

Universidade Federal do Rio Grande do Sul

Faculdade de Medicina

Programa de Pós-Graduação em Psiquiatria e Ciências do Comportamento

Doctoral Thesis

**Socioemotional skills throughout the life cycle: etiology, associations with
psychopathology and educational outcomes.**

Aline Romani Sponchiado

Advisor: Giovanni Abrahão Salum Jr

Co-advisor: Maurício Scopel Hoffmann

Porto Alegre, September 2021

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ABSTRACT

Background: Socioemotional skills are competencies related to emotion regulation, coping, empathy, prosocial skills and motivation. Despite the association with better life chances, very few studies investigated how they relate to psychopathology and educational outcomes. Also, there are no studies investigating their trajectories over development, and associations between socioemotional skills with etiological links with genetics and environmental exposures. Therefore, the main aim of this thesis was to investigate the construct of socioemotional skills, considering its etiology, its association with psychopathology and its impact on educational outcomes. In order to achieve better understanding of the construct, three empirical studies were performed. Article #1 investigated whether positive attributes (a unidimensional measure of socioemotional skills) and psychopathology had long-term impact on each other and whether they had interactive effects in predicting literacy ability and school dropout. Article #2 investigated etiological factors associated with trajectories of positive attributes from childhood to young adulthood considering environmental experiences of adversity, genetics and their interaction. Article #3 focused on associations of two aspects of socioemotional skills (empathy and compassion) and psychopathology in adults. The study focused on understanding whether empathy and compassion are distinct traits and how they are associated with negative affect (burnout, depression, anxiety and anger symptoms) in undergraduate students and professionals in medicine, psychology and nursing, a special population for which socioemotional skills do not only play a role in overall wellbeing, but also at constituting a professional expertise.

Methods: Articles #1 and #2 used data from a large prospective school-based community cohort of youths (n=2,511, 6-14 years of age, 45% female) that were assessed and followed up for 3 years (80% retention) and 6 years (71% retention). Positive attributes

were assessed in both studies by the Youth Strength Inventory (YSI). In Article #2, childhood exposure to threat and deprivation were assessed by a latent composite measure models. Genetic factors were assessed by polygenic risk scores for non-cognitive traits (NonCog PRS). Article #3 assessed a total of 461 undergraduate students currently registered in a university and active professionals in medicine, psychology, and nursing. Empathy and compassion were assessed with the Interpersonal Reactivity Index (IRI) and Empathy Index subscales. Negative affectivity was assessed using PROMIS – depression, anxiety and anger scales and burnout with the Medical Student Well-Being Index (MSWBI). Data were analysed with Structural Equation Modeling (SEM).

Results: Article #1 demonstrated that positive attributes negatively predicted, and were negatively predicted by, the general factor of psychopathology and conduct problems in the cross-lagged panel model. Positive attributes and specific conduct symptoms predicted school dropout, whereas the general factor of psychopathology predicted lower literacy ability. However, the protective association of positive attributes on school dropout decreases as the general factor of psychopathology increases. Article #2 demonstrated that trajectories of YSI differ by sex, with girls demonstrating higher YSI scores than boys until early adolescence and similar scores from adolescence to young adulthood. Exposure to adversity is associated with lower YSI over time, and this association was more pronounced early in development and was mitigated as the child transitions to young adulthood. In contrast, NonCog PRS did not present associations with average or trajectory levels of YSI and we did not find gene by environment interactions. Article #3 indicates that empathy is associated with higher negative affect, while compassion is associated with lower negative affect, suggesting that they are different types of socioemotional skills and this distinction might have professional implications to health workers.

Conclusion: This thesis provides new evidence on socioemotional skills in children, adolescents and adults. Using three empirical studies, we showed that the study of socioemotional skills is key to understand the abilities that might promote better life chances through the life cycle, such as better mental health and educational achievement.

Keywords: Positive attributes; Empathy; Compassion; Psychopathology; Adversity; Education.

RESUMO

Introdução: Habilidades socioemocionais são competências relacionadas à regulação emocional, *coping*, empatia, habilidades pró-sociais e motivação. Apesar da associação com melhores chances de vida, poucos estudos investigam como se relaciona com psicopatologia e desfechos educacionais. Além disso, não há estudos que investiguem sua trajetória ao longo do desenvolvimento e associações entre habilidades socioemocionais e ligações etiológicas com a genética e exposições ambientais. Portanto, o objetivo principal desta tese foi investigar o construto das habilidades socioemocionais, considerando sua etiologia, sua associação com a psicopatologia e seu impacto nos desfechos educacionais. Para melhor compreensão do construto, foram realizados três estudos empíricos. O Artigo #1 investigou se os atributos positivos (uma medida unidimensional das habilidades socioemocionais) e a psicopatologia apresentam um impacto de longo prazo um sobre o outro e se há efeitos interativos na previsão de alfabetização e evasão escolar. O Artigo #2 investigou os fatores etiológicos associados às trajetórias atributos positivos desde a infância até a idade adulta jovem, considerando experiências ambientais de adversidade, genética e sua interação. O Artigo #3 enfocou na diferenciação de dois aspectos das habilidades socioemocionais: empatia e compaixão. O estudo se concentrou em compreender se esses traços são distintos e como ambos estão associados a afeto negativo (sintomas de *burnout*, depressão, ansiedade e raiva) em estudantes de graduação e profissionais de medicina, psicologia e enfermagem, uma população especial para a qual as habilidades socioemocionais não desempenham apenas um papel no bem-estar geral, mas também na constituição de uma experiência profissional.

Métodos: Os artigos #1 e #2 usaram dados de uma grande coorte de jovens da comunidade com base na escola ($n = 2.511$, 6-14 anos de idade, 45% mulheres) que foram

avaliados e acompanhados por 3 anos (80% de retenção) e 6 anos (71% de retenção). Atributos positivos foram avaliados em ambos os estudos pelo *Youth Strength Inventory* (YSI). No Artigo #2, a exposição a ameaças e privações na infância foi acessada por modelos de medidas compostas latentes. Fatores genéticos foram avaliados por escores de risco poligênico para características não cognitivas (NonCog PRS). O artigo #3 acessou um total de 461 alunos de graduação atualmente matriculados em uma universidade e profissionais ativos nas áreas de medicina, psicologia e enfermagem. Empatia e compaixão foram avaliadas com as subescalas *Interpersonal Reactivity Index* (IRI) e *Empathy Index*. O afeto negativo foi avaliado por meio do PROMIS - escalas de depressão, ansiedade e raiva, já o *burnout*, com o *Medical Student Well-Being Index* (MSWBI). Os dados foram analisados com modelos de equações estruturais (SEM).

Resultados: O artigo #1 demonstrou que os atributos positivos previram negativamente e foram preditos negativamente pelo fator geral de psicopatologia e por conduta no modelo de painel *cross-lagged*. Atributos positivos e conduta previram evasão escolar, enquanto o fator geral da psicopatologia previu menor capacidade de alfabetização. No entanto, a associação protetora de atributos positivos sobre o abandono escolar diminuiu à medida que aumenta o fator geral da psicopatologia. O Artigo 2 demonstrou que as trajetórias de YSI diferem por sexo, com as meninas demonstrando pontuações de YSI mais altas do que os meninos até o início da adolescência e pontuações semelhantes desde a adolescência até jovem adulto. A exposição à adversidade está associada a menor YSI ao longo do tempo e essa associação foi mais pronunciada no início do desenvolvimento e atenuada conforme a criança faz a transição para a idade adulta jovem. Em contraste, NonCog PRS não apresentou associações com níveis médios ou de trajetória de YSI e não encontramos interações gene-ambiente. O artigo #3 indica que a empatia está associada a um maior afeto negativo, enquanto a compaixão está associada a um menor

afeto negativo, sugerindo que são diferentes tipos de habilidades socioemocionais e que essa distinção pode ter implicações para os profissionais de saúde.

Conclusão: Esta tese fornece novas evidências sobre habilidades socioemocionais em crianças, adolescentes e adultos. Por meio de três estudos empíricos, mostramos que o estudo das habilidades socioemocionais é fundamental para compreender as habilidades que podem promover melhores oportunidades de vida, pensadas no ciclo vital, como melhor saúde mental e conquistas educacionais.

Palavras-chave: Atributos positivos; Empatia; Compaixão; Psicopatologia; Adversidade; Educação.

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1 INTRODUCTION

This work consists of the doctoral thesis entitled “Socioemotional skills throughout the life cycle: Etiology, associations with psychopathology and educational outcomes”, presented to the Graduate Program in Psychiatry and Behavioral Sciences. The main aim of this thesis was to investigate the construct of socioemotional skills, considering its etiology, its association with psychopathology and its impact on educational outcomes. In this introduction section, we will present concepts that are relevant to understand the construct of socioemotional skills, describe some previous findings that constitute the background for the empirical studies of this thesis, discuss the relevance of the topic and briefly describe the two samples that were used in the empirical studies.

1.1 Socioemotional skills

1.1.1 Positive and negative mental health dimensions

Mental health is the combination of many psychological phenomena oriented by positive and negative dimensions (1–4). Negative dimension is also referred as mental ill-health, mental illness, mental health disorders, psychiatric conditions, or psychopathology (5,6). Positive dimension of mental health refers to many aspects, covering life satisfaction, well-being, happiness, purpose in life, optimism, self-efficacy, spirituality, resilience, and socioemotional skills, also known as soft or non-cognitive skills (1–8). Positive and negative dimensions of mental health are not perfectly correlated. As an example, a person may not have any symptoms of psychopathology but also is not happy, may have poor well-being and is not resilient to harmful life events. In this example, a person might be languishing even though no mental health disorder is

present. At the same time, a person might have a mental health disorder but have many socioemotional skills and could be resilient enough to have his/her life flourishing (9). Therefore, mental health of individuals can flourish or languish depending on different levels of these two broad independent constructs (3–5,8). However, literature related to psychiatry and psychology has a dominant focus on psychopathology, not taking into account positive aspects of mental health to compose the full mental health picture (10–12).

1.1.2 Socioemotional skills and positive attributes

Socioemotional skills are those competencies not captured by cognitive tests that enable individuals to “(a) recognize and manage their emotions, (b) cope successfully with conflict, (c) navigate interpersonal problem solving, (d) understand and show empathy for others, (e) establish and maintain positive relationships, (f) make ethical and safe choices, (g) contribute constructively to their community, and (h) set and achieve positive goals” (13). They are related with the five factor model of personality, which is currently well-accepted taxonomy used in personality research (14–16). These five factors are openness to experience (e.g., tendency to be open to new aesthetic, cultural, or intellectual experiences), conscientiousness (i.e., tendency to be organized, responsible, and hardworking), extroversion (i.e., the tendency to obtaining gratification from outside oneself, such as adventurous and social activities), agreeableness (i.e., tendency to act in a cooperative, generous and unselfish manner) and emotional stability (i.e., tendency to be emotionally placid, self-reliant and predictable, and behaviorally autonomous and independent) (16). Within this concept, positive attributes are defined as a construct composed by a set of positive emotional and behavioral traits and skills which

allow the individual to regain, sustain, or improve development (14,17). It is derived from the ego resilience concept, which is based on the positive side of personality traits (18).

Positive attributes of behavior, cover many aspects of socioemotional skills (13,14), such as sociability, optimism, empathy, self-confidence, conscientiousness, and cooperativeness (19). It is hypothesized that positive attributes functions as a resilience factor to improve mental health (8,18). This hypothesis have received support from previous findings which demonstrated that positive attributes are associated with lower risk of future psychopathology and cross-sectionally associated with better academic attainment and achievement (9,18,19).

The relationship between socioemotional skills and positive attributes become clear in the assessment Youth and Strength Inventory (YSI), which aims to measure the construct of positive attributes as a unidimensional assessment of the main features of socioemotional skills (20). Briefly, the YSI contains items related to conscientiousness (e.g., “reliable and responsible” and “keep his/her bedroom tidy”), amability (e.g., “good with friends” and “kind hearted”) and openness (e.g., interested in many things” and “does creative activities: art, acting, music, making things”) and emotional stability personality traits (e.g. “bounces back quickly after setbacks” and “independent”) (11,13,14).

In order to measure the latent variable of positive attributes, the Development and Well-Being Assessment (DAWBA) (20) contains a subscale which aims to collect information on strengths factors. The YSI is found on section N of the protocol and is composed by 24 items containing descriptions related to the main traits and skills of positive attributes. The scale is divided into two blocks of 12 questions each, the first block assesses traits (e.g., lively, easy going, responsible, bounces back quickly after setbacks) and the second block assess behaviors and skills (e.g., helps around the home,

well behaved, creative activities: art, acting, music, making things). The respondent must answer how applicable descriptions are to the youth as “No”, “A little”, or “A lot”. The YSI demonstrate good psychometric properties with high internal consistence both on parent and child report and on baseline and at 36 months follow-up. Also, a single-factor model explained between 79% and 83% of items’ variance at baseline and follow-up respectively (19).

Individuals with significant levels of socioemotional skills/positive attributes tend to have good employability, with better wages and, consequently, higher social class. Also, they present low risk of criminal behaviors, substance abuse and psychopathology, having good interpersonal relationships and general well-being (18,19,21–25). Therefore, differently from psychopathology, socioemotional skills have just begun to be incorporated in abnormal psychology and psychiatry field, despite the aforementioned associations with future outcomes (10,11,22,26,27).

1.1.3 Etiology of socioemotional skills

Very little is known about the etiology of socioemotional skills in the life course. Evidence on the genetics of traits related to socioemotional skills using twins suggest that these traits are partially influenced by genes (28–34) and tend to be stable over the years (30,35,36). In contrast, the impact of environmental factors in socioemotional skills is not widely explored and have divergent results. In one side, twins design studies demonstrate non-significant association of shared environmental factors on traits (28–30,32,33,37). On the other hand, some studies show that while the influence of genetics in personality traits is moderate and stable throughout life, the environment has an increasing effect that reaches the same moderate levels in adulthood (35). Nevertheless, there is no consensus on which environmental factors could later increase socioemotional skills.

In this sense, adverse childhood experiences have well-established associations with a range of important outcomes (38–45) and may also be associated with socioemotional skills. Trauma experiences in early life as abuse (physical, emotional, sexual), neglect (physical, emotional) and dysfunctional environment (substance abuse, mental illness, domestic violence, incarceration, parental separation) demonstrate associations with risky behaviors, poor health and psychosocial outcomes (38) as well as current and future general psychopathology (43). The lack of warmth predicts low self-compassion, while experiences of invalidation and abuse are associated with self-inadequacy (39). Also, adverse experiences seem to alter patterns of social and emotional information processing, increasing emotional reactivity and impairing emotion regulation and reward processing (42). Alterations are likewise found in neural development since studies demonstrate that threat and deprivation are associated with reduced volume but high activation of the amygdala and other nodes related to effortful control and emotion regulation (44,45). Therefore, understanding the etiology of this construct may lead to a better understanding of its conceptualization, relationship with negative mental health, to which extend it would be possible to modulate it and how interventions with the aim of promoting positive attributes may also affect different aspects of mental health.

In the genetics area of research, on the other hand, socioemotional skills were only tested through GWASs of specific traits. Therefore, a recent study (23) aimed to unify traits and skills in a unique latent trait to create a genomic architecture of socioemotional skills, allowing further and more accurate studies on its etiology. To perform this study, authors used an economics theory which analyzes socioemotional skills as the variation in educational attainment that was not explained by cognitive skills. Thereby, genomic structural equation modeling (Genomic-SEM) was applied to already published GWAS of educational attainment and cognitive skills in order to “subtract” the genetic influence

of cognitive skills from educational attainment. This method of GWAS-by-subtraction generated a GWAS of the socioemotional skills' phenotype, a latent factor entitled 'NonCog'.

1.1.4 Socioemotional skills and educational outcomes

Socioemotional skills are also claimed to promote better educational outcomes. There is evidence that these competencies are associated with educational attainment and achievement above and beyond traditional predictors such as cognition and intelligence (IQ). For instance, conscientiousness demonstrate significant association with academic attendance (46) and achievement (47–50) and results remain even when adjusted for general intelligence, family socioeconomic status and other personality traits (51). Moreover, consequences of low educational attainment, such as lower unemployment in adulthood, appears to be predicted by conscientiousness as well (52). As a temperament facet of socioemotional skills, effortful control (53) is also associated with academic attendance and performance (46,50,54–56). Trait openness does not have as consistent results as conscientiousness, however, studies indicate an association with academic performance (49,50,57). Authors understand that children that are more motivated, persistence and curious, for example, tend to try harder on tests and have better achievements. In this sense, observational and experimental studies demonstrate that socioemotional skills have an independent positive association with these educational outcomes, even interacting with cognitive skills and psychopathology (14,55,58–60).

1.1.5 Socioemotional skills in specific populations: health professionals

The study of socioemotional skills is of particular importance in health professionals, given health professionals must engage in socioemotional skills as part of

their daily lives. Here we focus on two important aspects of socioemotional skills: empathy and compassion. For a satisfactory performance, it is necessary that health professionals be socioemotionally competent, as they face daily challenges in dealing with others, combining technical knowledge and promoting relief from suffering, while they deal with their own emotional stability (61,62). Establishing an emotional connection during the clinical encounter between professionals and patients is a necessary condition for positive outcomes. Therefore, it is essential to balance between empathy of care about the patient and the indifference linked to the technique, considering, also, the physical and mental well-being of the professional (62). Studies demonstrate that higher levels of empathy traits are associated with lower burnout symptoms in resident physicians, been considered a protective factor (63). Moreover, studies indicate an association between empathy and adherence to treatment (64), better outcomes (65) and professional satisfaction (66). However, these professionals and undergraduate students face challenges on their daily routine as pressures from the university and work place, sleep deprivation and exposure to patient suffering and death, called by some authors as “hidden curriculum” (67,68). A growing number of studies indicate a negative impact on their overall quality of life, with high incidence of depression, anxiety, burnout, and suicidal ideation (69–71).

Considering the importance that empathy demonstrates to perform in health professionals work and own mental health, a hypothesis that could explain these psychopathology symptoms is how professionals and students emotionally respond to their patients’ problems. In a study aiming to differentiate empathy and compassion, also called concern or empathic concern, authors propose a new definition for the constructs (72). In this sense, empathy is characterized by emotional and/or behavioral contagion, in other words, when a person tends to feel what is inferred that the other is feeling (e.g.,

became sad when someone is crying) or to do what the other is doing (e.g., start to smile when someone is laughing). On the other hand, compassion is characterized by traits normally associated with empathy - understanding and caring about the welfare of others without an emotional contagion, resulting in more prosocial behaviors and less emotional distress (72,73).

1.2 Relevance of this thesis

Positive mental health is associated with a range of important areas of life in the long term. However, socioemotional skills construct has few empirical studies alongside psychopathology, from etiology to outcomes, therefore, little is known about its trajectory and associations. Evidence is currently based on studies of related specific traits and skills, as empathy, motivation, personality, not considering it as a latent trait. Consequently, literature have divergent and inconclusive results. Most studies are cross-sectional, not allowing investigation on long-term associations. Understanding the etiological factors and trajectories of socioemotional skills could enable early detection and interventions to prevent or treat factors that can impair the expected development of mental health. This is also the main reason for understanding the interplay between socioemotional skills and psychopathology. Finally, knowing the impact of socioemotional skills on future outcomes, strategies can be encouraged to improve and intensify the effects on important factors such as education, a well-established key element for future socioeconomic adjustment and health.

Therefore, the aim of this thesis was to address these gaps through three studies. The first study (article #1) aims to investigate if and how psychopathology and positive attributes have longitudinal cross-lagged associations using data from a large prospective school-based community cohort. In addition, we aim to investigate their independent and

interactive effects on educational attainment and literacy to further understand not only if they impact each other over time, but if they can moderate each other's effect on this earlier life chances determinant.

The second study (article #2) aims to identify etiological factors associated with trajectories of positive attributes in children and adolescents. Using data from the same cohort that was mentioned above, we investigate the trajectory of the positive attributes construct from childhood to young adulthood. We have investigated the associations between positive attributes and two sets of etiological factors: childhood adversity, in the form of threat and deprivation; and a polygenic risk score for non-cognitive traits.

The third study (article #3) focuses on a specific population for which socioemotional skills are part of their professional aptitudes: health professionals. Here we focus specifically on two aspects of socioemotional skills (empathy and compassion). In this study we aimed to verify the distinction between empathy and compassion and how those two aspects of positive attributes are associated to psychopathology symptoms in students and health workers. Therefore, undergraduate students and professionals in medicine, psychology and nursing were assessed to investigate the differentiation of empathy and compassion through an online protocol with self-report questionnaires covering the variables of interest. We tested the association of empathy and compassion with symptoms of burnout, depression, anxiety, and irritability (anger).

1.2.1 Description of the samples

1.2.1.1 The Brazilian High-Risk Cohort Study for Mental Conditions

The study of development since childhood allows understanding typical and atypical trajectories, favoring the early identification of risk factors and implementation of interventions. Therefore, data of articles #1 and #2 were obtained from a large

prospective school-based community cohort, named Brazilian High Risk Cohort for Mental Conditions (BHRCS) (74). This cohort aimed to investigate developmental trajectories of psychopathology and mental disorders through a two-stage design - screening and assessment phases.

A screening interview accessed 9,937 parents from 36 public schools in São Paulo (capital of one of the southeast states of Brazil) and 22 public schools in Porto Alegre (capital of the southernmost state of Brazil) for child symptoms and family history of psychiatric disorders. In Brazil, on specified registration days, at least one caregiver is required to register each child for compulsory school attendance. All parents and children who presented at the selected schools were invited to participate. Families were eligible for the study if the children (a) were registered by a biological parent capable of providing consent and information about the child's behavior, (b) were between 6 and 12 years of age, and (c) remained in the same school during the study period.

In the assessment phase, two subgroups were recruited for an extensive evaluation: a random subsample (n=957) (aimed to be representative from the community) and a high-risk sub-sample (n=1,554) based on the presence of early psychiatric symptoms and high family loading of psychopathology assessed by the screening interview. The second stage accessed psychological, genetic, and neuroimaging data and was designed to investigate typical and atypical trajectories of psychopathology and cognition over development. Assessments were performed through home interview with parents, child assessments with a psychologist and a speech therapist, and imaging and blood collection.

Currently, the cohort is composed by baseline (2010-2011), 3-year follow-up (2013-2014) and 6-year follow-up (2018-2019). At baseline, 2,511 youth (6 to 14 years of age, 45% female) participated in the study. The 3-year follow-up comprised 2,010

participants (80% retention; 9-17 years of age, 44% female) and 6-year follow-up involved a sample of 1,784 participants (71% retention; 13 to 23 years of age, 54% male).

1.2.1.2 Description of the sample of students and health professionals

Participants were invited to the study described in article #3 by their academic e-mails and through media advertisements targeted to this audience. Any undergraduate student, from all academic semesters, currently registered in a university and active professionals in medicine, psychology and nursing were eligible to participate. Protocol was available at the FormR survey software webpage (75) containing the informed consent and questionnaires. At the end of the protocol, participants received instant feedback with a personalized result based on the cutoff points or average scores. A total of 884 undergraduate students and professionals in medicine, psychology and nursing were accessed. From this sample, 877 participants provided written informed consent and started filling a sociodemographic data questionnaire and self-report questionnaires covering the variables of interest. However, 413 protocols were incomplete, and 13 participants were excluded for not being studying or working in the focused areas based on the answers given. The final sample is composed by 464 undergraduate students and professionals (79.7% female, with a median age of 23.3, 34.3% medicine, 47% psychology and 18.8% nursing).

2 OBJECTIVES AND HYPOTHESES

2.1 General objective

To investigate the construct of socioemotional skills, considering etiology, its association with psychopathology and impact on educational outcomes.

2.2 Specific objectives

To investigate:

- I. whether, both general and specific symptom dimensions of psychopathology, and positive attributes impact each other across time; (Article #1)
- II. the independent and interactive effects of positive attributes and psychopathology on educational attainment and learning; (Article #1)
- III. the trajectory of positive attributes from childhood to young adulthood; (Article #2)
- IV. the influences of experiences of threat and deprivation on positive attributes levels; (Article #2)
- V. the association between positive attributes and the noncognitive genetic risk score; (Article #2)
- VI. the potential interactions between early adversity and genetic risk scores; (Article #2)
- VII. whether empathy and compassion are distinct traits; (Article #3)
- VIII. how empathy and compassion are associated to psychopathology in adults. (Article #3)

2.3 Hypotheses

The main hypotheses of this thesis are:

- I. Positive attributes will have a negative association with all dimensions of psychopathology; (Article #1)
- II. Psychopathology will be independently associated with higher dropout rates and lower literacy; (Article #1)
- III. Positive attributes will be independently associated with lower dropout rates and higher literacy; (Article #1)
- IV. Positive attributes will interact with psychopathology, in a way that higher levels of positive attributes will buffer the impact of psychopathology dimensions on dropout and poor literacy; (Article #1)
- V. Positive attributes will demonstrate to be stable through years; (Article #2)
- VI. Positive attributes will be associated with both childhood adversity and polygenic risk scores; (Article #2)
- VII. Effects of childhood adversity will vary depending on levels of the NonCog PRS; (Article #2)
- VIII. Empathy is related to higher levels of psychopathology in adults, while compassion is related to lower levels of these outcomes. (Article #3)

3 ETHICAL CONSIDERATIONS

Data used on articles #1 and #2 was approved by the ethics committee of Universidade de São Paulo [IORG0004884/National Council of Health Registry number (CONEP): 15.457/Project IRB registration number: 1132/08]. Data used on article #3 was approved by the ethics committee of Universidade Federal do Rio Grande do Sul (approval number: 76845717.1.0000.5327). Studies have been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. All participants across all these samples provided written informed consent before inclusion in the study. Data were de-identified, and only raw data essential for analyses were shared with co-authors – therefore, attempts of identification of participants was not possible.

4 ARTICLES

4.1 Article #1

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Longitudinal associations between positive attributes and psychopathology and their interactive effects on educational outcomes

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Authors' contributions

Ms. Romani-Sponchiado, Dr. Salum and Dr. Hoffmann led the study at all stages and drafted the manuscript. Ms. Romani-Sponchiado and Dr. Hoffmann designed and did the analyses. Drs. Bressan, Mari, Miguel, Gadelha, Rohde and Salum developed and conducted the Brazilian High-Risk cohort data collection. Drs Vidal-Ribas and Evans-Lacko provided substantial contributions to interpretation of data and critically revised the paper for important intellectual content. All authors helped interpret the analyses and critically reviewed and revised the report for intellectual content and approved the final version. Everyone who meets the criteria is included as an author.

Abstract

Psychopathology is associated with impaired learning and early termination of schooling, whereas positive attributes are associated with better educational outcomes. However, it is important to understand if and how psychopathology and positive attributes longitudinally impact each other so we could shed light on where to intervene to promote educational outcomes through these constructs. A large prospective school-based community cohort of youths (5-15 years of age, 45% female) were assessed and followed up for 3 years (n=2,010; 80% retention). We assessed the longitudinal impact of positive attributes (Youth Strength Inventory) and psychopathology (bifactor model of Strengths and Difficulties Questionnaire) using a cross-lagged panel model. We also used generalized mixed effects models to investigate how these both constructs predict school dropout and literacy, adjusting for confounders and testing their interaction. Positive attributes negatively predicted, and were negatively predicted by, the general factor of psychopathology and conduct problems in the cross-lagged panel model. Positive attributes (OR = 0.57, 95% CI [0.44, 0.73], $p < 0.001$) and specific conduct symptoms (OR = 2.33, 95% CI [1.64, 3.33], $p < 0.001$) predicted school dropout, whereas the general factor of psychopathology predicted lower literacy ability ($\beta = -0.08$, 95% CI [-0.11, -0.05], $p < 0.001$). However, the protective association of positive attributes on school dropout decreases as the general factor of psychopathology increases. These findings provide new evidence that positive attributes and psychopathology mutually influence each other over development and have interactive effects on educational outcomes.

Keywords: socioemotional skills; non-cognitive skills; mental health; child psychiatry; literacy; school dropout.

Introduction

Educational attainment and achievement in childhood and adolescence are associated with future earnings, social adjustment, health and overall mortality [1]. Education is also influenced by mental health conditions [2–4], and positive attributes, defined as desirable behavioral traits (e.g., being generous and responsible) [5–9]. Although research has begun to examine the role of psychopathology and positive attributes on education outcomes, major questions remain.

First, there is still debate on how positive attributes and psychopathology influence each other over development. This is a first step towards understanding additive and interactive associations between them and education. Positive attributes are fundamentally positive behavioural traits, composed by items such as being affectionate, responsible, persistent, generous, or eager to learn, which are key components of socioemotional skills [7,9,10]. These skills are potentially modifiable and key to counteract deleterious effects of early disadvantages and mental health problems [6,7,9,10]. Positive attributes in childhood and adolescence are associated with less risk of future mental health conditions and internalizing and externalizing psychopathology [9,11,12]. However, it is unclear whether these longitudinal associations between positive attributes and both domains of psychopathology are mainly due to their shared aspects (the general factor of psychopathology, the “p-factor”) or due to specific variance, i.e., specific internalizing and externalizing aspects, as emotional, conduct or inattention/hyperactivity symptom dimensions.

The YSI is a section (N) of the Development and Well-Being Assessment (DAWBA) [13] which was developed to collect information on youth’s strengths. This subscale asks about descriptions on a set of behaviours that forms the construct of positive attributes (e.g., reliable, responsible, interested in many things and independent). To investigate the

associations between positive attributes and psychopathology, Vidal-Ribas and colleagues [11] tested the psychometric properties of the Youth Strength Inventory (YSI) and found that a single-factor explained between 79% and 83% of items' variance at baseline and follow-up. The authors found that positive attributes can predict later psychiatric disorders in healthy children 36 months later, beyond predictions based on baseline psychiatric symptoms [11]. Also, Hoffmann and colleagues [8] showed YSI are empirically discriminable from psychiatric symptoms (SDQc) through a confirmatory factor analysis (CFA), meaning that YSI and SDQc are distinct constructs, despite correlated [8].

Second, it is important to understand whether dimensional psychopathology (both general, and specific conduct, emotional, and inattention/hyperactivity symptom dimensions) and positive attributes can potentiate or cancel each other's effects on educational outcomes, although previous literature on this issue do not consider the differentiation between general and specific factors when testing associations. Such understanding can reveal, for example, if the association of psychopathology with school dropout depends on the level of positive attributes [8]. In that sense, if positive attributes modulate the effects of psychopathology on educational outcomes, interventions targeting the promotion of positive attributes [14] might have effects on educational outcomes by buffering the negative effects of psychopathology on such outcomes and vice versa.

The aim of this study was to address these gaps by, first, testing whether, both general and specific symptom dimensions of psychopathology, and positive attributes impact each other across time and, second, by examining the main and interactive effects on educational attainment and learning. Data from a large prospective school-based community cohort [15] were used to evaluate positive attributes and psychopathology at baseline and a 3-year follow-up. First, we investigate longitudinal associations between

general and specific symptom dimensions of psychopathology and positive attributes using cross-lagged panel model (CLPM). We hypothesize that positive attributes will have a negative association with all dimensions of psychopathology after 3 years. Second, the impact of general and specific symptom dimensions of psychopathology and positive attributes, as well as their interaction, on educational outcomes were tested using generalized mixed effects models, adjusted for confounders. We hypothesize that psychopathology will be associated with higher dropout rates and lower literacy, whereas positive attributes will be associated with the same outcomes in the opposite direction. In addition, positive attributes will interact with psychopathology, in a way that higher levels of positive attributes will buffer the impact of psychopathology dimensions on dropout and poor literacy.

Methods

Participants

Data were obtained from the Brazilian High Risk Cohort (BHRC) study for Psychiatric Disorders [15]. This school-based community cohort aimed to investigate developmental trajectories of psychopathology and mental disorders through a two-stage design - screening and assessment phases. At screening phase, all parents presented at state-funded schools in São Paulo (n=35) and Porto Alegre (n=22) on school registration days (compulsory in Brazil) were invited to participate. All state-funded schools with more than 1000 students in the age of interest were invited to participate in the study. Participation in all phases of the study was voluntary and written consent and assent were obtained from the caregivers and youths, respectively. Verbal informed consent and assent were obtained from parents and youths who were unable to read or write. Of those

approached, 8,012 caregivers (87.3% mothers) accepted to be interviewed with a modified version of the Family History Screen [16] conducted by lay interviewers, with the purpose to estimate family risk for psychiatric diagnosis [15]. Two subgroups were recruited from a total of 9,997 screened subjects: a random subsample (n=957) and a high-risk sub-sample (n=1,554). These subjects (N=2,511) were selected for full assessment.

We analysed data collected at baseline (2010-2011) and at 3-year follow-up (2013-2014). At baseline, 2,511 youth (5 to 15 years of age, 45% female) and their caregivers were interviewed. The 3-year follow-up comprised 2,010 participants (80% retention; 9-17 years of age, 44% female). Follow-up participation was associated with higher maternal education and socioeconomic status, living in Porto Alegre, and anxiety-related disorders at baseline.

Ethical Considerations

This study was approved by the ethics committee of the University of São Paulo [IORG0004884/National Council of Health Registry number (CONEP): 15.457/Project IRB registration number: 1132/08] and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Measures

Positive Attributes Positive attributes was measured with the Youth Strength Inventory (YSI), a subscale (section N) of the Development and Well-Being Assessment (DAWBA) [11,13]. It is a 24-item scale divided into two blocks of 12 questions each and caregivers

respond how applicable descriptions are to the child as “No”, “A little”, or “A lot”. The first block assesses child characteristics (e.g., lively, easy going, grateful, responsible) and the second block assess actions that please others (e.g., helps around the home, well behaved, keeps bedroom tidy). YSI factor scores was extracted from a confirmatory factor analysis model (CFA) and Cronbach’s alpha was 0.946 (See supplementary material page 1 and Table A1 for details).

Psychopathology (general and specific symptom dimensions) Child and adolescent psychopathology was assessed with the Strengths and Difficulties Questionnaire (SDQ) [14], a 25-item parent-report questionnaire with five subscales of five items each that provides scores of emotional, inattention/hyperactivity, conduct and peer relationships problems and prosocial behaviour. Responses were given as “Not true”, “Somewhat true” and “Certainly true” on how each attribute applied to the child. For the purposes of this study, we included emotional, inattention/hyperactivity and conduct problems, considering the overlap of peer relationship problems and prosocial behaviour with positive attributes. These 15 questions were modelled in CFA as a bifactor model [17], which included an overarching general psychopathology factor (loading in all 15 items) and three residual orthogonal specific psychopathology factors (emotional, conduct and inattention/hyperactivity). SDQ general and specific factor scores were extracted from the CFA and Cronbach’s alphas were 0.889 for general factor, 0.766 for emotional subscale, 0.808 for conduct subscale and 0.839 for inattention/hyperactivity subscale. Reliability coefficient omega of general factor were 0.734, and hierarchical omegas were 0.373 for emotional subscale, 0.176 for conduct subscale and 0.001 for inattention/hyperactivity subscale (See supplementary material page 1 and Table A2 for details).

Educational Outcomes

Literacy This evaluation comprised abilities of reading and writing measured by the School Performance Test (“Teste de Desempenho Escolar” - TDE) [18]. The test is composed of two right/wrong subtests of reading (12 items) and writing (61 items). A unidimensional model of reading and writing items was fitted using CFA. Factor scores from this model were extracted and used as the literacy ability outcome (See supplementary material page 1 for details).

School Dropout Caregivers reported information related to expulsion and dropout at baseline and follow-up using a retrospective life history chart, by asking parents “Did your child drop out of school (since last data collection)?” and “Has your child been expelled from school (since last data collection)?”. For this study, dropout and expulsion were grouped together into one binary variable (yes vs no): school dropout.

Covariates

Race/ethnicity Participants were grouped into one of five categories: White/Caucasian, Asian, Black, Mixed races, and Indigenous. For analytical purposes, race/ethnicity was grouped as White or non-White.

Social class Social class was assessed using the classification from the “Associação Brasileira de Empresas de Pesquisa” and categorized as A/B (wealthiest); C (middle class) and D/E (lowest social class) [19] (see supplementary material page 3 for details). The proportion of children in each economic classification criteria is similar to what is

encountered in the instrument's standardization from cities from which the sample was recruited [20].

Maternal education Maternal education was reported at baseline and categorized in four groups indicating complete educational level, from none to complete tertiary education (see supplementary material page 3 for details).

Maternal psychopathology We used the Mini International Psychiatric Interview (MINI) and the MINI Plus [21,22] to assess the presence of any maternal history of psychiatric disorders (see supplementary material page 3 for details).

Intelligence quotient (IQ) IQ estimate was made through vocabulary and block design subtests of the Wechsler Intelligence Scale for Children, 3rd edition [23], applying Brazilian norms [24] standardized by age and sex [25]. For the purposes of this study, IQ z-score was used.

Statistical Analysis

To test our first hypothesis, we used CLPM to test if there was a cross-lagged longitudinal association between positive attributes (YSI) and psychopathology (general and specific symptom dimensions) (SDQ) over time using package “*lavaan*” [26] in R software [27]. For this study, CLPM was conducted using structural equation modelling (SEM), considering YSI an unidimensional model and SDQ as a bifactor model as previously mentioned. SEM is interpreted considering goodness of fit of each separate model and the overall SEM fit [28]. We used comparative fit index (CFI) ≥ 0.95 , the Tucker–Lewis index (TLI) ≥ 0.95 , and the root mean square error of approximation (RMSEA) ≤ 0.06 as acceptable indices of model fit [29]. CLPM associations are interpreted as residualized change after the autoregressive effects is accounted [30].

To examine our second hypothesis, we estimated linear (literacy outcome) and logistic (dropout outcome) mixed effects models with random intercepts (clustered by schools at baseline). We conducted a sequence of hierarchical models, beginning with an autoregressive model (i.e., outcome at follow-up predicted by outcome at baseline) which all models were built upon. After this, we added variables to estimate 1) the independent and additive association of YSI and SDQ factors on the educational outcomes; 2) the association of YSI or SDQ factors alongside covariates and 3) the interaction of YSI with all SDQ factors in a fully adjusted model. For the first step, we included either YSI or each SDQ factor at a time (5 independent models – univariate models), following by the inclusion of all SDQ factors and YSI simultaneously. For the second step, we added a block of covariates (age, sex, race/ethnicity, IQ, social class, and maternal education and psychopathology) in a model containing YSI or SDQ factors. For the third step, a final model was estimated by adding all SDQ factors and YSI simultaneously plus their respective interaction term plus the block of covariates (fully adjusted model). All the above-mentioned linear and logistic regression models were adjusted for missing at follow-up and for high-risk sampling of this cohort using inverse probability weight (IPW) and sampling weights respectively (See supplementary material page 2 for details).

Results

Factor models and sample description between baseline and follow-up

Factor models accounting for both time-points for positive attributes (YSI), multidimensional psychopathology (general and specific) (SDQ bifactor model), and literacy ability, fitted the data well and generated reliable factors (See supplementary

material page 4 and Tables A1 and A2 for details). Table 1 describes the demographic characteristics of the sample, considering both baseline and follow-up, comprising all variables of interest of the study. Participants were divided almost equally between young male and female, being predominantly middle social class (C) and white.

Table 1 Characteristics of the study sample in baseline and follow-up

	Baseline (N=2511)	Follow-up (N=2010)
Age (years)		
Mean (SD)	10.2 (1.91)	13.5 (1.92)
Median [Min, Max]	10.2 [5.83, 14.4]	13.5 [9.21, 17.9]
Sex		
Male	1375 (54.8%)	1125 (55.9%)
Social class		
D/E	78 (3.1%)	54 (2.7%)
C	1435 (57.1%)	1188 (59.1%)
A/B	998 (39.7%)	767 (38.1%)
IQ (z-score)		
Mean (SD)	100 (15.0)	
Median [Min, Max]	99.2 [45.6, 151]	
Race/ethnicity		
White	1519 (60.5%)	1100 (54.7%)
Black	264 (10.5%)	266 (13.2%)
Mixed	706 (28.1%)	625 (31.1%)
Indigenous	11 (0.4%)	3 (0.1%)
Asian	5 (0.2%)	4 (0.2%)
Does not know	6 (0.2%)	12 (0.6%)
Maternal education		
Incomplete primary school	607 (24.4%)	384 (19.6%)
Complete primary school	857 (34.5%)	725 (37%)
Complete secondary school	934 (37.7%)	766 (39%)
Complete university	85 (3.4%)	86 (4.4%)
Any maternal psychiatric condition at baseline		
Yes	738 (29.4%)	
School dropout		
Yes	55 (2.2%)	113 (5.6%)

Literacy (sum score)		
Mean (SD)	60.4 (17.6)	69.1 (7.06)
Median [Min, Max]	68.0 [0, 73.0]	72.0 [3.00, 73.0]
Positive attributes (sum score)		
Mean (SD)	35.4 (8.62)	35.7 (7.95)
Median [Min, Max]	37.0 [0, 48.0]	39.0 [3.00, 48.0]
SDQ - Total (sum score)		
Mean (SD)	12.3 (6.63)	9.45 (6.12)
Median [Min, Max]	12.0 [0, 30.0]	7.00 [0, 28.0]
SDQ - Conduct (sum score)		
Mean (SD)	2.94 (2.37)	2.12 (2.05)
Median [Min, Max]	3.00 [0, 10.0]	1.00 [0, 10.0]
SDQ - Emotional (sum score)		
Mean (SD)	4.44 (2.79)	3.46 (2.56)
Median [Min, Max]	4.00 [0, 10.0]	2.00 [0, 10.0]
SDQ - Attention/hyperactivity (sum score)		
Mean (SD)	4.91 (3.09)	3.88 (2.79)
Median [Min, Max]	5.00 [0, 10.0]	3.00 [0, 10.0]

Longitudinal associations of positive attributes and psychopathology

Figure 1 depicts the longitudinal associations between positive attributes, and general and specific psychopathology dimensions. Positive attributes were associated with lower levels of general psychopathology (SDQ-general) at 3-year follow-up. Baseline general psychopathology was associated with lower levels of positive attributes three years later (Figure 1, Panel A).

Regarding specific dimensions of psychopathology, higher levels of baseline positive attributes were associated with lower levels of conduct and inattention/hyperactivity symptom dimensions at 3-year follow-up. At the same time, higher levels of baseline conduct symptoms were associated with lower levels of positive attributes. In contrast inattention/hyperactivity and emotional symptoms were not longitudinally associated with positive attributes (Table A3).

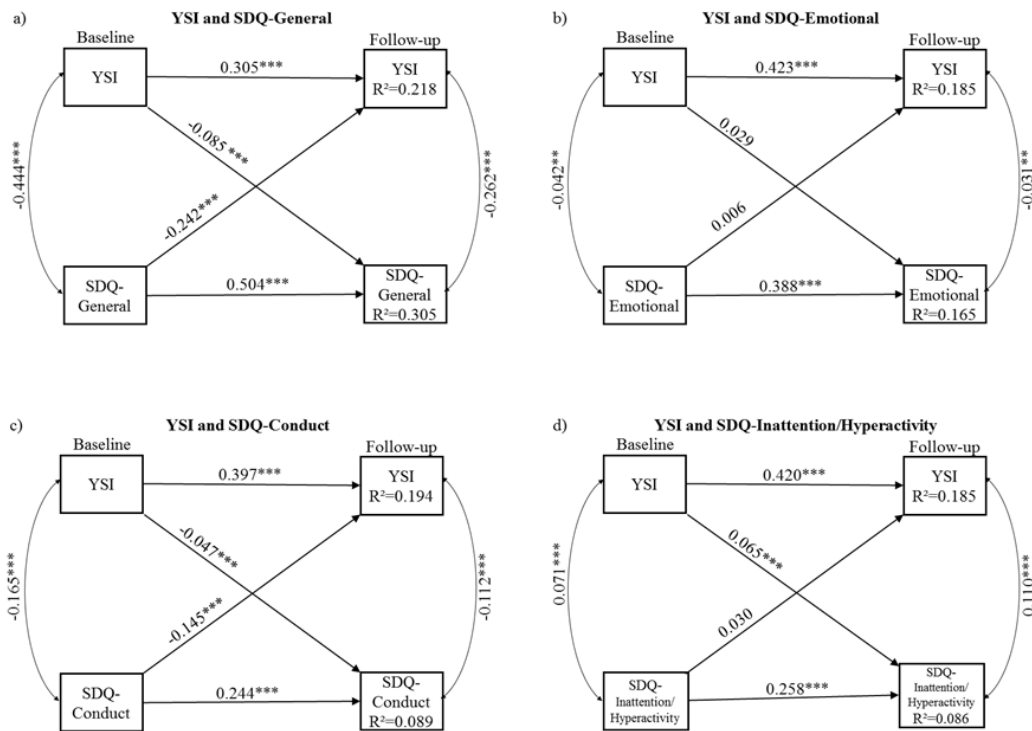


Fig 1 Cross-lagged panel model of longitudinal associations of positive attributes and general and specific psychopathology factors

Note: β , standardized regression coefficient; CI, 95% confidence interval; R^2 , total variance explained on the outcome; YSI, youth strength inventory derived from confirmatory factor analysis; SDQ, strength and difficulties questionnaire general factor extracted from confirmatory factor analysis. *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$.

Association of positive attributes and psychopathology with educational outcomes

In the bivariate models, higher levels of positive attributes were associated with both better literacy scores and lower dropout rates. However, the association between positive attributes and literacy was fully explained by the general and specific psychopathology

dimensions, whereas the associations with dropout were still significant even after adjusting for potential confounders, including psychopathology (Table 2).

In the bivariate models, higher levels of general psychopathology were associated with lower literacy scores and higher dropout rates. However, the association between general psychopathology and dropout rates was fully explained by co-occurring positive attributes in the model; in contrast, the association between general psychopathology and literacy was still significant even after adjusting for potential confounders, including positive attributes. Higher levels of conduct symptoms, but not inattention/hyperactivity and emotional symptoms, were associated with higher dropout rates in all models. All regression models can be found in Table A5 (literacy outcome) and A6 (school dropout outcome), in which it can be observed the increments in marginal and conditional explained variance of adding variables and blocks of variables (Table 2).

Table 2 Generalized mixed models predicting literacy ability and school dropout at 3-year follow-up from positive attributes of behaviour (YSI) and all SDQ-derived psychopathology factors

Models and Predictors	Literacy at follow-up			School dropout at follow-up		
	β	95% CI	p-value	OR	95% CI	p-value
<i>Bivariate models</i>						
YSI	0.03	0.01 – 0.06	0.013	0.57	0.44 – 0.73	<0.001
SDQ - General	-0.08	-0.11 – -0.05	<0.001	1.55	1.17 – 2.07	0.003
SDQ - Conduct	-0.03	-0.07 – 0.01	0.131	2.33	1.64 – 3.33	<0.001
SDQ - Emotional	-0.01	-0.05 – 0.02	0.438	1.06	0.76 – 1.47	0.733
SDQ - Inattention/Hyperactivity	-0.01	-0.05 – 0.03	0.704	0.77	0.52 – 1.13	0.185

Multiple model with YSI and SDQ simultaneously as predictors

YSI	-0.01	-0.04 – 0.02	0.678	0.59	0.44 – 0.80	0.001
SDQ - General	-0.09	-0.12 – -0.05	<0.001	1.10	0.78 – 1.56	0.586
SDQ - Conduct	-0.02	-0.06 – 0.02	0.377	1.88	1.29 – 2.75	0.001
SDQ - Emotional	-0.01	-0.05 – 0.02	0.419	1.05	0.75 – 1.47	0.765
SDQ - Inattention/Hyperactivity	-0.01	-0.05 – 0.02	0.470	0.86	0.58 – 1.27	0.439

Multiple model with YSI and SDQ (each one separately) adjusted for covariates (see list of covariates bellow)

YSI	0.03	-0.00 – 0.05	0.060	0.69	0.50 – 0.93	0.017
SDQ - General	-0.07	-0.10 – -0.04	<0.001	1.09	0.76 – 1.57	0.629
SDQ - Conduct	-0.00	-0.04 – 0.04	0.900	2.60	1.63 – 4.15	<0.001
SDQ - Emotional	0.00	-0.03 – 0.04	0.968	0.85	0.56 – 1.28	0.431
SDQ - Inattention/Hyperactivity	-0.00	-0.04 – 0.03	0.805	0.96	0.58 – 1.57	0.863

Multiple model with SDQ, YSI and covariates, including interaction terms (interaction terms depicted bellow)

YSI and SDQ - General	-0.01	-0.04 – 0.02	0.634	1.84	1.16 – 2.92	0.009
YSI and SDQ - Conduct	0.01	-0.03 – 0.06	0.590	1.07	0.66 – 1.76	0.777
YSI and SDQ - Emotional	-0.01	-0.05 – 0.03	0.630	0.96	0.64 – 1.46	0.855
YSI and SDQ - Inattention/Hyperactivity	-0.01	-0.05 – 0.03	0.677	0.70	0.40 – 1.24	0.228

Note: Regressions are adjusted for literacy level / dropout rate at baseline and weighted for follow-up attrition and high-risk sample. Complete models can be seen in Tables S4 and S5. All subjects were clustered at their schools at baseline (random intercept mixed effect models). β , standardized regression coefficient; OR, odds ratio; CI, 95% confidence interval; YSI, youth strength inventory z-score derived from confirmatory factor analysis at baseline; SDQ, strength and difficulties questionnaire general factor (z-score) extracted from confirmatory factor analysis at baseline. Covariates included but not shown in the table are age, sex, race/ethnicity, intelligence, baseline social class, baseline maternal education and psychiatric diagnosis, and baseline school dropout level.

Moreover, interactions were found between positive attributes and general psychopathology in relation to school dropout at follow-up in the fully adjusted model (Table 2). This means that the association of the general factor of psychopathology and positive attributes depends on the level of each other whereas predicting chances of school dropout. We estimated marginal effect analysis to understand this interaction (Figure 2). The results showed that increasing 1SD of positive attributes score is associated with lower chances of school dropout only for individuals with lower levels of psychopathology (SDQ-general factor score < 0.0 , Figure 2). Thus, the strength of the association between positive attributes and school dropout weakened as a function of increasing levels of psychopathology. For example, at a factor score of -1.5 of general psychopathology, an increase of one standardized unit of score in positive attributes reduces the OR to school dropout to 0.31 (95% CI [0.14, 0.68], $p = 0.004$); however, this effect is not seen at a score of 0.0 of general psychopathology (Figure 2 and Table A4).

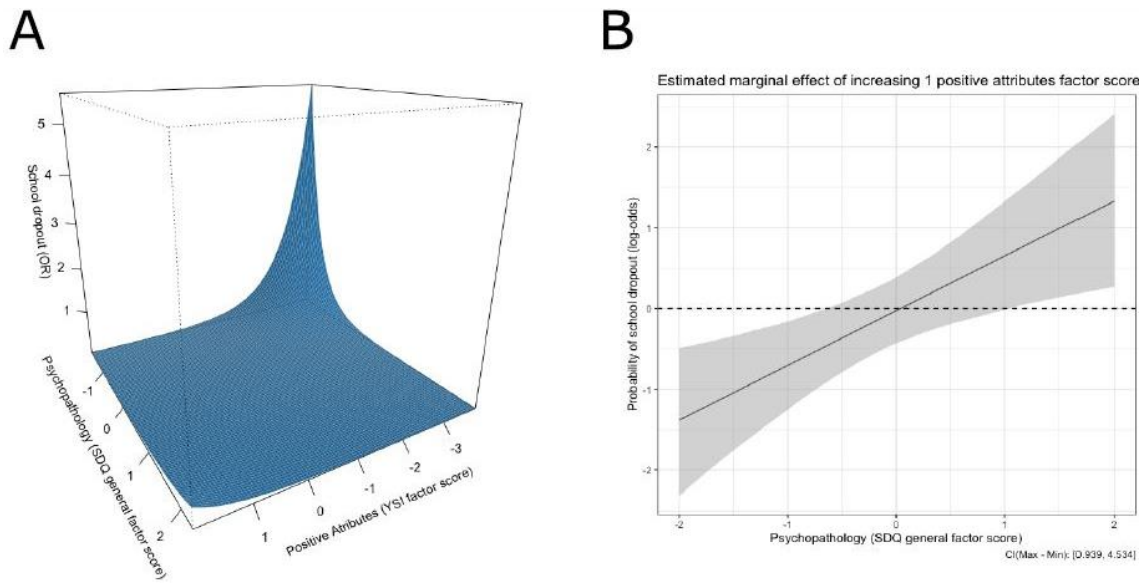


Fig 2 Interaction and marginal effects of positive attributes for fixed values of the general factor of psychopathology on the probability of school dropout

Note: (A) The y-axis represents the OR to school dropout by deciles of the general factor of psychopathology (x-axis) and YSI (z-axis); (B) The y-axis represents the OR to school dropout depending on the average marginal effect of increasing 1 SDQ-general z score (black dots with 95% CI) conditioned on increasing levels of YSI z scores (x-axis). OR, odds ratio; CI, confidence interval; SDQ, Strength and Difficulties Questionnaire; YSI, Youth Strengths Inventory.

Discussion

This study aimed to investigate whether positive attributes and psychopathology (general and specific symptom dimensions) had long-term impact on each other and whether they had interactive effects in the prediction of literacy ability and school dropout. Confirming our initial hypothesis, general and specific psychopathology dimensions and positive attributes were associated across time, providing evidence of the intertwined relationship of these constructs across development. We found prominent negative impact of general psychopathology and conduct symptoms specifically on positive attributes, but also of positive attributes conferring lower general psychopathology and conduct symptoms over time, mutually influencing each other. Our second hypothesis was that positive attributes would be associated with better literacy ability and low dropout rates, and the opposite would be for psychopathology. Interestingly we found independent negative association between positive attributes and dropout, and independent positive association between psychopathology and literacy ability. Moreover, we showed that positive attributes were associated with lower rates of school dropout only if the individuals presented lower levels of general psychopathology.

Mental health has a major impact on future life chances [31–34]. Early positive aspects of functioning might be prone to change and be trained throughout development. This can predict better job opportunities, lower substance use and lower criminality as much as well-being in the adult life [14,33,35]. At the same time, early psychopathology can reduce the likelihood of better life outcomes; it is therefore cost-effective to intervene early on this risk factor [31,34,36]. Furthermore, this mechanism might be happening early on, with psychopathology and positive attributes having opposite effects on the promotion of early education, which is key to foster life chances [1]. Studies on interventions focusing in develop skills related to positive attributes in any moment of

development demonstrate improvements in a range of socioeconomic outcomes and reduce future psychopathology [14,36–39]. These interventions also present to be effective even when applied in a disadvantaged environment. The Perry Preschool Project (PPP) and the Abecedarian Project (ABC) are projects which aimed to assign enriched environments to children at risk (e.g., mother/father with low educational level or $IQ \leq 90$, low family income, social agencies in the community indicate the family needs assistance). Investigations on long-term impact of interventions presented significant effects on general health and socioeconomic status via positive behavior [14]. Similar results are found in a low-cost intervention aiming to teach growth mindset, gratitude, and value affirmation to adolescents in Kenya. Participants were selected by presence of elevated symptoms on standardized depression or anxiety measures and a significant reduction of symptoms were demonstrated at the end of the intervention [39]. Here we extended previous findings on the distinction between positive attributes and psychopathology by showing the negative cross-lagged longitudinal association between these two mental health constructs.

Previous observational and experimental findings have demonstrated that positive attributes have negative longitudinal associations with mental health conditions, including externalizing and internalizing symptoms [9,11]. Here we demonstrated that this relationship might be due to a negative impact of positive attributes on the general factor of psychopathology and conduct specific factor, and similarly, these psychopathology dimensions at baseline are negatively associated with positive attributes three years later. It is important to underscore that the general factor explains variance from all symptomatic domains, including emotional and inattention/hyperactivity symptoms. This general domain explains most of the associations with positive attributes, which suggests this association is not due to a particular set of symptoms, but to overall

mental health problems which are shared among all symptomatic domains. After parsing out variance due to this common factor, the conduct score still explained additional variability in positive attributes, which suggests the associations between conduct specific factor and positive attributes might be due to other mechanisms not shared with the common factors such as genetic overlap with poor verbal and spatial reasoning, verbal knowledge, and general cognitive ability [40], for example. Previous research has found bidirectional associations between positive attributes and both internalizing and externalizing disorders, especially the latter [11]. However, the authors did not parse out the variance into general and specific domains of psychopathology, as we did in the current study. It is possible that this difference in methodological approach might explain why we did not find associations with emotional symptom domains after removing the variance explained by a general factor of psychopathology. Our findings encourage to examine whether interventions aiming at reducing general psychopathology in childhood and early adolescence can prevent the reduction of positive attributes in early to late adolescence. The same is valid for specific conduct problems. This can be key to promote better mental health and future life chances that depend upon these positive skills [7,32,36,41]. Nonetheless, caution should also be taken when interpreting the positive association between positive attributes and inattention/hyperactivity symptoms, since this construct presented small and some negative factor loadings, conferring it little reliability.

Nonetheless, positive attributes are associated with reduced rates of dropout only if the general factor of psychopathology is low. Previous literature have demonstrated that positive attributes interact with cognitive skills as well as with psychopathology to promote better educational outcomes [5,6,8,42] in a way that the association of positive attributes depends on the level of psychopathology. Therefore, the levels of psychopathology should be lowered in order to positive attributes can have a positive

impact on school dropout. This reinforces the argument for the prevention and early intervention of mental illness to promote positive attributes and mental well-being [31,32]. This is also important if we consider that most children and adolescents do not have a mental health condition [43] and therefore, are ready to receive interventions to increase such positive skills.

Findings of this study must be understood in the light of some limitations. First, although this is a longitudinal study, we only had data from a short follow-up. A longer follow-up period would enhance the long-term impact of the results. However, this time window can reveal the early mechanism of future outcomes. Second, observational studies are not appropriate for causal conclusions, as they may not incorporate all risk factors to explain the causality chain. However, we analysed our data using adjustment for confounders and autoregressive effects to enhance the potential for experimental interests. Third, psychopathology and positive attributes measurement considered one source of information only (parents), as well as the school dropout outcome. However, parents are widely used as a reliable source of information for these constructs in childhood and adolescence [44] and the constructs are only mildly correlated in our CLPM, which reinforce their measurement independence. Future research on this issue is encouraged to include other sources of information, such as self, teachers and peers, and approaches to assess the variables. Fourth, expulsion and dropping out of school can be circumvented, respectively, by the child being enrolled in another school that accepts it and by the child's decision/condition to return to school at a future time. Therefore, our results do not inform definitive evasion, but is an indicator of serious problems in the individual's educational course, which is a known risk factor for low attainment and educational poverty.

Conclusions

This study provides new evidence on the relationship of positive attributes and dimensional psychopathology, considering their interplay and the longitudinal impact on each other and educational outcomes. Our results suggest that the general factor of psychopathology and specific conduct symptoms negatively predicts, and are negatively predicted by, positive attributes. Therefore, it is demonstrated that the relationship between general and specific dimensions of psychopathology are linked with positive attributes. Also, these associations are through general and conduct dimensions, proposing a new perspective on the previous literature on internalizing dimensions from correlated models which do not account the general factor [11]. Nonetheless, as a mechanism by which this construct impact later life, we found that the general factor of psychopathology is negatively associated with literacy ability, while school dropout is positively predicted by specific conduct symptoms and negatively predicted by positive attributes. Furthermore, interaction analysis reveal that positive attributes predict low school dropout only if general psychopathology is low. Previous evidence on socioemotional skills could be read with different lenses after these finding, in a sense that only promoting these skills is not enough to enables better life chances, which would also require screening and treating mental health problems to enable socioemotional skills to have an impact on school dropout. These findings also encourage trials on positive attributes promotion to prevent psychopathology as much as prevention and treatment of psychopathology to promote positive attributes in children and adolescents.

Ethical standards

This study was approved by the ethics committee of the University of São Paulo [IORG0004884/National Council of Health Registry number (CONEP): 15.457/Project IRB registration

number: 1132/08] and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Participation in all phases of the study was voluntary and written consent and assent were obtained from the caregivers and youths, respectively. Verbal informed consent and assent were obtained from parents and youths who were unable to read or write.

Conflict of interest

PVR, JJM, ECM, SEL declare that they have no competing or potential conflicts of interest in relation to this work. ARS is supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES; Brazilian Federal Foundation for Support and Evaluation of Graduate Education; grant number 88882.346693/2019-01). RAB has been a consultant and/or advisor to or has received honoraria from: Pfizer, Torrent and Sanofi-Aventis. AG has been a consultant and/or advisor to or has received honoraria from: Janssen, Aché, Daiichi-Sankyo, Cristália and Torrent in the last three years. LAR has been a consultant and/or advisor to or has received honoraria from: Novartis/Sandoz and Shire/Takeda in the last three years. The ADHD and Juvenile Bipolar Disorder Outpatient Programs chaired by LAR have received unrestricted educational and research support from the following pharmaceutical companies in the last three years: Novartis/Sandoz and Shire/Takeda. LAR has received authorship royalties from Oxford Press and ArtMed and travel grants from Shire to take part in the 2018 APA annual meeting. GAS is supported by the US National Institute of Mental Health (grant number R01MH120482). MSH is supported by the research grant of the Brazilian Ministry of Health under the “Termo De Execução Descentralizada - TED 12/2019”, the US National Institute of Mental Health (grant number R01MH120482) and by the Newton International Fellowship (Ref: NIF\R1\181942), awarded by the Academy of Medical Sciences through the UK Government's Newton Fund Programme.

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Availability of data and material

Data is available upon request in the *Open Science Framework* public repository (<https://osf.io/ktz5h/>) and syntax to process raw variables used in this study can also be found in *gitlab* (<https://gitlab.com/bhrc/bhrc>).

Code availability

Code is available upon request to the corresponding author.

Consent for publication

The manuscript final version and publication is approved by all authors.

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Longitudinal associations between positive attributes and psychopathology and their interactive effects on educational outcomes

European Child & Adolescent Psychiatry

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Supplementary Information

Details on the study methods

Confirmatory factor analysis for YSI, SDQ and literacy modelling

All confirmatory factor analysis (CFA) were performed in R using the *lavaan* package [1]. The CFA of TDE (literacy), SDQ (multidimensional psychopathology) and YSI (positive attributes) in a longitudinal dataset, we used items from the two time points and defined the subjects as a cluster, applying pairwise method to deal with missing data. We used delta parameterization and weighted least square with diagonal weight matrix with

standard errors and mean- and variance- adjusted chi-square test statistics (WLSMV) estimator and pairwise deletion of missing data. Model fit was tested by root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker–Lewis index (TLI). RMSEA near or below 0.080 represent acceptable model fit, and values lower than 0.060 represent good-to-excellent model fit CFI and TLI values near or above 0.900 represent acceptable model fit, while values higher than 0.950 represent a good-to-excellent model fit [2]. Omega (ω), hierarchical omega (ω_H) and Cronbach's α coefficient were calculated to estimate factor reliability. ω computes the proportion of variance in the observed total score attributable to all sources of common variance, which takes factor loadings to account the variance computation. ω_H calculate the unique variance associated with each specific/subscale factor once controlling for the variance due to the general factor [3]. All factor scores were extracted using Empirical Bayes Modal method, and further saved to be used in the cross-lagged and regression models.

YSI was modelled as a one-factor model. Items were allowed to correlate if indicated by high correlation (>0.50) in the modification indices. The one-factor solution was conducted and indicated an adequate fit index (RMSEA=0.051 [90% CI = 0.049, 0.053]; CFI = 0.987; TLI = 0.985). Factor loadings, reliability and item correlations are displayed in supplementary table A1.

To access psychopathology (general and specific) in present study, we used emotional, inattention/hyperactivity and conduct subscales (15 items) of the Strength and Difficulties Questionnaire (SDQ). It was modelled with CFA using a bi-factor structure [4], in which all 15 items loaded in the general psychopathology factor (SDQ-general) and each specific subscale items loaded in their specific factor. All factors were orthogonal. This model indicated an adequate fit index (RMSEA=0.055 [90% CI = 0.052, 0.058]; CFI=0.980, TLI=0.972).

Literacy comprised reading and writing skills measured by the School Performance Test (“Teste de Desempenho Escolar” - TDE) [5]. It is composed of two right/wrong subtests of reading and writing tests. We used 12 items of reading and 61 items assessing writing ability from the two time-points. Reading and writing items were modelled with CFA to be loaded by one common literacy. CFA demonstrated excellent model fit and reliability indices [2,6] for this latent variable (RMSEA = 0.019 [90% CI = 0.018, 0.020]; CFI 0.999; TLI 0.999; $\alpha = 0.995$; $\omega = 0.984$). Literacy factor scores were mean-centred and standardized and extracted to be used in main analysis.

Covariates

Social class. “Associação Brasileira de Empresas de Pesquisa” [7] is a Brazilian standardized instrument that is an indicator of family social class. Classification is made through a composite score comprising the main caregiver’s educational level and household assets and conditions. A/B represent the high/comfortable class; C is considered a medium class; and D/E the lowest social class.

Maternal education: Maternal education was reported at baseline and, for this study, was categorized in four blocks: (1) no formal education or less than lower secondary school (incomplete former 8th grade); (2) complete lower secondary school or uncomplete upper-secondary school; (3) complete upper-secondary or incomplete tertiary education and (4) complete tertiary education. This categorization was done due to the importance of having a complete degree of education for the job marketing in Brazil (Amorim, Lecrubier, Weiller, Hergueta, & Sheehan, 1998) [8].

Maternal psychopathology: We used the Mini International Psychiatric Interview (MINI) and the MINI Plus [9,10] to assess the presence of any maternal history of psychiatric

disorders namely: depressive episode, manic episode, panic disorder, agoraphobia, social anxiety disorder, alcohol abuse and dependence, drug abuse and dependence, psychotic conditions, generalized anxiety disorder and attention deficit hyperactivity disorder.

Inverse probability weight (IPW) and sampling weights

IPW was calculated from regressing the likelihood of being in the sample at follow-up on maternal education, any anxiety disorder, study site, and social class, which was previously associated with attrition in our sample [11]. The predicted probability of this regression was inverted to generate IPW [12]. Sampling weights were calculated to adjust for the high-risk procedure used in this cohort, in a way that the rate of mental health conditions was equal among random and high-risk sample, as described previously [13]. IPW and sampling weights were multiplied and used as the final weight.

Details on the study results

Regression models with complete predictors

Regression models are described in the main text. Here, they are described in full in the supplementary tables A5 (literacy as outcome) and A6 (dropout as outcome) considering YSI and SDQ-general factor, emotional factor, conduct factor and inattention/hyperactivity factor as predictors.

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Table A1. Factor loadings from confirmatory factor analysis of Youth Strengths Inventory in both waves

YSI item	
Generous	0.587
Lively	0.613
Keen to learn	0.671
Affectionate	0.720
Reliable and responsible	0.741
Easy going	0.749
Good fun, good sense of humour	0.686
Interested in many things	0.739
Caring, kind-hearted	0.763
Bounces back quickly after setbacks	0.653
Grateful, appreciative of what he gets	0.770
Independent	0.539
Helps around the home	0.444
Gets on well with the rest of the family	0.738
Does homework without needing to be reminded	0.510
Creative activities: art, acting, music, making things	0.506
Likes to be involved in family activities	0.713
Takes care of his appearance	0.547
Good at school work	0.615
Polite	0.760
Good at sport	0.447
Keep his bedroom tidy	0.509
Good with friends	0.748
Well behaved	0.747

Note: Errors of the following item were correlated in the model: *Good at School* with *Keen to Learn* ($r=0.278$), *Does homework without need to be reminded* ($r=0.399$) and *Creative activities* ($r=0.212$). *Good fun/humour* with *Lively* ($r=0.353$). *Interested in many things* with *Keen to learn* ($r=0.251$). *Caring/Kind-hearted* with *Affectionate* ($r=0.215$) and *Generous* ($r=0.204$). *Keep his/her bedroom tidy* with *Helps around* ($r=0.272$) and *Does homework without need to be reminded* ($r=0.208$). *Well behaved* with *Polite* ($r=0.178$). *Affectionate* with *Generous* ($r=0.223$). *Creative activities* with *Does homework without need to be reminded* ($r=0.249$). YSI, Youth Strengths Inventory.

Table A2. Factor loadings from confirmatory factor analysis of parent-report Strength and Difficulties Questionnaire in both waves

SDQ Item	General factor	Emotional	Conduct	Inattention/ Hyperactivity
Often complains of headaches, stomach-aches or sickness	0.427	0.394		
Many worries or often seems worried	0.223	0.642		
Often unhappy, depressed or tearful	0.543	0.442		
Nervous in new situations, easily loses confidence	0.495	0.357		
Many fears, easily scared	0.456	0.506		
Often loses temper	0.684		0.207	
Generally well behaved, usually does what adults request (R)	0.539		0.279	
Often fights with other children/youth or bullies them	0.600		0.322	
Often lies or cheats	0.575		0.529	
Steals from home, school or elsewhere	0.401		0.654	
Restless, overactive, cannot stay still for long	0.749			0.277
Constantly fidgeting or squirming	0.769			0.415
Easily distracted, concentration wanders	0.787			-0.170
Thinks things out before acting (R)	0.594			-0.232
Good attention span, sees chores or homework through to the end (R)	0.707			-0.370

Note: SDQ, Strength and Difficulties Questionnaire. R, reverse code.

Table A3 - Cross-lagged panel models of positive attributes (YSI) and psychopathology (all SDQ-derived factors) in a 3-year follow-up

Model	Outcome Follow-up	Predictor Baseline	β	S.E.	95% CI	p-value
YSI and SDQ - General	YSI	YSI	0.305	0.023	0.259 - 0.351	0.000
		SDQ - General	-0.242	0.027	-0.295 - -0.190	0.000
	SDQ - General	YSI	-0.085	0.020	-0.124 - -0.045	0.000
		SDQ - General	0.504	0.023	0.459 - 0.549	0.000
YSI and SDQ - Emotional	YSI	YSI	0.423	0.020	0.384 - 0.462	0.000
		SDQ - Emotional	0.006	0.027	-0.047 - 0.058	0.828
	SDQ - Emotional	YSI	0.029	0.015	0.000 - 0.057	0.050
		SDQ - Emotional	0.388	0.020	0.350 - 0.427	0.000
YSI and SDQ - Conduct	YSI	YSI	0.397	0.021	0.357 - 0.437	0.000
		SDQ - Conduct	-0.145	0.033	-0.208 - -0.081	0.000
	SDQ - Conduct	YSI	-0.047	0.013	-0.072 - -0.021	0.000
		SDQ - Conduct	0.244	0.020	0.204 - 0.284	0.000
YSI and SDQ - Inattention/hyperactivity	YSI	YSI	0.420	0.020	0.381 - 0.459	0.000
		SDQ - Inattention/hyperactivity	0.030	0.032	-0.033 - 0.092	0.349
	SDQ - Inattention/hyperactivity	YSI	0.065	0.013	0.038 - 0.091	0.000
		SDQ - Inattention/hyperactivity	0.258	0.021	0.216 - 0.300	0.000

Note: β , standardized regression coefficient; S.E., standardized error; CI, 95% confidence interval; YSI, youth strength inventory z-score derived from confirmatory factor analysis at baseline; SDQ, strengths and difficulties questionnaire general factor (z-score) extracted from confirmatory factor analysis at baseline.

Table A4 - Marginal effects of positive attributes for fixed values of the general factor of psychopathology on the probability of school dropout

Fixed z-score	Positive attributes (YSI)			
		95% CI		
SDQ-general factor	School dropout (OR)	LB	UB	p-value
-2.0	0.23	0.08	0.62	0.004
-1.5	0.31	0.14	0.68	0.004
-1.0	0.42	0.23	0.77	0.005
-0.5	0.57	0.36	0.90	0.015
0.0	0.78	0.53	1.15	0.204
0.5	1.06	0.67	1.66	0.817
1.0	1.43	0.78	2.63	0.245
1.5	1.95	0.88	4.33	0.101
2.0	2.65	0.97	7.25	0.058

Note: Marginal effects derived from adjusted model predicting school dropout with interactions of YSI with all SDQ factors (general, emotional, conduct and inattention/hyperactivity). All regressions are weighted for follow-up response and oversampling for high-risk of family psychopathology. Covariates included but not shown in the table are age, sex, race/ethnicity, intelligence, baseline social class, baseline maternal education and psychiatric diagnosis, and baseline school dropout level. UB, 95% confidence interval upper bound; LB, 95% confidence interval lower bound.

Table A5 - Complete weighted mixed regression models of YSI, SDQ factors and covariates predicting literacy ability at follow-up

<i>Predictors</i>	Literacy (baseline)		YSI		SDQ (all)		YSI+ SDQ (all)		Covariates	YSI + covariates		SDQ (all)	YSI * SDQ (all) +			
	β	95% CI	β	95% CI	β	95% CI	β	95% CI		β	95% CI	β	95% CI	β	95% CI	β
Baseline literacy ability	0.47 ***	0.44 – 0.50	0.47 ***	0.44 – 0.50	0.46 ***	0.43 – 0.49	0.46 ***	0.43 – 0.49	0.50 ***	0.46 – 0.53	0.50 ***	0.46 – 0.53	0.49 ***	0.46 – 0.52	0.49 ***	0.46 – 0.52
YSI			0.03 *	0.01 – 0.06			-0.01	-0.04 – 0.02			0.03	-			-0.01	-0.04 – 0.02
SDQ-General					-	-0.11 --	-	-0.12 --					-0.07 ***	-0.10 --	-	-0.11 --
					0.08 ***	0.05	0.09 ***	0.05						0.04	0.07 ***	0.04
SDQ-Conduct					-0.01	-0.05 – 0.03	-0.02	-0.06 – 0.03					0.00	-	0.00	-0.04 – 0.04
SDQ-Emotional					-0.01	-0.04 – 0.03	-0.01	-0.04 – 0.03					0.01	-	0.01	-0.03 – 0.04
SDQ-Inattention/Hyperactivity					-0.01	-0.05 – 0.03	-0.01	-0.05 – 0.03					-0.00	-	0.00	-0.04 – 0.04
Interaction of YSI and SDQ-General															-0.01	-0.04 – 0.02
Interaction of YSI and SDQ-Conduct															0.01	-0.03 – 0.06
Interaction of YSI and SDQ-Emotional															-0.00	-0.04 – 0.03
Interaction of YSI and SDQ-Inattention/Hyperactivity															-0.00	-0.04 – 0.04
Age									-0.05 ***	-0.07 --	-	-0.07 --	-0.05 ***	-0.07 --	-	-0.07 --
									0.09 ***	0.04	0.05 ***	0.04	0.08 ***	0.04	0.05 ***	0.04
Sex (ref: male)									0.09 ***	0.05 – 0.14	0.09 ***	0.05 – 0.14	0.08 ***	0.04 – 0.13	0.08 ***	0.04 – 0.13
Skin colour (ref: White)									-0.07 **	-0.12 --	-0.07 **	-0.12 --	-0.06 **	-0.11 --	-0.06 *	-0.11 --
									0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Social class (ref: E/D)									-0.06 **	-0.11 --	-0.07 **	-0.12 --	-0.07 **	-0.12 --	-0.07 **	-0.12 --
									0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Maternal education (ref: Incomplete primary school)									0.01	-0.02 – 0.04	0.02	-	0.01	-	0.01	-0.02 – 0.04
Maternal psychiatric diagnosis (ref: No)									-0.06 *	-0.12 --	-0.06 *	-0.11 --	-0.04	-	-0.04	-0.10 – 0.01
									0.01	0.01	0.00	0.00	0.10 – 0.01	0.10 – 0.01	0.10 – 0.01	0.10 – 0.01
IQ (standardized)									0.07 ***	0.05 – 0.10	0.08 ***	0.05 – 0.10	0.07 ***	0.05 – 0.10	0.07 ***	0.05 – 0.10

Observations	1566	1566	1566	1566	1455	1455	1455	1455
Marginal R ² / Conditional R ²	0.438 / 0.487	0.440 / 0.488	0.448 / 0.495	0.447 / 0.495	0.484 / 0.524	0.484 / 0.533	0.490 / 0.537	0.490 / 0.536

Note: Literacy ability are standardized factor scores derived from reading and writing test (Teste de Desempenho Escolar). All regression models were weighted for follow-up attrition and for random sample. Subjects were clustered in their schools at baseline (random intercept mixed effect regression models). β , standardized regression coefficient; CI, 95% confidence interval; YSI, youth strenght inventory z-score derived from confirmatory factor analysis at baseline; SDQ, strenght and difficulties quesstionaire general factor (z-score) extracted from confirmatory factor analysis at baseline; Social class measured at baseline by the Associação Brasileira de Empresas de Pesquisa (ABEP) criteria, in which E is the lowest social class and A the highest, combined in E/D, C and A/B strata; IQ, intelligence quotient measured by Weschler Intelligence scale for children using cubes and vocabulary tests and transformed in z-scores. *, p<0.05; **, p<0.01; ***, p<0.001.

Table A6 - Complete weighted mixed regression models of YSI and SDQ general factor predicting school dropout at follow-up

<i>Predictors</i>	School dropout (baseline)		YSI		SDQ (all)		YSI+ SDQ (all)		Covariates		YSI + covariates		SDQ (all) + covariates		YSI * SDQ (all) + covariates	
	<i>OR</i>	95% CI	<i>OR</i>	95% CI			<i>OR</i>	95% CI	<i>OR</i>	95% CI	<i>OR</i>	95% CI	<i>OR</i>	95% CI	<i>OR</i>	95% CI
Baseline school dropout (ref: No)	4.10 *	1.19 – 14.15	3.81 *	1.10 – 13.17	3.34	0.93 – 12.02	3.41	0.95 – 12.23	4.19 *	1.05 – 16.74	3.89	0.96 – 15.81	4.07	0.98 – 16.87	3.82	0.90 – 16.18
YSI			0.57 ***	0.44 – 0.73			0.69 *	0.51 – 0.94			0.69 *	0.50 – 0.93			0.81	0.54 – 1.23
SDQ-General					1.35 *	1.00 – 1.82	1.08	0.76 – 1.53					0.96	0.66 – 1.39	0.97	0.62 – 1.53
SDQ-Conduct					2.12 ***	1.48 – 3.05	1.89 ***	1.29 – 2.75					2.82 ***	1.78 – 4.46	2.55 ***	1.54 – 4.21
SDQ-Emotional					1.08	0.78 – 1.51	1.09	0.78 – 1.52					0.94	0.62 – 1.42	0.91	0.59 – 1.40
SDQ- Inattention/Hyperactivity					0.80	0.55 – 1.18	0.85	0.57 – 1.26					1.01	0.62 – 1.67	0.94	0.56 – 1.57
Interaction of YSI and SDQ-General															1.98 **	1.22 – 3.19
Interaction of YSI and SDQ-Conduct															0.86	0.50 – 1.48
Interaction of YSI and SDQ-Emotional															0.93	0.58 – 1.48
Interaction of YSI and SDQ- Inattention/Hyperactivity															0.73	0.40 – 1.34
Age									1.78 ***	1.51 – 2.11	1.77 ***	1.49 – 2.09	1.78 ***	1.50 – 2.12	1.76 ***	1.47 – 2.10
Sex (ref: male)									0.73	0.41 – 1.28	0.77	0.44 – 1.36	0.71	0.40 – 1.27	0.75	0.41 – 1.37
Skin colour (ref: White)									0.70	0.39 – 1.25	0.70	0.39 – 1.26	0.55	0.30 – 1.02	0.59	0.32 – 1.11
Social class (ref: E/D)									1.18	0.68 – 2.06	1.27	0.72 – 2.24	1.37	0.77 – 2.43	1.44	0.80 – 2.61
Maternal education (ref: Incomplete primary school)									0.75	0.53 – 1.07	0.74	0.52 – 1.06	0.73	0.51 – 1.04	0.71	0.49 – 1.02
Maternal psychiatric diagnosis (ref: No)									2.72 ***	1.55 – 4.77	2.32 **	1.30 – 4.16	2.45 **	1.33 – 4.51	2.28 *	1.21 – 4.30
IQ (z-score)									0.95	0.71 – 1.28	0.99	0.73 – 1.33	0.95	0.70 – 1.30	1.01	0.73 – 1.39

Observations	2001	2000	2001	2000	1796	1795	1796	1795
Marginal R ² / Conditional R ²	0.010 / 0.227	0.076 / 0.276	0.081 / 0.276	0.097 / 0.283	0.300 / 0.418	0.312 / 0.435	0.350 / 0.456	0.363 / 0.476

Note: School dropout included dropout and expulsion. All regression models were weighted for follow-up attrition and for random sample. Subjects were clustered in their schools at baseline (random intercept mixed effect regression models). OR, odds ratio; CI, 95% confidence interval; YSI, youth strenght inventory z-score derived from confirmatory factor analysis at baseline; SDQ, strenght and difficulties quesstionaire general factor (z-score) extracted from confirmatory factor analysis at baseline; Social class measured at baseline by the Associação Brasileira de Empresas de Pesquisa (ABEP) criteria, in which E is the lowest social class and A the highest, combined in E/D, C and A/B strata; IQ, intelligence quotient measured by Weschler Intelligence scale for children using cubes and vocabulary tests and transformed in z-scores. *, p<0.05; **, p<0.01; ***, p<0.001.

4.2 Article #2

Environmental and genetic factors influencing the trajectories of positive attributes from childhood to young adulthood

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**Environmental and genetic factors influencing the trajectories of positive
attributes from childhood to young adulthood**

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Abstract

Background: In contrast with the literature on mental disorders, very little is known about the trajectories of positive attributes in youth. The aims of this study are to investigate the trajectory of positive attributes from childhood to early adulthood and to explore how those trajectories can be modified by exposure to adversity early in life, genetic factors and their interplay.

Methods: A large prospective school-based community cohort of youths (n=2,511, 6-14 years of age, 45% female) were assessed and followed up for 3 years (80% retention) and 6 years (71% retention). Positive attributes were assessed by the Youth Strength Inventory (YSI). Childhood exposure to threat and deprivation were assessed by a latent composite measure model. Genetic factors were assessed by polygenic risk scores for non-cognitive traits (NonCog PRS). Generalized additive mixed models were used to investigate the YSI trajectories and associations between those trajectories with environmental and genetic factors and their interaction.

Results: Trajectories of YSI scores varied according to sex. Girls had higher YSI scores than boys until early adolescence and similar scores than boys from adolescence to young adulthood. Exposure to adversity (both threat and deprivation) were associated with lower YSI over time. These associations were more pronounced early in development and it were mitigated as the child transitions to young adulthood. NonCog PRS was not associated with the average or the trajectory of YSI and we did not find genetic by environmental interactions.

Conclusion: Our findings provide new evidence on trajectories of positive attributes in youth and reveal and how experiences of adversity in early life impact positive aspects of mental health in a period of high incidence of mental health problems.

Keywords: socioemotional skills; positive mental health; personality; adversity; threat; deprivation.

Introduction

Children that are empathetic, helpful and persistent, among other skills, have better future outcomes such as higher employment, wages, work experiences, better interpersonal relationships and lower risk of criminal behaviors (1–7). This set of emotional and behavioural traits are called positive attributes, a construct comprising main aspects of socioemotional skills, also known as soft or noncognitive skills (8–10). Understanding the trajectories of positive attributes from childhood to young adulthood and the etiological factors related to them is essential to not only prevent children to have mental health problems, but also help children to thrive and flourish in life (6,11,12). The determination of typical trajectories allows accurate intervention planning for specific age ranges; whereas studying etiological factors that are related to positive attributes allows a better definition of targets for interventions.

Most of the evidence on etiological studies on mental health focus on mental health problems. Early life stress is one of the most consistent factors associated with psychopathology (13–16), and also with mental health traits related to positive attributes (15). During childhood, trauma experiences of abuse, neglect and dysfunctional environments show impact on a range of outcomes as future psychopathology, personality traits, neural development, reward processing and emotional reactivity and regulation (14,16–20). Sibling studies suggest the role of environmental factor vary with development, being near-zero in early childhood to moderate in adulthood (21).

Among genetic factors, the available evidence on positive traits in children and adolescents focus on related traits such as self-regulation, personality traits and more broad terms such as motivation. For example, studies with twins have shown a significant genetic influence in traits related to positive attributes such as self-control (22), effortful and attentional control (23), openness (24,25), conscientiousness (24,26) and motivation

(27,28). In contrast with environmental factors, sibling studies suggest those genetic influences are relatively stable with age (21).

The current literature is limited in a number of important ways. First, most of studies are cross-sectional and therefore cannot investigate the trajectory of positive attributes from childhood to early adulthood. Second, most of the genetic evidence are focused on behavioral genetics (twin studies) and we found no molecular genetic studies on traits such as positive attributes and very little is known on genetic contributions to positive traits using molecular genetic studies. Finally, we find no studies investigating the interactions between environmental and genetic factors related to positive attributes in this age range.

In order to address this gaps, this study aims to investigate (1) the trajectory of positive attributes from childhood to young adulthood; (2) the influences of experiences of threat and deprivation on positive attributes levels; (3) the association between positive attributes and the noncognitive genetic risk score (NonCog PRS) (3); and (4) the potential interactions between early adversity and genetic risk scores. We hypothesize that positive attributes will demonstrate to be stable through years and will be associated with both childhood adversity and polygenic risk scores. We also hypothesize that the effects of childhood adversity will vary depending on levels of the NonCog PRS (gene by environment interaction).

Methods

Participants

Data were obtained from the Brazilian High Risk Cohort for Mental Conditions (BHRCS) (29). At screening phase, all parents presented at state-funded schools in São Paulo (n=35) and Porto Alegre (n=22) on school registration days were invited to participate.

Participation in all phases of the study was voluntary and written consent and assent were obtained from the caregivers and youths, respectively. Verbal informed consent and assent were obtained from parents and youths who were unable to read or write. Of those approached, 8,012 caregivers (87.3% mothers) accepted to be interviewed with a modified version of the Family History Screen (30) conducted by lay interviewers, with the purpose to estimate family risk for psychiatric diagnosis (29). Two subgroups were recruited from a total of 9,997 screened subjects: a random subsample (n=957) and a high-risk sub-sample (n=1,554). These subjects (N=2,511) were selected for full assessment.

We analysed data collected at baseline (2010-2011), 3-year follow-up (2013-2014) and 6-year follow-up (2018-2019). At baseline, 2,511 youth (6 to 14 years of age, 45% female) participated in the study. The 3-year follow-up comprised 2,010 participants (80% retention; 9-17 years of age, 44% female) and 6-year follow-up involved a sample of 1,784 participants (71% retention; 13 to 22 years of age, 54% male).

Ethical Considerations

This study was approved by the ethics committee of the University of São Paulo [IORG0004884/National Council of Health Registry number (CONEP): 15.457/Project IRB registration number: 1132/08] and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Measures

Positive Attributes. Positive attributes was measured by the block from Youth Strength Inventory (YSI), a subscale (section N) of the Development and Well-Being Assessment (DAWBA) (7,31) that assesses child characteristics (e.g., lively, easy going, grateful,

responsible). It is a 12-item scale that caregivers respond how applicable descriptions are to the child as “No”, “A little”, or “A lot”. YSI factor scores was extracted from a confirmatory factor analysis model (CFA) and was modelled as a one-factor model using items from the three time points. The one-factor solution was conducted and indicated an adequate fit index (RMSEA=0.086 [90% CI = 0.083, 0.089]; CFI = 0.974; TLI = 0.969).

Adversity Experiences – Threat and Deprivation. Threat and deprivation dimensions are latent constructs measured through indicators based on theoretical models of adversity (32) chosen from the baseline evaluation of the BHRCs. Variables selected for measuring experiences of threat were drawn from the Posttraumatic Stress Disorder (PTSD) assessment of DAWBA (31) and questionnaires specifically designed for the BHRCs (29). These experiences include lifetime exposure to bullying, physical and sexual abuse, attack or threat, witnessing domestic violence, and witnessing attack. Deprivation measures included indicators of neglect, parental absence, mother’s educational level, family income (measured in quintiles), and socioeconomic classification according to Brazilian Economic Classification Criterion (A/B – the wealthiest, C, or D/E – the poorest) (33).

Non-cognitive traits – Polygenic risk score. Genotyping was performed using the Global Screening Array (Illumina) with genomic DNA isolated from saliva samples (Oragene) using prepIT-L2P reagent (DNAgenotek). Single-nucleotide polymorphisms (SNPs) with a minor allele frequency <1%, locus missingness >10%, or Hardy-Weinberg equilibrium significance <0.000001 and individuals with genotype missingness >10% and an estimation of identity by descent >0.12 were excluded. We calculated the PRS for noncognitive skills using PRSice v2 software based on summary statistics from previous

genome-wide association studies (3). P-value-informed clumping was performed retaining the SNP with the smallest p-value within a 250-kb window and excluding SNPs in linkage disequilibrium ($r^2 > 0.1$).

The NonCog PRS was based on the work of Demange and colleagues (2021), which performed a genetics study aiming to create a GWAS of a noncognitive skills phenotype. Based on an economics strategy, authors performed GWAS-by-subtraction analysis on the residual “noncognitive” of a genetic variation in educational attainment that was not explained by cognitive skills. For this purpose, genomic structural equation modeling (Genomic-SEM) were applied to published GWAS summary statistics for educational attainment and cognitive performance. From this, the genetic influence on cognitive performance could be "subtracted" from the association of each SNP with educational level and remaining associations of each SNP with educational attainment formed a latent factor entitled ‘NonCog’ (3).

Statistical Analysis

Generalized additive mixed models (GAMM) were used to test all hypotheses of this study. In order to run all GAMM models in R software (34), we used the package “*gamm4*” (35). GAMM is interpreted considering the effective degrees of freedom (edf), a degree of non-linearity in the associations. An edf of 1 is equivalent to a linear relationship, $\text{edf} > 1$ and ≤ 2 is a weakly non-linear relationship, and $\text{edf} > 2$ is considered a highly non-linear relationship (36). For the purpose of this study, all models specify the random effects for age and individual and models using genetic variables (NonCog PRS) were also adjusted by the 10 principal components of ancestry.

To test our first hypothesis, a GAMM considering years of age predicting YSI and stratified by sex was used to investigate the trajectory of positive attributes (YSI) from

childhood to young adulthood. To investigate the second hypothesis, GAMM were used to investigate an interaction between age and adversity predicting positive attributes (YSI) through two models - threat and deprivation as predictors. The third aim was to test the association between positive attributes (YSI) and NonCog PRS, therefore we conducted a sequence of GAMM analysis considering (a) all NonCog PRS thresholds (z-score) as predictor of the overall mean of YSI, and (b) an interaction of all NonCog PRS thresholds (z-score) and age (z-score) as predictors for the trajectory of YSI. Finally, two GAMM analyses were used to test our fourth hypothesis – positive attributes levels being predicted by the interaction of NonCog PRS (z-score) and threat or deprivation.

Results

Positive attributes from childhood to young adulthood

Figure 1 depicts the trajectory of positive attributes and psychopathology over time, depicting differences of male and female levels between six and 22 years old. Despite demonstrating to have similar levels of positive attributes in adolescence and young adulthood, females show higher levels in childhood, which decline in pre-adolescence and become lower than male levels. On the other hand, males tend to have stable levels of positive attributes from childhood to young adulthood.

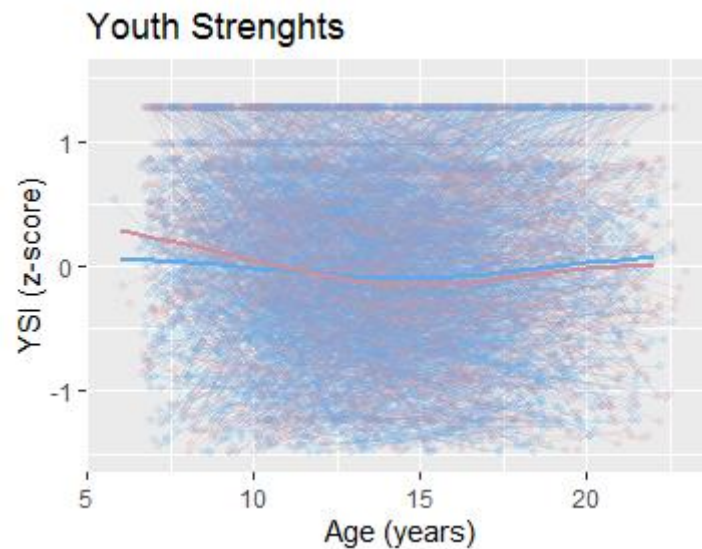


Figure 1. Generalized additive mixed model showing the trajectory of positive attributes from childhood to young adulthood in boys (blue) and girls (red).

Association between positive attributes and experiences of adversity

We found associations between childhood exposure to threat (edf=2.14, $F=9.02$, $p<0.001$) and YSI overall scores and a threat by age interaction (edf=1.05, $F=27.3$, $p<0.001$). This interaction means that exposure to threat is significantly associated with lower YSI, but this association is higher early in development and seems to be mitigated as the child transitions to young adulthood. A similar finding was also found for exposure of deprivation. We found significant associations between childhood exposure to deprivation (edf=1, $F=59.4$, $p<0.001$) and YSI overall scores and a deprivation by age interaction (edf=2.33, $F=3.01$, $p=0.02$). Again, deprivation was associated with lower YSI scores, but this association is more pronounced early in development, and seems to be mitigated as the child transitions to young adulthood. See Figure 2.

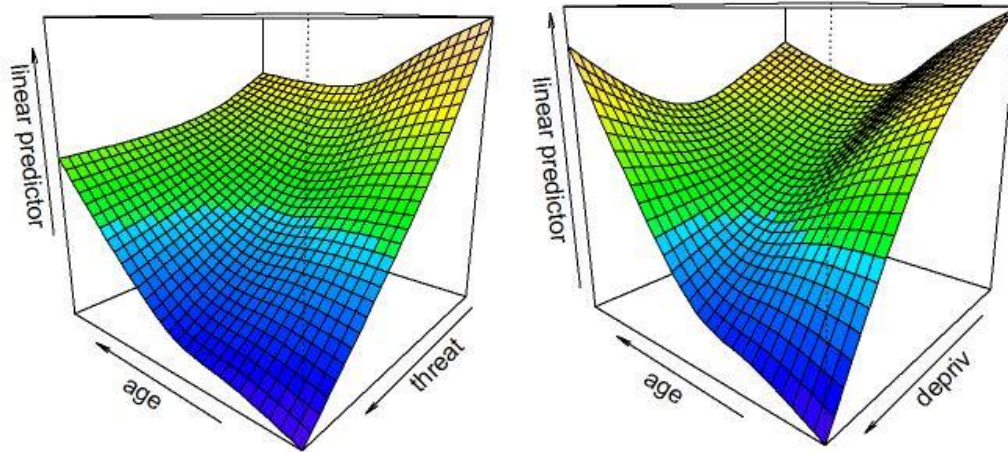


Figure 2. Interaction of age and adversity experiences associated with future levels of positive attributes

Non-Cognitive polygenic risk score and positive attributes

We did not find an association between NonCog PRS with mean levels of YSI (all p -values > 0.05), neither associations with the trajectory of YSI over time (NonCog PRS by age interactions with all p -values > 0.05). See Table 1.

Table 1. Generalized additive mixed models predicting positive attributes from non-cognitive polygenic risk score thresholds and age

	NonCog PRS		Age		NonCog PRS*Age	
	F	p-value	F	p-value	F	p-value
NonCog PRS thresholds						
0.000001	2.794	0.094	2.459	0.033	1.069	0.401
0.0001	3.266	0.070	4.109	0.003	0.211	0.894
0.01	1.573	0.144	5.019	0.001	0.686	0.407
0.1	0.571	0.547	2.597	0.024	0.620	0.478
1	0.123	0.881	2.412	0.092	0.904	0.464

Gene by environment interactions

No gene by environment interactions were found between NonCog PRS thresholds (using the 0.0001, the one with the higher F-value), and threat (NonCog PRS

by threat interaction, $\text{edf}=3.37$, $F=1.036$, $p=0.423$) and deprivation scores (NonCog PRS by deprivation interaction, $\text{edf}=1.07$, $F=1.245$, $p=0.291$).

Discussion

This study aimed to investigate etiological factors associated with trajectories of positive attributes from childhood to young adulthood considering environmental experiences of adversity and genetics. Between the ages of 6 and 22, confirming our initial hypothesis, positive attributes are generally stable, but subtle sex differences were detected. Girls have higher levels of positive attributes than boys, but those are similar after early adolescence. Furthermore, exposure to threat and deprivation significantly impacted YSI levels and YSI trajectories. Exposure to adversity is significantly associated with lower YSI, but this association is much more pronounced early in development and seems to be mitigated as the child transitions to young adulthood. Opposing our third and fourth hypothesis, NonCog PRS demonstrates no significant association with mean levels and trajectory of positive attributes, and no gene by environment interactions were detected for neither average nor trajectories of positive attributes in youth.

Our results demonstrate a generally stable trajectory of positive attributes from adolescence to young adulthood with subtle sex differences in childhood corroborating with previous data on the area. Reviews of personality trajectory considering the Big Five personality model (37,38), which is related to socioemotional skills and positive attributes, demonstrate that the transition from childhood to adolescence is a turning point to traits trajectory. Evidence shows alterations in all five domains around the age of 15 years and an increasing stability during adolescence and young adulthood. Regarding sex differences, our results corroborate with previous evidence on little or no differences

between men and women (38–40). Despite this, literature is conflicting, since there are studies that demonstrate the existence of sex differences in personality (41,42).

Even demonstrating a stable trajectory, positive attributes can also present changes influenced by environment. Adversity experiences present an important impact as exposure to both threat and deprivation in early life have associations with low positive attributes during childhood. Although there is no consistent evidence on this association, early life stress is widely related to psychosocial outcomes. Studies demonstrate that trauma experiences during childhood, as abuse, neglect and dysfunctional environment, present association with a range of personality traits, psychopathology and poor health outcomes (13,15,16,20). A growing literature also demonstrate the impact of early life stress on neural development, patterns of social and emotional information processing, emotional reactivity, emotion regulation and reward processing (13,14,16,18,19). Therefore, results highlight the importance of interventions early in life preventing adversity experiences. Besides other well-known outcomes of threat and deprivation, the impact of having low positive attributes in childhood entails future impairment on a range of outcomes, as educational, social and well-being (4–7).

In contrast we did not found associations between positive attributes and genetics. Regarding the possible hereditary factor of socioemotional skills, from which the positive attributes are derived, our results do not corroborate with our initial hypothesis. Nevertheless, previous studies focused only on specific characteristics (22–28), which does not allow generalization to results of the latent construct, and the NonCog factor created by Demange and colleagues (3) to be a GWAS of a noncognitive skills phenotype present limitations that must be considered. Despite demonstrating that NonCog has a significant association with Openness ($r_g = 0.30$ (s.e. = 0.04)) and a negative association with Neuroticism ($r_g = -0.15$ (s.e. = 0.04)), only modest associations were found for

Conscientiousness ($r_g = 0.13$ (s.e. = 0.03)), Extraversion ($r_g = 0.14$ (s.e. = 0.03)), and Agreeableness ($r_g = 0.14$ (s.e. = 0.05)). Therefore, this GWAS may not fully capture the socioemotional skills phenotype, especially the positive attributes construct, possibly because NonCog was based on GWAS of educational attainment. In this sense, authors suggest that NonCog may refer to a noncognitive genetics that is different from noncognitive genetics that affect other outcomes, such as those in the present study (3).

The present study has some limitations that should be mentioned. Although this is a longitudinal study, we only had data from six to 22 years old, a longer follow-up period would enhance the long-term impact of the results. Also, observational studies are not appropriate for causal conclusions, as they may not incorporate all risk factors to explain the causality chain. The same limitation is applicable for the PRS NonCog analysis, even though all models are adjusted by the 10 main components of ancestry. Moreover, questionnaires used in this study considered one source of information only (parents), future studies in this area may include other sources of information, such as self, teachers and peers, and approaches to assess the variables. Finally, a larger sample size than ours would more accurately estimate associations between genetics and other variables, having more genotypic contribution.

Despite limitations, this study demonstrates the trajectories of positive attributes until young adulthood, providing new evidence on its association with environmental experiences and genetics. Trajectory presented to be stable and with no significant distinction between male and female. However, this stability can be altered in long-term, as adversity experiences in childhood impact positive attributes levels through years without interaction with genetics. Genetics results evidence the necessity of more research in the area, providing alternative GWASs for positive attributes latent factor in order to advance in heritability studies. Our findings encourage interventions in childhood

to prevent adversity experiences and promote positive attributes, given the significant impact on outcomes as mental health and education.

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4.3 Article #3

Distinct Correlates of Empathy and Compassion with Burnout and Affective Symptoms in Health Professionals and Students

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**Distinct Correlates of Empathy and Compassion with Burnout and
Affective Symptoms in Health Professionals and Students**

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ABSTRACT

Objective: The causes of high rates of psychological distress among health professionals and students are largely unknown. Health professionals respond to those who are in distress with empathy (feeling what others feel) or compassion (caring about what others feel). This study aims to investigate if empathy and compassion are distinct traits and how both traits are associated to negative affect (burnout, depression, anxiety and anger symptoms) in undergraduate students and professionals in medicine, psychology and nursing.

Methods: A sample of 464 students and professionals filled out an online protocol with a sociodemographic data questionnaire and self-report questionnaires covering the variables of interest.

Results: Findings indicate that empathy is associated with higher negative affect, while compassion is associated with lower negative affect, also denoting to be different traits.

Conclusion: Our findings provide new evidence that the well-being of health professionals might be affected differently depending on socio-emotional traits relevant to emotional connection.

Keywords: Empathy; Compassion; Burnout; Physicians

INTRODUCTION

As concern for the well-being of medical professionals has increased, the high rates of depression and suicidal ideation observed among medical students¹ and residents² have garnered increasing attention. However, the causes of such psychological distress among health professionals are still largely unknown.

One possibility is that such negative outcomes arise from individual differences in how clinicians respond to the emotional states of their patients. Prior work has shown that people differ in how they respond to those who are in distress: while some tend to respond with empathy (feeling what others feel), others tend to respond with compassion (caring about what others feel)³. Here we investigate the hypothesis that empathy is related to higher levels of burnout and affective symptoms, while compassion is related to lower levels of these outcomes.

METHODS

Participants

A total of 884 undergraduate students currently registered in a university and active professionals in medicine, psychology and nursing were accessed. A total of 464 undergraduate students and professionals completed the protocol (79.7% female, with a median age of 23.3, 34.3% medicine, 47% psychology and 18.8% nursing).

Measures

The Interpersonal Reactivity Index (IRI)⁴ was used to assess Compassion by two subscales, concern and perspective taking. Empathy was assessed with the Empathy Index³ by two subscales, empathy and behavioral contagion. Symptoms of negative

affectivity were assessed using PROMIS⁵ – depression, anxiety and anger scales, and burnout with the Medical Student Well-Being Index (MSWBI)⁶.

Procedures

Participants were invited to the study by their academic e-mails and through media advertisements. Any undergraduate student, from all academic semesters, currently registered in a university and active professionals in medicine, psychology and nursing were eligible to participate. Protocol was available at the FormR survey software webpage containing the informed consent and questionnaires. At the end of the protocol, participants received instant feedback with a personalized result based on the cutoff points or average scores.

Ethics

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Written informed consent was obtained from all subjects. All procedures involving human subjects/patients were approved the Ethics Committee of the Federal University of Rio Grande do Sul (approval number: 76845717.1.0000.5327).

Statistical Analysis

Confirmatory Factor Analysis (CFA) of IRI and Empathy Index subscales were conducted to test if empathy and compassion are different constructs. To test if empathy and compassion predict symptoms of burnout, depression, anxiety and anger, Structural

Equation Modeling (SEM) was performed. All analyzes were ran using package “lavaan” in R software.

RESULTS

Empathy and Compassion traits

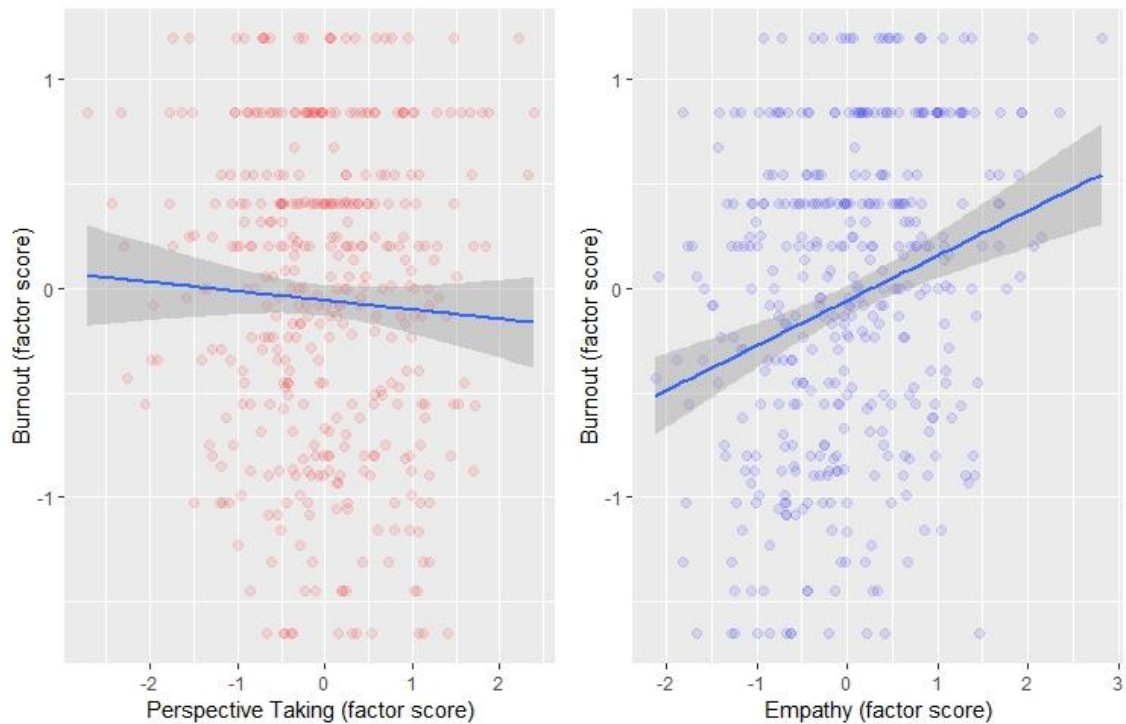
Unidimensional confirmatory factor analysis models using IRI and Empathy items as indicators of a single unifying construct revealed unacceptable fit to the data (RMSEA=0.105, CFI=0.780, TLI=0.762). A second-order model with concern and perspective taking subscales indicating compassion, and empathy and behavioral contagion subscales indicating empathy provides acceptable fit to the data (RMSEA=0.066, CFI=0.917, TLI=0.910) and support the discriminability between those traits.

Empathy and Compassion predict mood symptoms

Structural equation models considering the second-order model of empathy and compassion showed that higher traits of empathy were associated with higher symptoms of burnout ($\beta=.691$, $p<.001$), depression ($\beta=.456$, $p<.001$), anxiety ($\beta=.669$, $p<.001$) and anger ($\beta=.59$, $p<.001$); higher levels of compassion were associated with lower burnout ($\beta=-.457$, $p=.002$), depression ($\beta=-.47$, $p<.001$), anxiety ($\beta=-.487$, $p=.002$) and anger ($\beta=-.642$, $p<.001$).

Post-hoc analysis revealed that the negative association of compassion with burnout, depression, anxiety, and anger was driven by the perspective taking subscale of the IRI, while the positive association of empathy with all measured symptoms was driven by the empathy subscale of the EI (Figure 1). There were no significant results in regressions with the variables concern and behavioral contagion.

Figure 1. Associations between Perspective Taking and Empathy with burnout



Post-hoc analysis showed association of Perspective Taking with lower depression ($\beta = -.298$, $p < .001$), anxiety ($\beta = -.313$, $p < .001$), anger ($\beta = -.415$, $p < .001$) and burnout ($\beta = -.267$, $p = .005$). Empathy was associated with higher levels of depression ($\beta = .33$, $p = .016$), anxiety ($\beta = .514$, $p = .001$), anger ($\beta = .373$, $p = .008$) and burnout ($\beta = .578$, $p = .006$).

DISCUSSION

This study shows that empathy and compassion are distinct traits that have opposite associations with burnout and domains of negative affect (depression, anxiety and anger); empathy was associated with higher levels of burnout and negative affect symptoms, and compassion was associated with lower levels of burnout and negative affect symptoms.

Previous literature has mostly shown that empathy was associated with lower burnout and psychological distress⁷. However, the most common measures of empathy, such as the Jefferson Scale of Physician Empathy (JSPE)⁸, are constituted by subscales

that evaluate perspective taking and compassionate care – the two core components of compassion. Therefore, studies that demonstrated empathy as a protective factor for burnout and negative affect might be failing to differentiate empathy from compassion, two interrelated constructs that have distinct association with psychological distress. While our study has the strength of separating those two constructs, it is also important to consider the limitations of the study which are mainly the convenience sampling of participants and the exclusive use of self-report questionnaires.

To conclude, this study raises two important issues. First, that a conceptual distinction in the medical literature is needed in order to assess empathy and compassion as two distinct traits, given current instruments mix those two higher order concepts. Second, the training of health professionals focusing on increasing empathy might have unwanted consequences, whereas a focus on compassion and, specifically, on perspective taking might have desirable consequences on their well-being.

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5 FINAL CONSIDERATIONS

This thesis aimed to investigate the socioemotional skills, a set of emotional and behavioral traits and skills associated with a positive development and better life chances. For this purpose, three studies investigated the etiology, possible association with psychopathology from childhood to adulthood and impact of this construct on educational outcomes.

The first article provides more information on the relation between positive attributes and psychopathology. There is a significantly mutual negative impact of positive attributes with both general psychopathology and conduct symptoms. This data demonstrate that positive attributes can be a protective factor for future psychopathology, however, symptoms can negatively impact this positive trait. Positive attributes also demonstrate to be a protective factor for school dropout, while conduct symptoms enhance chances. However, this negative association of positive attributes is significant only if low levels of general psychopathology. Also, general psychopathology is negatively associated with future levels of literacy.

Article #2 demonstrated that, positive attributes tend to be a stable trait since childhood until young adulthood with males and females presenting similar levels over years, although females seem to oscillate during childhood and pre-adolescence. Additionally, adversity experiences impact this trajectory, as threat and deprivation present a significantly association with lower levels of positive attributes. However, this association is stronger during childhood and seems to mitigate in the transition to adulthood. On the other hand, NonCog PRS present no significant association or interaction impacting on positive attributes levels or trajectory.

In adulthood, the association between socioemotional skills and psychopathology indicate to persist, as shown on the third article. Empathy, a trait related to emotional and behavioral contagion, is also characterized by personal distress as well as present positive association with negative affect (depression, anxiety and anger) and burnout symptoms. On the other hand, compassion is characterized by traits as altruism, caring, being helpful and skills as perspective taking, denoting to be more related to socioemotional skills. Also, higher levels of compassion demonstrated to be associated with lower levels of psychopathology symptoms in health students and professionals. Nevertheless, it is important to consider that measures of this study are limited since Empathy Index is the only scale in literature officially intended to differentiate empathy and compassion. Also, only self-report questionnaires were used to access data and the protocol was applied online, resulting on a mainly convenience sampling of participants. It is recommended that future studies include a larger and more controlled sample assessed by a wider range of tests in order to achieve more robust results.

In conclusion, this thesis aimed to contribute with new evidence to the understanding of socioemotional skills. Once the etiological factors and the expected trajectories of the latent trait are identified, the early identification and treatment of deficiencies is made possible, preventing negative outcomes. In this sense, defining the construct by using measures which consider the latent trait, not specific traits, and differentiating it from psychopathology allows more accurate studies in the area and more precise interventions. Additionally, the definition and differentiation of well-known traits as empathy and compassion are also open to debate and in need of more investigation. Nonetheless, it is essential to highlight the impact that psychopathology demonstrated to have on educational outcomes and the impact of adversity experiences on positive attributes. Finally, our findings both in young and adults encourage interventions to

stimulate and improve socioemotional skills as much as interventions on prevention and treatment of psychopathology and trauma to promote a positive development.

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