The Anatomy of Developmental Predictors Of Healthy Lives Study (TADPOHLS)

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Abstract

Numerous studies have followed people across significant portions of their lives. Secondary analyses with these studies offer opportunities to study life trajectories across diverse samples. To aid integrative efforts, we introduce The Anatomy of Developmental Predictors Of Healthy Lives Study (TADPOHLS), a data base that categorizes items and constructs from 14 prospective longitudinal studies that followed participants from adolescence into adulthood. To classify items and measures, we created an extensive typology that provides a common language for categorizing study concepts. We illustrate the utility of the data base by examining adolescent perseverance and optimism as predictors of physical health outcomes across six studies. Adolescent perseverance and optimism were related to better physical health outcomes 15 to 20 years later. Overall, the data base offers a resource that contributes toward life-span studies of positive psychological and physical health.

Keywords: adolescents; well-being; physical health; integrative data analysis; longitudinal analysis; life-span perspective; secondary data analysis

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"Long term longitudinal studies are like mature trees… like a century-old oak, such studies are rare resources and can add to our knowledge base in ways newer longitudinal studies cannot."
~ Daniel Mroczek, 2014

Longitudinal studies are invaluable for investigating the development of health and well-being over the life course. There are now numerous studies available for secondary data analyses that have followed participants across decades of their lives. These investigations have collected detailed information on personal factors, environments, behaviors, physical health, and psychological functioning. Analysts wishing to use one of these datasets can feel overwhelmed in finding and selecting the right one for their purpose. To address this challenge, we developed The Anatomy of Developmental Predictors Of Healthy Lives Study (TADPOHLS) data base, which provides a typology of items and constructs from 14 longitudinal studies.

Longitudinal studies are rich sources of data that potentially can be used to examine temporal associations and change, control for confounding covariates, and capture different contexts of development (Hofer, Berg & Era, 2003; Hofer & Sliwinski, 2001; Salthouse & Nesselroade, 2002; Slavich & Irwin, 2014). Each longitudinal study represents a major investment of time, money, and resources for researchers, participants, and funding agencies; therefore, it is incumbent on the research community to make optimal use of these data. However, any single longitudinal study is limited in numerous ways, including selection effects, historical period, attrition, missing data, and the quality of measures and documentation (Curran & Hussong, 2009; Hofer & Piccinin, 2009; Hofer & Sliwinski, 2006; Salthouse & Nesselroade, 2002).

Both cross-sectional and longitudinal designs have strong underlying assumptions that affect conclusions about development (Schaie, 1965). Cross-sequential, measurement burst, and

other designs that combine elements of cross-sectional and longitudinal data have been developed to address some of the problems and limitations inherent to either type (e.g., Hofer & Sliwinski, 2001; Nesselroade, 2004; Salthouse & Nesselroade, 2002; Schaie, 1965; Schai & Strother, 1965). Although we cannot change the structure of existing longitudinal studies, there is growing evidence that it is possible to directly integrate some studies together in a quasi cross-sequential design to test developmental theories of health and well-being (e.g., Friedman, Kern, Hampson, & Duckworth, 2014; Hofer & Piccinin, 2010; Hussong, Curran, & Bauer, 2013; Piccinin & Hofer, 2008). However, such work is neither straightforward nor simple.

Hofer and Picinnin (2009) summarized several levels of strategies that can be employed to build a comprehensive understanding of development with longitudinal studies. A typical approach is *sequential independent replication*, in which one study finds an association that is then replicated and extended in other studies. This approach is a key foundation of causal theory in contemporary social science. However, two common problems arise. First, due to study limitations, differing methodologies across studies, and an overreliance on significance rather than effect sizes, a subsequent study that purports to address the same hypothesis as a predecessor may produce findings that are quantitatively or qualitatively different. For example, comparing multiple cross-sectional cohorts with the same individuals measured over time, Schaie and Strother (1968) found strikingly different patterns, suggesting that developmental differences were more a function of cohort than developmental change. Second, due to the tendency within the field to focus on “new” findings, replications are often not conducted or have been only conceptual in nature, such that the self-correcting process of science has not occurred (Duncan, Engel, Claessens, & Dowsett, 2014; Ioannidis, 2012; Makel, Plucker, & Hegarty, 2012; Pashler & Harris, 2012).

Meta-analyses are often considered a gold standard for summarizing effects. In a typical meta-analysis, a comprehensive literature review is conducted based on a specified set of search criteria. Effects are standardized and combined to provide an average overall effect, and moderators of the effect can be examined. Several guidelines have been developed to regulate and evaluate the quality of reviews (e.g., Higgins & Green, 2011; Higgins et al., 2013; Moher et al., 2009; Shea et al., 2007). Meta-analyses offer the opportunity to find commonalities across studies and help the field to become more unified (Staats, 1999). However, studies are often excluded from an analysis because effect sizes cannot be calculated from the statistics reported in the study. As non-significant findings are often not published, averaged effects can be overestimated. Further, a common question is the extent to which it is even appropriate to combine the effect sizes. Divergent constructs may have the same label (a "jingle" fallacy) and similar constructs may have different names (a "jangle" fallacy) (Block, 1995; Peck, 2004). Thus, the analyses combine apples and oranges, creating more of a mixed fruit salad than a blended apple pie.

There is a growing body of literature focused on *mega-analysis* or *individual participant data analyses* (IDA). Rather than using the effect sizes reported in studies, IDA compiles the raw data from multiple studies, examines items and constructs for conceptual and structural overlap, combines data at the individual participant level, and then tests specific theoretical models using the larger pooled dataset. To establish comparability across studies, the investigator must go beyond construct labels and engage with the specific items and measures used in each study. Heterogeneity across studies can be directly included in the analysis, making it an interesting test of generalizability, rather than being treated as problematic noise (Curran & Hussong, 2009).

IDA approaches have been used for years in medicine, genetics, and economics. Many of these studies harmonize variables across studies by finding a common metric (e.g., dichotomized items), and then directly combine the aligned data. As many clinical trials are registered before the study begins and the same measures are often used across studies, combining studies is a relatively straightforward process. Stewart and Clarke (1995) provided practical methodology for such mega-analytic reviews, noting that the statistical component is often the least time consuming and easiest aspect of the project.

IDA approaches have only recently appeared in the social sciences, where it is considerably more challenging to find commonalities across studies. Many of the existing longitudinal studies have included numerous constructs, items, and variables, but the questions depended upon the original investigators' interests. Even when similar constructs exist across studies, the wording of the items often differs in terms of temporal orientation (e.g., last seven days versus past 12 months), and the response options vary. Still, a growing number of studies suggest that IDA in the social sciences is indeed possible (Hussong et al., 2013). For example, in the Healthy Ageing Across the Life Course (HALCyon) research program, physical capabilities data were harmonized across eight UK studies to examine cross-sectional age and gender differences in the measures (Cooper et al., 2011). Bath and colleagues (2010) harmonized 26 variables from the Longitudinal Aging Study Amsterdam (LASA) in The Netherlands and the Nottingham Longitudinal Study of Activity and Ageing (LSAA) in the UK, including demographic composition, physical and mental health, physical activity, religious attendance, pet ownership, and health service utilization. These studies demonstrate that integrating data across studies at the item level is possible, provides greater power to test complex models, and allows direct comparisons of study heterogeneity.

Hofer and Piccinin (2009) described the benefits of coordinating research across multiple longitudinal studies to enable such integrative data analysis to occur. Collaborative efforts allow more detailed analyses to be done, improve detailed data checking across studies, promote appropriate analyses and more balanced interpretations of results, and allow wider endorsement and dissemination of results (Hussong et al., 2013; Stewart & Clarke, 1995). The Integrative Analysis of Longitudinal Studies on Aging (IALSA), a collaborative network of longitudinal studies on cognition, health, and personality, provides one of the best examples of such coordinated efforts, and has pioneered numerous strategies for aligning and combining studies (Hofer & Piccinin, 2009; Piccinin & Hofer, 2008). To date, about 100 studies have agreed to be a part of the network (see https://www.maelstrom-research.org/mica/network/ialsa).

To complement the IALSA and other such consortium resources, we introduce The Anatomy of Developmental Predictors Of Healthy Lives Study (TADPOHLS), a collection of studies that prospectively followed participants from adolescence into adulthood, and included measures of psychological, social, and physical health at multiple measurement occasions. Our goal was to identify and classify overlapping studies that potentially can be integrated together to study healthy development from adolescence into adulthood. In creating our structure, we were inspired by Drs. Hofer, Piccinin, and others who created and developed IALSA, and thus modeled our structure after their early work. TADPOHLS adds a catalogue of studies that included assessments of physical and psychological health in both adolescence and adulthood, to enable the assessment of developmental trajectories of health and well-being as youth transition into adulthood. In addition, we contribute an extensive coding typology, which is particularly detailed in terms of physical health variables. The typology provides a common language for

categorizing study concepts, allowing analysts to examine concepts both within and across studies.

In this article, we provide background information on the rationale and methodology for developing TADPOHLS, introduce the data base and typology, and describe the studies and information included. We then provide a simple illustrative example in which we used the data base to identify six overlapping studies, and combined data from these studies to examine prospective associations between perseverance and optimism in adolescence and physical health outcomes in adulthood.

Developing the TADPOLHS Data base

Study Identification

A key goal of the project was to aggregate studies with measures of both physical health and psychological well-being in adolescence and adulthood. To identify studies, we built upon Friedman et al. (2014), who identified 88 different longitudinal studies that included personality and health variables from different periods of the life span. The authors searched a set of existing data bases (e.g., the Henry Murray Research Archives, the Inter-University Consortium for Political and Social Research), as well as PsycInfo, and Google, using the keywords "personality," "health," and "longitudinal." We used the list of 88 studies as a foundation, selecting studies that included measurement occasions in both adolescence and adulthood. In addition, we searched the set of existing data bases (see Table 1 in Friedman et al., 2014) for additional studies that fit our inclusion criteria. Through this process, we identified 60 potential studies for further consideration.

Research assistants then attempted to track down the identified studies. To be included in the data base, studies had to have (1) accessible, readable codebooks; (2) data that could be

acquired by researchers; (3) measurement occasions that occurred in both adolescence (age 13-18) and adulthood (18+); and (4) measures that included items on physical health and positive psychological functioning.

Coding Typology

To classify item-level and construct-level concepts across studies, we created a comprehensive coding typology (see Online Appendix 1). To frame our categories, we began with the well-known International Classification of Functioning (ICF), which is divided into three components: functioning, personal factors, and environmental factors. We divided functioning into physical and psychological components, and the latter we further divided into positive and negative components to reflect our interest in both psychological well-being and emotional distress. Lastly, we added behaviors to provide a more comprehensive set of health predictors. This step resulted in six broad categories: physical functioning, positive psychological functioning, negative psychological functioning, health behaviors, individual differences, and socio-environmental factors.

As illustrated in Figure 1, we structured the typology hierarchically. Within each of the six categories, we defined specific outcomes (e.g., cardiovascular system, depression, externalizing behaviors, personality, physical activity, relationships, socioeconomic status), and sub-outcomes (e.g., blood pressure, depression diagnosis, bullying, Big Five Inventory, leisure time activities, teacher connectedness, education).

Coding Procedure

For each study, the TADPOHLS typology was used as a guiding manual for selecting and coding relevant items from the original study codebooks. Each selected item was coded into a Microsoft Access data base. For example, starting with the question “I wish I had more friends”,

we first determined that the item was relevant to the positive psychological functioning category, and then recognized that it focused on relationships (an outcome). Since the question dealt with lack of social connection, it was classified as "loneliness" (a sub-outcome). This process was repeated for each question from each of the studies.

Over a two-year period, our team spent thousands of hours coding items into the data base, identifying over 8,000 items. To ensure inter-rater reliability between coders, the coders went over each others' work and weekly meetings addressed any discrepancies. After all items were entered, four research assistants cleaned the data base, fixing any remaining inconsistencies, checking for spelling mistakes, wrong categories, and repetitious questions, and adding missing information.

Resulting Resource

Items were classified for 25 studies. We focus here on 14 studies in which we established data-sharing agreements and were able to obtain the data. Table 1 summarizes descriptive information about each study, and Online Appendix 2 provides more detailed study descriptions. Studies were conducted in the United States and the United Kingdom. The earliest study (the Terman Life Cycle Study) began in 1921 and followed people across their entire lives; the latest study began in 2002. Baseline age ranged from prenatal to 18 years, sample sizes ranged from 451 to 17,415 individuals, and measurement occasions ranged from three to 23. The final data base includes 8,447 items. Table 2 summarizes the number of items available for each outcome. The full data base can be accessed at [website to be determined]. Users can query the data base by study, type, outcome, and sub-outcome.[1]

[1] To protect participants and honor data sharing agreements, the website provides detailed information about the variables available, and provides contact information or websites for each study, but does not provide the actual

Discussion

The TADPOHLS data base has classified items from longitudinal studies according to an extensive coding scheme. Although the goal of this data base is to enable integrative research and collaborative work, a wealth of research has already occurred using these data sets, as evidenced by the thousands of publications that other researchers have built their careers upon. We hope that the data base will help researchers identify studies that have similarities, making it easier to develop cross-study collaborations. The typology provides a structure for classifying items and measures across six broad areas. The detailed physical health categorization is a particularly useful addition.

There are both strengths and limitations of the TADPOHLS data base. It currently contains 14 studies that can be accessed by researchers, although some are difficult to work with or costly to gain access to. Our data base does not make the data from these studies available; rather, it is designed to classify the information to make it easier for an analyst to know what data are available. Although there are many extant studies that could have been included in the data base, we purposely focused on studies bridging the transition from adolescence into adulthood. The extensive classification scheme used in the data base makes it possible to scale it to many other studies. We hope that additional studies will be added over time, building the resource as a whole to enable collaborative and integrative work.

Illustrative Example Utilizing the Data base

The data base can be queried to select specific constructs and locate studies with overlapping constructs and items. To illustrate, we examined whether perseverance and optimism measured in adolescence predicted four physical health outcomes measured in

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questionnaires, codebooks, or data. It is the user's responsibility to work directly with the original study investigators to obtain the data.

adulthood, 15 to 20 years later: self-rated health, physical energy, fatigue, and cardiovascular-related conditions. As an illustration of the potential for the data base as a resource, we used a rudimentary harmonization method to align items. Better methods are still being developed for psychological data, which are much more challenging to collect and harmonize than medical data (Bauer & Hussong, 2009 provides a good example). This limitation should be kept in mind when interpreting the results.

Prior research has suggested associations between positive psychological functioning and better physical health, both cross-sectionally and longitudinally (Diener & Chan, 2011; Howell, Kern, & Lyubomirsky, 2007; Pressman et al., 2013). Although hundreds of studies have examined this association, most have focused on adults. We aimed to better understand whether this association also pertained to the transition between adolescence and adulthood, using two psychological constructs and four physical health constructs.

Perseverance refers to the tendency to work hard and stick with tasks despite challenges or setbacks. It is a facet of the Big Five personality factor of conscientiousness, which has repeatedly demonstrated small but meaningful associations with health-related outcomes, including better self- and physician-rated health and longer life (e.g., Friedman & Kern, 2014; Kern & Friedman, 2008; Roberts et al., 2014). Optimism refers to the tendency to have hope and positive expectations for the future, or alternatively as an explanatory style in which good events are seen as internal, stable, and global and negative events are seen as external, unstable, and specific to the person. Optimism has been related to less reported pain, better physical function, fewer physical symptoms, lower risk of heart disease, and faster recovery from surgery (Boehm & Kubzansky, 2012; Carver, Scheier, & Segerstrom, 2010; Rasmussen, Scheier, Greenhouse, 2009). We predicted that on average across samples, higher perseverance or optimism would be

related to higher levels of energy, better self-rated health, and less cardiovascular disease and fatigue.

Method

Study selection. We searched the data base for items related to perseverance or optimism during an adolescent assessment (age 13 to 18). We examined items that had been coded into the optimism or perseverance outcomes into the data base (under the positive psychological functioning category), and also examined items in other similar categories, in case of item misspecification. It appeared that items had been correctly specified during the coding process. Items were rated for relevance to our definitions; a few items were excluded as irrelevant (e.g., items assessing self-esteem rather than optimism). If studies had relevant perseverance/optimism items assessed in the adolescent time period, we then examined whether there were physical health items assessed in adulthood. Our final inclusion criteria were: (a) at least one item measuring perseverance and/or optimism in adolescence (age 13-18), and (b) at least one item measuring self-rated health, physical energy, fatigue, or heart conditions in adulthood (age 28-36).

Included studies. Altogether, four studies had items measuring perseverance and five studies had items measuring optimism. For perseverance, we included the British Birth Cohort Study, 1958 cohort (ESDS), the Family Transition Project (FTP), the National Longitudinal Study of Adolescent Health (NLSA), and the Terman Life Cycle Study (TLCS). For optimism, we included the Family Transition Project (FTP), National Longitudinal Survey of Youth, 1979 Cohort - Children and Youth (NLSC) and 1997 Cohort (NLS2), the National Longitudinal Study of Adolescent Health (NLSA), and the Terman Life Cycle Study (TLCS). Table 1 and Online

Appendix 2 provide sample descriptions, and Online Appendix 3 provides items included from each study.

Data analyses. To harmonize the perseverance and optimism items, scores were standardized and averaged to create an overall measure of the construct.[2] For health outcomes, variables were dichotomized (e.g., self-rated health: poor versus good/very good; heart conditions: present versus absent). In each study, we first computed Spearman rho correlations between perseverance/optimism and each health outcome. We then meta-analytically combined the *r* effect sizes, using a fixed effects model. To combine effects, we transformed the *r*s to the Fisher equivalent, $Zr = .5*\ln((1+r)/(1-r))$. *Zr*s were weighted by sample size (degrees of freedom, calculated as df = *n* -3 for each study), and then averaged together and 95% confidence intervals were calculated. Values were converted back to *r*s for presentation purposes (Rosenthal & DiMatteo, 2001).

Results

Table 3 summarizes Spearman rho correlations between perseverance or optimism and physical health, separately in each sample. Across studies, both optimism and perseverance were positively related to self-rated health. Associations varied across the other outcomes. The average correlation and 95% confidence intervals are summarized in the right column. In general, correlations aligned across the individual studies. Both perseverance and optimism were positively associated with self-rated health and was negatively related to fatigue. Optimism was also positively related to physical energy.

Discussion

[2] It is possible that responses differ due to the question wording and/or sample characteristics. IDA allows such differences to be directly tested and included in the model. As an illustrative example, we simply harmonized variables. To fully consider associations between adolescent perseverance and optimism and adult health, more sophisticated approaches to harmonization should be used.

In this illustrative example, we demonstrated how the data base can be used to identify items representing the same concepts in different studies, and then combined to examine overall effects. Before analyses were preformed, items were harmonized, such that analyses in each study were aligned, and the meta-analytic combination was based upon the aligned variables. Adolescent perseverance and optimism were related to better self-reported physical health outcomes 15 to 20 years later. As analyses were limited to the studies within the data base, effects are generalizable only to the studies included here, but offer support for the importance of optimism and perseverance as protective adolescent characteristics that potentially should be supported and developed in adolescence.

It is striking that both optimism and perseverance were predictive of better health outcomes over a 15 to 20 year period, and across diverse samples in terms of geographical location, period in time, and other individual factors. The effect sizes were small in size, and yet were significant when combined across multiple studies and many participants, demonstrating the added power and value of combining data at the individual participant level. Many factors influence variations in physical health outcomes, such that small effects can be practically meaningful (Rosenthal & Rosnow, 2008). The pattern of associations is similar to studies that have linked perseverance, optimism, and related attributes to health outcomes in adults, providing a proof of concept for the utility of the data base and the use of integrative approaches. Subsequent studies can use other variables available in these data sets to examine processes and moderators of these associations.

Two of the samples were very large, while the others were relatively small. The meta-analytic results are mostly determined by the larger samples, such that meta-analysis may not be useful in this situation. Still, smaller studies can complement large nationally representative

samples. Large samples often can only include one or two items for a construct, whereas a small study can include richer assessments. For example, the Family Transition Project is an intensive study of rural families, with hundreds of items on parent/child relationships, parenting, and externalizing behaviors (Conger & Elder, 1994; Conger & Conger, 2002). Integrative techniques can be used to link studies, and then be extended to the unique information offered by each study (McArdle et al., 2009). Further, when results align across the large and small studies, it provides greater confidence in the overall pattern of findings.

General Discussion

Developmental psychology has a rich history of studying developmental trajectories, but cross-sectional and longitudinal studies can provide contradictory information. Schaie and others introduced cross-sequential and other study designs for separating age, time of measurement, and cohort effects and understanding different influences on outcomes of interest (e.g., Salthouse & Nesselroade, 2002; Schaie, 1965; Schaie & Strother, 1968). Integrating existing longitudinal studies together may provide a quasi cross-sequential approach for studying developmental trajectories. We developed the TADPOHLS data base as a resource for researchers who are interested in advancing longitudinal study of human development. Strengths of this resource include providing the opportunity to piece together different cohorts and constructs, and focusing explicitly on studies that followed individuals from adolescence in to adulthood. Our analysis of perseverance, optimism, and physical health provides an illustration of using the TADPOHLS resource.

Studies of psychological well-being and physical health often occur independently. A more holistic and integrated approach involves identifying protective factors that lead to optimal psychological and physical functioning across years or decades, while simultaneously attending

to physical, mental, and social components of the individual. Psychological, social, and physical health are interrelated outcomes that are developed and influenced by personality, socioecological context, habits and behaviors, and experiences (Friedman & Kern, 2014). Furthermore, health and psychological research has traditionally focused on negative aspects of risk, atypical development, and disease onset and progression. Although it is certainly important to identify and reduce risk factors, it is also beneficial to identify and strengthen assets that buffer against disease, strengthen an individual's adaptability, and promote thriving. The TADPOHLS data base particularly includes positive psychological characteristics, which can be explored as protective factors from disease.

A growing number of longitudinal studies have examined predictors of adolescent and adult outcomes. For example, in one study, adolescents with high levels of positive affect and self-esteem reported better overall health, and engaged in fewer risky behaviors across a six-year period (Hoyt, Chase-Landsale, McDade, & Adam, 2012). Adults with high levels of optimism were at lower risk for developing coronary heart disease across a 10-year period (Kubzansky, Sparrow, Vokonas, & Kawachi, 2001). There are many constructs yet to be investigated, and moderators and processes of such relationships are relatively unknown. By combining multiple studies, developmental trajectories, moderators, and processes impacting such trajectories, and boundary conditions of such associations can potentially be investigated. Both cross-sectional and longitudinal studies make various assumptions that limit conclusions that can be made about development (Schaie, 1965); combining multiple longitudinal studies at the item level provides the potential to test age and cohort-related effects.

At the same time, any attempts to combine data should proceed cautiously. As sample sizes increase, many associations will be statistically significant but not necessarily meaningful.

Creating mega-samples simply to reach significance is not useful, but when data are combined directly to test specific theories or to generate new hypotheses, combined data may be useful. For instance, in our example, perseverance and optimism were positively related to good health outcomes. This finding aligns with other studies and provides a proof of concept for using studies in the data base. However, our approach was rather rudimentary and conclusions stemming from this analysis are limited. In addition, combining data and increasing sample size potentially limits Type II errors, and highlights potential associations that should be studied in more detail in subsequent studies. With health outcomes, small effects can be important (Meyer et al., 2001), and large samples are needed to find such effects. By integrating multiple studies, we might uncover important health protective factors that otherwise would be missed with smaller samples.

There are a growing number of collaborations and groups both within and across disciplines, such as the NIH Patient Reported Outcomes Measurement Information Systems (PROMIS; Cella et al., 2007), the NIMH Collaborative Data Synthesis for Adolescent Depression Trials group (CDSADT; Perrino et al., 2013), the eXtending Treatments, Education and Networks in Depression study (xTEND; Allen et al., 2013), Data Aggregation Through Anonymous Summary-statistics from Harmonised Individual levEL Data bases (DataSHIELD; Jones et al., 2012), and the Grid Enabled Measures Data base (GEM, Moser et al., 2011), among many others. IALSA is an open and growing network, and inspired our work here. The TADPOHLS data base complements these existing resources.

In conclusion, we have developed a resource that contributes toward life span studies of positive psychological and physical health during the transition from adolescence into adulthood. Many of the studies in the data base have already influenced public policy, institutional practices,

family, and individual discourse. However, it is clear there is still much to be learned and disseminated to both identify and promote psychological and physical health development in all stages of life.

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Table 1

Study descriptions

Abbr	Study Name	Start Year	Country	Years Follow up	Measure Occasions	Baseline N	Age at baseline	Sample Type
AHCE	Adolescent Health Care Evaluation Study	1984	US	6	4	2788	13-18	specific characteristic
ESDS	British Birth Cohort Study: 1958 Cohort	1958	UK	55	10	16000	birth	nationally representative
ESD2	British Birth Cohort Study: 1970 Cohort	1970	UK	34	6	17415	birth	nationally representative
FTP	Family Transitions Project	1989	US	20	4	451	12	specific population
HLSU	Harlem Longitudinal Study of Urban Black Youth	1968	US	26	5	668	12-18	nationally representative
NLSA	National Longitudinal Study of Adolescent Health	1994	US	14	4	15701	10-18	nationally representative
NLS2	National Longitudinal Survey of Youth - 1997 Cohort	1997	US	14	12	8984	12-17	nationally representative
NLSC	National Longitudinal Survey of Youth - 1979 Child and Young Adult	1986	US	10	12	5255	birth - 22	nationally representative
NLSY	National Longitudinal Survey of Youth - 1979 Cohort	1979	US	27	23	12686	14-22	nationally representative
NSHD	British Birth Cohort Study: 1946 Cohort	1946	UK	59	21	5362	newborn	convenience sample
TBSS	The Beginning School Study	1982	US	20	9	790	1st grade	community representative
TLCS	Terman Life-Cycle Study of Children with High Ability	1921	US	90	15	1528	3-19	specific population
WCFA	Welfare, Children, and Families: A Three City Study	1999	US	7	3	2402	0-4; 10-14	specific population
YTP	Youth in Transition Project	1966	US	4	4	2213	15-16	nationally representative

Note. See Online Appendix 2 for a more detailed overview of each study.

Table 2

Outcomes included in each study, with the number of items classified into each outcome

	AHCE	ESDS	ESD2	FTP	HLSU	NLSA	NLS2	NLSC	NLSY	NSHD	TBSS	TLCS	WCFA	YTP
Physical														
Cardiovascular	10	18	9	2	1	10	2	4	19	23	0	0	0	1
Development milestones	0	28	2	12	1	9	5	49	1	12	1	10	11	0
Endocrine	1	5	4	0	1	1	2	1	5	5	0	0	0	0
Functional autonomy	3	26	20	43	4	8	3	13	20	38	1	8	0	1
Gastrointestinal	5	16	17	0	0	1	0	1	7	17	0	0	0	0
General health history	12	50	110	12	28	25	20	47	55	48	2	47	10	1
Genitourinary	41	21	29	0	0	12	9	4	10	70	0	2	1	1
Heme-immune	8	4	6	0	2	3	2	2	1	2	1	0	0	0
Infectious parasitic	0	1	6	1	0	1	0	0	2	6	0	4	0	0
Metabolic/ nutrition	14	28	16	9	5	11	5	14	4	28	4	4	4	0
Musculoskeletal	8	12	16	3	4	2	0	1	14	9	0	0	0	0
Nervous	10	30	20	7	7	6	2	5	12	15	0	6	0	1
Respiratory	6	22	41	4	8	5	2	21	15	31	0	0	0	1
Sensory	3	56	43	0	3	9	11	8	8	22	2	7	0	0
Skin	3	18	23	2	1	3	0	0	10	9	0	2	0	0
Special health needs	0	10	10	0	1	1	5	15	1	19	2	1	0	0
Well-Being														
Accomplishment	1	13	20	4	1	7	17	12	5	5	25	14	1	16
Engagement	20	15	46	15	7	25	17	83	4	21	22	17	5	63
Happiness	0	2	1	11	5	3	2	12	3	1	5	2	0	5
Life satisfaction	0	13	7	19	12	11	5	20	6	20	18	34	1	93
Meaning/purpose	0	1	3	0	2	4	3	1	0	0	0	0	0	1
Optimism	1	4	6	5	9	11	20	8	5	1	1	2	0	49
Perseverance	5	7	8	8	12	4	0	18	7	2	6	11	0	46
Relations/connectedness	7	24	40	186	55	73	31	107	26	15	26	8	7	53
Ill-Being														
Anxiety	22	51	21	25	3	3	1	9	2	19	5	17	0	16
Depression	49	19	17	18	6	9	4	9	14	36	3	2	0	6
Externalizing behavior	37	28	54	109	0	85	49	64	10	1	15	5	20	4
Negative affect	2	8	15	5	2	2	0	13	6	0	0	6	0	0

	AHCE	ESDS	ESD2	FTP	HLSU	NLSA	NLS2	NLSC	NLSY	NSHD	TBSS	TLCS	WCFA	YTP
Other psychopathology	15	19	24	3	0	9	2	16	2	8	3	2	3	0
Stress reactions	1	2	2	2	0	4	0	2	0	5	0	0	0	2
Health behaviors														
Alcohol use	33	42	32	25	2	27	4	35	53	8	5	4	1	0
Diet/ nutrition	3	52	36	0	3	44	8	0	4	7	4	1	0	0
Drug use	53	28	19	30	0	49	5	71	55	0	16	0	2	0
Other behaviors	3	6	17	0	5	12	3	0	0	7	2	0	2	0
Physical activity	2	85	7	2	14	15	7	6	5	16	7	7	0	5
Sexual behavior	23	1	7	6	17	18	19	18	11	7	1	0	4	3
Sleep	5	16	5	3	4	10	5	3	10	7	3	5	0	0
Tobacco/ smoking	12	10	12	2	1	14	3	13	13	15	2	1	1	0
Individual Diff														
Coping style	0	0	0	0	5	0	0	0	0	0	0	1	0	11
Intelligence	0	8	0	0	0	2	1	21	0	0	2	9	2	10
Personality	0	17	2	5	1	8	7	36	3	0	14	56	11	9
Self-esteem	13	2	4	24	3	6	0	32	11	24	10	6	0	28
Temperament	0	0	0	1	0	1	0	62	0	0	0	8	0	0
Socio-environmental														
Caregiving	0	7	3	0	0	0	1	1	2	0	3	1	0	0
Environment	0	40	7	6	0	4	2	69	9	3	1	5	2	32
Life events	19	24	22	21	8	27	37	31	35	21	11	41	1	2
Neighborhood	8	1	6	0	1	3	3	5	8	0	4	2	6	0
Parenting	17	46	30	200	0	40	73	205	17	0	12	13	42	21
Socio-economic status	14	41	49	24	32	30	98	64	27	23	22	31	23	19
Victimization/ abuse	14	11	9	2	0	19	11	5	0	0	0	1	6	0
Total # of coded items	503	988	903	856	276	686	506	1236	537	626	261	403	166	500

Note. Numbers indicate how many items from a study were coded into that sub-outcome, at any measurement occasion. See Online Appendix 1 for outcome definitions and Table 1 for full study names.

Table 3

Prospective associations between adolescent perseverance or optimism and physical health (self-rated health, energy, fatigue, heart conditions) for each sample (parallel analysis) and the combined sample (meta-analysis of effect sizes).

	ESDS		FTP		NLSA		NLS2		NLSC		TLCS		Fixed Effects Meta-analysis				
	N	r	N	r	N	r	N	r	N	r	N	r	K	N	r	r LL	r UL
Perseverance																	
Gender [a]	9724	**.10**	334	.09	13884	**.09**					334	**.18**	4	38828	**.10**	.08	.11
Heart conditions [b]	9013	.00	334	-.03	13884	.00					318	-.06	4	38085	.00	-.01	.01
Energy [c]			334	.03									1	668	.03	-.08	.14
Fatigue [c]	9017	**-.06**	334	**-.13**	13883	**-.04**							3	37451	**-.05**	-.06	-.03
Self-rated health [c]	8977	**.09**	334	-.02	13886	**.06**					299	.01	4	38015	**.07**	.05	.08
Optimism																	
Gender [a]			333	-.04	13871	**-.05**	3501	.00	838	-.04	334	.00	5	18877	**-.04**	-.05	-.02
Heart conditions [b]			333	.01	13869	-.01			838	.00	318	-.07	4	15358	-.01	-.03	.00
Energy [c]			333	-.03			3043	**.07**	788	.05			3	4164	**.06**	.03	.09
Fatigue [c]			333	-.01	13869	**-.08**							2	14202	**-.07**	-.09	-.06
Self-rated health [c]			333	-.08	13871	**.11**	3500	.02	838	**.07**	299	.07	5	18841	**.09**	.08	.10

[a] 0 = male, 1 = female; [b] 0 = no heart condition, 1 = one or more heart conditions; [c] 0 = low, 1 = high

Note. Gender, perseverance, and engagement were assessed in adolescence; health outcomes were assessed in adulthood, 15 to 20 years later. Significant correlations ($p < .05$) are bolded. K = number of studies included in meta-analysis calculation; LL = lower 95% confidence interval; UL = upper 95% confidence interval; ESDS = British Birth Cohort Study: 1958 Cohort; FTP = Family Transitions Project; NLSA = National Longitudinal Study of Adolescent Health; NLS2 = National Longitudinal Survey of Youth - 1997 Cohort; NLSC = National Longitudinal Survey of Youth - 1979 Child and Young Adult; TLCS = Terman Life Cycle Study.

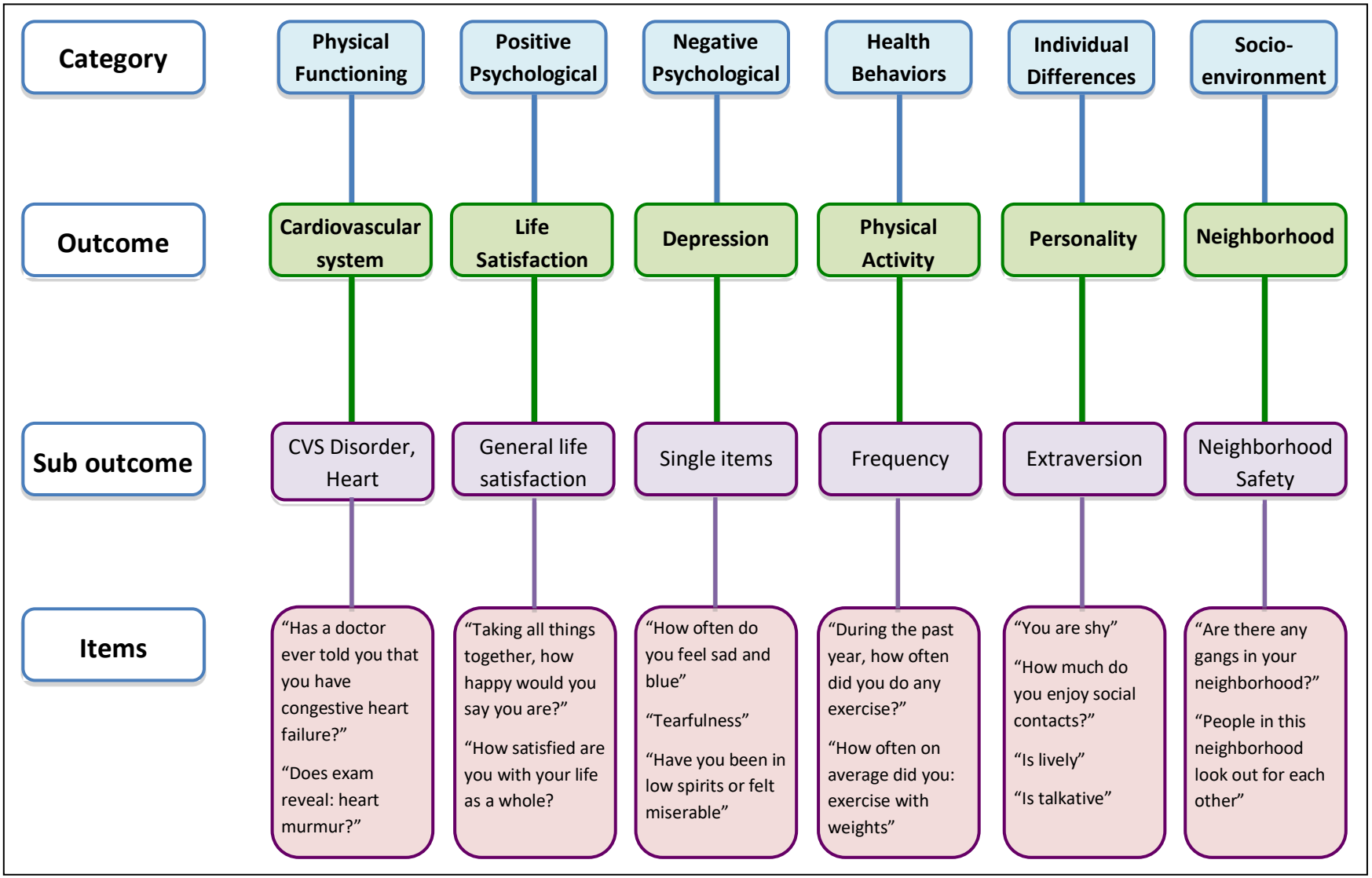

Figure 1. Typology hierarchical structure. Variables were coded into six major categories (top). Example outcomes, sub-outcomes, and items are given. See Online Appendix 1 for full typology.