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Research Article

# Beyond School Climate: Validating the *School as a Protective Factor-Brief* Survey

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## ABSTRACT

**BACKGROUND:** The conceptual framework for *School as a Protective Factor* approach was presented in a companion article in this issue of the journal. The current article describes the validation of the *School as a Protective Factor-Brief* (*SPF-Brief*), a 13-item survey measuring the 3 core constructs and 13 defining characteristics of this framework.

**METHODS:** The *SPF-Brief* was validated through 2 studies. The developmental study used a longitudinal design including 1349 participants who completed surveys over 5 semesters, while the validation study used a cross-sectional design with 2775 participants. Both studies included middle and high school students. Factor analysis, growth model analysis, criterion-related validation, and outcome analysis were employed.

**RESULTS:** Analyses provided strong evidence supporting the reliability and validity of the instrument and conceptual framework. Higher *SPF-Brief* scores were associated with higher math grades, English grades, and quality of life, as well as lower rates of anxiety, depression, conduct disorder, alcohol, e-cigarette, tobacco, and cannabis use. Effect size estimates ranged from moderate to strong.

**CONCLUSIONS:** These findings suggest the utility of the *SPF-Brief* instrument and the *School as a Protective Factor* framework. Together, they may offer advantages to the traditional school climate approach.

**Keywords:** school health; school climate; adolescent depression; adolescent substance abuse; adolescent mental health; academic achievement.

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The companion article *Beyond School Climate: Conceptualizing the School as a Protective Factor* Approach presented a new framework for understanding the school social environment and a new practice-integrated, multi-targeted approach to enhancing it. This new framework and approach were designed to build on the professional literature related to school climate, to address common concerns associated with the school climate concept, and to advance a new framework designed to enhance the conceptualization, measurement, and implementation of efforts to improve the school social environment—*School as a Protective Factor*.

Together, this paper along with its companion article have endeavored to: (a) establish a new conceptual framework for *School as a Protective Factor* that defines and describes key concepts associated with this approach, (b) develop and validate a brief survey

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that selectively measures key aspects of the school social environment using the *School as a Protective Factor* conceptual framework (*SPF-Framework*), and (c) assess the association of *School as a Protective Factor* with key indicators related to adolescent academic achievement, health behaviors, and well-being.

The companion article, also published in this issue of the journal, presented the conceptual framework for *School as a Protective Factor* in detail. As such, please see that article for a full description of the *SPF-Framework* and the theoretical background of this approach. For those who would appreciate a brief description, see Table 1, which provides a brief summary of the framework's foundational principles, goals, definitions, and concepts as well as the conceptual model illustrated in Figure 1. However, the 2-paper format was intentionally developed to provide a comprehensive introduction to the *SPF-Framework* and instrument. Ideally, the 2 papers will be read together as intended. For readers unable to consult the companion article, it may be important to note that *School as a Protective Factor* is not school climate or an attempt to refine or redefine the school climate concept. Instead, it represents a new way of conceptualizing how to maximize connection in schools in a manner that contributes to positive academic, health, and life outcomes.

This article concentrates on validating a brief tool used to measure *School as a Protective Factor* and presenting empirical evidence that supports the efficacy of the conceptual framework. In it, we present evidence associated with the reliability and validity of

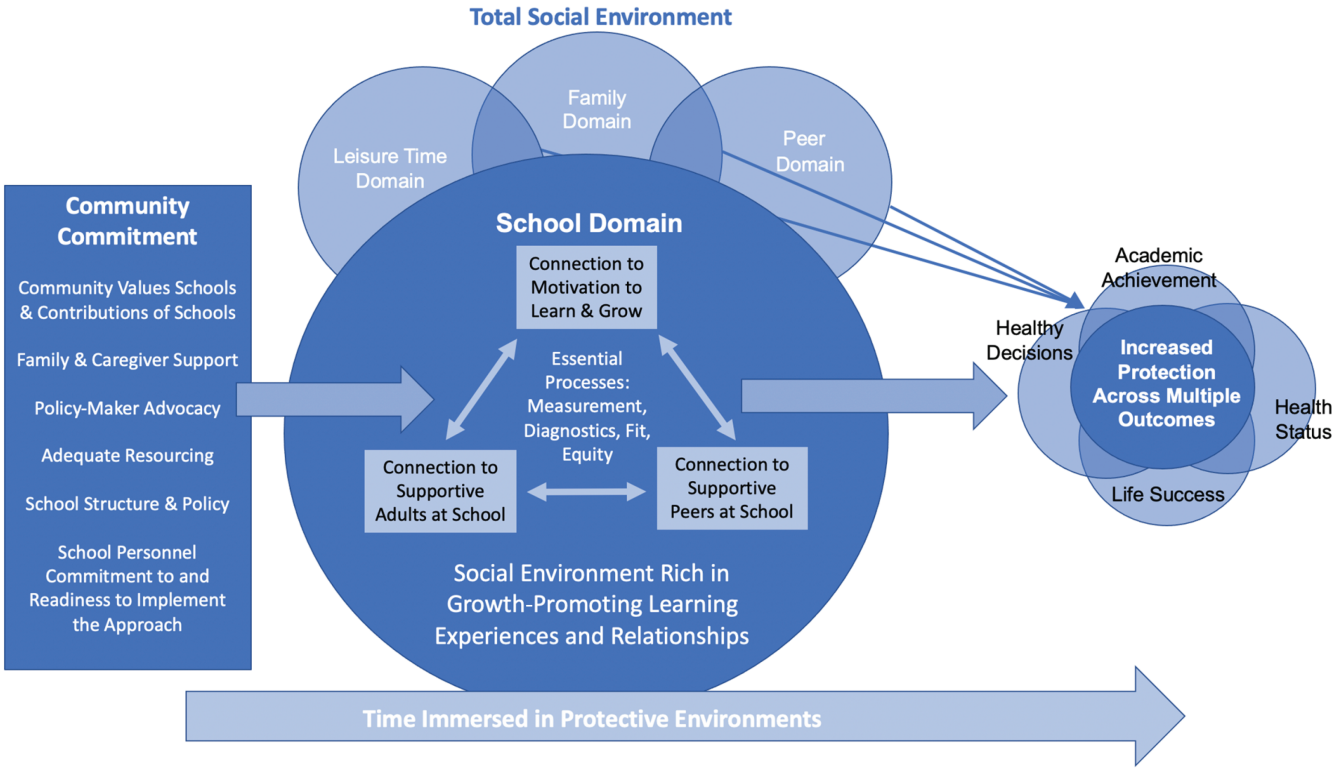
Table 1. **A Brief Summary of *School as a Protective Factor* Foundational Principles, Goals, Definitions, and Concepts**

| **The 5 Foundational Principles of *School as a Protective Factor*** |
|---|
| Principle 1: Young people are likely to reflect the total social environments in which they grow and develop. |
| Principle 2: Young people's total social environment consists of 4 social domains and each social domain makes an important contribution to their overall academic, health, and life outcomes. These include the family, peer, leisure time, and school domains. |
| Principle 3: Although it is possible to identify risk and protective factors that are commonly influential for each social domain, it is also important to determine the relative impact of those risk and protective factors across cultures, diverse settings, and within individual communities and build social environments that are tailored to each school in the context of its community. |
| Principle 4: Although each social domain matters to each individual, individuals are most likely to reflect the net impact of their total social environment. Therefore, strengthening all 4 social domains—the family, school, leisure time, and peer domains—represents the best form of protection. |
| Principle 5. The profile of risk and protective factors within a domain will give rise to multiple types of harm or benefits related to academic, health, and life outcomes. |
| **The Core Definitions, Goals, and Concepts of *School as a Protective Factor*** |
| The *School as a Protective Factor a*pproach represents a different way of conceptualizing the school domain. The *School as a Protective Factor* approach is not school climate. It is not interested in describing perceptions of the overall school environment or outcomes associated with various environments. Instead, this approach focuses on intervening using an intentionally limited number of high-leverage targets that are well-established, easily integrated into school practice in no/low-cost ways, congruent with how school professionals want to work, connected to multiple positive whole child outcomes, and include brief, free, and easy to use measurement and diagnostic tools. |
| The overarching goal of the *School as a Protective Factor* approach is to simultaneously improve student outcomes related to (1) academic achievement, (2) health behavior, (3) mental health and emotional well-being, and (4) overall life success by identifying and addressing key risk and protective factors commonly associated with those desired outcomes. |
| *School as a Protective Factor* can be defined as a systematic approach to creating a school social environment low in student risk factors and high in student protective factors by maximizing student connections to (a) their motivation to learn and grow, (b) supportive adults at school, and (c) supportive peers at school. *School as a Protective Factor* can be more accurately be conceptualized as an extension of the school connection concept, rather than the school climate concept. |
| Connection to student motivation to learn and grow is comprised of 6 key characteristics. They include relevance, self-discovery, growth orientation, engagement/effort, pathways to a positive future, and fun/enjoyment. |
| Connection to supportive adults at school is comprised of 4 key characteristics. They include caring, fairness, safety, and awareness/responsiveness to student needs. |
| Connection to support students at school is comprised of 3 key characteristics. They include friends who care about the student, friends who try their best at school, and kindness in the school-at-large. |
| The *School as a Protective Factor* (*SPF*) approach recognizes these connections as key sources of protection for young people in schools and as essential elements that can be combined to catalyze growth-promoting learning experiences and relationships that further protect young people from risk and promote protection. |
| The *SPF* approach involves measuring the school environment and key outcomes annually, using school-level diagnostics to identify which constructs and characteristics are most influential in a specific school community, selecting school-specific targets for improving the social environment annually, and intentionally cultivating a school environment in which students are universally well-connected to all 3 core constructs of the SPF over time. The approach also recognizes that creating true shifts in the social environment take time and are most powerful when sustained over time. |
| The SPF approach intentionally values parsimony and believes that—in terms of implementation and intervention—that being effective is more important than being comprehensive. In practice, this means intentionally focusing on a small number of well-established, high-leverage targets for intervention that produce maximum results and implementing them well. |
| The *SPF* comes with a well-validated, free 13 item survey that can be used to assess the social environment in terms of the 3 core constructs of the approach and the 13 characteristics that comprise them. |
| The *SPF* approach also conceptualizes schools as a reflection of community values and underscores the importance of community support for schools, school professionals, and students. As such, strengthening community commitment to schools as a core institution is a key strategy in the *SPF* approach. |


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Figure 1. **The Conceptual Model of the *School as a Protective Factor Approach***




the instrument using 2 samples, 1 longitudinal and the other cross-sectional.

## METHODS

### Participants

This study included 2 sets of participants. The first ''developmental'' sample included students who were participating in a 5-year longitudinal study. The second ''validation'' sample included a cross-section of students participating in a separate study. For both samples, participating schools were recruited via collaborative agreements with county superintendents and individual school principals. Depending on school size, all schools were compensated with between $500 and $1000 for their data collection assistance for each wave. Table 2 includes demographic and descriptive statistics for each of the 5 time points for the development sample, and demographic and descriptive statistics for the validation sample. The details of each sample are described below.

*Development Sample*. As part of the Young Mountaineer Health Study[1] beginning in the fall of 2020, a single cohort of sixth-grade middle school students in 5 geographically and socioeconomically diverse counties and 20 schools in West Virginia were prospectively surveyed once per semester for 5 semesters (Baseline $N = 1349$, response rate 80.7%). Study design, including data linkage procedures, has been described by Kristjansson et al.[1] In short, we had 2927 unduplicated participants with at least 1 time point. Across time points, sample size ranged from 1348 and 1648 (sixth graders fall and spring semesters), to 1908 and 1698 (seventh graders fall and spring semesters), to 1782 eighth graders during the fall semester. Between 45% and 48% of the sample self-reported their gender identity as girl, 46% to 51% as boy, and 3% to 7% as another option. Consistent with the state demographics, the majority of the sample (86-89%) reported their race as White. A financial comparative question was used to assess socioeconomic status; the largest percent of participants reported their financial status as similar to others (36-41%). For substance use, between 16% and 21% of participants reported ever drinking alcohol. Notably, as participants aged an increasing number of participants reported ever smoking (range: 4-9%) and using e-cigarettes (range: 8-20%), while fewer participants reported ever using cannabis with a substantial increase among the late 6th- and 7th-grade cohorts (range: 2-8%).

*Validation Sample*. As part of the Integrated Community Engagement (ICE) Collaborative,[2,3] the implementation of the Icelandic Prevention Model in West Virginia, cross-sectional surveys were conducted with all accessible students in grades 7 to 12 in 16 middle


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Table 2. **Demographic and Descriptive Characteristics, Development Sample (n = 2633) Across 5 Time Points, and Validation Sample (n = 2927)**

| | Development time 1 (n = 1348) | | | Development time 2 (n = 1648) | | | Development time 3 (n = 1908) | | | Development time 4 (n = 1698) | | | Development time 5 (n = 1782) | | | Validation (n = 2927) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Categorical variables** | **Total N** | **n** | **Valid %** | **Total N** | **n** | **Valid %** | **Total N** | **n** | **Valid %** | **Total N** | **n** | **Valid %** | **Total N** | **n** | **Valid %** | **Total N** | **n** | **Valid %** |
| Current gender identity (select all) | 1287 | | | 1644 | | | 1904 | | | 1692 | | | 1776 | | | 2927 | | |
| Girl | | 659 | 46.15 | | 793 | 48.24 | | 865 | 45.43 | | 802 | 47.4 | | 842 | 47.41 | | 1344 | 45.92 |
| Boy | | 594 | 51.2 | | 770 | 46.84 | | 913 | 47.95 | | 779 | 46.04 | | 821 | 46.23 | | 1368 | 46.74 |
| Other option selected | | 34 | 2.64 | | 81 | 4.93 | | 126 | 6.62 | | 111 | 6.56 | | 113 | 6.36 | | 263 | 7.34 |
| Current grade | | | | | | | | | | | | | | | | 2754 | | |
| 5th grade | | | | | | | | | | | | | | | | | 3 | 0.11 |
| 6th grade | 1348 | | | 1648 | | | | | | | | | | | | | 8 | 0.29 |
| 7th grade | | | | | | | 1908 | | | 1698 | | | | | | | 553 | 20.08 |
| 8th grade | | | | | | | | | | | | | 1782 | | | | 541 | 19.64 |
| 9th grade | | | | | | | | | | | | | | | | | 558 | 20.26 |
| 10th grade | | | | | | | | | | | | | | | | | 503 | 18.26 |
| 11th grade | | | | | | | | | | | | | | | | | 338 | 12.27 |
| 12th grade | | | | | | | | | | | | | | | | | 250 | 9.08 |
| Race/ethnicity (select all) | | | | | | | | | | | | | | | | 2927 | | |
| White | 1348 | 1155 | 85.68 | 1648 | 1433 | 86.95 | 1908 | 1656 | 86.79 | 1698 | 1506 | 88.69 | 1782 | 1555 | 87.26 | | 2568 | 87.73 |
| Black or African American | 1348 | 111 | 8.23 | 1648 | 127 | 7.71 | 1908 | 145 | 7.6 | 1698 | 140 | 8.24 | 1782 | 168 | 9.43 | | 141 | 4.82 |
| American Indian or Native American | 1348 | 50 | 3.71 | 1648 | 71 | 4.31 | 1908 | 61 | 3.2 | 1698 | 60 | 3.53 | 1782 | 74 | 4.15 | | 120 | 4.1 |
| Hispanic | 1319 | 48 | 3.64 | 1628 | 51 | 3.13 | 1890 | 65 | 3.44 | 1684 | 79 | 4.69 | 1764 | 89 | 5.05 | | 96 | 3.28 |
| Other option selected | | 14 | 1.04 | | 25 | 1.52 | | 36 | 1.89 | | 52 | 3.06 | | 64 | 3.59 | | 157 | 5.36 |
| Financially, compared to other families, my family is: | 1279 | | | 1596 | | | 1866 | | | 1653 | | | 1737 | | | 2759 | | |
| Much better off | | 255 | 19.94 | | 332 | 20.8 | | 358 | 19.19 | | 308 | 18.63 | | 278 | 16 | | 440 | 15.95 |
| Considerably better off | | 186 | 14.54 | | 264 | 16.54 | | 342 | 18.33 | | 306 | 18.51 | | 332 | 19.11 | | 502 | 18.19 |
| A little better off | | 210 | 16.42 | | 232 | 14.54 | | 327 | 17.52 | | 299 | 18.09 | | 332 | 19.11 | | 488 | 17.69 |
| Similar to others | | 519 | 40.58 | | 639 | 40.04 | | 706 | 37.83 | | 596 | 36.06 | | 643 | 37.02 | | 1045 | 37.88 |
| A little worse off | | 83 | 6.49 | | 90 | 5.64 | | 97 | 5.2 | | 103 | 6.23 | | 115 | 6.62 | | 198 | 7.18 |
| Considerably worse off | | 17 | 1.33 | | 19 | 1.19 | | 15 | 0.8 | | 20 | 1.21 | | 18 | 1.04 | | 57 | 2.07 |
| Much worse off | | 9 | 0.7 | | 20 | 1.25 | | 21 | 1.13 | | 21 | 1.27 | | 19 | 1.09 | | 29 | 1.05 |

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Table 2. *(Continued on next page)*

| Categorical variables | Development time 1 (n = 1348) | | | Development time 2 (n = 1648) | | | Development time 3 (n = 1908) | | | Development time 4 (n = 1698) | | | Development time 5 (n = 1782) | | | Validation (n = 2927) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total N | n | Valid % | Total N | n | Valid % | Total N | n | Valid % | Total N | n | Valid % | Total N | n | Valid % | Total N | n | Valid % |
| Substance use | | | | | | | | | | | | | | | | | | |
| Ever drank alcohol | 1326 | 229 | 17.52 | 1626 | 369 | 22.69 | 1854 | 503 | 27.13 | 1637 | 464 | 28.34 | 1723 | 526 | 30.53 | 2467 | 647 | 26.23 |
| Ever smoked | 1323 | 46 | 3.51 | 1622 | 84 | 5.18 | 1857 | 134 | 7.22 | 1642 | 136 | 8.28 | 1726 | 161 | 9.33 | 2487 | 402 | 16.16 |
| Ever used e-cigarettes | 1324 | 110 | 8.4 | 1622 | 195 | 12.02 | 1855 | 303 | 16.33 | 1642 | 282 | 17.17 | 1724 | 341 | 19.78 | 2483 | 506 | 20.38 |
| Ever used cannabis | 1326 | 25 | 1.91 | 1625 | 48 | 2.95 | 1854 | 82 | 4.42 | 1634 | 119 | 7.28 | 1724 | 144 | 8.35 | 2477 | 216 | 8.72 |
| Math grade last year | | | | | | | | | | | | | | | | 2668 | | |
| A | | | | | | | | | | | | | | | | | 1264 | 47.38 |
| B | | | | | | | | | | | | | | | | | 763 | 28.6 |
| C | | | | | | | | | | | | | | | | | 401 | 15.03 |
| D | | | | | | | | | | | | | | | | | 162 | 6.07 |
| F | | | | | | | | | | | | | | | | | 78 | 2.92 |
| English grade last year | | | | | | | | | | | | | | | | 2670 | | |
| A | | | | | | | | | | | | | | | | | 1472 | 55.13 |
| B | | | | | | | | | | | | | | | | | 675 | 25.28 |
| C | | | | | | | | | | | | | | | | | 297 | 11.12 |
| D | | | | | | | | | | | | | | | | | 132 | 4.94 |
| F | | | | | | | | | | | | | | | | | 94 | 3.52 |

| Continuous variables | Total | | | Total | | | Total | | | Total | | | Total | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | *M* | SD | n | *M* | SD | n | *M* | SD | n | *M* | SD | n | M | SD | n | M | SD |
| SPF final scale, CS Adults subscale | 1318 | 4.25 | 0.79 | 1627 | 4.09 | 0.88 | 1884 | 3.92 | 0.93 | 1661 | 3.80 | 0.97 | 1748 | 3.75 | 0.97 | 2685 | 3.77 | 1.10 |
| SPF final scale, CS Peers subscale | 1316 | 4.08 | 0.84 | 1627 | 3.89 | 0.90 | 1870 | 3.77 | 0.89 | 1654 | 3.65 | 0.92 | 1742 | 3.66 | 0.92 | 2668 | 3.75 | 0.99 |
| SPF final scale,C Motivation subscale | 1315 | 4.23 | 0.78 | 1625 | 4.06 | 0.89 | 1871 | 3.95 | 0.90 | 1653 | 3.85 | 0.95 | 1741 | 3.80 | 0.95 | 2676 | 3.88 | 1.05 |
| SPF final total scale | 1319 | 4.20 | 0.70 | 1631 | 4.03 | 0.80 | 1886 | 3.90 | 0.81 | 1662 | 3.79 | 0.84 | 1748 | 3.75 | 0.85 | 2693 | 3.81 | 0.94 |
| School Climate Resnick | 1310 | 19.61 | 3.58 | 1616 | 19.12 | 4.17 | 1881 | 18.50 | 4.31 | 1657 | 17.75 | 4.61 | 1741 | 17.45 | 4.70 | | | |
| Anxiety | 1301 | 5.96 | 2.75 | 1607 | 6.28 | 2.95 | 1829 | 6.43 | 2.97 | 1614 | 6.55 | 3.05 | 1708 | 6.65 | 3.08 | 2458 | 5.96 | 3.18 |
| Depressed affect | 1285 | 18.65 | 7.89 | 1595 | 19.66 | 8.61 | 1809 | 19.94 | 8.77 | 1604 | 20.30 | 8.90 | 1703 | 20.50 | 9.05 | 2455 | 18.39 | 9.59 |
| Conduct disorder | 1293 | 8.45 | 2.93 | 1604 | 8.75 | 3.36 | 1815 | 8.88 | 3.80 | 1603 | 9.18 | 4.14 | 1703 | 8.93 | 3.89 | 2466 | 8.14 | 2.89 |
| Quality of life | 1214 | 28.11 | 6.22 | 1561 | 27.42 | 6.68 | 1712 | 26.85 | 6.79 | 1525 | 32.61 | 8.17 | 1640 | 32.20 | 8.38 | | | |

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and high schools in 2 counties during the fall of 2022 (N = 2775, response rate 70.8%).

### Instruments

*School as a Protective Factor-Brief* (*SPF-Brief*). The *SPF-Brief* instrument consists of 13 items divided into 3 subscales that reflect the 3 core constructs of the overall *SPF-Framework*. These constructs/subscales include: (1) *Connections to Supportive Adults at School*, (2) *Connections to Supportive Peers at School*, and (3) *Connections to the Motivation to Learn and Grow*.

The final *Connections to Supportive Adults at School* (CS Adults) subscale consists of 4 items. Example items include: ''The adults at my school care about me,'' and ''The adults at my school notice when I'm having a hard time and offer to help me.''

The final *Connections to Supportive Peers at School* (CS Peers) subscale consists of 3 items. Example items include: ''I have friends at school that care about me,'' ''My friends think we should try our best at school,'' and ''The students at my school are nice to each other.''

The final *Connections to the Motivation to Learn and Grow* (C Motivation) subscale consists of 6 items that reflect 6 key characteristics of the construct. These 6 key characteristics include relevance, effort/engagement, growth, self-discovery, pathways to a positive future, and fun/enjoyment. Example items include: ''My school is helping me achieve goals that matter to me,'' ''My school helps me discover things I'm good at doing,'' and ''Doing my best in school now will help me have a good life when I'm older.''

All subscales were answered using a 5-point Likert scale with responses ranging from ''strongly agree'' to ''strongly disagree.'' Each subscale was summed to form a total subscale score. The entire instrument can also be summed to form a total instrument score. See ''Results'' section of this study for evidence of instrument validity and reliability.

*Depression*. Symptoms of depressed mood were measured SCL-90 outpatient assessment tool defined by Derogatis et al.[4] The respondents were asked how often during the previous 7 days the following 10 statements applied to them: ''I was sad or had little interest in doing things,'' ''I had little appetite,'' ''I felt lonely,'' ''I had sleeping problems,'' ''I cried easily or wanted to cry,'' ''I felt sad or blue,'' ''I was not excited in doing things,'' ''I was slow or had little energy,'' ''The future seemed hopeless,'' and ''I thought of committing suicide.'' Response categories were ''Almost never,'' ''Seldom,'' ''Sometimes,'' and ''Often.'' The scores were summed to form a score for the total scale. Cronbach's Alpha ranged from .89 to .92.

*Anxiety*. Symptoms of anxiety were measured with 3 items also from the SCL-90 assessment tool.[4] The respondents were asked how often during the previous 7 days the following statements applied to them: ''Nervousness,'' ''Sudden fear for no apparent reason,'' ''I felt tense.'' Response categories were ''Almost never,'' ''Seldom,'' ''Sometimes,'' and ''Often.'' Responses were summed to form a score for the total scale. Cronbach's Alpha ranged from .74 to .81.

*Conduct Disorder*. Indicators of conduct disorder were measured using the Oregon Adolescent Depression Project-Conduct Disorder Screen.[5] This is a 6-item scale that asks: ''How often during the past 12 months have you done any of the following?'': (1) broken the rules at home, (2) broken the rules in school, (3) got into fights, (4) truancy, (5) run away from home, and (6) got into trouble for lying or for stealing. The response format was ''Almost Never or Seldom,'' ''A few times or sometimes,'' ''Quite often or often,'' and ''Almost all the time or all the time.'' Responses were summed to form a score for the total scale. Cronbach's alpha range from .74 to .86.

*Rates of Substance Use/Abuse*. Substance use was measured with standard universal questions from the Monitoring the Future Survey[6] and the European School Project on Alcohol and other Drugs[7] into lifetime cigarette smoking, e-cigarette use, alcohol use, and drunkenness.

*Grades*. Self-reported grades were captured using a single question, ''What were your FINAL grades in the following subjects LAST year?'' for Mathematics and English.[8] Responses were combined to represent students' overall grades at each time point. Academic grades were then pooled into ordered categories, ''mostly A's,'' ''mostly B's,'' ''mostly C's,'' ''mostly D's,'' and ''mostly F's.'' Mostly A's and B's signified higher academic performance.

*School Connectedness Scale*. Students' connection to school was measured with Resnick's 5-item School Connectedness Scale measure.[9] Respondents were asked to rate each item on a 5-point Likert scale ranging from ''strongly disagree'' to ''strongly agree.'' Items included: ''I feel close to people at this school,'' ''I am happy to be at this school,'' ''I feel like I am a part of this school,'' ''The teachers at this school treat students fairly,'' and ''I feel safe in this school.'' Responses were summed to form a score for the total scale. Cronbach's alpha was reported as .78.

*Quality of Life Scale*. The Satisfaction with Life Scale (SWLS)[10] is a 5-item instrument measuring general life satisfaction including the item, ''I am satisfied with my life.'' The SWLS is measured on a 7-point Likert scale where a higher average response indicates more satisfaction with life. Responses were summed to form a score for the total scale. Cronbach's alpha was reported as .87.


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*Covariates*. Study covariates were selected and supported using citations based on a review of school and student-based research literature. They included:

Current gender identity was assessed with multiple-choice questions pertaining to gender expression. Due to a low rate of non-cisgender respondents (~2-7%), those responses were merged into 1 category resulting in a final categorization of boy, girl, and other.

Family financial status was assessed with a single question, ''How well off is your family compared to other families in your area?'' Responses ranged from 1 = ''Much better off'' to 7 = ''Much worse off.''

## Procedures

*Initial Instrument Development*. The development of this instrument began with the development of the *SPF-Framework*. Developing this framework included conducting a thorough literature review, establishing a strong theoretical perspective, and considering years of collective team experience in this area of study.

Once a strong conceptual framework was established, 58 items were developed to reflect each of the 3 core constructs and their defining characteristics. The initial set of 58 potential items were refined to 15 items for testing among the development and validation samples. The 58 items were tested in a survey of ~2700 middle and high school students at a different location in the United States. Traditional methods for scale development were employed, including analysis of distributional properties, inter-item correlation, assessment of internal consistency, exploratory and confirmatory factor analyses (CFAs), and regression modeling. During these analyses, individual items were removed in a total of 6 rounds of data analyses, leading to the final 15 items. In keeping with the framework's conceptual orientation, item reductions were based on (a) fidelity to the *SPF-Framework* and (b) data from the preliminary study that evaluated the relative contribution of each item to predicting grades, substance use, and perceived stress. Focusing on the predictive power of the instrument was essential and fully in keeping with the framework's broader conceptual orientation.

It is also important to note that the original 58 items included questions that focused on the role of school in strengthening connections outside of the school domain (see the companion paper for a description of the 4 domains). For example, ''The adults at my school want me to have good relationships with my family'' or ''The adults at my school connect me to my community in a positive way.'' However, these items did not contribute to predicting academic achievement, substance use/abuse, or perceived stress. As such, we chose to eliminate this group of questions and focus on questions directly related to the school environment/domain itself.

*Data collection for the Development Sample*. Survey data collection was confidential, and protocols ensured the anonymity of participants. No identifying information was collected. An introductory letter and/or email was sent to all parents and caregivers in September 2020 to notify them about the study and provide an opportunity to opt their children out of participation and to put forth any questions or concerns about the study. Consent procedures were explained and participants were informed about their rights to deny participation without any repercussions. Data collection procedures utilized an honest-broker system to link individual data across study waves which secured individual confidentiality. Students responded to a confidential computer-based survey using the Qualtrics software. Data collection was supervised by research staff. Students responded to the surveys either inside schools or during designated online classes from home with their cameras turned on, depending on accessibility during COVID-19 mitigation efforts. The Institutional Review Board of West Virginia University approved all study protocols (#1903499093A001).

*Data collection for the Validation Sample* was identical to the data collection procedures for the developmental sample, except for the data linkage procedures that were not applied due to the study's ecologic focus.

## Statistical Analysis

Analyses were conducted in SAS 9.4 and Mplus v. 8. Descriptive statistics included valid percentages and frequencies for categorical variables, and means and standard deviations for continuous variables. A preliminary exploratory factor analysis (EFA) was conducted to examine the factor patterns to explore use of a 3-factor subscale solution. Next, the analysis included a rigorous set of validation and reliability assessments.

*Confirmatory factor analysis (CFA)*. This set of analyses was conducted in SAS as guided by O'Rourke and Hatcher.[11] Initial validation and further refinement of the items and subscales were conducted for the development sample at time 1, and then the validation sample. For this step, the ordinal items were converted to polychoric correlations[12,13] from the set of items resulting from the face and content validation. Next, a series of 7 CFA models were conducted on the development dataset polychoric correlations of the items using Full Information Maximum Likelihood (FIML) estimation, including variations of parallel tests, tau-equivalence tests, and partially constrained parallel tests.[14] Model 1: all items as a single scale with correlated errors by subscale, model 2: all items as a single scale with no correlated errors, model 3: items loading onto their respective subscales, allowing the latent subscales to correlate, model 4: extends model


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3 by adding correlated errors among subscales, model 5: 3 subscale model with a parallel test of equivalence (same loadings and error variances within subscale), model 6: 3 subscale model with tau equivalence (same loadings within subscales), model 7: modified final scale, which dropped 2 items from model 3. Models were compared by comparing lowest Akaike Information Criterion (AIC). We present the 2 best-fitting models (models 3 and 7 above) and include the following model fit indicators: chi-square (preferred $p$-value $>.05$, although we are unlikely to obtain this with our large samples), Standardized Root Mean Square Residual (SRMR, $<0.08$ preferred), Goodness of Fit and Adjusted Goodness of Fit Indexes (GFI and AGFI, $>0.90$ preferred), Root Mean Square Error of Approximation (RMSEA, preferred $<0.10$) with 90% confidence intervals (CI), and several Comparative Fit Index (CFI) including the Bentler-Bonnet Normed Fit Index (NFI) and Non-normed Index (preferred $>0.90$). We also present the unstandardized estimates for the items, including standard error, $t$-value and $p$-value, and $R^2$. Covariance estimates among exogenous variables are also given. Finally, we replicated the best-fitting model (model 7) on the validation dataset.

*Reliability: Growth model analysis and internal consistency*. As an initial foray into understanding how the measure might change over time (reliability), we conducted a series of growth models for the 5 time points on the development sample in Mplus as guided by Muthén and Muthén.[15] The final model from the CFA was used to inform an average scale score for both the total SPF measure and subscales. Then a series of random effects models were tested, including testing for random slope, intercept, both random slope and intercept, means and variances for the intercept, residual variances, and allowing the intercept to load onto the slope, using ML estimation. We did not assume linear growth, so a series of slope values were also tested. The final model was selected based on smallest AIC. We present the results from the total score with random effects for intercept and slope, mean, and variance estimated for the intercept. Model fit presented includes chi-square, RMSEA, CFI, SRMR, and the Tucker-Lewis Index (TLI, preferred value $>0.90$). Next, we present the total and subscale Cronbach's alpha for internal consistency (preferred value $>0.70$) among all 5 development time points and the validation dataset.

*Validity: Criterion-related validation and outcome analysis*. This set of analyses was conducted in Mplus for both the development time 1 and the validation dataset. The goal was to examine the relationship between the total score or subscales with a-priori outcomes. This included convergent validation with outcomes like Resnick's School Connectedness Scale and quality of life measures as well as discriminate validation from outcomes like anxiety, depression, and substance use. Finally, the validation dataset provides information on past years' self-reported grades in English and Math. English and Math were treated as ordinal categorical variables with the $F$ grade as the referent group for the thresholds. As these analyses combined categorical and continuous outcomes, a Weighted Least Square Mean and Variance Adjusted (WLSMV) estimator was used, with delta parameterization and probit link. All outcomes were allowed to correlate. Model fit for both the development time 1 and validation datasets include the chi-square, RMSEA, CFI, TLI, and SRMR. Although the cross-validation model was just identified and returned perfect model fit. We focus primarily on interpreting the unstandardized estimates of the total score with the outcomes available for each of the datasets.

*Multi-group grade sensitivity analysis*. In order to ensure the reliability and validity of the measure held up across developmental subgroups, the final CFA results underwent multi-group analysis by grade for both developmental and validation samples. Grades were stratified and included as groups in the CFA, first constraining all groups to be equal and then allowing all groups to be unconstrained (ie, configural invariance). Model fit for both the development and validation datasets include the SRMR, GFI, and NNFI. Substantial improvements across models in model fit were examined. Similar fit when allowing each grade to have configural invariance (ie, the unconstrained models) relative to the constrained models indicate similar measurements across grades. Improved fit for the unconstrained models would indicate a different measurement model may be needed by grade. Unsatisfactory fit across models would indicate the scale may not be appropriate for a particular grade level. Due to small cell sizes for 5th and 6th grades, only grades 7 to 12 were analyzed for the validation sample.

## RESULTS

### Descriptive Statistics

Final SPF scale and subscale scores (after validation) are given in Table 2. Average total scores generally decreased over time, means from 4.2 to 3.75. Similar decreasing scores are noted for the Resnick's School Connectedness Scale[9] ($M = 19.61$-$17.45$). Anxiety ($M = 5.96$-$6.65$), depression ($M = 18.65$-$20.5$), and conduct disorder ($M = 8.45$-$8.93$) all saw increases over time.

The validation sample included 2927 participants, mostly in 7th to 12th grades. For these participants, 46% reported their current gender identity as girl, 88% White, and 38% financially similar to other families. Substance use was similar for alcohol (26%), and higher for smoking (16%), e-cigarette use (20%), and


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cannabis (9%). Most students reported A and B grades for Math (76%) and English (77%). The average SPF total score was 3.81, anxiety was 5.96, depression 18.39, and conduct disorder 8.14.

EFA results for the 15 items showed a strong single factor with sufficient evidence of 3 total factors to continue. The first 3 eigenvalues were as follows: 22.35, 1.83, 0.74, with a cumulative proportion of 1.04. Square canonical correlations for the 3 factors were: .98, .88, and .67.

### Confirmatory Factor Analysis

The 15 items were tested using CFA for the time 1 development sample. Across the original 6 tested models, the best-fitting model based on lowest AIC is presented in Table 3. This best-fitting model allowed the items to load on the subscale (CS Adults, CS Peers, and C Motivation) while allowing the latent subscales (CS Adults, CS Peers, and C Motivation) to correlate. This model resulted in generally appropriate to excellent model fit indices: RMSEA (90% CI): 0.08 (0.07, 0.08) is below the desired 0.10, GFI and AGFI both above the desired 0.90 (0.92 and 0.90), SRMR is at 0.04 well below 0.08, and all CFI fits are also above desired 0.90 (CFI: 0.95, NFI: 0.94, NNFI: 0.94).

Adaptions were made to improve upon this model. Based on examinations of the items, 2 items appeared to load strongly on both the assigned subscale as well as the other subscales. Specifically, the items: ''The adults at my school believe I can help make the world a better place'' from the adult subscale, and the item: ''At my school, it is not a big deal to make mistakes while trying your best'' from peer subscale loaded strongly on all 3 subscales: adult, peer, and school. Removing these 2 items substantially improved AIC (from 832.55 to 535.15) while maintaining slightly improved model fit indicators, see Table 3. This model was used to finalize the number of items to 13.

As is typical of validation models, model fit slightly worsened but remained satisfactory to excellent across all indices in the validation sample. RMSEA was at the desired minimum (0.10) and AGFI dropped slightly below desired to 0.85. Otherwise, all indices remained excellent, as reported in Table 3.

### Reliability: Growth Model Analysis and Internal Consistency

The 13 items were checked for internal consistency, both within subscales and across the total scale for all 5 time points in the development sample, and for the validation sample. The internal consistency was above the desired 0.70 for all scales and subscales. Specifically, the total scale alphas ranged from 0.91 to 0.93 for the development dataset 5 time points, and 0.94 for the validation dataset. The subscales were slightly lower but generally satisfactory to excellent: adults (alpha range: 0.84-0.88, validation: 0.90), peers (alpha range: 0.70-0.72, validation: 0.75), and school (alpha range: 0.87-0.90, validation: 0.92).

Next, we examined the growth over all 5 time points (every 6 months starting in fall year of 6th grade) for the development sample for the SPF scales made from the reduced 13 items. We noticed initially decreasing means over time from the descriptive statistics in Table 2, and thus further explored nonlinear options. A best-fitting decreasing in time growth model for the full scale is presented in Table 4; subscale growth was generally consistent. Model fit for the growth model was generally satisfactory to excellent: RMSEA: 0.05, CFI: 0.98, TLI: 0.98, and SRMR: 0.08. Growth was modeled using the following weights: 0, −0.25, −0.50, −0.75, and −0.80, generally following the means presented in Table 2. Thus, the mean intercept was estimated at 4.17, with decreasing scores over time and a slight leveling out between the end of sixth grade and the start of seventh grade.

Pearson correlations of the scales (total scores) and subscales (CS Adults, CS Peers, and C Motivation) over each time point of the development sample are further available in Appendix 1. All correlations are statistically significant. Notably, total scale scores across times 1 through 5 saw decreasing correlations over time, correlations ranged from $r = .64$ to $r = .40$ from time 1 to time 5. Across the total scale and the 3 subscales within the same time point correlations remained quite high, and then correlations followed a decreasing pattern across further time points. For example, the correlations of the total score at the same time point with each of the subscales ranged from $r = .86$ to .88 for the adult subscale, $r = .81$ to .82 for peers, and $r = .94$ to .95 for school subscale. The lowest correlations were between the peer subscale at time 5 and the adult subscale at time 1, $r = .26$.

### Validity: Criterion-Related Validation and Outcome Analysis

The subscales and scale scores were then used for outcome analysis. Total scale scores for development sample time 1 and validation sample were used against available outcomes. For the development sample, unstandardized estimates were all statistically significant and in the correction direction for all outcomes (Table 5). SPF total score was negatively associated with: anxiety Est. = −0.96, depression Est. = −4.22, conduct disorder Est. = −1.40, and all substances including alcohol Est. = −0.38, electronic cigarettes Est. = −0.45, smoking Est. = −0.52, and cannabis Est. = −0.46. SPF total score was positively associated with quality of life (Est. = 5.11) and Resnick's School Connectedness Scale[9] (Est. = 2.05).

For the validation sample, unstandardized estimates were all statistically significant and in the correction


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Table 3. **Development Sample Time 1 and Validation Sample CFA Results for Items and Subscales**

| Model name | Model 3: 3 subscales, all items | Model 7: 3 subscales, removed 2 items | Model 7: 3 subscales, removed 2 items |
|---|---|---|---|
| Sample | Development, time 1 | Development, time 1 | Validation |
| Model estimator | FIML on polychoric correlations | FIML on polychoric correlations | FIML on polychoric correlations |
| Model fit | | | |
| n | 1310 | 1310 | 2654 |
| Fit function | 0.59 | 0.36 | 0.67 |
| Chi-square | 766.55 | 477.15 | 1768.39 |
| Chi-square DF | 87 | 62 | 62 |
| Pr > chi-square | <.0001 | <.0001 | <.0001 |
| Standardized RMR (SRMR) | 0.04 | 0.03 | 0.04 |
| Goodness of Fit Index (GFI) | 0.92 | 0.94 | 0.90 |
| Adjusted GFI (AGFI) | 0.90 | 0.92 | 0.85 |
| RMSEA estimate | 0.08 | 0.07 | 0.10 |
| RMSEA lower 90% confidence limit | 0.07 | 0.07 | 0.10 |
| RMSEA upper 90% confidence limit | 0.08 | 0.08 | 0.11 |
| Akaike Information Criterion | 832.55 | 535.15 | 1826.39 |
| Bentler Comparative Fit Index | 0.95 | 0.96 | 0.95 |
| Bentler-Bonett NFI | 0.94 | 0.96 | 0.95 |
| Bentler-Bonett Non-normed Index | 0.94 | 0.96 | 0.94 |

| | Model 3 | | | | | Model 7a | | | | | Model 7b | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Estimate** | **SE** | ***t* Value** | **Pr > \|*t*\|** | **$R^2$** | **Estimate** | **SE** | ***t* Value** | **Pr > \|*t*\|** | **$R^2$** | **Estimate** | **SE** | ***t* Value** | **Pr > \|*t*\|** | **$R^2$** |
| Adults 1: The adults at my school care about me. | 0.84 | 0.02 | 40.83 | <.0001 | 0.80 | 0.84 | 0.02 | 40.83 | <.0001 | 0.80 | 1.14 | 0.02 | 62.16 | <.0001 | 0.86 |
| Adults 2: The adults at my school are fair and kind to me. | 0.78 | 0.02 | 39.87 | <.0001 | 0.78 | 0.79 | 0.02 | 40.51 | <.0001 | 0.80 | 1.09 | 0.02 | 60.14 | <.0001 | 0.82 |
| Adults 3: It is safe to be around the adults at my school. | 0.66 | 0.02 | 33.30 | <.0001 | 0.62 | 0.67 | 0.02 | 33.96 | <.0001 | 0.63 | 1.02 | 0.02 | 56.57 | <.0001 | 0.77 |
| Adults 4: The adults at my school notice when I'm having a hard time and offer to help me. | 0.86 | 0.03 | 30.89 | <.0001 | 0.55 | 0.85 | 0.03 | 29.92 | <.0001 | 0.53 | 1.17 | 0.02 | 54.55 | <.0001 | 0.73 |
| Adults 5: The adults at my school believe I can help make the world a better place. | 0.86 | 0.03 | 33.51 | <.0001 | 0.62 | | | | | | | | | | |
| Peers 1: I have friends at school that care about me. | 0.66 | 0.03 | 25.84 | <.0001 | 0.44 | 0.70 | 0.03 | 27.35 | <.0001 | 0.49 | 0.87 | 0.02 | 47.03 | <.0001 | 0.63 |
| Peers 2: My friends think we should try our best at school. | 0.80 | 0.03 | 32.02 | <.0001 | 0.61 | 0.87 | 0.03 | 34.78 | <.0001 | 0.71 | 1.08 | 0.02 | 57.27 | <.0001 | 0.82 |

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Table 3. *(Continued on next page)*

| Variable | Model 3 | | | | | Model 7a | | | | | Model 7b | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Estimate | SE | *t* Value | Pr > \|*t*\| | $R^2$ | Estimate | SE | *t* Value | Pr > \|*t*\| | $R^2$ | Estimate | SE | *t* Value | Pr > \|*t*\| | $R^2$ |
| Peers 3: The students at my school are nice to each other. | 0.76 | 0.03 | 26.54 | <.0001 | 0.46 | 0.74 | 0.03 | 25.08 | <.0001 | 0.43 | 0.92 | 0.02 | 38.09 | <.0001 | 0.46 |
| Peers 4: At my school, it is not a big deal to make mistakes while trying your best. | 0.74 | 0.02 | 29.60 | <.0001 | 0.54 | | | | | | | | | | |
| Motivation 1: My school is helping me achieve goals that matter to me. | 0.92 | 0.02 | 38.09 | <.0001 | 0.73 | 0.92 | 0.02 | 37.81 | <.0001 | 0.73 | 1.14 | 0.02 | 58.40 | <.0001 | 0.79 |
| Motivation 2: I try my best in school. | 0.59 | 0.02 | 30.07 | <.0001 | 0.53 | 0.59 | 0.02 | 30.31 | <.0001 | 0.54 | 0.89 | 0.02 | 49.45 | <.0001 | 0.64 |
| Motivation 3: At least 1 thing I do at my school makes me want to be the best I can be. | 0.80 | 0.02 | 36.06 | <.0001 | 0.68 | 0.80 | 0.02 | 36.06 | <.0001 | 0.68 | 1.11 | 0.02 | 60.33 | <.0001 | 0.82 |
| Motivation 4: I have a good time participating in activities at my school. | 0.78 | 0.03 | 30.59 | <.0001 | 0.55 | 0.78 | 0.03 | 30.62 | <.0001 | 0.55 | 1.10 | 0.02 | 56.36 | <.0001 | 0.76 |
| Motivation 5: My school helps me discover things I'm good at doing. | 0.89 | 0.03 | 34.75 | <.0001 | 0.65 | 0.88 | 0.03 | 34.62 | <.0001 | 0.65 | 1.19 | 0.02 | 59.72 | <.0001 | 0.81 |
| Motivation 6: Doing my best in school now will help me have a good life when I'm older. | 0.74 | 0.02 | 34.91 | <.0001 | 0.66 | 0.74 | 0.02 | 34.92 | <.0001 | 0.66 | 1.01 | 0.02 | 55.07 | <.0001 | 0.74 |

**Covariances Among Exogenous Variables**

| Parameter | Estimate | SE | *t* Value | Pr > \|*t*\| | Estimate | SE | *t* Value | Pr > \|*t*\| | Estimate | SE | *t* Value | Pr > \|*t*\| |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adults and peers | 0.83 | 0.01 | 60.21 | <.0001 | 0.74 | 0.02 | 41.28 | <.0001 | 0.72 | 0.01 | 61.78 | <.0001 |
| Adults and school | 0.83 | 0.01 | 74.74 | <.0001 | 0.81 | 0.01 | 66.62 | <.0001 | 0.82 | 0.01 | 107.20 | <.0001 |
| Peers and school | 0.90 | 0.01 | 81.77 | <.0001 | 0.84 | 0.01 | 61.32 | <.0001 | 0.80 | 0.01 | 86.83 | <.0001 |

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Table 4. **Growth Model for the Development Sample Across 5 Time Points**

| Model Fit | Growth Model | | |
|---|---|---|---|
| Chi-square test of model fit | 64.708 (df = 10), $p < .0001$ | | |
| RMSEA | 0.05 | | |
| 90% CI | 0.04, 0.06 | | |
| $p$-value < .05 | 0.74 | | |
| CFI | 0.98 | | |
| TLI | 0.98 | | |
| SRMR | 0.08 | | |
| | **Estimate** | **SE** | ***p*-Value** |
| Intercept | | | |
| Time 1 | 1.00 | 0.00 | — |
| Time 2 | 1.00 | 0.00 | — |
| Time 3 | 1.00 | 0.00 | — |
| Time 4 | 1.00 | 0.00 | — |
| Time 5 | 1.00 | 0.00 | — |
| Slope | | | |
| Time 1 | 0.00 | 0.00 | — |
| Time 2 | −0.25 | 0.00 | — |
| Time 3 | −0.50 | 0.00 | — |
| Time 4 | −0.75 | 0.00 | — |
| Time 5 | −0.80 | 0.00 | — |
| Slope on intercept | 0.23 | 0.07 | <.0001 |
| Means | | | |
| Intercept | 4.17 | 0.02 | <.0001 |
| Intercepts | | | |
| Time 1 | 0.00 | 0.00 | — |
| Time 2 | 0.00 | 0.00 | — |
| Time 3 | 0.00 | 0.00 | — |
| Time 4 | 0.00 | 0.00 | — |
| Time 5 | 0.00 | 0.00 | — |
| Slope | −0.38 | 0.28 | .172 |
| Variances | | | |
| Intercept | 0.36 | 0.02 | <.0001 |
| Residual variances | | | |
| Time 1 | 0.17 | 0.02 | <.0001 |
| Time 2 | 0.26 | 0.01 | <.0001 |
| Time 3 | 0.25 | 0.01 | <.0001 |
| Time 4 | 0.23 | 0.01 | <.0001 |
| Time 5 | 0.28 | 0.02 | <.0001 |
| Slope | 0.45 | 0.04 | <.0001 |

direction for all outcomes (Table 5). Similar to the development sample, SPF total score was negatively associated with: anxiety Est. = −0.52, depression Est. = −2.26, conduct disorder Est. = −0.72, and all substances including alcohol Est. = −0.24, electronic cigarettes Est. = −0.27, smoking Est. = −0.34, and cannabis Est. = −0.37. Although quality of life and school climate measures were not available in this sample, we were additionally able to obtain self-reported grades, with significant positive associations between grades in both Math (Est. = 0.22) and English (Est. = 0.24).

### Multigroup Grade Sensitivity Analysis

Both development and validation samples were stratified by grade and tested against a series of measurement constraints. Constrained (ie, each measurement was identical across grades) and fully unconstrained (ie, each grade was allowed their own measurement model) are presented in Table 6. Notably, model fit did not significantly improve when allowing grades to be unconstrained relative to constrained model for the development sample grades (constrained total model fit: SRMR: 0.09, GFI: 0.91, NNFI: 0.94; unconstrained total model fit: SRMR: 0.03, GFI: 0.92, NNFI: 0.95). This suggests a similar measurement model as the students progressed through middle school grades.

Model fit appeared to improve slightly when allowing grades to fit differently for the validation sample (constrained total model fit: SRMR: 0.08, GFI: 0.81, NNFI: 0.90; unconstrained total model fit: SRMR: 0.04, GFI: 0.86, NNFI: 0.92). A closer examination of grades indicates an improved fit only for 12th grade (constrained 12th grade model fit: SRMR: 0.09, GFI: 0.52, NNFI: 0.82; unconstrained 12th grade model fit: SRMR: 0.04, GFI: 0.78, NNFI: 0.91). This improved model fit suggests 12th grade students may differ slightly on these scales relative to their younger counterparts; however, with unconstrained fit all model fits are satisfactory, suggesting these scales can be used across middle and high school grades.

## DISCUSSION

This study provided strong evidence supporting the reliability and validity of the *SPF-Brief* instrument and the *SPF-Framework*. All results supported the reliability and validity of the instrument overall and each of its 3 sub-scales. Confirmatory factor analyses suggested the psychometric integrity of the tool across both middle and high school students in both the developmental and validation samples. All estimates of reliability, both longitudinal and cross-sectional, were strong. Estimates of convergent validity supported the validity of the *SPF-Brief* instrument as its associations with Resnick's School Connectedness Scale[9] were in the proper direction and in keeping with the expected strength of association.

In addition, a review of the results estimating the associations between the *SPF-Brief* instrument and a wide range of intended outcomes indicated statistically significant differences for all outcomes in the desired directions. These outcomes included student self-reports of math grades, English grades, anxiety, depression, conduct disorder, quality of life, alcohol, e-cigarette, tobacco, and cannabis use. Estimates of effect size indicated moderate to strong associations across outcomes with the strongest associations including a decreased likelihood of reporting depression and an increased likelihood of reporting high levels of life satisfaction.


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Table 5. **Outcomes for the Development Time 1 and Validation Samples for the SPF Total Score**

| Model fit | Development | Validation |
|---|---|---|
| Model estimator | WLSMV, delta parameterization, and probit link | WLSMV, delta parameterization, and probit link |
| n | 1330 | 2689 |
| Number of free parameters | 53 | 63 |
| Chi-square test of model fit | 31.41 (df = 8), $p = .0001$ | 0 (df = 0), $p < .0001$ |
| RMSEA (90% CI), *p*-value | 0.047 (0.030, 0.065), $p = .58$ | 0 (0, 0), $p < .0001$ |
| CFI | 0.993 | 1 |
| TLI | 0.958 | 1 |
| SRMR | 0.019 | 0 |

| Outcomes | Estimate | SE | *p*-value | Outcomes | Estimate | SE | *p*-value |
|---|---|---|---|---|---|---|---|
| Anxiety | −0.96 | 0.10 | <.0001 | Anxiety | −0.52 | 0.07 | <.0001 |
| Depression | −4.22 | 0.29 | <.0001 | Depression | −2.26 | 0.21 | <.0001 |
| Conduct disorder | −1.40 | 0.09 | <.0001 | Conduct disorder | −0.72 | 0.05 | <.0001 |
| Quality of life | 5.11 | 0.21 | <.0001 | Alcohol use | −0.24 | 0.03 | <.0001 |
| Alcohol use | −0.38 | 0.05 | <.0001 | Electronic cig | −0.27 | 0.03 | <.0001 |
| Electronic cig | −0.45 | 0.06 | <.0001 | Smoking | −0.34 | 0.03 | <.0001 |
| Smoking | −0.52 | 0.07 | <.0001 | Cannabis | −0.37 | 0.04 | <.0001 |
| Cannabis | −0.46 | 0.10 | <.0001 | Math grade | 0.22 | 0.02 | <.0001 |
| Resnick | 2.05 | 0.08 | <.0001 | English grade | 0.24 | 0.02 | <.0001 |
| Means | | | | Intercepts | | | |
| Resnick | 19.61 | 0.11 | <.0001 | Anxiety | 7.96 | 0.24 | <.0001 |
| SPF total score | 4.20 | 0.03 | <.0001 | Depression | 27.02 | 0.70 | <.0001 |
| Intercepts | | | | Conduct disorder | 10.91 | 0.18 | <.0001 |
| Anxiety | 9.98 | 0.41 | <.0001 | Thresholds | | | |
| Depression | 36.36 | 1.12 | <.0001 | Math grade D | −1.09 | 0.09 | <.0001 |
| Conduct disorder | 14.33 | 0.34 | <.0001 | Math grade C | −0.52 | 0.09 | <.0001 |
| Quality of life | 6.66 | 0.79 | <.0001 | Math grade B | 0.13 | 0.09 | .127 |
| Thresholds | | | | Math grade A | 0.92 | 0.09 | <.0001 |
| Alcohol | −0.64 | 0.21 | .003 | English grade D | −0.95 | 0.09 | <.0001 |
| *E*-cig | −0.50 | 0.26 | .055 | English grade C | −0.50 | 0.09 | <.0001 |
| Smoking | −0.38 | 0.32 | .229 | English grade B | 0.03 | 0.09 | .708 |
| Cannabis | 0.14 | 0.44 | .748 | English grade A | 0.78 | 0.09 | <.0001 |
| Variances | | | | Alcohol use | −0.27 | 0.11 | .016 |
| Resnick | 12.80 | 0.45 | <.0001 | Smoking use | −0.25 | 0.12 | .038 |
| SPF total | 0.48 | 0.02 | <.0001 | E-cig use | −0.19 | 0.12 | .106 |

Furthermore, all results provide strong evidence supporting the *SPF-Framework*, especially in terms of the multi-targeted contributions of the model across diverse outcome variables related to increasing protection and reducing risk. Together, the 3 core constructs in the model contributed to (a) an increased likelihood of academic achievement, (b) a decreased likelihood of choosing risky health behavior related to substance use/abuse, and (3) a decreased prevalence of poor mental health outcomes. Although additional studies will be an important part of further evaluating the viability of this framework, these initial results establish the framework and each of its core constructs as legitimate targets for intervention and the framework itself as worthy of future study.

## IMPLICATIONS FOR SCHOOL HEALTH POLICY, PRACTICE, AND EQUITY

The *SPF-Brief* questionnaire provides a new tool that schools can use to support the academic and life success of the whole student. It is based on the *SPF-Framework*, a new theoretical model that describes an approach to school-based, universal prevention focused on creating learning and social environments that intentionally co-promote student academic achievement, emotional health and well-being, and healthy decision-making.

The *SPF-Brief* questionnaire consists of 13 questions and can be used to assess the overall social environment at the school in terms of whole child outcomes related to learning, health, and decision-making. If so desired, these 13 questions can be split into 3 subscales focused on how well the environment connects students to (a) their motivation to learn and grow (n = 6 questions), (b) supportive adults at the school (n = 4 questions), and (c) supportive peers at school (n = 3 questions).

Higher levels of *School as a Protective Factor* were associated with higher levels of academic achievement and quality of life; lower rates of depression, anxiety, and conduct disorder; and lower rates of substance use and abuse. Each of these outcomes are critically


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Table 6. **Multigroup Grade Sensitivity Analysis**

| | | Development | | | | | | Validation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Spring 6th | Fall 7th | Spring 7th | Fall 8th | Spring 8th | Total | 7th | 8th | 9th | 10th | 11th | 12th |
| Constrained | | | | | | | | | | | | | | |
| Modeling info | Number of Observations | 8178 | 1310 | 1616 | 1866 | 1649 | 1737 | 2593 | 520 | 506 | 522 | 479 | 325 | 241 |
| | Number of Variables | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| | Number of Moments | 455 | 91 | 91 | 91 | 91 | 91 | 546 | 91 | 91 | 91 | 91 | 91 | 91 |
| | Number of Parameters | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 |
| Fit Index | Fit Function | 0.59 | 0.60 | 0.49 | 0.52 | 0.64 | 0.71 | 1.40 | 1.03 | 0.88 | 0.96 | 1.34 | 2.07 | 3.46 |
| | Percent Contribution to Chi-Square | 100 | 16 | 16 | 20 | 22 | 25 | 100 | 15 | 12 | 14 | 18 | 19 | 23 |
| | Root Mean Square Residual (RMR) | 0.10 | 0.18 | 0.05 | 0.05 | 0.10 | 0.10 | 0.13 | 0.15 | 0.07 | 0.10 | 0.10 | 0.20 | 0.14 |
| | Standardized RMR (SRMR) | 0.09 | 0.19 | 0.04 | 0.04 | 0.07 | 0.07 | 0.08 | 0.11 | 0.05 | 0.06 | 0.07 | 0.12 | 0.09 |
| | Goodness of Fit Index (GFI) | 0.91 | 0.91 | 0.93 | 0.92 | 0.90 | 0.89 | 0.81 | 0.87 | 0.89 | 0.87 | 0.82 | 0.72 | 0.52 |
| | Bentler-Bonett NFI | 0.94 | 0.93 | 0.95 | 0.95 | 0.94 | 0.93 | 0.90 | 0.90 | 0.93 | 0.93 | 0.90 | 0.87 | 0.82 |
| Unconstrained | | | | | | | | | | | | | | |
| Modeling info | Number of Observations | 8178 | 1310 | 1616 | 1866 | 1649 | 1737 | 2593 | 520 | 506 | 522 | 479 | 325 | 241 |
| | Number of Variables | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| | Number of Moments | 455 | 91 | 91 | 91 | 91 | 91 | 546 | 91 | 91 | 91 | 91 | 91 | 91 |
| | Number of Parameters | 145 | 29 | 29 | 29 | 29 | 29 | 174 | 29 | 29 | 29 | 29 | 29 | 29 |
| Fit Index | Fit Function | 0.51 | 0.36 | 0.44 | 0.50 | 0.58 | 0.62 | 1.07 | 0.73 | 0.74 | 0.86 | 1.18 | 1.85 | 1.70 |
| | Percent Contribution to Chi-Square | 100 | 12 | 17 | 23 | 23 | 26 | 100 | 14 | 14 | 16 | 20 | 22 | 15 |
| | Root Mean Square Residual (RMR) | 0.05 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.07 | 0.06 | 0.05 | 0.07 | 0.07 | 0.09 | 0.07 |
| | Standardized RMR (SRMR) | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.04 | 0.04 | 0.05 | 0.04 |
| | Goodness of Fit Index (GFI) | 0.92 | 0.94 | 0.93 | 0.92 | 0.91 | 0.91 | 0.86 | 0.90 | 0.90 | 0.88 | 0.83 | 0.75 | 0.78 |
| | Bentler-Bonett NFI | 0.95 | 0.96 | 0.96 | 0.95 | 0.95 | 0.94 | 0.92 | 0.93 | 0.94 | 0.94 | 0.91 | 0.89 | 0.91 |

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important to students in terms of their likelihood to thrive as a student, graduate from high school, and achieve life success.[9,16,17] The *SPF-Brief* was validated in both middle and high school populations while incorporating longitudinal designs and advanced statistical techniques.

The *SPF-Framework* explicitly and purposefully integrates best practices in student learning, mental health, and health decision-making. It recognizes that students who are engaged in the type of growth-promoting learning that connects students to their motivation to learn and grow via clear connections to relevance, authentic self-discovery, and personally meaningful achievement are more likely to perform well in school, make health decisions that preserve their future, and report higher levels of health and well-being.[18,19] Furthermore, it recognizes the importance of growth-promoting relationships with adults, friends, and the broader peer group at school, as well as the contributions each group makes to ensure a supportive, distraction-free environment in which students can try their best and in which learning is likely.

Both the *SPF-Framework* and the *SPF-Brief* questionnaire are intentionally economical, parsimonious, and user-friendly. They recognize the complexity of the school environment and the need for manageable tools that can make broad and deep contributions to the success of the whole child. As such, they focus on identifying, monitoring, and enhancing a select list of key elements in the school environment that most contribute to successful student outcomes across a range of academic and developmental priorities. By design, neither tool is meant to be comprehensive, but instead selective based on the elements of the school environment most likely to contribute to student academic and life success.

Both the *SPF-Framework* and the *SPF-Brief* questionnaire move beyond previous conceptualizations of school climate by providing: (a) a strong and selective theoretical framework that includes explicit goals, well-defined constructs, and clear relationships between constructs, (b) descriptions of the theoretical relationships between the model and intended outcomes related to academic achievement, health and well-being, and life success, (c) full and practical integration into every aspect of schooling in a manner likely to enhance policy and practice across every aspect of schooling and all school personnel, and (d) a well-validated, brief, and free measurement instrument that is user-friendly and intentionally focused on the most essential elements of creating a protective school environment.

For a more comprehensive description of how the SPF-Framework and *SPF-Brief* improve upon existing conceptualizations and measures of the school social environment, see the companion article published in this issue of the journal.

### Limitations

While this study had many strengths, there are a few limitations worth noting. First, this study was conducted in 1 mid-Atlantic state among 2 populations of somewhat homogenous participants. Future studies should include populations from a wide range of community and cultural settings among diverse populations.[20] Second, although the development sample incorporated a longitudinal research design, the second validation sample used a cross-sectional design. Although this was more than adequate for a study of this type, there are benefits to incorporating longitudinal designs into future studies. Third, the study conducted grade-related analyses using student self-report of grades. Finally, the *SPF-Framework* describes the likelihood of long-term impacts and positive impacts on indicators of life success. Although this study includes common precursors to this type of life success, the length of the study and data collected did not allow for the direct assessment of long-term life success as an adult.

### Conclusions

Current evidence supports the validity and reliability of the *SPF-Brief* instrument and the viability of the *SPF-Framework*. The strength of these findings suggests the utility of both the *SPF-Brief* instrument and the *SPF-Framework*, including their potential value in guiding policy and practice related to establishing protective school environments that increase academic achievement, while concurrently reducing risks to student health and life success. Associations between *SPF* scores and reports of depression and quality of life were especially strong and indicate the value of strengthening positive connections to adults in school, peers in school, and student motivation to learn. Based on these findings, both the instrument and the concept warrant further study in the future. Together, the *SPF-Framework* and *SPF-Brief* instrument may offer advantages to and improvements on the school climate approach.

Again, for a full description of the *School as a Protective* conceptual framework, see the companion article in this issue of the journal that presents the framework in detail.

### Human Subjects Approval Statement

This study was approved by the Institutional Review Board at West Virginia University.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.


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## Appendix 1.
## Correlations of Development Sample for Total Scales and Subscales Across 5 Time Points

| Scale | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. CS Adults time 1 | 1.00 | .49 | .44 | .37 | .32 | .58 | .37 | .37 | .27 | .26 | .70 | .43 | .45 | .31 | .30 | .86 | .48 | .48 | .36 | .34 |
| 2. CS Adults time 2 | .49 | 1.00 | .55 | .47 | .43 | .37 | .61 | .42 | .38 | .31 | .42 | .75 | .49 | .42 | .36 | .49 | .88 | .55 | .48 | .42 |
| 3. CS Adults time 3 | .44 | .55 | 1.00 | .55 | .51 | .37 | .42 | .60 | .38 | .37 | .42 | .52 | .74 | .51 | .45 | .47 | .56 | .88 | .55 | .51 |
| 4. CS Adults time 4 | .37 | .47 | .55 | 1.00 | .57 | .30 | .39 | .43 | .61 | .39 | .31 | .46 | .49 | .71 | .47 | .37 | .49 | .55 | .88 | .55 |
| 5. CS Adults time 5 | .32 | .43 | .51 | .57 | 1.00 | .31 | .36 | .33 | .45 | .61 | .27 | .42 | .44 | .52 | .71 | .34 | .45 | .48 | .59 | .88 |
| 6. CS Peers time 1 | .58 | .37 | .37 | .30 | .31 | 1.00 | .45 | .43 | .33 | .33 | .67 | .41 | .42 | .32 | .32 | .81 | .45 | .45 | .35 | .36 |
| 7. CS Peers time 2 | .37 | .61 | .42 | .39 | .36 | .45 | 1.00 | .54 | .45 | .39 | .39 | .69 | .48 | .42 | .35 | .45 | .82 | .53 | .46 | .41 |
| 8. CS Peers time 3 | .37 | .42 | .60 | .43 | .33 | .43 | .54 | 1.00 | .51 | .42 | .40 | .48 | .69 | .49 | .37 | .45 | .53 | .82 | .53 | .41 |
| 9. CS Peers time 4 | .27 | .38 | .38 | .61 | .45 | .33 | .45 | .51 | 1.00 | .51 | .28 | .42 | .42 | .67 | .42 | .32 | .46 | .48 | .81 | .51 |
| 10. CS Peers time 5 | .26 | .31 | .37 | .39 | .61 | .33 | .39 | .42 | .51 | 1.00 | .29 | .39 | .40 | .47 | .68 | .33 | .41 | .44 | .52 | .82 |
| 11. C Motivation time 1 | .70 | .42 | .42 | .31 | .27 | .67 | .39 | .40 | .28 | .29 | 1.00 | .54 | .50 | .38 | .34 | .94 | .53 | .50 | .38 | .35 |
| 12. C Motivation time 2 | .43 | .75 | .52 | .46 | .42 | .41 | .69 | .48 | .42 | .39 | .54 | 1.00 | .60 | .54 | .48 | .54 | .95 | .61 | .55 | .49 |
| 13. C Motivation time 3 | .45 | .49 | .74 | .49 | .44 | .42 | .48 | .69 | .42 | .40 | .50 | .60 | 1.00 | .60 | .53 | .53 | .60 | .94 | .59 | .53 |
| 14. C Motivation time 4 | .31 | .42 | .51 | .71 | .52 | .32 | .42 | .49 | .67 | .47 | .38 | .54 | .60 | 1.00 | .60 | .39 | .53 | .61 | .94 | .61 |
| 15. C Motivation time 5 | .30 | .36 | .45 | .47 | .71 | .32 | .35 | .37 | .42 | .68 | .34 | .48 | .53 | .60 | 1.00 | .37 | .46 | .51 | .59 | .94 |
| 16. Total time 1 | .86 | .49 | .47 | .37 | .34 | .81 | .45 | .45 | .32 | .33 | .94 | .54 | .53 | .39 | .37 | 1.00 | .56 | .55 | .41 | .40 |
| 17. Total time 2 | .48 | .88 | .56 | .49 | .45 | .45 | .82 | .53 | .46 | .41 | .53 | .95 | .60 | .53 | .46 | .56 | 1.00 | .64 | .56 | .50 |
| 18. Total time 3 | .48 | .55 | .88 | .55 | .48 | .45 | .53 | .82 | .48 | .44 | .50 | .61 | .94 | .61 | .51 | .55 | .64 | 1.00 | .63 | .55 |
| 19. Total time 4 | .36 | .48 | .55 | .88 | .59 | .35 | .46 | .53 | .81 | .52 | .38 | .55 | .59 | .94 | .59 | .41 | .56 | .63 | 1.00 | .64 |
| 20. Total time 5 | .34 | .42 | .51 | .55 | .88 | .36 | .41 | .41 | .51 | .82 | .35 | .49 | .53 | .61 | .94 | .40 | .50 | .55 | .64 | 1.00 |

All $p < .0001$, n = 883 to 1886.


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