairment throughout the lifespan (Caspi et al., 2014). It explains high levels of comorbidity in mental disorders within an individual at one point in time, throughout an individual's lifespan, and across generations (Caspi et al., 2020, 2023). People high in p are prone to experience multidimensional psychiatric symptoms, whereas people low in p may experience symptoms only within a single dimension. That is, p can be conceptualized as a proxy of mechanisms that span across mental disorders and across time.

Rather than being measured directly, currently p is constructed using statistical modelling of common variance after collecting highly detailed, potentially longitudinal measurements of psychopathology using established inventories (Caspi et al., 2014; Haltigan et al., 2018). This complexity constrains its use in contexts where detailed phenotyping and modeling are not feasible. To enhance its accessibility and utility, this study intends to explore the feasibility of developing a streamlined, single-time-point instrument that accurately captures the p-factor using a subset of items from the Multidimensional Personality Questionnaire (MPQ).

The rationale behind using personality traits as markers of the p-factor stems from previous studies that have uncovered significant correlations between personality traits, personality disorders, and the p-factor (Sharp et al., 2015; Wright et al., 2016; Oltmanns et al., 2018;

McCabe et al., 2022). McCabe et al (2022) found high correlations between the p-factor, a general factor of personality disorder (PD) and a general factor of personality (GFP) [r(p, PD) = .94; r(p, GFP) = .74; r(PD, GFP) = .78]. Their "General Factor of Everything," which combined indicators of all three, fit well, suggesting that p and personality share important features. Personality traits might not only reflect an individual's inherent disposition towards psychopathology but may also potentially alter with the onset and progression of psychopathology (Lewinsohn, et al., 1981; Rhode, Lewinsohn, Seeley, 1990).

In this study, we aim to capitalize on the rich data from the Dunedin Study, with a specific focus on personality measurements at ages 18 and 26. Our primary objective is to construct a streamlined, single-time-point instrument representing the p-factor, by using a subset of items from the Multidimensional Personality Questionnaire (MPQ). We hope that this tool will make the p-factor more accessible and practical in predicting and understanding psychopathology. Additionally, we will ensure that our p-screener effectively captures known correlates of the p-factor, akin to the performance of the p-factor itself. Finally, to test the validity and applicability of our new instrument, we will apply it to diverse datasets that contain MPQ item-level data and assess its precision in predicting the p-factor across varying populations. This work holds the potential to significantly enrich our understanding of psychopathology and provide clinicians and researchers with a practical tool in their work.

This study aims to answer the following questions:

Question 1: Can we develop a streamlined, single-time-point instrument that accurately represents the p-factor using a subset of items from the Multidimensional Personality Questionnaire (MPQ) at ages 18 and 26 in the Dunedin Study?

Question 2: Does our p-screener capture known correlates of the "real" p-factor as effectively as the p-factor itself?

Question 3: How accurately does our instrument, derived from Dunedin Study data, predict the p-factor when applied to different datasets that have MPQ item-level data?

Data analysis methods:

Initial item screening

We will begin by screening MPQ items at age 18 and 26 to determine data coverage and the extent of missing data. The age 18 MPQ documentation suggests we will likely need to deal with missing item-level data. Specifically, due to time constraints, a substantial number of study members did not receive approximately 40 MPQ items. We will determine the most appropriate way to deal with missing data. Possible approaches include (i) examining the stability of those items from age 18-26 to determine whether "back-filling" missing age 18 items with age 26 data would alter results substantially, (ii) removing items with substantial missing data from consideration, or (iii) implementing more sophisticated approaches such as multiple imputation or full information maximum likelihood.

Question 1: Can we develop a streamlined, single-time-point instrument that accurately represents the p-factor using a subset of items from the Multidimensional Personality Questionnaire (MPQ) at ages 18 and 26 in the Dunedin Study?

To answer this question, we will use elastic net regression to (i) test the accuracy with which p can be estimated from MPQ items and (ii) identify which items are necessary for estimating p. Elastic net regression is a widely-used penalized linear regression technique for predicting outcomes based on a high-dimensional dataset. When building our model, we will split the Dunedin Study cohort into training/validation/testing subsets to help ensure predictive accuracy of our regression models. Once models are constructed, we will inspect the individual regression weights assigned to each MPQ item to determine which items were most important in generating an accurate prediction of p. These influential items are potential candidates for inclusion in our streamlined instrument.

By applying all non-zero regression weights, we will be able to develop an algorithm to estimate p using a subset of MPQ responses. This algorithm's effectiveness in accurately predicting p will be our primary criterion in deciding which items to include in the final instrument. Furthermore, we will aim for an optimal balance between the number of items (i.e., length of the instrument) and the instrument's accuracy, as brevity and ease-of-use are key considerations for a practical, clinically useful tool.

Items with strong predictive value will be prioritized. We will also consider the face validity of the items in relation to the p-factor, ensuring the final instrument is not only statistically robust but also conceptually aligned with the construct of p. The resulting instrument will then be subjected to rigorous cross-validation, where its performance will be assessed based on its ability to accurately predict p within the validation subset of the Dunedin Study cohort. The instrument may undergo several rounds of refinement, based on these validation results, before a final version is confirmed. This systematic approach ensures the reliability, validity, and practical utility of our streamlined instrument for capturing p, while also taking into account the stability of the instrument over time.

In addition to creating this single-time-point instrument, we will pay special attention to the stability of the instrument over time. This will involve comparing the selected MPQ items and their respective regression weights at ages 18 and 26, and assessing whether the same items are selected at both time points. Further, we will examine if the p-screener's total score at either age point better reflects the p-factor. We will also evaluate the stability and changes in individuals' p-screener total scores from ages 18 to 26.

Question 2: Does our p-screener capture known correlates of the “real” p-factor as effectively as the p-factor itself?

To validate our p-screener against the established p-factor, we will conduct a series of comparative analyses focused on replicating the known correlational network of the p-factor, often referred to as a "nomological net." This methodological approach provides a robust framework for exploring whether our p-screener echoes the same relationships with a chosen set of key variables as does the p-factor.

First, we will identify a set of salient constructs, each with established associations with the p-factor, to serve as our comparative measures. The selection may include parameters such as family history of psychopathology, childhood IQ, self-control in early life, exposure to maltreatment during childhood, inflammation, social class of origin, and aging markers. These variables have demonstrated consistent and substantial correlations with the p-factor, underscoring their validity in our comparative analysis.

Subsequently, we'll calculate two distinct sets of correlations. The first will depict the relationship between the established p-factor and the chosen measures, using p-factor scores derived from the comprehensive Dunedin Study dataset. The second set of correlations will outline the relationship between our novel p-screener and the chosen measures, using scores derived from the p-screener.

Our analytic strategy will involve contrasting these two sets of correlation coefficients. If our p-screener indeed embodies the same psychopathological essence as the p-factor, we expect the corresponding correlations between our p-screener scores and the chosen measures to parallel those derived from the original p-factor.

To quantify the degree of congruence between the two sets of correlations, we'll compute differential scores. These represent the deviations between correlations involving the p-factor and those involving the p-screener. To determine if these differential scores significantly deviate from zero, we will employ one-sample t-tests. Non-significant deviations from zero would lend credence to the argument that our p-screener effectively mirrors the p-factor.

This approach ensures a robust evaluation of our p-screener, addressing its ability to capture the breadth of psychopathological outcomes and correlates reflected in the "real" p-factor. This is a critical step in substantiating the validity of our p-screener, setting the stage for its future applications in research and clinical settings.

Question 3: How accurately does our instrument, derived from Dunedin Study data, predict the p-factor when applied to different datasets that have MPQ item-level data?

We will attempt to replicate findings from the Dunedin study using other data that have the MPQ available (e.g., Minnesota Twin Registry data). This will help us evaluate the accuracy of our instrument when applied to different datasets.

Secondary analyses:

In purely exploratory analyses, we will repeat the analyses outlined above using psychopathology factors from the correlated-factors model (i.e., Externalizing, Internalizing, Thought Disorders) to investigate how the derived personality-based screening measures compare to that derived for the p-factor.

Similarly we will repeat the analyses outlined above using mental disorder Age of Onset, Persistence, and Variety to investigate how the derived personality-based screening measures compare to that derived for the p-factor.

Variables needed at which ages:

Dependent variables:

- (primary) p-factor from Phase 45 bi-factor model
- (secondary) externalizing, internalizing, and thought disorder factors from Phase 45 correlated-factors model; age of onset of mental health disorders, persistence of mental health disorders, variety of mental health disorders (from Caspi, et al., 2020)

Independent variables:

- (primary) Individual MPQ items (and scales/composites) at Phases 18 & 26

Covariates/additional independent variables

- Sex
- Education
- Childhood SES
- Any mental health diagnosis, ages 11-15y, 18y, 21y, 26y, 32y, 38y, 45y

Possible "nomological net" testing variables (ala Caspi, et al, 2014)

- Big 5
    - Extraversion
    - Agreeableness
    - Conscientiousness
    - Neuroticism
    - Openness to experience
- Life impairment
    - Suicide attempt
    - Psychiatric hospitalization
    - Duration of social welfare benefit use
    - Violence conviction
- Developmental history
    - Social class
    - Family history of psychiatric disorder (depression, anxiety, psychosis, conduct disorder or antisocial personality, substance dependence)
    - Childhood history of psychiatric disorder
    - Childhood maltreatment
- Brain integrity
    - At 45:
        - WAIS-IV 45 (FSIQ, VCI, PRI, WMI, PSI)
        - Trail Making Test B
        - WMS-III: Mental control
        - Rey (recall & delayed recall)
        - Grooved pegboard
        - One-legged balance
        - "Everyday cognitive impairment"
    - At age 3y:
        - Brain integrity (w/ subtests: PPVT, Baley, Reynell, neurological abnormalities, examiner-rated lack of control)

    - Childhood:
        - IQ-5
        - WISC-R 7-11
        - Low self-control
- Possible additional measures not included in Caspi, et al (2014)
    - BrainAge
    - Gait speed
    - Inflammation (e.g, suPAR)

Significance of the Study (for theory, research methods or clinical practice):

Having a direct and translatable measure of p will increase the use of p in research and clinical settings.

For theory, the study (i) will provide insight on which trait-level characteristics are most associated with general psychopathology; (ii) will provide alternative means of conceptualizing general psychopathology; and (iii) may help identify at which time points during adulthood certain traits are most predictive of general psychopathology. This deepens our understanding of the p-factor and its intricate relationship with personality traits, advancing theoretical perspectives on the universal propensity for psychopathology.

For research methods, the study will create a tool that (i) can be used in studies of continuity and change of psychopathology across the lifespan as well as studies of interventions; (ii) can identify traits that are highly correlated with general psychopathology to guide future questions about etiology; and (iii) will allow better harmonization of findings across research studies, fostering a unified, consistent, and comparable approach to studying the p-factor.

For clinical practice, a short self-report questionnaire predictive of psychopathology can be used to screen patients in both mental health and primary care visits. This will enable early detection, targeted intervention, and better patient care outcomes. By integrating the p-screener into routine clinical assessments, practitioners will be better equipped to identify at-risk individuals and tailor treatment strategies accordingly.

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