

## RESEARCH ARTICLE

# Happy children! A network of psychological and environmental factors associated with the development of positive affect in 9–13 children

Tommaso Feraco<sup>1\*</sup>, Giorgia Cona<sup>1,2,3</sup>

**1** Department of General Psychology, University of Padova, Padua, Italy, **2** Department of Neuroscience, University of Padova, Padua, Italy, **3** Padua Neuroscience Center, University of Padova, Padua, Italy

\* [tommaso.feraco@unipd.it](mailto:tommaso.feraco@unipd.it)



## Abstract

To deepen the development of positive affect during early adolescence and shed new light on its predictors, this study adopts an exploratory network approach to first identify the main domains that describe the variability of children's psychological, environmental, and behavioral characteristics, and then use these domains to longitudinally predict positive affect and its development within a latent growth framework. To this aim, we considered 10,904 US participants (9 years old at baseline; 13 years old 42 months later), six measurement occasions of positive affect, and 46 baseline indicators from the ABCD study. Our results not only confirm that positive affect declines between 9 and 13 years old, but also show that among the five domains identified (behavioral dysregulation, cognitive functioning, psychological problems, supportive social environment, and extracurricular activities), only a supportive social environment consistently predicts positive affect. This is crucial for practitioners and policymakers, as it can help them focus on the elements within our complex network of psychological, social, and environmental variability.

## OPEN ACCESS

**Citation:** Feraco T, Cona G (2024) Happy children! A network of psychological and environmental factors associated with the development of positive affect in 9–13 children. PLoS ONE 19(9): e0307560. <https://doi.org/10.1371/journal.pone.0307560>

**Editor:** Sandra Julia Diller, Private University Schloss Seeburg: Privatuniversität Schloss Seeburg, AUSTRIA

**Received:** February 22, 2024

**Accepted:** July 9, 2024

**Published:** September 6, 2024

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**Data Availability Statement:** Data are available under request from the NIMH Data Archive: <https://nda.nih.gov/abcd/>.

**Funding:** The author(s) received no specific funding for this work.

**Competing interests:** The authors have declared that no competing interests exist.

## Introduction

«*Vivere, Gallio frater, omnes beate uolunt, sed ad peruidendum quid sit quod beatam uitam efficiat caligant*»

«*Everyone, brother Gallione, wishes to live happily, but is dull at perceiving exactly what it is that makes life happy*»

De Vita Beata ("On the Happy Life", 58 AD)

Around the year 58 AD, the Latin philosopher Seneca wrote 'De Vita Beata' (On the Happy Life), a dialogue with his brother Gallio, in which he defined the concept of the happy life and discussed how it can be achieved. Interestingly, long time after, in the pandemic year 2020, the

term ‘happiness’ was shown to be searched more than ever on Google Search. These two, extremely far, examples underline an ancestral human need. Indeed, identifying what are the key factors to pursuit happiness has represented and still represents a central question for humans.

The study of happiness, as well as the strictly related terms ‘subjective well-being’ and ‘life satisfaction’, has grown in popularity within the discipline of psychology [1], with developmental psychologists being particularly interested in its variability and decline in early adolescence [2], which is classically considered a challenging period. Indeed, adolescence represents a critical period in which children face substantial changes in almost every aspect of their lives. In particular, during the transition from childhood to adulthood, adolescents encounter significant hormonal changes that influence their physical, sexual, and brain maturation and develop cognitive abilities and more stable personality traits [3–6]. Changes, however, also encompass their social lives: adolescents are required to make choices for their own future, take responsibilities and achieve increasing independence. They also change schools and schoolmates, friendships, build their first intimate relationships, and actively engage in extra-curricular activities and with the larger community [7–10]. All these changes might lead to a psychological crisis for adolescents, who might encounter emotional and health problems, including depression and mental disorders, and might represent risk factors for future substance use and abuse [7, 11]. Indeed, adolescence has been associated with the steepest decline in subjective well-being of the entire life span [10, 12]. Some researchers argue that this is because children have not yet developed the necessary abilities to control and regulate their emotions, which are consequently disrupted by the new challenges of this transition phase [9, 13, 14]. However, having high positive emotions remains crucial for a positive and healthy development. Indeed, positive affect longitudinally predicts mental and physical health, effective coping, positive social relationships, and success in adolescence and across the entire life-span [15–19]. Positive affect, for example, is associated with improved cardiovascular (e.g., lower heart rate and blood pressure) neuroendocrine (e.g., cortisol levels) and immune systems [17, 20, 21]. Additionally, positive affect leads to healthy outcomes through social and behavioral pathways as it reduces risky behaviors, while increasing social support, friends and positive relationships, which are all predictors of better mental health [19–21].

Given the centrality of positive emotions and the detrimental effects that low positive affect could cause, it is fundamental to identify the patterns of development and the main predictors of positive affect in the first years of adolescence to understand how it might be possible to favor a successful and positive development in adolescence. To answer these questions we take advantage of the longitudinal Adolescent Brain Cognitive Development data collection (ABCD; Volkow et al., 2018; <https://nda.nih.gov/abcd>), a large database of data collected in the United States (US).

## Positive affect in adolescence

Despite a common definition of emotions and affect is yet to be found, affect can be described as a general experience of feelings or emotions that are distributed along two dimensions of valence and intensity [22]. Specifically, we refer to positive affect when the person feels pleasant or positive emotions (e.g., joy, calm, interest, pride); contrarily, we refer to negative affect when the person feels negative emotions like stress, fear, or anger. Importantly, affect encompasses a generally stable tendency of the individual toward experiencing more or less positive and negative emotions [23]. Studies interested in developmental affective changes focused on (a) the variability of affective experiences and (b) the age-related trajectories of mean level scores in positive and negative affect. Maciejewski and colleagues [14, 24], for example, in a

5-year longitudinal diary study report that affective variability decreases in late adolescence (i.e., negative and positive affect are more stable in late adolescence) and that the mean level scores in positive affect decreases, while negative affect increases from early to middle adolescence. In a larger study, Griffith and colleagues [22] confirmed these findings on a sample of 9–17 years old participants who were asked to report positive and negative affect every 18 months for three years. In particular, the authors found that positive affect linearly decreases with age while negative affect follows a curvilinear pattern in the total sample. These results are also in line with changes in personality and emotion regulation strategies [25–28] that show an increase in neuroticism and extraversion and a decrease in emotion regulation strategies during early adolescence. In other words, it is expected that positive affect decreases in early and middle adolescence, but more research is needed to corroborate these findings as also the authors [22] highlight that they contradict previous studies on children between 9 and 13 years old which show an increase in positive affect during this early period [29]. The ABCD data collection, which includes an extremely large amount of longitudinal data, could be precious to better understand how positive affect develops between 9 and 18 years old. Importantly, the ABCD study includes a plethora of additional information giving the opportunity to also identify the predictors of positive affect, at least in US children. The ABCD team has already released data from 9 to 13 years old, allowing the study of the critical period characterizing the end of childhood and the first years of adolescence.

### What makes a child happier? Correlates of positive emotions in adolescence

While the study of affective development is fundamental to understand the age of adolescence, a further and crucial step is to detect those factors that possibly promote higher levels of positive affect during adolescence [27]. Other than neural and biophysiological characteristics [10, 30, 31], there are many social, environmental, and psychological aspects that may concur to higher or lower levels of positive and negative affect. One key factor are interpersonal relationships with peers, parents, and teachers [32–34], but other studies and meta-analyses highlight the role of many other factors in explaining and supporting positive affect in adolescence. Among the many, there are physical activity [35], sleep [36], personality traits [37], academic achievement [38], nature connectedness and environment [39, 40], the practice of leisure activities [41, 42], psychological and behavioural problems [43, 44], or social networks and use of phones, tablets, and computers [45, 46].

**Toward a low dimensionality of the predictors of positive affect.** This plethora of results and meta-analyses on the topic highlight the attention that the study of positive affect's correlates has received in recent years. For practical reasons, however, most studies focus on a narrow group of specific variables and cannot take in consideration the vast majority of the other factors that might be linked to positive affect. Nonetheless, most psychological variables are correlated between each other and pondering on or taking into account such multiple and mutual associations is an important key to better understand psychological phenomena. Indeed, it is an emerging matter of discussion that the psychological realm of individuals could be better represented by a network of superordinate domains [47–53]. In other words, if we believe that psychological dimensions are not independent but instead interact with each other and with various characteristics of the individual and their environment, then bivariate associations poorly describe their interrelationships. It is therefore needed to adopt alternative approaches to unveil the pattern among a wide set of inter-related variables, such as network analysis.

In addition, recent strands of research are accompanying the reflection on psychological networks with the concept of low dimensionality. In fact, network analyses highlight regions (domains) of highly interconnected nodes (variables) that work together following specific patterns of associations and that are less related with nodes from other domains. The researchers from different fields are increasingly focusing on hierarchical models of personality, character, or psychopathology [54–60] rather than considering the multiplicity of specific factors or abilities as separate and isolated variables. Smith et al. (2015), for example, found that people spread along a single positive-negative continuum linking brain connectivity, lifestyle, intelligence, and demographic variables. This suggests that a single mode of population variation can explain most of the variance in distinct psychological aspects. Moreover, Granzio and Cona (2023) recently found that the 38 variables included in their large study are well described by a network of seven separate but inter-related domains. Such low dimensionality of psychological data could help to highlight which are the main—hidden—domains that characterize social, environmental, and psychological data and to understand which—among the few instead of dozens of interrelated variables, should be the focus of research and interventions. In the present context, this would be translated in identifying the core psychological and/or environmental dimensions that can promote high positive affect.

Despite the potentialities of this approach are enormous, gathering this kind of data is extremely difficult because individuals should be measured on a large spectrum of variables and a large population is necessary to obtain precise estimates of the models/networks. Fortunately, large and open data collection projects are on the rise and could serve to effectively study the best predictors of positive affect across a large spectrum of psychological, environmental, and social data. Again, the ABCD perfectly fits this aim and also gives the opportunity to study such association longitudinally and in youths. The project, in fact, aims to longitudinally collect a large amount of data from more than 10,000 US children aged 9–10 for a period of ten years. Importantly, they already measured children's positive affect at six different time points, as well as a plenty of other features (e.g., cognitive, environmental, psychological features). This allowed us to establish a network of their psychological domains at the baseline and understand which of the domains individuated best predict positive affect and its development over 42 months.

### Aims of the study

Taking advantage of the large and longitudinal ABCD data collection, this study aimed to answer two main research questions regarding positive affect:

- How does positive affect develop between 9 and 13 years old? To this aim, measures of positive affect from 7 time points were analyzed using latent growth models.
- What are the main predictors of positive affect and its development between 9 and 13 years old? To this aim 46 variables generally concerning mental health, physical health, environment, and neurocognition were considered as possible predictors of positive affect and its development. To decrease the dimensionality of the predictors, we decided to follow a network approach [61] to firstly analyse the network structure of the ABCD variables and use the domains individuated to longitudinally predict (across six waves and up to three years) children's positive affect.

Our work could be of primary importance as it will (a) accumulate knowledge on the topic of positive affect development, (b) inform us about the network structure (even if always inevitably partial) of youths' variability and, importantly, (c) show which are the more relevant domains in longitudinally predicting a fundamental developmental factor such as positive

affect. In addition, the network approach and the focus on “umbrella domains”—instead of inspecting multiple single variables—follow recent evidence sustaining a network structure of various psychological domains underpinning a lower dimensionality of psychological variables [48, 49, 62].

## Materials and methods

### Participants

To the aim of this study, we used archive data provided by the ABCD project (<https://nda.nih.gov/abcd>). The ABCD is a prospective longitudinal study starting with children aged 9–10 that will be followed for ten years [63]. Exclusion criteria were limited to proficiency in English language, severe sensory, intellectual, medical, or neurological issues, and contraindications to MRI scanning. We accessed the data on December 18<sup>th</sup> 2022. No information that could identify individual participants was provided.

A total of 11,878 children were initially enrolled at 21 research sites across the USA and evaluated on different aspects including mental health, environmental factors, substance use and attitudes, biospecimens, physical health and sport involvement, culture, cognitive abilities, and social and emotional development. fMRI was also used to measure brain development and its correlates through adolescence. ABCD data are released every year and we took advantage of the last data release available at the time of writing: Data Release 4.0 (<https://nda.nih.gov/study.html?id=1299>). Other than imaging data that will not be included in our analysis, this release contains non-imaging assessment at baseline and follow-up for seven different time points: baseline, 6 months, 12 months, 18 months (full cohort), 30 months, 36 months, and 42 months (interim data).

We specifically included all participants who showed no missing values on the selected variables (see below) at the baseline. Longitudinally, we only included information about positive affects at the different data collection points. The full baseline sample consisted of 10904 children (Females = 5226) aged 9.91 in mean (SD = .62). The numerosity differed at the subsequent time points depending on how many children that filled the positive affect measure were made available in the Data Release 4.0 (see [Table 1](#)). A total of 2629 participants always completed the survey and had no missing values in any variable, including demographics. As stated before, the last three waves of data are interim data and missing data do not correspond to participants’ dropout, but they are mostly data that still must be processed and made available by the ABCD team.

### Materials

Assessment measures were broadly included into nine different main areas by the ABCD team: substance use, mental health, physical health, culture, environment, neurocognition, genetics, mobile technology, and imaging data. To the aim of our study, we selected only mental health, physical health, environment, and neurocognition areas (see [S1 Table](#)). Indeed,

**Table 1. Numerosity at each time point.** Females are reported within parenthesis.

	Baseline	6 months	12 months	18 months	30 months	36 months	42 months	Complete
N (Females)	10904 (5226)	9621 (4598)	9466 (4532)	9392 (4482)	7249 (3479)	5280 (2491)	2816 (1356)	2629 (1272)
M age (SD)	9.92 (0.63)	9.92 (0.63)	9.91 (0.63)	9.91 (0.63)	9.93 (0.62)	9.98 (0.62)	10.01 (0.6)	10.01 (0.6)

*Note.* Age always refers to participants’ age at the baseline

<https://doi.org/10.1371/journal.pone.0307560.t001>

substance use variables were not informative at the baseline as almost no children reported using any substance at this age; mobile technology measures were not collected at the baseline; and imaging and genetics data were not the focus of our work. In case the same measure was filled twice, once by the children and once by the parent, we decided to consider the children version (e.g., prosocial behaviour, screen time, family conflict). Given the focus of our study on children characteristics, we also excluded measures directly referring to parents and filled by the parents (e.g., measures of parents' substance use or psychopathology). Measures of brain injury, culture (e.g., black, Hispanic, American Indian), medication use, substance use, and personal information such as handedness, vision, or weight were not used. Indeed, specific medical information are beyond the scope of our study and may have medical and biological implication that are not in our field of expertise.

A summary of the measures included in this study is available in [S1 Table](#).

**Demographic measures.** A demographic questionnaire adapted from the PhenX toolkit [64] was used to collect information about the children and their parents/guardians [65]. These included sex at birth, age, race, ethnicity, family income, and parent's education. Only information about the responding parent were used because information about the second partner was often missing without specification of the reason. Sex, age, family income, and parent's education will be entered as covariates in the analyses.

**Mental health measures.** A series of questionnaires were used to measure mental health factors. The abbreviated youth version of the UPPS-P Impulsive Behavior Scale [66] was used to measure five facets of impulsivity behaviour: lack of perseverance, lack of planning, sensation seeking, negative urgency, and positive urgency. The abbreviated Prodromal Psychosis Scale [67] was used as index of subclinical psychosis risk phenotypes. The BIS/BAS scale [68] was used to measure three facets of behavioural activation reflecting positive affect: Fun Seeking, Drive, and Reward Responsiveness, and Behavioural Inhibition scale. The number of friends and close friends was also measured with ad-hoc questions (i.e., Friendship scale). The Parent General Behavior Inventory [69] was used to measure symptoms of mania. The total score of the Achenbach Child Behavior Check List [70] was used as a measure of children's internalizing and externalizing behavioural problems. The computerized version of the Kidie-Structured Assessment for Affective Disorders and Schizophrenia for DSM-5 [65, 71] was used as a diagnostic interview measuring depression, anxiety disorders, somatic disorder, ADHD, oppositional conductive disorders, conduct disorders, obsessive compulsive disorders, sluggish cognitive tempo, and stress disorders. Raw scores were used for each of these.

A complete description of the measures included in the Mental Health area is available in the corresponding ABCD study [65].

**Physical health measures.** The physical health area included measures of physical activity, in terms of amount of weekly physical activity [72]; screen time, as a sum of time spent watching TV, videos, or playing video games, chatting, and using social network during a typical day [73, 74]; involvement in sport and other activities, as a measure of months in which the children practiced a sport or a hobby during their past life [75]; and sleep disturbance [76].

A complete description of the measures included in the Physical Health area is available in the corresponding ABCD study [65].

**Culture and environment measures.** The culture and environment area included measures of prosocial behaviour [77]; parental monitoring, or parent's active efforts to keep track of child's whereabouts [78]; parent's acceptance reported by the children [79, 80]; family conflicts, or the amount of openly expressed conflicts among family members [81]; three subscales of the School Risk and Protective Factors Survey [82] were used to measure school environment, school involvement, and school disengagement. Information about children's neighbourhood, in terms of feelings about safety and presence of crime in the respondent's



neighbourhood, were obtained using the ABCD Youth Neighbourhood Safety/Crime Survey Modified from PhenX [83]. Information about culture (e.g., spoken language, family heritage) were not included in our analysis.

A complete description of the measures included in the Culture and Environment area is available in the corresponding ABCD publication [84].

**Neurocognition measures.** A 70-minute-long neurocognitive battery including ten different measures was administered with an iPad. These measures included seven tasks from the NIH Toolbox<sup>®</sup> (<http://www.nihtoolbox.org>) evaluating episodic memory (Picture Sequence Memory Test), inhibition and conflict monitoring (Flanker Task), cognitive flexibility (Dimensional Change Card Sort Task), working memory (List Sorting Working Memory Test), processing speed (Pattern Comparison Processing Speed Test), verbal abilities (Picture Vocabulary Task), reading (Oral Reading Recognition Task). Additionally, the Rey Auditory Verbal Learning Test was used to measure learning, memory and recognition [85]; the Little Man Task to measure visuospatial abilities [86]; and the Matrix Reasoning Task from the Wechsler Intelligence Test for Children-V [87] to measure fluid intelligence. A single item measure of delay of gratification with dichotomous response [88] was also included in the neurocognition tasks, but it will not be included in the analysis because it does not load on cognitive factors [89].

A complete description of the neurocognitive battery is available in the ABCD publication by Luciana and collaborators [88].

**Positive affect.** The Positive Affect Scale from the NIH Toolbox Battery [90] was administered at different time points but not at the baseline (i.e., after 6, 12, 18, 30, 36, and 42 months from the baseline) to evaluate positive emotions and affective well-being in past week [90]. Positive affect has been characterized as “feelings that reflect a level of pleasurable engagement with the environment such as happiness, joy, excitement, enthusiasm, and contentment (p. 4, Salsman et al., 2013). Respondents were provided with 9 positive affects items (e.g., “I felt calm”, “I felt delighted”) and indicated on a 3-points Likert scale (1 = Not true; 3 = Very true) how much they felt that way in the last week. The scale showed high internal validity (Cronbach’s alpha = .96).

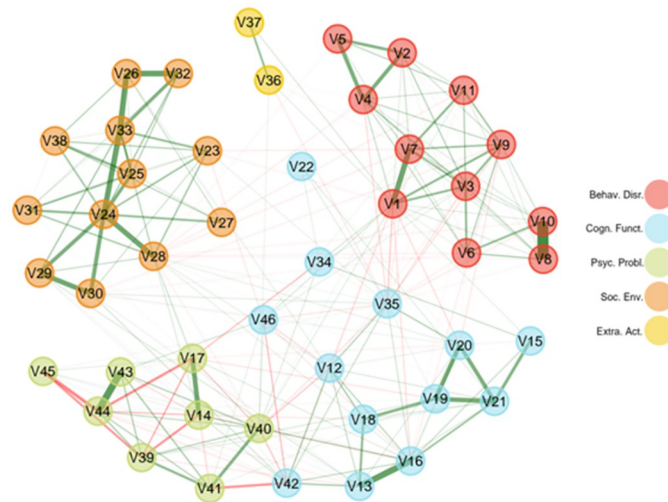
## Statistical analysis

To the aims of the study, two main groups of analyses were run. The first to detect what are the main social, environmental, and psychological domains of the baseline network structure of ABCD variables and the second to study the development of positive affect and its association with the domains individuated (i.e., what makes children happy?). All the analysis were run in R [91].

Given the large number of participants included in the study, we decided not to rely on significance of the effects (which are more likely to result significant) but only on the magnitude of the effects. In particular, we will interpret only effects with an associated standardized effect of .10 or higher as practically useful in line with the principles of the region of practical equivalence [92, 93].

## Exploratory graph analysis

An Exploratory Graph Analysis (EGA) approach was adopted to study the underlying network of connections between the measures included in our study. EGA is a recently proposed technique [61] that, starting from the matrix of partial correlations between a set of variables, allows to estimate the number of domains to be retained and also estimates and graphically represents the associations (i.e., edges) between the measures (i.e., nodes) [94]. After the



**Fig 1. Graphical representation of the network.** Each colored circle represents a variable and its domain (1 to 5). Lines indicate associations between variables: green lines for positive relations and red lines for negative relations. The width of the lines represents the strength of the association. **Note.** V1 = vocabulary; V2 = inhibition; V3 = working memory; V4 = cognitive flexibility; V5 = processing speed; V6 = episodic memory; V7 = reading; V8 = verbal memory; V9 = fluid reasoning; V10 = long term memory; V11 = visuospatial abilities; V12 = prodromal psychosis; V13 = negative urgency; V14 = lack of planning; V15 = sensation seeking; V16 = positive urgency; V17 = Lack of perseverance; V18 = behavioral inhibition (bis); V19 = reward responsiveness (bas); V20 = drive (bas); V21 = fun seeking (bas); V22 = friends; V23 = symptoms of mania; V24 = total ext-int problems; V25 = depression; V26 = anxiety disorders; V27 = somatic disorder; V28 = ADHD; V29 = oppositional conductive disorders; V30 = conduct disorders; V31 = sluggish cognitive tempo; V32 = obsessive compulsive disorders; V33 = stress disorders; V34 = weekly physical activity; V35 = screen time; V36 = sport activity; V37 = hobbies/other activities; V38 = sleep disturbance; V39 = prosocial behaviour; V40 = parental monitoring; V41 = parent's acceptance; V42 = family conflict; V43 = school environment; V44 = school involvement; V45 = school disengagement; V46 = safe neighbourhood.

<https://doi.org/10.1371/journal.pone.0307560.g001>

network is estimated, EGA provides different indices including the strength of the association between each node and its dimension, which is equivalent to factor loadings in factor analysis [95] and the strength of the edges, which represents the semipartial correlation between two nodes and is represented in the network graph (see Fig 1) with thinner or thicker lines depending on the magnitude of the association [50]. EGA has different advantages and an equal or better performance than other traditional measures (i.e., VSS, MAP, K1, BIC, EBIC, PA). A first advantage is that it relies less on the subjectivity of the researcher, who must traditionally choose the rotation of the loadings matrix [96]; it also allows for a graphical and easy to interpret representation of the model (see Fig 1); and has the practical advantage of estimating the number of dimensions, the edges, and the loadings within the same algorithm, without using two different set of analyses. For what concerns actual statistical performance, a recent simulation study showed that EGA has high accuracy in all the condition tested (varying number of factors, sample size, factor loadings, number of variables, factor correlations, and number of response options) and that it has the best accuracy to correctly estimate the number of factors and the lowest mean bias error [94] across condition. Parallel analysis (PA) also performed very well across most conditions, but EGA outperformed it in large datasets and large structures (e.g., four or more domains), as in our case [61, 94]. For these reasons, EGA is perfectly suited to the aims of our study.

To ensure that a network is reliable, stable, and not sample-specific, it is possible to follow a bootstrap procedure [97]. In this case we applied a non-parametric bootstrap with 10,000 replications. The median network obtained via bootstrap was then compared with the original



network and the stability of the network was calculated as the proportion of times the network was equally replicated in the bootstraps. Additionally, we inspected the reliability of each node looking at how many times the same node belonged to each domain of the network. A node is assumed to be stable when it appears at least 80% of the times as loading on the same component [97]. The EGAnet package was used for this analysis [98]. Finally, the *net.scores()* function was used to extract participants' latent scores for each dimension of the estimated network. These scores will serve as predictors of positive affect in subsequent analysis.

## The development of positive affect and its association with the ABCD dimensions

To study the development of positive affect and its associations with the domains extracted following the EGA, we used a latent growth model. Factor loadings of the observed composite variables were fixed at 1 for each time point. The loadings for the linear change factor were fixed in ascending order as 0 (6 months), 1 (12 months), 2 (18 months), 4 (30 months), 5 (36 months), and 6 (42 months; 3 is missing because participants were not contacted after 24 months). Predictors were the scores extracted from the network. *z scores* in positive affect were used after scaling positive affect on the whole sample. To handle missing data and avoid losing information we used full information maximum likelihood (FIML) to estimate missing data. Goodness-of-fit was evaluated using the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI), the Standardized Root Mean Squared Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA) [99].

The R packages Lavaan [100] was used for this set of analyses.

## Results

### Exploratory graph analysis

The EGA run on the baseline sample including 10904 participants, shows that the 46 variables included in this analysis can be aptly described by five inter-related domains (see Fig 1) that we interpreted and named as behavioural dysregulation (D1), cognitive functioning (D2), psychological problems (D3), supportive social environment (D4), and extracurricular activities (D5). The behavioural dysregulation domain is composed by 13 nodes (variables) including the four BIS/BAS measures, physical activity, screen time, the number of friends, safe neighbourhoods, sensation seeking, negative and positive urgency (UPPS scale), family conflict, and prodromal psychosis. This domain was labelled as behavioural dysregulation because the most central and correlated nodes of the domain encompass behavioural inhibition and activation systems, negative and positive urgency, and sensation seeking. The other nodes were less associated, but might be proxies of behavioural dysregulation (e.g., individuals with higher behavioural dysregulation might encounter higher family conflicts). The cognitive functioning domain included all the 11 measures of neurocognition. The psychological problems domain was composed by 12 nodes including behavioural problems, sleep disturbance, mania symptoms, and the disorders measured with the K-SADS interview (i.e., conduct, oppositional, somatic, stress, ADHD, sluggish cognitive tempo, obsessive compulsive disorder, anxiety, and depression). The supportive social environment domain is composed of 8 nodes including the three measures of school environment, prosocial behaviour, parent acceptance and monitoring, and the two measures of the UPPS scale for lack of perseverance and lack of planning. Finally, the extracurricular activities domain included two nodes measuring the months spent by the children doing sport or other activities (e.g., hobbies). All the standardized loadings of the network are available in S2 Table.

**Table 2. Pearson correlations between the five dimensions, positive affect at different time points, and covariates.** Correlations  $\geq |.10|$  are reported in bold.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. D1	-													
2. D2	<b>-.34</b>	-												
3. D3	<b>.25</b>	<b>-.18</b>	-											
4. D4	<b>-.25</b>	<b>.14</b>	<b>-.22</b>	-										
5. D5	<b>-.22</b>	<b>.38</b>	<b>-.07</b>	<b>.13</b>	-									
6. PA 6	<b>-.09</b>	<b>.16</b>	<b>-.10</b>	<b>.28</b>	<b>.12</b>	-								
7. PA 12	<b>-.03</b>	<b>.07</b>	<b>-.09</b>	<b>.30</b>	<b>.06</b>	<b>.35</b>	-							
8. PA 18	<b>-.12</b>	<b>.15</b>	<b>-.14</b>	<b>.28</b>	<b>.11</b>	<b>.40</b>	<b>.41</b>	-						
9. PA 30	<b>-.10</b>	<b>.12</b>	<b>-.15</b>	<b>.24</b>	<b>.09</b>	<b>.30</b>	<b>.34</b>	<b>.43</b>	-					
10. PA 36	<b>-.06</b>	<b>.04</b>	<b>-.11</b>	<b>.25</b>	<b>.02</b>	<b>.25</b>	<b>.36</b>	<b>.39</b>	<b>.50</b>	-				
11. PA 42	<b>-.06</b>	<b>.05</b>	<b>-.14</b>	<b>.20</b>	<b>.05</b>	<b>.24</b>	<b>.28</b>	<b>.36</b>	<b>.49</b>	<b>.52</b>	-			
12. Age	<b>-.07</b>	<b>.27</b>	<b>-.01</b>	<b>.04</b>	<b>.13</b>	<b>.02</b>	<b>.00</b>	<b>-.02</b>	<b>-.04</b>	<b>-.01</b>	<b>-.03</b>	-		
13. Sex (M)	<b>-.13</b>	<b>.05</b>	<b>-.10</b>	<b>.20</b>	<b>.10</b>	<b>.08</b>	<b>.04</b>	<b>.06</b>	<b>.00</b>	<b>-.04</b>	<b>-.07</b>	<b>-.02</b>	-	
14. Income	<b>-.25</b>	<b>.44</b>	<b>-.17</b>	<b>.06</b>	<b>.32</b>	<b>.10</b>	<b>.04</b>	<b>.12</b>	<b>.10</b>	<b>.06</b>	<b>.04</b>	<b>.04</b>	<b>-.00</b>	-
15. Education	<b>-.20</b>	<b>.40</b>	<b>-.09</b>	<b>.04</b>	<b>.31</b>	<b>.11</b>	<b>.03</b>	<b>.13</b>	<b>.11</b>	<b>.05</b>	<b>.05</b>	<b>.02</b>	<b>-.01</b>	<b>.62</b>

Note. PA = Positive Affect; D1 = behavioural dysregulation; D2 = cognitive functioning; D3 = psychological problems; D4 = supportive social environment; D5 = extracurricular activities

<https://doi.org/10.1371/journal.pone.0307560.t002>

Finally, the bootstrap procedure suggests that the network individuated is highly stable. Specifically, it replicated exactly 99% of the times. Nodes were also highly stable and none of them was under the .80 cut-off. Physical activity (V34, behavioural dysregulation) was the less stable node with a replication of 94%. It appeared in the fourth domain on 6% of the occasions. The complete stability results are pictured in [S1 Fig](#).

Given the goodness of the model, latent domain scores for the five domains were extracted and used in the following analyses. Pearson correlations between domain scores and the other variables are available in [Table 2](#). The five factors were only slightly correlated between each other.

## The development of positive affect and its relationship with the ABCD dimensions

Results of the latent growth model show that the model adequately fit the data as indicated by three of the four indices adopted (SRMR = .04; RMSEA = .06; GFI = .95). The CFI (.89) was slightly lower than what is deemed acceptable. The latent intercept value for positive affect was slightly higher than the mean ( $\beta_{\text{intercept}} = .23$ ;  $b = .14$ ) with a latent slope value indicating that positive affect decreases with time ( $\beta_{\text{slope}} = -.48$ ;  $b = -.06$ ). Intercept and slope resulted slightly correlated ( $r = -.25$ ) indicating that the higher is positive affect at the baseline, the steepest is the decline. The effect of the predictors on the latent intercept was the biggest for *supportive social environment* ( $\beta = .43$ ;  $b = .27$ ). Psychological problems showed a very small association with positive affect intercept ( $\beta = .15$ ;  $b = .09$ ). Behavioural dysregulation ( $\beta = .06$ ;  $b = .04$ ), cognitive functioning ( $\beta = -.04$ ;  $b = -.02$ ), and extracurricular activities ( $\beta = .08$ ;  $b = .05$ ) showed negligible effects on the intercept. The slope was almost unaffected by the predictors with only cognitive functioning and psychological problems having a small but almost negligible association with positive affect's slope ( $\beta = -.11$ ;  $b = -.01$  in both cases). The effect of behavioural dysregulation ( $\beta = -.05$ ;  $b = -.01$ ), supportive social environment ( $\beta = -.08$ ;  $b = -.01$ ), and extracurricular activities ( $\beta = -.05$ ;  $b = -.01$ ) on the slope was practically negligible. Betas ( $\beta$ )

indicate standardized coefficients while *bs* (*b*) indicate unstandardized coefficients. This model explained 25% of the intercept variance, and 3% of the slope variance.

## Discussion and conclusions

Adolescence is a period of changes and adolescents face social insecurity, uncertainty, and higher responsibilities. Being able to functionally adapt to such requests is a hard job that may undermine one's well-being and positive affect, as evident from their decline highlighted in early adolescence [12, 22]. A decline in positive affect, however, may lead to additional difficulties in areas that include physical and mental health, cognitive functioning, school success, sociality, and decision making, among the others [15–20, 101]. For this reason, it is crucial to further investigate the development of positive affect and its antecedents.

In the light of these observations, our study had two main aims: the first, and preliminary, aim was to study the network of associations among a large number of variables pertaining to social, environmental, and psychological characteristics of the children; the second was to study the longitudinal development of positive affect between 9 and 13 years old and its association between the domains individuated in the network. The first aim, in line with recent studies suggesting that different psychological facets can be well described by a lower number of network domains [48, 49, 62], allowed us to reduce the number of possible variables to be considered as predictors of positive affect while taking into account their entire network of associations and their latent superordinate structure. This could help overcoming the problems inherent to previous research in the field (and in psychology in general) in which narrow predictors have been used, causing a proliferation of studies and meta-analyses that do not account for the complex structure of psychological, social, and environmental variables. Contrarily, with a network approach, educators, policymakers, institutions, or whoever is involved in promoting positive affect, could focus on a restricted range of aspects that might be more effective to the goal. In fact, out of the five domains individuated and—by literature—plausibly associable to positive affect, only one resulted predicting it strongly in children: a supportive social environment.

### The network structure

Recent psychological literature [48, 49, 52, 62] highlights the tendency toward a lower dimensionality of psychological constructs. For practical reasons, however, most studies narrow their focus to specific variables and do not consider the high interconnection that binds psychological, social, and environmental variables. A large study that identifies the network of associations between a large number of variables could thus help to understand their reciprocal association and also to reduce the number of domains that we should focus on to promote positive affect in adolescence.

The EGA applied on the 46 baseline variables included has individuated five stable and interconnected domains in the network structure: behavioural dysregulation, cognitive functioning, psychological problems, supportive social environment, and extracurricular activities. The 'behavioural dysregulation' domain encompasses activities and attitudes characterized by high energy, impulsive behaviours, and the need for new experiences and people. Surprisingly, it also includes family conflicts and safe neighbourhoods. Indeed, while one might expect these nodes as belonging to the 'supportive social environment' domain, they instead represent a bridge between 'behavioural dysregulation' and 'supportive social environment' (see Fig 1) possibly connecting the tendency to develop a less regulated behaviour to the presence of a less supportive social environment. This is in line with previous studies highlighting that the social environment could drive on the long term to deviant, impulsive, and uncontrolled behaviours

[84, 102–104]. In other words, the way one behaves and their social environment are two separate but entangled dimensions. The ‘supportive social environment’ domain, on the other side, is characterized by variables concerning a positive adaptation or belongingness to the most influential social environments to which children are exposed: school and their family. Together with these aspects, a supportive environment seems to favour children’s future planning abilities in the sense that such children are more projected into the future and tend to persevere and plan their future more than others. This is highlighted by the two future-oriented subscales of the UPPS scale (i.e., lack of perseverance and lack of planning) that emerged as part of this domain and not of the first domain (i.e., ‘behavioural dysregulation’ domain) wherein the present-oriented subscales were included (i.e., sensation seeking, and positive and negative urgency). The ‘cognitive functioning’ domain clearly reflects the well-known *g factor* [105] of intelligence and separates it from the other not strictly cognitive domains, highlighting a distance between cognitive variables and social, psychopathological, environmental, and behavioural nodes. The ‘psychological problems’ domain is composed of all—with the exception of prodromal psychosis symptoms—the externalizing and internalizing problems measured. This is perfectly in line with new evidence in literature suggesting the existence of an overarching psychopathology factor [57, 106, 107], as already emerged in other ABCD studies specifically focusing on these variables (the ‘*p factor*’; Brislin et al., 2021). This factor, following Caspi and collaborators (2014) could represent a person’s vulnerability to mental disorders and their comorbidity. Finally, the ‘extracurricular activities’ domain emerged as a small domain including the practice of sport and other extracurricular activities (e.g., music, art, hobbies). This is the less connected domain of the network, but it is a prominent aspect of children and adolescents’ lives because they freely choose and engage in such activities and their participation is important for different aspects of their lives, ranging from educational outcomes, to physical and mental health, skills, and well-being [108–111].

The five domains individuated are obviously not sufficient to entirely describe the environmental, social, and psychological aspects of children’s lives and key aspects are probably missing (e.g., personality traits, motivation, self-beliefs). Nonetheless, our model is still one of the most complete in literature—thanks to the large ABCD data collection—and we believe that the five domains well describe a large spectrum of children’s variability and that our results could well inform about the role of these domains for children’s positive affect, as discussed in the next paragraph.

### What makes children happy? Positive affect development and its predictors

Longitudinal studies about the development of positive affect between late childhood and early adolescence are not abundant, but, with some exceptions, they point to a decrease in happiness or positive affect during this period [22, 24]. Our results are in line with this finding as we show that positive affect decreases every 6 months (ca) by 0.06 points in *z* scores, which may lead to a decrease of almost half standard deviation in four years. This is an important point because it confirms that the decline of positive affect starts years before adolescence and, as researchers, we should be interested in finding ways to sustain children’s positive affect as it may lead to the successful or unsuccessful development of future health and wellbeing, psychopathology, and interpersonal relationships among the others [2, 10, 20, 32]. To this aim, we also studied the association between the five domains individuated by the EGA and positive affect. Indeed, starting from the literature it is difficult to discern which factors may have a major or minor role for positive affect in childhood and adolescence and all the five domains that we individuated could theoretically sustain children’s positive affect. In fact, there is plenty of research highlighting the role of—among the many—physical activity, environmental

features, sleep, personality, interpersonal relationships, psychological problems, and maladaptive behaviors [33, 35, 36, 39–41, 44]. However, the different domains and the variables within and between them are often correlated, as evident for example in the relation between the characteristics of the social environment and impulsive or externalizing and internalizing behaviours [84, 112, 113]. For these reasons, we argued that a holistic approach to the question, that includes a high number of variables and their associations, could foster our understanding of the mechanisms underlying positive affect in children and adolescents.

Following this approach, we regressed the scores of the five domains on the latent intercept and the latent slope of positive affect. From these results, the primary role of a supportive social environment emerged. In fact, the ‘supportive social environment’ domain showed a medium-to-large positive association ( $\beta = .44$ ) with the latent intercept of positive affect. Contrarily, none of the other factors showed a strong association with positive affect, as highlighted by standardized effect lower than  $|.10|$ , with the exception of ‘psychological problems’. In other words, practicing extracurricular activities, having higher cognitive abilities, lower psychological problems, or behaving less impulsively does not directly, or only slightly in the case of psychological problems, influence adolescents’ positive affect. The effect of a supportive social environment also resulted stable for all participants across time, as highlighted by the correlations in Table 2. This is particularly important given the instability of positive affect across time. Interestingly, correlation values between a ‘supportive social environment’ and positive affect are comparable to the mutual correlations between different observations of positive affect itself (see Table 2). This indicates that a supportive social environment, in the long run, could predict positive affect as well as baseline positive affect does.

These results are in line with the evidence in the literature about the great importance that the relationship with parents has for adolescents’ positive affect [32, 114–116], with adolescents also qualitatively reporting about the importance of their family relationship for their own well-being [117]. On the same line, quantitative and qualitative research strongly support the role that teachers and school environment play for students in middle and high school [118–122]. For example, a supportive environment at school and a good school climate are strong predictors of students’ mental health, positive relationships, academic outcomes, motivations, and emotions [122]. Our results, however, suggest that other factors might not be as effective in directly sustaining their happiness when they are included within a larger network of variables. This might have a great practical impact because, even if positive effects of psychological interventions aimed at increasing subjective well-being exist [123], institutions and organizations that aim at increasing adolescents happiness on a larger scale might shift (or keep) their focus to the social environments children are exposed to, instead of focusing on narrow aspects of their lives such as extracurricular activities. For example, school programs aimed at increasing students’ scholastic engagement, sense of belonging and school climate [121, 124–127] might be increasingly implemented with the additional aim, this time, of increasing adolescents’ happiness. This aligns with recent suggestions to prioritize school and classroom climate as predictors of students’ adjustment and wellbeing [127]. Social-emotional learning (SEL) programs, which aim to foster students’ skills to manage their emotions and establish and maintain supportive and caring relationships, might be well suited to this aim given their impact on students’ well-being, emotional competencies, schools’ climate, and attitude [128–131]. As also suggested by Oberle et al. [132], these results suggest strengthening and emphasizing strategies that may foster adolescents’ relationships with both peers and adults at school. Similarly, research and interventions might focus on parent trainings, trying to make them more effective and possibly focusing on promoting the relationships between parents and children in term of increasing children acceptance of their parents, and parents competences and self-esteem and lowering family conflicts [133–135]. In particular, it might be important to

foster parents' emotion socialization abilities, that might consequently help children to develop emotion regulation skills [136, 137]. Parents' emotion regulation strategies and emotionally supportive responses are in fact associated with higher emotion regulation abilities and lower depressive symptoms in children [137]. These might also affect other aspects, such as adolescents' behavioural and psychological problems [138]. In other words, investing in schools and families could be, again, a solution to promote children's and adolescents' happiness as well as other important factors, such as education, behaviours, or social relationships.

### Limitations and future directions

Although our study is based on a large and longitudinal data collection including more than 46 variables, it also has limitations that future studies could overcome. Firstly, our study is limited to a US population, which may restrict the generalizability of our findings. This is particularly pertinent for our main predictor, identified as the 'supportive social environment,' which could exhibit markedly different characteristics in other contexts where family and school structures and values may vary. It is also important to note that we tested the longitudinal association between a set of baseline predictors and multiple measurements of positive affect. This follows a temporal relationship that we deemed causal, but cross-lagged panel models and multiple measurement of the predictors should be used to confirm the directionality of the relationships. Future studies, once the ABCD data will be completely available, could tackle this question and unveil such important theoretical paths. The study is also limited to the variables available from the ABCD data collection, but other important factors (e.g., personality, social skills) could play a significant role for positive affect. However, following our study, future research could directly test the effects of such factors beyond that of a supportive social environment.

### Conclusions

Adopting a network approach applied to a very large sample size and using a longitudinal data collection, our study identified—for the first time—what are the main domains characterizing children's cognitive, psychological and environmental measures. Also, not only confirmed that positive affect declines between 9 and 13 years old but, more importantly, deepened the fundamental question about “what makes children happy”. This allowed us to make reliable conclusions about the importance of specific domains—while taking into account the interconnectedness of many psychological variables—and to pinpoint what are the most important factors responsible for children's and adolescents' happiness: their families and schools, or, more in general, the presence of a supportive social environment. This is of primary importance for practitioners and policymakers as it might narrow their attention to what, within the complex network of our psychological, social, and environmental variability, effectively has a direct impact on positive affect.

### Supporting information

#### **S1 Table. List of the measures.**

(DOCX)

#### **S2 Table. Standardized loadings of the EGA model.**

(DOCX)

**S1 Fig. Stability of the nodes across replication.** Numbers represent the percentage of times the node loaded on the expected domain.

(DOCX)



## Acknowledgments

Data used in the preparation of this article were obtained from the Adolescent Brain Cognitive Development<sup>SM</sup> (ABCD) Study (<https://abcdstudy.org>), held in the NIMH Data Archive (NDA). This is a multisite, longitudinal study designed to recruit more than 10,000 children age 9–10 and follow them over 10 years into early adulthood. The ABCD Study<sup>®</sup> is supported by the National Institutes of Health and additional federal partners under award numbers U01DA041048, U01DA050989, U01DA051016, U01DA041022, U01DA051018, U01DA051037, U01DA050987, U01DA041174, U01DA041106, U01DA041117, U01DA041028, U01DA041134, U01DA050988, U01DA051039, U01DA041156, U01DA041025, U01DA041120, U01DA051038, U01DA041148, U01DA041093, U01DA041089, U24DA041123, U24DA041147. A full list of supporters is available at <https://abcdstudy.org/federal-partners.html>. A listing of participating sites and a complete listing of the study investigators can be found at [https://abcdstudy.org/consortium\\_members/](https://abcdstudy.org/consortium_members/). ABCD consortium investigators designed and implemented the study and/or provided data but did not necessarily participate in the analysis or writing of this report. This manuscript reflects the views of the authors and may not reflect the opinions or views of the NIH or ABCD consortium investigators.

The ABCD data repository grows and changes over time. The ABCD data used in this report came from data release 4.0 and can be found with the following NIMH Data Archive Digital Object Identifier: [10.15154/1528737](https://doi.org/10.15154/1528737). DOIs can be found at [nda.nih.gov/general-query.html?q=query=studies](https://nda.nih.gov/general-query.html?q=query=studies).

## Author Contributions

**Conceptualization:** Tommaso Feraco, Giorgia Cona.

**Formal analysis:** Tommaso Feraco.

**Methodology:** Tommaso Feraco.

**Supervision:** Giorgia Cona.

**Visualization:** Tommaso Feraco.

**Writing – original draft:** Tommaso Feraco.

**Writing – review & editing:** Tommaso Feraco, Giorgia Cona.

## References

1. Gilbert D. *Stumbling on happiness*. Vintage Canada; 2009.
2. Reitsema AM, Jeronimus BF, van Dijk M, de Jonge P. Emotion dynamics in children and adolescents: A meta-analytic and descriptive review. *Emotion*. 2022; 22:374–96. <https://doi.org/10.1037/emo0000970> PMID: 34843305
3. Bramen JE, Hranilovich JA, Dahl RE, Forbes EE, Chen J, Toga AW, et al. Puberty Influences Medial Temporal Lobe and Cortical Gray Matter Maturation Differently in Boys Than Girls Matched for Sexual Maturity. *Cereb Cortex N Y NY*. 2011 Mar; 21(3):636–46. <https://doi.org/10.1093/cercor/bhq137> PMID: 20713504
4. Demetriou A, Spanoudis GC, Greiff S, Makris N, Panaoura R, Kazi S. Changing priorities in the development of cognitive competence and school learning: A general theory. *Front Psychol [Internet]*. 2022 [cited 2022 Oct 2]; 13. Available from: <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.954971> PMID: 36248549
5. Yurgelun-Todd D. Emotional and cognitive changes during adolescence. *Curr Opin Neurobiol*. 2007 Apr; 17(2):251–7. <https://doi.org/10.1016/j.conb.2007.03.009> PMID: 17383865
6. Feraco T, Cona G. Differentiation of general and specific abilities in intelligence. A bifactor study of age and gender differentiation in 8- to 19-year-olds. *Intelligence*. 2022 Sep 1; 94:101669.

7. Allen N, Sheeber L. The importance of affective development for the emergence of depressive disorders during adolescence. 2008 Nov 20;
8. Dahl RE. Adolescent Brain Development: A Period of Vulnerabilities and Opportunities. Keynote Address. *Ann N Y Acad Sci*. 2004; 1021(1):1–22. <https://doi.org/10.1196/annals.1308.001> PMID: 15251869
9. Napolitano CM, Sewell MN, Yoon HJ, Soto CJ, Roberts BrentW. Social, Emotional, and Behavioral Skills: An Integrative Model of the Skills Associated With Success During Adolescence and Across the Life Span. *Front Educ* [Internet]. 2021 [cited 2022 Apr 14]; 6. Available from: <https://www.frontiersin.org/article/10.3389/educ.2021.679561>
10. Sawyer SM, Azzopardi PS, Wickremarathne D, Patton GC. The age of adolescence. *Lancet Child Adolesc Health*. 2018 Mar 1; 2(3):223–8. [https://doi.org/10.1016/S2352-4642\(18\)30022-1](https://doi.org/10.1016/S2352-4642(18)30022-1) PMID: 30169257
11. Masselink M, Van Roekel E, Hankin BL, Keijsers L, Lodder GMA, Vanhalst J, et al. The Longitudinal Association between Self—Esteem and Depressive Symptoms in Adolescents: Separating Between—Person Effects from Within—Person Effects. *Eur J Personal*. 2018 Nov 1; 32(6):653–71. <https://doi.org/10.1002/per.2179> PMID: 31105382
12. Orben A, Lucas RE, Fuhrmann D, Kievit RA. Trajectories of adolescent life satisfaction. *R Soc Open Sci*. 2022; 9(8):211808. <https://doi.org/10.1098/rsos.211808> PMID: 35937913
13. Feraco T, Meneghetti C. Social, Emotional, and Behavioral Skills: Age and Gender Differences at 12 to 19 Years Old. *J Intell*. 2023 Jun; 11(6):118. <https://doi.org/10.3390/jintelligence11060118> PMID: 37367520
14. Maciejewski DF, van Lier PAC, Branje SJT, Meeus WHJ, Koot HM. A 5-Year Longitudinal Study on Mood Variability Across Adolescence Using Daily Diaries. *Child Dev*. 2015; 86(6):1908–21. <https://doi.org/10.1111/cdev.12420> PMID: 26464350
15. Danner DD, Snowdon DA, Friesen WV. Positive emotions in early life and longevity: Findings from the nun study. *J Pers Soc Psychol*. 2001; 80(5):804–13. PMID: 11374751
16. Salovey P, Rothman AJ, Detweiler JB, Steward WT. Emotional states and physical health. *Am Psychol*. 2000; 55(1):110–21. <https://doi.org/10.1037//0003-066x.55.1.110> PMID: 11392855
17. Tugade MM, Fredrickson BL, Feldman Barrett L. Psychological Resilience and Positive Emotional Granularity: Examining the Benefits of Positive Emotions on Coping and Health. *J Pers*. 2004; 72(6):1161–90. <https://doi.org/10.1111/j.1467-6494.2004.00294.x> PMID: 15509280
18. Kansky J, Allen JP, Diener E. Early Adolescent Affect Predicts Later Life Outcomes. *Appl Psychol Health Well-Being*. 2016; 8(2):192–212. <https://doi.org/10.1111/aphw.12068> PMID: 27075545
19. Hoyt LT, Chase-Lansdale PL, McDade TW, Adam EK. Positive Youth, Healthy Adults: Does Positive Well-being in Adolescence Predict Better Perceived Health and Fewer Risky Health Behaviors in Young Adulthood? *J Adolesc Health*. 2012 Jan 1; 50(1):66–73. <https://doi.org/10.1016/j.jadohealth.2011.05.002> PMID: 22188836
20. Steptoe A, Dockray S, Wardle J. Positive Affect and Psychobiological Processes Relevant to Health. *J Pers*. 2009; 77(6):1747–76. <https://doi.org/10.1111/j.1467-6494.2009.00599.x> PMID: 19796062
21. Dockray S, Steptoe A. Positive affect and psychobiological processes. *Neurosci Biobehav Rev*. 2010 Sep 1; 35(1):69–75. <https://doi.org/10.1016/j.neubiorev.2010.01.006> PMID: 20097225
22. Griffith JM, Clark HM, Haraden DA, Young JF, Hankin BL. Affective Development from Middle Childhood to Late Adolescence: Trajectories of Mean-Level Change in Negative and Positive Affect. *J Youth Adolesc*. 2021 Aug 1; 50(8):1550–63. <https://doi.org/10.1007/s10964-021-01425-z> PMID: 33791947
23. Watson D. *Mood and Temperament*. Guilford Press; 2000. 360 p.
24. Maciejewski DF, van Lier PAC, Branje SJT, Meeus WHJ, Koot HM. A daily diary study on adolescent emotional experiences: Measurement invariance and developmental trajectories. *Psychol Assess*. 2017; 29:35–49. <https://doi.org/10.1037/pas0000312> PMID: 27099977
25. Borghuis J, Denissen JJA, Oberski D, Sijsma K, Meeus WHJ, Branje S, et al. Big Five personality stability, change, and codevelopment across adolescence and early adulthood. *J Pers Soc Psychol*. 2017; 113:641–57. <https://doi.org/10.1037/pspp0000138> PMID: 28253001
26. Soto CJ. The Little Six Personality Dimensions From Early Childhood to Early Adulthood: Mean-Level Age and Gender Differences in Parents' Reports. *J Pers*. 2016; 84(4):409–22. <https://doi.org/10.1111/jopy.12168> PMID: 25728032
27. Zimmermann P, Iwanski A. Emotion regulation from early adolescence to emerging adulthood and middle adulthood: Age differences, gender differences, and emotion-specific developmental variations. *Int J Behav Dev*. 2014 Mar 1; 38(2):182–94.

28. Zimmermann P, Iwanski A. Development and Timing of Developmental Changes in Emotional Reactivity and Emotion Regulation During Adolescence. In: Emotion Regulation. Routledge; 2018.
29. Olino TM, Lopez-Duran NL, Kovacs M, George CJ, Gentzler AL, Shaw DS. Developmental trajectories of positive and negative affect in children at high and low familial risk for depressive disorder. *J Child Psychol Psychiatry*. 2011; 52(7):792–9. <https://doi.org/10.1111/j.1469-7610.2010.02331.x> PMID: 21039488
30. Guyer AE, Silk JS, Nelson EE. The neurobiology of the emotional adolescent: From the inside out. *Neurosci Biobehav Rev*. 2016 Nov 1; 70:74–85. <https://doi.org/10.1016/j.neubiorev.2016.07.037> PMID: 27506384
31. Nelson EE, Jarcho JM, Guyer AE. Social re-orientation and brain development: An expanded and updated view. *Dev Cogn Neurosci*. 2016 Feb 1; 17:118–27. <https://doi.org/10.1016/j.dcn.2015.12.008> PMID: 26777136
32. Griffith JM, Young JF, Hankin BL. Longitudinal associations between positive affect and relationship quality among children and adolescents: Examining patterns of co-occurring change. *Emotion*. 2021; 21:28–38. <https://doi.org/10.1037/emo0000682> PMID: 31524419
33. Ramsey MA, Gentzler AL. An upward spiral: Bidirectional associations between positive affect and positive aspects of close relationships across the life span. *Dev Rev*. 2015 Jun 1; 36:58–104.
34. Schwartz-Mette RA, Shankman J, Dueweke AR, Borowski S, Rose AJ. Relations of friendship experiences with depressive symptoms and loneliness in childhood and adolescence: A meta-analytic review. *Psychol Bull*. 2020; 146:664–700. <https://doi.org/10.1037/bul0000239> PMID: 32406698
35. Li J, Huang Z, Si W, Shao T. The Effects of Physical Activity on Positive Emotions in Children and Adolescents: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health*. 2022 Jan; 19(21):14185. <https://doi.org/10.3390/ijerph192114185> PMID: 36361067
36. Short MA, Booth SA, Omar O, Ostlundh L, Arora T. The relationship between sleep duration and mood in adolescents: A systematic review and meta-analysis. *Sleep Med Rev*. 2020 Aug 1; 52:101311. <https://doi.org/10.1016/j.smrv.2020.101311> PMID: 32240932
37. Steel P, Schmidt J, Shultz J. Refining the relationship between personality and subjective well-being. *Psychol Bull*. 2008; 134(1):138–61. <https://doi.org/10.1037/0033-2909.134.1.138> PMID: 18193998
38. Kaya M, Erdem C. Students' Well-Being and Academic Achievement: A Meta-Analysis Study. *Child Indic Res*. 2021; 14(5):1743–67.
39. Capaldi CA, Dopko RL, Zelenski JM. The relationship between nature connectedness and happiness: a meta-analysis. *Front Psychol [Internet]*. 2014 [cited 2022 Jul 8]; 5. Available from: <https://www.frontiersin.org/articles/10.3389/fpsyg.2014.00976> PMID: 25249992
40. McMahan EA, Estes D. The effect of contact with natural environments on positive and negative affect: A meta-analysis. *J Posit Psychol*. 2015 Nov 2; 10(6):507–19.
41. Kuykendall L, Tay L, Ng V. Leisure engagement and subjective well-being: A meta-analysis. *Psychol Bull*. 2015; 141(2):364–403. <https://doi.org/10.1037/a0038508> PMID: 25602273
42. Soga M, Gaston KJ, Yamaura Y. Gardening is beneficial for health: A meta-analysis. *Prev Med Rep*. 2017 Mar 1; 5:92–9. <https://doi.org/10.1016/j.pmedr.2016.11.007> PMID: 27981022
43. Ho J, Ngai SPC, Wu WKK, Hou WK. Association between daily life experience and psychological well-being in people living with nonpsychotic mental disorders: Protocol for a systematic review and meta-analysis. *Medicine (Baltimore)*. 2018 Jan; 97(4):e9733. <https://doi.org/10.1097/MD.00000000000009733> PMID: 29369215
44. Jovanović V. Internalizing behaviors in adolescence: The unique contribution of life satisfaction beyond positive and negative affect. *Personal Individ Differ*. 2022 Jul 1; 192:111593.
45. Lei H, Chiu MM, Li S. Subjective well-being and internet overuse: A meta-analysis of mainland Chinese students. *Curr Psychol*. 2020 Jun 1; 39(3):843–53.
46. Shankleman M, Hammond L, Jones FW. Adolescent Social Media Use and Well-Being: A Systematic Review and Thematic Meta-synthesis. *Adolesc Res Rev*. 2021 Dec 1; 6(4):471–92.
47. Borsboom D, Deserno MK, Rhemtulla M, Epskamp S, Fried EI, McNally RJ, et al. Network analysis of multivariate data in psychological science. *Nat Rev Methods Primer*. 2021 Aug 19; 1(1):1–18.
48. Cona G, Koçillari L, Palombit A, Bertoldo A, Maritan A, Corbetta M. Archetypes of human cognition defined by time preference for reward and their brain correlates: An evolutionary trade-off approach. *NeuroImage*. 2019 Jan 15; 185:322–34. <https://doi.org/10.1016/j.neuroimage.2018.10.050> PMID: 30355533
49. Corbetta M, Siegel JS, Shulman GL. On the low dimensionality of behavioral deficits and alterations of brain network connectivity after focal injury. *Cortex*. 2018 Oct 1; 107:229–37. <https://doi.org/10.1016/j.cortex.2017.12.017> PMID: 29357980

50. Dalege J, Borsboom D, van Harreveld F, van der Maas HLJ. Network Analysis on Attitudes: A Brief Tutorial. *Soc Psychol Personal Sci*. 2017 Jul 1; 8(5):528–37. <https://doi.org/10.1177/1948550617709827> PMID: 28919944
51. Feraco T, Sella E, Meneghetti C, Cona G. Adapt, Explore, or Keep Going? The Role of Adaptability, Curiosity, and Perseverance in a Network of Study-Related Factors and Scholastic Success. *J Intell*. 2023 Feb; 11(2):34. <https://doi.org/10.3390/jintelligence11020034> PMID: 36826932
52. Granzio U, Cona G. Architecture and relationships among cognition, mental health and other human domains revealed by network analysis perspective. *Curr Psychol [Internet]*. 2023 May 3 [cited 2023 May 4]; Available from: <https://doi.org/10.1007/s12144-023-04698-8>
53. Sporns O. The human connectome: a complex network. *Ann N Y Acad Sci*. 2011; 1224(1):109–25. <https://doi.org/10.1111/j.1749-6632.2010.05888.x> PMID: 21251014
54. Brislin SJ, Martz ME, Joshi S, Duval ER, Gard A, Clark DA, et al. Differentiated nomological networks of internalizing, externalizing, and the general factor of psychopathology ('p factor') in emerging adolescence in the ABCD study. *Psychol Med*. 2021 Jan 14;1–11. <https://doi.org/10.1017/S0033291720005103> PMID: 33441214
55. Feraco T, Casali N, Meneghetti C, Greiff S, Cona G. Is Good Character All that Counts? A Comparison Between the Predictive Role of Specific Strengths and a General Factor of "Good Character" Using a Bifactor Model. *J Happiness Stud [Internet]*. 2023 Sep 9 [cited 2023 Sep 14]; Available from: <https://doi.org/10.1007/s10902-023-00686-8>
56. McAbee ST, Oswald FL, Connelly BS. Bifactor Models of Personality and College Student Performance: A Broad Versus Narrow View. *Eur J Personal*. 2014; 28(6):604–19.
57. Mike A, King H, Oltmanns TF, Jackson JJ. Obsessive, compulsive, and conscientious? The relationship between OCPD and personality traits. *J Pers*. 2018; 86(6):952–72. <https://doi.org/10.1111/jopy.12368> PMID: 29272027
58. Musek J. A general factor of personality: Evidence for the Big One in the five-factor model. *J Res Personal*. 2007 Dec 1; 41(6):1213–33.
59. Ree MJ, Carretta TR, Teachout MS. Pervasiveness of Dominant General Factors in Organizational Measurement. *Ind Organ Psychol*. 2015 Sep; 8(3):409–27.
60. Zhang B, Sun T, Cao M, Drasgow F. Using Bifactor Models to Examine the Predictive Validity of Hierarchical Constructs: Pros, Cons, and Solutions. *Organ Res Methods*. 2021 Jul 1; 24(3):530–71.
61. Golino HF, Epskamp S. Exploratory graph analysis: A new approach for estimating the number of dimensions in psychological research. *PLOS ONE*. 2017 Jun 8; 12(6):e0174035. <https://doi.org/10.1371/journal.pone.0174035> PMID: 28594839
62. Smith SM, Nichols TE, Vidaurre D, Winkler AM, Behrens TEJ, Glasser MF, et al. A positive-negative mode of population covariation links brain connectivity, demographics and behavior. *Nat Neurosci*. 2015 Nov; 18(11):1565–7. <https://doi.org/10.1038/nn.4125> PMID: 26414616
63. Volkow ND, Koob GF, Croyle RT, Bianchi DW, Gordon JA, Koroshetz WJ, et al. The conception of the ABCD study: From substance use to a broad NIH collaboration. *Dev Cogn Neurosci*. 2018 Aug 1; 32:4–7. <https://doi.org/10.1016/j.dcn.2017.10.002> PMID: 29051027
64. Stover PJ, Harlan WR, Hammond JA, Hendershot T, Hamilton CM. PhenX: a toolkit for interdisciplinary genetics research. *Curr Opin Lipidol*. 2010 Apr; 21(2):136–40. <https://doi.org/10.1097/MOL.0b013e3283377395> PMID: 20154612
65. Barch DM, Albaugh MD, Avenevoli S, Chang L, Clark DB, Glantz MD, et al. Demographic, physical and mental health assessments in the adolescent brain and cognitive development study: Rationale and description. *Dev Cogn Neurosci*. 2018 Aug 1; 32:55–66. <https://doi.org/10.1016/j.dcn.2017.10.010> PMID: 29113758
66. Watts AL, Smith GT, Barch DM, Sher KJ. Factor Structure, Measurement and Structural Invariance, and External Validity of an Abbreviated Youth Version of the UPPS-P Impulsive Behavior Scale. *Psychol Assess*. 2020 Apr; 32(4):336–47. <https://doi.org/10.1037/pas0000791> PMID: 31841018
67. Loewy RL, Bearden CE, Johnson JK, Raine A, Cannon TD. The prodromal questionnaire (PQ): Preliminary validation of a self-report screening measure for prodromal and psychotic syndromes. *Schizophr Res*. 2005 Nov 1; 79(1):117–25. PMID: 16276559
68. Pagliaccio D, Luking KR, Anokhin AP, Gotlib IH, Hayden EP, Olino TM, et al. Revising the BIS/BAS Scale to study development: Measurement invariance and normative effects of age and sex from childhood through adulthood. *Psychol Assess*. 2016; 28(4):429–42. <https://doi.org/10.1037/pas0000186> PMID: 26302106
69. Youngstrom EA, Frazier TW, Demeter C, Calabrese JR, Findling RL. Developing a 10-Item Mania Scale From the Parent General Behavior Inventory for Children and Adolescents. *J Clin Psychiatry*. 2008 May 11; 69(5):4319. <https://doi.org/10.4088/jcp.v69n0517> PMID: 18452343

70. Achenbach T M. The Achenbach System of Empirically Based Assessment: Development, Findings, Theory and Applications. University of Vermont, Research Center for Children, Youth, & Families; 2009.
71. Kaufman J, Kobak K, Birmaher B, de Lacy N. KSADS-COMP Perspectives on Child Psychiatric Diagnostic Assessment and Treatment Planning. *J Am Acad Child Adolesc Psychiatry*. 2021 May; 60(5):540–2. <https://doi.org/10.1016/j.jaac.2020.08.470> PMID: 33385508
72. CDC. Youth Risk Behavior Survey [Internet]. 2016 [cited 2022 Jun 27]. <https://www.cdc.gov/healthyyouth/data/yrbs/index.htm>
73. Hull JG, Brunelle TJ, Prescott AT, Sargent JD. A longitudinal study of risk-glorifying video games and behavioral deviance. *J Pers Soc Psychol*. 2014; 107(2):300–25. <https://doi.org/10.1037/a0036058> PMID: 25090130
74. Sharif I, Wills TA, Sargent JD. Effect of Visual Media Use on School Performance: A Prospective Study. *J Adolesc Health*. 2010 Jan 1; 46(1):52–61. <https://doi.org/10.1016/j.jadohealth.2009.05.012> PMID: 20123258
75. Huppertz C, Bartels M, de Zeeuw EL, van Beijsterveldt CEM, Hudziak JJ, Willemsen G, et al. Individual Differences in Exercise Behavior: Stability and Change in Genetic and Environmental Determinants From Age 7 to 18. *Behav Genet*. 2016 Sep 1; 46(5):665–79. <https://doi.org/10.1007/s10519-016-9799-x> PMID: 27406597
76. Ferreira VR, Carvalho LBC, Ruotolo F, de Morais JF, Prado LBF, Prado GF. Sleep Disturbance Scale for Children: Translation, cultural adaptation, and validation. *Sleep Med*. 2009 Apr 1; 10(4):457–63. <https://doi.org/10.1016/j.sleep.2008.03.018> PMID: 18706856
77. Goodman R. Psychometric Properties of the Strengths and Difficulties Questionnaire. *J Am Acad Child Adolesc Psychiatry*. 2001 Nov 1; 40(11):1337–45. <https://doi.org/10.1097/00004583-200111000-00015> PMID: 11699809
78. Karoly HC, Callahan T, Schmiege SJ, Feldstein Ewing SW. Evaluating the Hispanic Paradox in the Context of Adolescent Risky Sexual Behavior: The Role of Parent Monitoring. *J Pediatr Psychol*. 2016 May 1; 41(4):429–40. <https://doi.org/10.1093/jpepsy/jsv039> PMID: 25972373
79. Schaefer ES. A configurational analysis of children's reports of parent behavior. *J Consult Psychol*. 1965 Dec; 29(6):552–7. <https://doi.org/10.1037/h0022702> PMID: 5846126
80. Schludermann E, Schludermann S. Replicability of Factors in Children's Report of Parent Behavior (CRPBI). *J Psychol*. 1970 Nov 1; 76(2):239–49.
81. Moos RH, Moos BS. Family environment scale. In: *Handbook of measurements for marriage and family therapy*. 1987. (82).
82. Arthur MW, Briney JS, Hawkins JD, Abbott RD, Brooke-Weiss BL, Catalano RF. Measuring risk and protection in communities using the Communities That Care Youth Survey. *Eval Program Plann*. 2007 May 1; 30(2):197–211. <https://doi.org/10.1016/j.evalprogplan.2007.01.009> PMID: 17689325
83. Echeverria SE, Diez-Roux AV, Link BG. Reliability of self-reported neighbourhood characteristics. *J Urban Health*. 2004 Dec 1; 81(4):682–701.
84. Zucker RA, Gonzalez R, Feldstein Ewing SW, Paulus MP, Arroyo J, Fuligni A, et al. Assessment of culture and environment in the Adolescent Brain and Cognitive Development Study: Rationale, description of measures, and early data. *Dev Cogn Neurosci*. 2018 Aug 1; 32:107–20. <https://doi.org/10.1016/j.dcn.2018.03.004> PMID: 29627333
85. Daniel MH, Wahlstrom D, Zhang Q. Equivalence of Q-interactive™ and Paper Administrations of Cognitive Tasks: WISC®–V. Q-Interact Tech Rep. 2014; 13.
86. Acker W, Acker C. Bexley Maudsley Automated Psychological Screening and Bexley Maudsley Category Sorting Test Manual. NFER-Nelson; 1982.
87. Wechsler D. Wechsler intelligence Scale for Children—Fifth Edition (WISC–V): Technical and Interpretive Manual. Pearson Clinical Assessment; 2014.
88. Luciana M, Bjork JM, Nagel BJ, Barch DM, Gonzalez R, Nixon SJ, et al. Adolescent neurocognitive development and impacts of substance use: Overview of the adolescent brain cognitive development (ABCD) baseline neurocognition battery. *Dev Cogn Neurosci*. 2018 Aug 1; 32:67–79. <https://doi.org/10.1016/j.dcn.2018.02.006> PMID: 29525452
89. Thompson WK, Barch DM, Bjork JM, Gonzalez R, Nagel BJ, Nixon SJ, et al. The structure of cognition in 9 and 10 year-old children and associations with problem behaviors: Findings from the ABCD study's baseline neurocognitive battery. *Dev Cogn Neurosci*. 2019 Apr 1; 36:100606. <https://doi.org/10.1016/j.dcn.2018.12.004> PMID: 30595399
90. Salsman JM, Butt Z, Pilkonis PA, Cyranowski JM, Zill N, Hendrie HC, et al. Emotion assessment using the NIH Toolbox. *Neurology*. 2013 Mar 12;80(11 Supplement 3):S76–86.



91. R Core Team. R: The R project for statistical computing [Internet]. 2022 [cited 2021 Jun 22]. <https://www.r-project.org/>
92. Kruschke JK. Rejecting or Accepting Parameter Values in Bayesian Estimation. *Adv Methods Pract Psychol Sci*. 2018 Jun 1; 1(2):270–80.
93. Lakens D. Equivalence Tests: A Practical Primer for t Tests, Correlations, and Meta-Analyses. *Soc Psychol Personal Sci*. 2017 May 1; 8(4):355–62. <https://doi.org/10.1177/1948550617697177> PMID: 28736600
94. Golino HF, Shi D, Christensen AP, Garrido LE, Nieto MD, Sadana R, et al. Investigating the performance of exploratory graph analysis and traditional techniques to identify the number of latent factors: A simulation and tutorial. *Psychol Methods*. 2020 Jun; 25(3):292–320. <https://doi.org/10.1037/met0000255> PMID: 32191105
95. Christensen AP, Golino H, Silvia P. A Psychometric Network Perspective on the Validity and Validation of Personality Trait Questionnaires [Internet]. *PsyArXiv*; 2019 [cited 2022 Jun 30]. <https://psyarxiv.com/ktejp/>
96. Sass DA, Schmitt TA. A Comparative Investigation of Rotation Criteria Within Exploratory Factor Analysis. *Multivar Behav Res*. 2010 Jan 29; 45(1):73–103. <https://doi.org/10.1080/00273170903504810> PMID: 26789085
97. Christensen AP, Golino HF. Estimating the stability of the number of factors via Bootstrap Exploratory Graph Analysis: A tutorial. *PsyArXiv*; 2019.
98. Golino HF, Christensen AP. EGAnet: Exploratory Graph Analysis—A framework for estimating the number of dimensions in multivariate data using network psychometrics. 2021; <https://cran.r-project.org/web/packages/EGAnet/EGAnet.pdf>
99. Schermelleh-engel K, Moosbrugger H, Müller H. Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods Psychol Res*. 2003;23–74.
100. Rosseel Y. lavaan: an R package for structural equation modeling and more Version 0.5–12 (BETA). 2012;37.
101. Brosch T, Scherer K, Grandjean D, Sander D. The impact of emotion on perception, attention, memory, and decision-making. *Swiss Med Wkly* [Internet]. 2013 May 5 [cited 2022 Sep 19];( 19). Available from: <https://smw.ch/article/doi/smw.2013.13786> PMID: 23740562
102. Loukas A, Fitzgerald HE, Zucker RA, Von Eye A. Parental alcoholism and co-occurring antisocial behavior: Prospective relationships to externalizing behavior problems in their young sons. *J Abnorm Child Psychol*. 2001; 29(2):91–106. <https://doi.org/10.1023/a:1005281011838> PMID: 11321632
103. Wills TA, Simons JS, Manayan O, Robinson MK. Emotion regulation and substance use disorders in adolescents. *Emot Regul Psychopathol Child Adolesc*. 2017;210–34.
104. Zucker RA, Heitzeg MM, Nigg JT. Parsing the Undercontrol—Disinhibition Pathway to Substance Use Disorders: A Multilevel Developmental Problem. *Child Dev Perspect*. 2011; 5(4):248–55. <https://doi.org/10.1111/j.1750-8606.2011.00172.x> PMID: 22116786
105. Carroll JB. *Human Cognitive Abilities: A Survey of Factor-Analytic Studies*. Cambridge University Press; 1993. 832 p.
106. Caspi A, Houts RM, Belsky DW, Goldman-Mellor SJ, Harrington H, Israel S, et al. The p Factor: One General Psychopathology Factor in the Structure of Psychiatric Disorders? *Clin Psychol Sci*. 2014 Mar 1; 2(2):119–37. <https://doi.org/10.1177/2167702613497473> PMID: 25360393
107. Caspi A, Moffitt TE. All for One and One for All: Mental Disorders in One Dimension. *Am J Psychiatry*. 2018 Sep; 175(9):831–44. <https://doi.org/10.1176/appi.ajp.2018.17121383> PMID: 29621902
108. Buecker S, Simacek T, Ingwersen B, Terwiel S, Simonsmeier BA. Physical activity and subjective well-being in healthy individuals: a meta-analytic review. *Health Psychol Rev*. 2021 Oct 2; 15(4):574–92. <https://doi.org/10.1080/17437199.2020.1760728> PMID: 32452716
109. Feraco T, Meneghetti C. Sport Practice, Fluid Reasoning, and Soft Skills in 10- to 18-Year-Olds. *Front Hum Neurosci* [Internet]. 2022 [cited 2022 Mar 14]; 16. Available from: <https://www.frontiersin.org/article/10.3389/fnhum.2022.857412> PMID: 35360291
110. Hoffmann MD, Barnes JD, Tremblay MS, Guerrero MD. Associations between organized sport participation and mental health difficulties: Data from over 11,000 US children and adolescents. *PLOS ONE*. 2022 Jun 1; 17(6):e0268583. <https://doi.org/10.1371/journal.pone.0268583> PMID: 35648742
111. Shulruf B. Do extra-curricular activities in schools improve educational outcomes? A critical review and meta-analysis of the literature. *Int Rev Educ*. 2010 Dec; 56(5–6):591–612.
112. Buist KL, Deković M, Gerris JRM. Dyadic family relationships and adolescent internalizing and externalizing problem behavior: Effects of positive and negative affect. *Fam Sci*. 2011 Jan 1; 2(1):34–42.



113. Otterpohl N, Wild E, Havighurst SS, Stiensmeier-Pelster J, Kehoe CE. The Interplay of Parental Response to Anger, Adolescent Anger Regulation, and Externalizing and Internalizing Problems: A Longitudinal Study. *Res Child Adolesc Psychopathol*. 2022 Feb 1; 50(2):225–39. <https://doi.org/10.1007/s10802-021-00795-z> PMID: 33712990
114. Barnhart S, Garcia AR, Karcher NR. Adolescent Mental Health and Family Economic Hardships: The Roles of Adverse Childhood Experiences and Family Conflict. *J Youth Adolesc* [Internet]. 2022 Aug 23 [cited 2022 Sep 19]; Available from: <https://doi.org/10.1007/s10964-022-01671-9> PMID: 35997913
115. Ben-Zur H. Happy Adolescents: The Link Between Subjective Well-Being, Internal Resources, and Parental Factors. *J Youth Adolesc*. 2003 Apr 1; 32(2):67–79.
116. Joronen K, Åstedt-Kurki P. Familial contribution to adolescent subjective well-being. *Int J Nurs Pract*. 2005; 11(3):125–33. <https://doi.org/10.1111/j.1440-172X.2005.00509.x> PMID: 15853791
117. Navarro D, Montserrat C, Malo S, González M, Casas F, Crous G. Subjective well-being: what do adolescents say? *Child Fam Soc Work*. 2017; 22(1):175–84.
118. Bacter C, Băltătescu S, Marc C, Săveanu S, Buhaş R. Correlates of Preadolescent Emotional Health in 18 Countries. A Study Using Children's Words Data. *Child Indic Res*. 2021 Aug 1; 14(4):1703–22.
119. Suldo SM, Riley KN, Shaffer EJ. Academic Correlates of Children and Adolescents' Life Satisfaction. *Sch Psychol Int*. 2006 Dec; 27(5):567–82.
120. Suldo SM, Friedrich AA, White T, Farmer J, Minch D, Michalowski J. Teacher Support and Adolescents' Subjective Well-Being: A Mixed-Methods Investigation. *Sch Psychol Rev*. 2009 Mar 1; 38(1):67–85.
121. Wong MD, Dosanjh KK, Jackson NJ, Rüniger D, Dudovitz RN. The longitudinal relationship of school climate with adolescent social and emotional health. *BMC Public Health*. 2021 Jan 23; 21(1):207. <https://doi.org/10.1186/s12889-021-10245-6> PMID: 33485308
122. Thapa A, Cohen J, Guffey S, Higgins-D'Alessandro A. A Review of School Climate Research. *Rev Educ Res*. 2013 Sep 1; 83(3):357–85.
123. Sin NL, Lyubomirsky S. Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: a practice-friendly meta-analysis. *J Clin Psychol*. 2009; 65(5):467–87. <https://doi.org/10.1002/jclp.20593> PMID: 19301241
124. Allen KA, Bowles T. Belonging as a Guiding Principle in the Education of Adolescents. *Aust J Educ Dev Psychol*. 2012; 12:108–19.
125. Pelcher A, Rajan S. After-School Program Implementation in Urban Environments: Increasing Engagement Among Adolescent Youth. *J Sch Health*. 2016; 86(8):585–94. <https://doi.org/10.1111/josh.12411> PMID: 27374348
126. St-Amand J, Girard S, Smith J. Sense of Belonging at School: Defining Attributes, Determinants, and Sustaining Strategies. *IAFOR J Educ* [Internet]. 2017 Sep 1 [cited 2022 Jul 18]; 5(2). Available from: <https://iafor.org/journal/iafor-journal-of-education/volume-5-issue-2/article-5/>
127. Wang MT, Degol J L., Amemiya J, Parr A, Guo J. Classroom climate and children's academic and psychological wellbeing: A systematic review and meta-analysis. *Dev Rev*. 2020 Sep 1; 57:100912.
128. Durlak JA, Weissberg RP, Dymnicki AB, Taylor RD, Schellinger KB. The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions: Social and emotional learning. *Child Dev*. 2011 Jan; 82(1):405–32.
129. Oberle E, Domitrovich CE, Meyers DC, Weissberg RP. Establishing systemic social and emotional learning approaches in schools: a framework for schoolwide implementation. *Camb J Educ*. 2016 Jul 2; 46(3):277–97.
130. Taylor RD, Oberle E, Durlak JA, Weissberg RP. Promoting Positive Youth Development Through School-Based Social and Emotional Learning Interventions: A Meta-Analysis of Follow-Up Effects. *Child Dev*. 2017; 88(4):1156–71. <https://doi.org/10.1111/cdev.12864> PMID: 28685826
131. Baumsteiger R, Hoffmann JD, Castillo-Gualda R, Brackett MA. Enhancing school climate through social and emotional learning: effects of RULER in Mexican secondary schools. *Learn Environ Res*. 2022 Jul 1; 25(2):465–83.
132. Oberle E, Guhn M, Gadermann AM, Thomson K, Schonert-Reichl KA. Positive mental health and supportive school environments: A population-level longitudinal study of dispositional optimism and school relationships in early adolescence. *Soc Sci Med*. 2018 Oct 1; 214:154–61. <https://doi.org/10.1016/j.socscimed.2018.06.041> PMID: 30072159
133. Barlow J, Smailagic N, Huband N, Roloff V, Bennett C. Group-based parent training programmes for improving parental psychosocial health. *Campbell Syst Rev*. 2012; 8(1):1–197. <https://doi.org/10.1002/14651858.CD002020.pub3> PMID: 22696327
134. Barlow J, Bergman H, Kornør H, Wei Y, Bennett C. Group-based parent training programmes for improving emotional and behavioural adjustment in young children. *Cochrane Database Syst Rev*

[Internet]. 2016 [cited 2022 Jul 18];( 8). Available from: <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD003680.pub3/full>

135. Chacko A, Jensen SA, Lowry LS, Cornwell M, Chimklis A, Chan E, et al. Engagement in Behavioral Parent Training: Review of the Literature and Implications for Practice. *Clin Child Fam Psychol Rev*. 2016 Sep 1; 19(3):204–15. <https://doi.org/10.1007/s10567-016-0205-2> PMID: 27311693
136. Campos JJ, Frankel CB, Camras L. On the Nature of Emotion Regulation. *Child Dev*. 2004; 75(2):377–94. <https://doi.org/10.1111/j.1467-8624.2004.00681.x> PMID: 15056194
137. Sanders W, Zeman J, Poon J, Miller R. Child Regulation of Negative Emotions and Depressive Symptoms: The Moderating Role of Parental Emotion Socialization. *J Child Fam Stud*. 2015 Feb 1; 24(2):402–15.
138. Menting ATA, Orobio de Castro B, Matthys W. Effectiveness of the Incredible Years parent training to modify disruptive and prosocial child behavior: A meta-analytic review. *Clin Psychol Rev*. 2013 Dec 1; 33(8):901–13. <https://doi.org/10.1016/j.cpr.2013.07.006> PMID: 23994367