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**Measurement and Segmentation of  
College Students' Noncognitive  
Attributes: A Targeted Review**

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The Bill & Melinda Gates Foundation’s Postsecondary Success strategy is sponsoring the Student Segmentation Initiative, which encourages colleges to examine qualities other than the demographic and academic characteristics that institutions typically use to understand their students. Under the initiative, the Foundation is working with four colleges and the strategy firm Marakon to develop and implement a tool designed to support measurement and segmentation of college populations on a broader variety of characteristics—in particular, students’ noncognitive attributes. Mathematica Policy Research serves as a measurement and evaluation planning partner on the initiative.

This report presents findings from a targeted document review intended to inform the efforts of stakeholders involved in the Student Segmentation Initiative. The review addresses three questions relevant to the initiative: (1) What instruments and measures are available to assess postsecondary students’ noncognitive attributes? (2) To what extent are these instruments used to classify or segment student populations? (3) How have institutions used these instruments and classification systems to improve student success?

Key findings from the review of published and unpublished materials, as well as input from expert researchers and practitioners, include the following:

- Many instruments are available to postsecondary institutions, but most research reporting findings from noncognitive assessment and segmentation approaches has been theoretical in nature, not applied to college practice.
- There is some convergence in the literature and among expert opinions around a limited number of key noncognitive attributes that matter for students’ success, and multiple instruments are available to measure these attributes.
- We found no example of published research that describes how colleges used segmentation to improve students’ success; however, authors do hypothesize about the potential applications of their research and experts interviewed for the study agree that such approaches have promise for segmenting students to improve postsecondary success.

This report begins with a brief overview of the Student Segmentation Initiative and describes the purposes and approach to the review. Section II details key findings from the review, focusing on measurement of postsecondary students’ noncognitive attributes and colleges’ use of such measures to support students’ success. Section III concludes with a discussion of the implications of our findings.

## **I. BACKGROUND AND PURPOSE OF THE REVIEW**

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### **A. The Student Segmentation Initiative: A new way to look at postsecondary students**

The Student Segmentation Initiative was motivated by a belief that “students learn best when education is targeted to their needs and goals” (Bill & Melinda Gates Foundation 2014) and a corresponding concern that the information typically available to college officials does not always enable them to fully understand the specific needs and goals of the students they serve. Prompted by the idea that “there is more to student success than cognitive ability, curriculum and

instruction” (Yeager et al. 2013), the first phase of the initiative resulted in the development of a survey tool by the strategy firm Marakon that enables colleges to segment students according to so-called internal perspectives and external barriers to success. The tool provides a low-cost, easy-to-use instrument to help college officials better understand and address their students’ needs, beyond the demographic characteristics and academic performance that they already measure. Appendix A describes the tool in greater detail.

In the current phase of the project, a group of four colleges is piloting the survey tool, demonstrating how its use can inform decisions about how to support students’ success in different college contexts.

## **B. Purposes and approach to the review**

This targeted document review has three complementary purposes. First, the review will help to situate the work of the Student Segmentation Initiative within the extant literature, focusing on the research questions presented earlier. Second, it will present the perspectives of several experts and college practitioners on the value of measuring students’ noncognitive attributes and the potential of segmentation approaches using such measures. Third, by drawing on the research that has informed other Foundation-sponsored activities and the products of those activities, the review will support alignment of the initiative with the broader Postsecondary Success portfolio, particularly the portfolio dedicated to “personalizing” postsecondary approaches to target students’ specific needs and goals.

**Article screening and review procedures.** Our review began with a broad search of peer-reviewed articles and unpublished gray literature on the use of noncognitive measures in a postsecondary context. With input from the Foundation and Marakon, we identified five categories of keywords for the search: segmentation approaches, measures of noncognitive attributes, measures of postsecondary noncompletion risk, approaches to target student supports, and instruments to measure key student attributes (Table I.1). We limited our search to papers written after 2000.

Our search for relevant literature proceeded in four major steps. In the first step, the database search identified 5,759 articles meeting eligibility criteria of being (1) a substantive publication, (2) in English, and (3) focusing on a postsecondary population in the United States. Our second step was to screen the 5,759 titles on two categories of relevance: studies that measured postsecondary students’ noncognitive attributes and/or described a segmentation or typology of postsecondary students; this step left 628 articles that merited further investigation. In our third step, we screened abstracts of the 628 articles for relevance on the same criteria, which left 147 articles meeting standards. In the fourth step, we excluded dissertations<sup>1</sup> and documents that, on closer inspection of the text, were determined to be irrelevant according to all the criteria described previously (for example, because they focused on foreign populations, but this had not been clear from the title or abstract). We ultimately gathered 43 full-text articles from the database search and another 18 articles provided by the Gates Foundation, Marakon, and experts for a final analysis sample of 61 articles. Appendix B provides a full bibliography of the 61 articles reviewed for this report.

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<sup>1</sup>We excluded dissertations to conserve resources and keep to the project’s time line.

**Table I.1. List of keywords for database search**

Category	Keywords
Segmentation approaches	Student segmentation/Student segments Student profile Student taxonomy Student typology Student classification Predictive modeling Cluster analysis Factor analysis Latent class analysis Random forest
Measures of student noncognitive attributes	Noncognitive attributes/skills/factors Psychosocial attributes/skills/factors Self-efficacy Sense of belonging Student attitudes Student engagement Student mindsets Student motivation Grit
Measures of postsecondary noncompletion risk	Student risk factors (grade point average, first generation, developmental education, placement) College dropout/stopout predictors Barriers to student success Student retention/persistence/completion predictors
Approaches to target student supports	Early alert system Early warning system On-track indicator Tailoring Personalization Customization Market-oriented services/offerings
Instruments to measure key student attributes	ACT Engage Bar-On EQ-i Cooperative Institutional Research Program (CIRP) Freshman Survey College Student Self-Assessment Survey College Student Experiences Questionnaire Community College Survey of Student Engagement Educational Benchmarking Inc. (EBI) MAP-Works Grit Scale Hope Scale Learning and Study Strategies Inventory (LASSI) National Survey of Student Engagement Noel-Levitz College Student Inventory Noel-Levitz Student Retention Predictor Noel-Levitz Student Satisfaction Inventory Survey of Entering Student Engagement (SENSE) SmarterMeasure StrengthsQuest

We employed a systematic approach to review the 61 articles: identification of the name and properties of each instrument used, noncognitive and other constructs measured, whether and how students were segmented, researchers' findings, and whether and how segmentation and/or measures of students' noncognitive characteristics were applied in a postsecondary setting. We used a Microsoft Excel database to store and analyze information from the reviews.

**Interviews with experts and practitioners.** Concurrent with the document review, the Mathematica team conducted semistructured telephone interviews with five experts, identified with input from the Foundation and Marakon. Interviews focused on (1) the noncognitive predictors of students' success and (2) colleges' use of information on students' noncognitive attributes to support students' success. At the recommendation of one expert, we conducted two additional calls with representatives of two colleges that are currently using data from noncognitive assessments to improve their student supports. Each interview lasted about 45 minutes, with one researcher conducting the interview and another taking notes in an analytic template aligned to the research questions.

**Review of supplementary materials.** Finally, after early analyses showed that our database search had yielded very few practice-oriented articles, we conducted an additional review of abstracts of all presentations at the Association for Institutional Research (AIR) annual forums, from 2010 to 2014. AIR is a leading organization for higher education professionals working in institutional research, assessment, and planning. Its annual forum draws thousands of participants who present their work on using data to support institutional decision making. Our keyword search of 2010–2014 forum programs yielded 48 presentations of interest (out of a total of more than 1,800 forum presentations). A further screening of these results identified 32 presentations dealing with noncognitive measures and 5 dealing with segmentation of the student population, 4 of which used noncognitive measures.

### C. Notes on terminology

Two terms that figure prominently in this report merit definition. First, we use the term *noncognitive* broadly to refer to those attributes, including both skills and behaviors (Farrington et al. 2012; Savitz-Romer et al. 2014), that contribute to students' success, but that are explicitly *not captured by measures of cognitive ability*. Other terms that are used similarly in the literature include, for example, *psychosocial* and *social and emotional* attributes. To paraphrase one scholar, because we are not analyzing cognitive attributes (intellectual abilities and subject-matter achievement), we use the term noncognitive “by default to describe everything else” (Messick 1979, p. 282, cited by Duckworth et al. in review, p. 5). Given the exploratory nature of the review, we believe a broad definition is appropriate. Examples of noncognitive attributes that have received attention in the wider literature include perseverance, mindsets or attitudes, learning strategies, and social skills (Farrington et al. 2012).

Second, *segmentation* is a term common in marketing strategy, but less often used in higher education. In a generic sense, segmentation is merely the division of a broader group into subgroups with shared characteristics. For strategic purposes, segmentation implies that *subgroups can be targeted* based on their specific characteristics. The higher education literature tends to use terms such as *typology* or *classification*, which involve description of groups with shared characteristics, but *do not necessarily imply targeted action toward subgroups*. For our purposes, we use the terms interchangeably; however, because there is nothing that would

preclude the use of a typology or classification system for targeted actions and the applied use of descriptive information is of primary interest to the review.

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## II. FINDINGS

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This section integrates findings from the document review (including published and unpublished literature and AIR forum programs) and expert and practitioner interviews. We begin with an overview of the populations addressed by and objectives of the literature reviewed (Section II.A). We then address the key research questions, discussing the instruments used and noncognitive constructs measured (Section II.B), the segmentation approaches reported (Section II.C), the predictive power of noncognitive measures and segmentation reported in the literature (Section II.D), and the use of segmentation to support students' success (Section II.E) as identified through the various sources. Throughout the discussion, we offer observations on the similarities and differences between the approaches identified in our review and the Marakon approach.

### A. Student populations and objectives of the literature

Historically, typologies of postsecondary populations have classified students according to academic, demographic, and socioeconomic indicators (Luo and Jamieson-Drake 2005), rather than noncognitive measures. The use of noncognitive indicators in classification appears to be more common in the recent literature, however, as we discuss later in this review. Earlier student typologies were also conceptual in nature (for example, Clark and Trow 1966), whereas more recent typologies (Astin 1993; Kuh et al. 2000) have been empirically validated (Luo and Jamieson-Drake 2005). The papers we examined followed this more recent trend, offering typologies grounded in empirical patterns among students' characteristics, skills, and behaviors, including some noncognitive attributes.

**Student populations.** A majority (44 of 61) of the studies we reviewed addressed populations in four-year colleges; the others addressed two-year college students (7 studies), a combination of two- and four-year students (2 studies), or did not specify the particular institutional level of the population studied (8 studies). About one-third of the studies we examined focused on first-year students. This is reasonable, given that these students are most likely to drop or stop out (Adelman 2006) and are presumably most in need of support services; correspondingly, first-year students are most often targeted for surveys.

**Objectives.** There were three general objectives among most of the research we reviewed:

1. To explore relationships between students' characteristics and behaviors—reported either as individual measures or as groups of measures comprising a segment or type—and observable student success outcomes, such as achievement and persistence (27 papers)
2. To explore correlations between different student skills and behaviors, including those in the noncognitive domain (22 papers)
3. To validate specific noncognitive measures or to compare the predictive power of different instruments or scales (10 papers)<sup>2</sup>

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<sup>2</sup> Of the two remaining articles, one was a meta-analysis and one segmented institutions rather than students.

## B. Instruments used and constructs measured

Our review of the literature reveals wide variation in the instruments used to measure postsecondary students' noncognitive attributes, but we did see some convergence around certain published instruments and a few key noncognitive constructs.

**Instruments used.** The instruments most often cited in the literature were those that are widely fielded among colleges nationwide.<sup>3</sup> In Table II.1, we provide an overview of the instruments most often used to describe postsecondary populations in our review. Among the instruments identified, seven papers used data from the National Survey of Student Engagement (NSSE); another four studies used data from the Cooperative Institutional Research Program (CIRP) Freshman Survey; three used the Rosenberg Self-Esteem Scale; and the rest of the instruments listed in Table II.1 were cited twice each.

Beyond using secondary data from extant surveys, another common strategy for researchers was to combine disparate instruments and/or scales into a battery to measure various noncognitive constructs among students. These batteries were typically administered in person to relatively small, nonrandom populations of students, usually as part of a course in the discipline in which the authors were faculty members. Across the 61 studies we reviewed, we identified the use of 95 distinct instruments or scales, with 17 of the 61 studies using multiple instruments administered together in a battery. In contrast, 15 studies used a single homegrown instrument developed by the study authors and 25 used a single published instrument other than those listed in Table II.1.

Fielding surveys—whether published or homegrown—can require a great deal of effort, including financial resources, as well as students' and staff time. As Table II.1 shows, the resources required for colleges to field these published surveys varies, with some publishers charging flat or per-student fees, sometimes on a sliding scale depending on the number of students surveyed. The time and effort required to respond to surveys and to process the data is another important resource. We were able to identify information about the length of 63 instruments, which ranged from 4 to 235 items, and averaged 35 items, with a majority (more than 60 percent) having 30 or fewer items. When researchers used a battery of scales, the complete instrument tended to be longer, averaging 54 items.

Among those instruments with 30 or fewer items, none were reported to measure more than five constructs, indicating that most instruments use multiple items to gauge each construct measured. In interviews, three experts emphasized the importance of this approach for accurate measurement, but acknowledged a trade-off between accuracy and resources required for administration and data processing.

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<sup>3</sup> As noted earlier, we included several major survey instruments as keywords in our database search, so it is perhaps not surprising that our results show researchers frequently using secondary data—from their own and sometimes from other institutions—from these surveys.

**Table II.1. Instruments most used to describe postsecondary populations**

Instrument name	Publisher/ developer	Constructs measured	Availability and cost
National Survey of Student Engagement	Indiana University, Bloomington	Level of academic challenge Active and collaborative learning Student-faculty interaction Enriching educational experiences Supportive campus environment	Price depends on enrollment
CIRP Freshman Survey	UCLA and the American Council on Education	Established behaviors in high school Academic preparedness Admissions decisions Expectations of college Interactions with peers and faculty Student values and goals Student demographic characteristics Concerns about financing college	Flat fee for participation, fee per survey processed, and optional services
Rosenberg Self-Esteem Scale	Rosenberg (1965)	Self-esteem	In public domain (free for use)
College Self-Efficacy Inventory	Solberg et al. (1993)	Self-efficacy	Information not available
Institutional Integration Scale	Pascarella and Terenzini (1980)	Institutional integration	In public domain (free for use)
Narcissistic Personality Scale	Raskin and Terry (1988)	Narcissism	Free for use in research purposes
Big Five Inventory	John, Naumann, and Soto (2008)	Conscientiousness Agreeableness Openness to experience Extraversion Emotional stability/neuroticism	Free for noncommercial research purposes
Life Satisfaction Scale	Diener, Emmons, Larsen, and Griffin (1985)	Life satisfaction	In public domain (free for use)
Bar-On EQ-i <sup>a</sup>	Bar-On (2004)	Intrapersonal abilities Interpersonal abilities Adaptability Stress management	Software for purchase

Source: Author analysis supplemented by Internet research.

Note: Instruments reported were all that appeared in two or more papers in the literature review.

<sup>a</sup> The short (55-item) and long (125-item) versions of this instrument were used.

**Constructs measured.** Despite diversity in the instruments and approaches used by researchers, the literature coalesces around a limited number of noncognitive constructs measured. This reflects the observation of one expert claimed that, despite the variety of and occasional disagreement over specific terms, there is “substantial agreement about the specific attributes worth measuring” (Duckworth et al. in review). The noncognitive constructs most frequently measured in the literature we reviewed include the following:

- **Self-efficacy** was explicitly measured in 12 studies, and its components—such as locus of control, goal-setting, and motivation—were also well documented.
- **Sense of belonging** appears in at least nine studies, though researchers use a variety of terms and might conceptualize it somewhat differently across studies.

- **Engagement**, a related construct that is also important to postsecondary education, was also frequently measured, reflecting the prominence of the NSSE instrument—which focuses on engagement—in the literature reviewed.
- **Student-faculty interaction**, which is an indicator of engagement and also measured via NSSE (and the related Community College Survey of Student Engagement [CCSSE]), was measured by researchers in 12 studies.

These last three constructs—sense of belonging, engagement, and student-faculty interaction—are related insofar as all consider the student’s attitudes, skills, and behaviors with respect to *his or her role in the college environment*. Such constructs have been extensively considered in postsecondary research, in particular through Tinto’s (1975, 1993) model of student departure and subsequent theoretical models that emphasize students’ integration in the college environment (for example, Bean and Metzner 1985; Cabrera et al. 1993). We provide operational definitions of some of the most common constructs identified through our review in Table II.2, along with examples of instruments used to measure them.

**Table II.2. Operational definitions of key constructs in the literature**

Construct	Operational definition	Sample instruments
Self-efficacy	Perception that one can effectively perform behaviors leading to a goal; belief that attainment of goals is possible and within one’s control	College Self-Efficacy Inventory Adapted Self-Efficacy for Academic Milestones College Learning Effectiveness Inventory
Goal orientation/motivation	Belief that learning activities have value and relate to current and future goals; can be mediated by self-efficacy	Motivational Orientation Scale Patterns of Adaptive Learning Noel Levitz College Student Inventory, Form B Learning and Study Strategies Inventory
Sense of belonging	Belief that one belongs to an academic community; involves students’ sense that they have a rightful place and a sense of membership in a given academic setting	Student Adaptation to College Questionnaire Institutional Integration Scale
Student engagement	The time and effort a student dedicates to purposeful educational activities	National Survey of Student Engagement Community College Survey of Student Engagement
Student-faculty interaction	An indicator of engagement, reflecting student interaction with faculty in both formal and informal roles	National Survey of Student Engagement Community College Survey of Student Engagement Institutional Integration Scale
Emotional intelligence	Awareness of and ability to control emotions required for effective functioning; comprised of inter- and intrapersonal skills, stress management, adaptability, and general mood	Bar-On EQ-i (multiple forms)

Source: Author analysis; some definitions adapted from Atkins-Burnett and Fernández (2012).

Although there was not perfect agreement among the experts during interviews, there was some convergence around the constructs named and these align fairly well—though not perfectly—with the constructs measured most often in the literature. In particular, there is broad agreement among the experts we interviewed around the importance of self-efficacy (and related constructs of growth mindset, motivation, and agency) and conscientiousness (and related constructs of grit and persistence) for students’ success. The experts also tended to agree that some facet of students’ ability to relate to other people matters, though as in the literature, there was more divergence in the specific terms used and perhaps the concepts reflected (grouped here with sense of belonging). In Table II.3, we categorize the constructs cited by experts in line with the constructs most common in the literature.

**Alignment with the Marakon instrument.** Finally, as shown in the far right column of Table II.3, there is a fair degree of conceptual alignment among the constructs studied in the literature and cited by experts with the eight *internal perspectives* segments put forward by Marakon. Specifically, the *questions academic ability* segment is conceptually in line with a lack of self-efficacy. Marakon’s approach yielded three segments explicitly encompassing sense of belonging—with the *lacks sense of belonging* segment at higher risk than the *strong sense of belonging but financial worries* and *well-supported from home and sense of belonging* segments. The *persevering independent* would appear to exhibit the same underlying construct captured in conscientiousness, grit, and persistence (which experts described as reflecting a single construct). The *ROI skeptic*, a high-risk category, might struggle with components of emotional intelligence, especially perceiving the value in education versus the opportunity costs. Two of the Marakon segments have less obvious alignment with the constructs named by experts and studied in the literature: The segment marked by a *positive perspective overall* could presumably encompass any or all the constructs named in the table that align with any of the other Marakon segments—that is, because the *positive perspective overall* segment presumably includes those individuals scoring in a positive direction on all or most of the various constructs measured by the Marakon tool. Similarly, it is not entirely obvious how the *lacks family support and college knowledge* segment would align with the constructs cited in the literature and by experts, but nor is it clearly independent of them (for example, it might encompass both sense of belonging and financial stability).

**Table II.3. Construct alignment across literature, experts, and Marakon tool**

Literature	Experts				Marakon Internal Perspectives
	1 and 2 <sup>a</sup>	3	4	5	
Self-efficacy (also goal orientation/motivation)		Growth mindset/optimism	Hope - Pathways - Agency Confidence and motivation	Achievement motivation	Questions academic ability (inverse)
Sense of belonging	Ability to relate to peers	Agreeableness	Social capital		Lacks sense of belonging (inverse)  Strong sense of belonging but financial worries  Well supported from home and sense of belonging
Student engagement		Openness to experience			
Student-faculty interaction					
Emotional intelligence (also goal orientation/motivation)	Emotional intelligence - Sees value in education - Able to defer gratification	Meaning and purpose			ROI skeptic (inverse)
		Conscientiousness	Grit/persistence	Persistence/grit	Persevering independent
				Ethics and integrity	
			Financial stability		Strong sense of belonging but financial worries  Well supported from home and sense of belonging  ROI skeptic (inverse)
					Positive perspective overall
					Lacks family support and college knowledge

Note: ROI = return on investment.

<sup>a</sup> Two experts participated in a single interview.

### **C. Segmentation using noncognitive and other measures**

Slightly more than one-quarter of the articles reviewed (16 of 61) reported findings from a classification of postsecondary students and more than two-thirds of these (11 of 16) used noncognitive measures. These studies classified students according to noncognitive constructs, including students' social skills and openness, and aspirations, attitudes, and perceptions of their own abilities, which Savitz Romer et al. (2014) consider to be indicative of noncognitive attributes. Six studies classified student populations using observed and reported academic behavioral measures, such as the number of transfers to different institutions and class attendance. With respect to the data sources used to identify segments, 4 studies used college administrative data, 5 others used primary data collected using instruments developed specifically for the study (including one that combined homegrown measures with a published instrument), and 7 used secondary data from published instruments (including the CCSSE, NSSE, CIRP Freshman Survey, Beginning Postsecondary Students Longitudinal Survey, and the U.S. Education Sentiment Survey). These studies typically described the distribution of segments across the student population and sometimes analyzed relationships between segments and students' outcomes (discussed later). Most researchers used similar methodologies to arrive at their segmentation solutions, typically conducting factor analysis for data reduction and cluster analysis for classification of students.

**Number of student types or segments.** Classification approaches typically yielded 3 to 8 student types or segments. However, two of the studies reviewed presented typologies with 15 categories: (1) the exploratory analysis by Saenz et al. (2011) of a nationwide sample using CCSSE data detected 15 clusters of students grouped into high, diverse, and low engagers; and (2) the Leo Burnett Company (2009) study of the obstacles to postsecondary attainment, funded by the Gates Foundation, found a 15-segment solution when it analyzed data from a nationally representative sample of 18- to 26-year-olds.

**Alignment with the Marakon segmentation approach.** The methodologies used to develop student classification systems in the literature were in line with the methods used by Marakon to develop its segmentation tool, with both using a combination of factor analytic and clustering approaches. The Marakon segmentation solution yielded 15 segments, which was more than most of the studies yielded. However, these 15 segments are organized into two distinct lenses on student persistence—internal perspectives and external barriers—represented in 8 and 7 segments, respectively, which is closer to most of the solutions derived in the literature.

### **D. Testing the predictive power of noncognitive measures and segmentation**

The predictive power of a measure or segmentation will determine its usefulness in both research and practice. The relative predictive power of the various noncognitive constructs presented in Tables II.2 and II.3 is not perfectly clear from our review of the literature. This lack of clarity stems from the variety of measures used, outcomes analyzed, populations addressed, and analytic methods applied. However, like Farrington et al. (2012), we find that some noncognitive constructs appear to be better predictors of postsecondary success than others:

- **A number of studies find that self-efficacy and goal orientation have positive associations with student success outcomes** (Arthur et al. 2006; Beck and Davidson 2001; Campbell et al. 2013; Duckworth et al. 2007; Feldt 2012; Hawley and Harris 2005; Horn and Weko 2009; Kennett and Reed 2009; Klomegah 2007; Krumrei-Mancuso et al. 2013; Mattern and Shaw 2010). However, Nakajima et al. (2012) find no relationship between self-efficacy and retention in the California community college that they studied, net of other academic, demographic, and other noncognitive variables.
- **Engagement predicted academic achievement and retention in a handful of articles** (Arthur et al. 2006; Horn and Weko 2009; Hu and McCormick 2012; Krumrei-Mancuso et al. 2013). On the other hand, one study (Melius 2011) found that engagement practices (including student-faculty interaction, as well as collaborative learning and extracurricular activities) were not predictive of grade point average, net of other covariates, at a Historically Black Institution.
- **Sense of belonging was related to enrollment outcomes in one study** (Campbell et al. 2013). The related institutional integration predicted persistence in one other (Nakajima et al. 2012). Emotional intelligence, which includes intrapersonal abilities, social skills, adaptability, stress management, and general mood, was shown to predict positive outcomes in two studies (Parker et al. 2006; Sparkman et al. 2012).

Of the 16 papers reviewed that presented a classification approach, about half examine the power of the segments to predict key postsecondary outcomes (the others simply describe differences in composition and distribution between the student types). Specific outcomes addressed include persistence and completion, engagement behaviors (including course load and enrollment continuity), academic performance, major selected, and mental health. Most of these studies report significant variation in outcomes across segments, and they show that some segments are more predictive of key outcomes than others. Although none of these present findings from applied use of their approaches, such variation in predictive power of segments would be important for practitioners, as the research findings suggest that some student segments are at higher risk than others, whereas some segments have more salience for the outcomes in question.

The predictive power of the Marakon tool has not yet been established, but it could be tested in the pilot colleges.

### **E. Using segmentation to support students' success**

Applications of student classifications—based on noncognitive or other measures—were not represented in the literature. None of the studies reported how colleges actually used student classification systems, much less the results of that usage. Nevertheless, study authors did speculate about how segmentation might inform institutional practice to support student success. Moreover, experts were optimistic about the potential for such approaches.

**Applications suggested by study authors.** Among the ideas offered by researchers, admissions was mentioned as one potential application of segmentation (Thomas et al. 2007; Luo and Jamieson-Drake 2005), and experts asserted that this is the area in which segmentation has most often been applied in the past. Similarly, the research reviewed suggested that classification

approaches might be used in marketing particular services more effectively to current students. For example, studies suggest segmenting students to attract them to career services (Garver et al. n.d.) or online education (Bailey et al. 2014). Study authors also discuss potential applications for targeting student supports more generally (for example, Denson and Ing 2014; Hu and McCormick 2012; and Kenyon and Koerner 2009).

**Applications in institutional research.** Review of abstracts of presentations at the AIR annual Forums from 2010 to 2014 suggests that segmentation based on non-cognitive measures is an uncommon practice. Among the 48 abstracts identified as relevant through our keyword search, instruments mentioned by name included CIRP (named in 6 abstracts), NSSE (4), Noel-Levitz College Student Inventory (CSI) (2), CCSSE (1), the Motivated Strategies for Learning Questionnaire (1), and the Student Experience in the Research University survey (1). Five abstracts addressed student segmentation, 4 of which used noncognitive measures to define segments. Although the abstracts do not provide a great deal of detailed information, none of these 4 presentations appear to have reported results of a college having used the information to address students' needs. Indeed, only one presentation appears to have reported actual outcomes of an effort to support students through the use of information from noncognitive assessment (Durodoye 2011); but the information was used at the individual student level, not for segmentation purposes.

**Expert perspectives on application of noncognitive measures and segmentation to target supports.** The proliferation of instruments to measure students' noncognitive attributes, combined with the relative paucity of research on the application of such measures to support students' success, suggests that applied work in this area is ripe for development. Correspondingly, the experts we interviewed shared enthusiasm for the potential of noncognitive measures and segmentation approaches to improve postsecondary outcomes. In particular, they emphasized two areas of promise:

- **Noncognitive attributes are important and malleable.** All experts felt that some noncognitive skills were strong contributors to academic outcomes. Moreover, they noted that because certain noncognitive attributes are malleable, they might be responsive to intervention. Contemporary experimental research supports this idea, for example by psychologists focusing on changing the mindsets of college students (Yeager et al. 2013; Yeager and Walton 2011). One expert pointed out that by addressing the potential importance of noncognitive skills, colleges might encourage students to embrace the fact that college is *supposed* to be cognitively difficult, while helping them to recognize that there are still many avenues to success.
- **Noncognitive measures prompt equity discussions.** Experts contended that approaches like that of the Student Segmentation Initiative could cause colleges to question their assumptions about the primacy of cognitive factors, which in turn would force them to examine equity issues more carefully. As one expert put it, a focus on cognitive measures—such as test scores and grades—allows colleges to “wash their hands” and point the blame for postsecondary failure at high schools and students themselves. Examination of issues in the noncognitive domain could change the conversation and encourage colleges to think about what they can do to meet students' needs better.

At the same time, however, experts urged caution with respect to a few risks associated with using noncognitive measures to target student supports:

- **Measures should be validated.** Experts echoed the message of some of the research we reviewed (for example, Campbell and Cabrera 2011; Thomas et al. 2007), emphasizing that before institutions act on a large scale, they should be confident of the validity of the particular noncognitive measures they wish to use. In the absence of validation, colleges could end up wasting resources, either by measuring attributes that do not matter for success or improperly measuring attributes that do matter. Similarly, colleges run the risk of undermining public confidence if they use flawed measures to determine how to treat students. This is particularly true if colleges plan to intervene at the individual level. As one expert stressed, measurement error is more tolerable if the purpose is to describe a group's characteristics; in contrast, if the purpose is to understand and intervene at the individual level, then the measure must be "spot on."
- **Information must be used carefully.** The experts' enthusiasm was tempered by the recognition that colleges might not know how best to use the information generated by noncognitive assessments. For example, noncognitive assessments could result in stigmatization of students with less desirable characteristics or those deemed in need of certain supports. Experts urged caution with respect to screening or tracking of students on the basis of noncognitive measures. Similarly, they emphasized that intervention at the individual level—especially interventions targeting a particular noncognitive skill or behavior, such as mindset—could backfire. Yeager and Walton (2011) echo this sentiment; they insist that noncognitive interventions "are not magic," but rather must be informed by strong theoretical justification and rigorous empirical evidence. If colleges were to act in uninformed ways, or if they were unable to act on the information generated by noncognitive assessments, the effort could not only harm students, but frustrate broader efforts to use noncognitive information to support student success.

**Examples from colleges using noncognitive assessment.** In our conversations with experts, we asked for examples of colleges that were using noncognitive measures to target student supports and we conducted telephone interviews with representatives from two of the identified colleges: Chaffey College in Rancho Cucamonga, California, and Miami-Dade College (MDC) in Florida. We briefly describe the efforts of each college next, followed by some integrative observations that address the question of colleges' use of noncognitive measures to improve student supports.

Chaffey College has used the Adult Trait Hope Scale (Snyder et al. 1991) to assess incoming students since fall 2011. The effort was originally stimulated by a Title V Hispanic Serving Institution grant and was part of the evolution of the college's "basic skills transformation" processes. In particular, in revising the developmental English curriculum, faculty were eager to have information beyond "traditional background variables." They chose the Hope Scale after reviewing research and working with Gallup scientists, who had worked extensively with the scale. The instrument is available for free, though the college has invested resources in its administration and processing of the data. The full instrument is composed of 12 items to assess respondents' level of hope, as conceived by the developers, which includes subscales of 4 items each for agency (goal-directed energy) and pathways (planning to

accomplish goals). The Chaffey team incorporated the 8 substantive items from the Hope Scale into its Accuplacer academic placement exam. Although not all students are required to take the Accuplacer, in practice, more than 90 percent of Chaffey students do, and the proportion should increase as state policies governing enrollment incentivize it. The concept of hope is now at the center of the college's strategic vision. It is expressed in its Hope-Engage-Succeed framework, which demonstrates how the college has adopted hope as a core value across the institution.

In concrete terms, Chaffey officials have used the Hope-Engage-Succeed framework in ways that are both visible and invisible. A visible application is Chaffey's one-hour workshop on hope, in which scale items are discussed with an eye toward helping students understand how the pathways and agency constructs matter for their college success. An example of an invisible application is the "hope syllabus," which faculty are trained in and encouraged to develop; such a syllabus is intentionally structured to guide the student toward help-seeking pathways and to empower the student to receive and use feedback from the course. Chaffey officials have also used students' hope scores for research purposes—for example, examining correlations with key outcomes such as credit accumulation and persistence—and they plan to incorporate the scores in their academic placement process. The next step and key challenge, as Chaffey officials view it, is to determine how to make the information provided by the assessment "more actionable." They plan to use the Faculty Success Center and staff training as the primary means toward that end.

Officials at MDC were interested in assessing students' noncognitive attributes for the college's front-end redesign, which was part of its Gates-funded Completion by Design effort. Since 2013, they have used the Student Strengths Inventory (SSI), which was offered for free as part of a suite of enterprise software products that the college had purchased. The SSI is a web-based, 48-item questionnaire that measures six noncognitive factors: academic engagement, academic self-efficacy, educational commitment, campus engagement, social comfort, and resiliency. First-time college students enrolling at MDC complete the assessment as part of mandatory orientation activities.

MDC currently uses SSI scores to guide individual advising by senior advisors, a new cadre of more highly trained and credentialed counselors than the college had used in the past. MDC leadership is trying to determine how best to use SSI results beyond advising—in particular, how to link the information to each of their campus's support resources. As a first step, they plan to incorporate strategies to support development of the key noncognitive skills measured by SSI into the student life skills course required of all first semester freshmen. Like Chaffey College, they are also considering incorporation of SSI results into the academic placement process. To date, they have not segmented the student population using SSI scores, but they see potential value in such an approach.

A few cross-cutting lessons emerge from the experience of Chaffey and Miami-Dade colleges, some of which resonate with the findings from the literature review and experts' insights:

- **Assessment is easy; acting upon it is hard.** College representatives agreed that a number of good assessments are readily available to colleges seeking to measure students' noncognitive attributes, and these can be administered well within normal college resources.

The challenge, as suggested by the experts and practitioners (and perhaps by the lack of applied literature), is determining how to use the information.

- **Assessment needs to align with the institution’s strategic vision.** Whatever instrument a college ultimately decides to use, the information that it generates must be framed in a way that aligns with the college’s strategic vision. If not, the assessment process can become unnecessarily burdensome and the information will not be useful. Related to this point, a successful approach requires buy-in at all levels of the institution, with college representatives emphasizing the particular importance of faculty and executive leadership.
- **Assessment can launch important, mission-oriented conversations.** A Chaffey representative recounted how students sometimes ask, “Why are you asking me these questions [about hope]?” She continued, noting that the question itself is useful because it can serve as an opportunity to send a critical, early message to students: “Because we care about your well-being.” Similarly, at MDC, SSI results are a starting point for advisors to engage students around issues broader than, but related to, academics. At the same time, both colleges have used the information generated by the noncognitive assessments to deepen strategic conversations with faculty and staff by focusing them on things that matter for student success, but which would not necessarily be known or understood without the assessments.

#### **IV. CONCLUSIONS AND IMPLICATIONS FOR COLLEGES AND THE FOUNDATION**

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The overarching conclusion from our document review and related interviews is that although many instruments are available to measure students’ noncognitive attributes, and segmentation offers a constructive approach, applying this kind of information to students’ success is a new frontier with both promise and risks. In this section we discuss the implications of our findings for colleges interested in using noncognitive measures to segment and serve their student populations, as well as for the Foundation in its ongoing efforts to personalize and improve the college student experience.

##### **A. Implications for colleges**

Given the variety of instruments available to colleges interested in measuring students’ noncognitive attributes, *a pragmatic approach is justified in selecting a particular instrument.* The college representatives to whom we spoke had done some investigation of different instruments before determining which best met their needs, but they did not necessarily believe that the instruments they ultimately chose would be best for all colleges. Indeed, one respondent speculated that most instruments “measure the same things anyway”—an assertion supported at least somewhat by our analysis of the constructs measured in the studies reviewed. Moreover, expert opinion emphasized that the specific measures might be less important than the resulting processes and conversations focused on students’ noncognitive attributes. Nevertheless, colleges should consider the resources required to administer assessments and to process the data—including licensing and other fees, as well as students’ and college staff members’ time. In particular, colleges might have to be cautious about the amount of time such assessments can take from the limited student orientation period. Finally, as practitioners emphasized, whatever

instrument is chosen, the information it generates has to be framed to align with the college's strategic vision.

A second implication is that *colleges should be aware of and actively manage the risks associated with using noncognitive information to target student supports*. In particular, colleges should consider equity issues and the potential for stigma that might be associated with screening, tracking, or labeling based on noncognitive measures. Such concerns are echoed in a recent review of noncognitive interventions (Yeager and Walton 2011) and were at the heart of one expert's caution that interventions targeting noncognitive skills or behaviors could "backfire." For example, if a student lacks a sense of belonging, an intervention targeting the student might reinforce his or her sense of being marginalized.

To manage risks and avoid some of the pitfalls that could stem from measuring students' noncognitive attributes, colleges might—at least in the near term—*focus efforts on what one expert called "universal" (as opposed to individual) approaches*. The idea is to create an *institutional environment* that fosters development of positive noncognitive skills and behaviors at the same time that it mitigates negative skills and behaviors. Ideally, such an approach would be informed by a detailed understanding of the institution's student population, which segmentation could provide. Such universal approaches can help to avoid stigmatizing any particular student. At the same time, they decrease the importance of measurement error, making the choice of a particular instrument less critical and freeing colleges to focus their attention on how best to use the information, rather than how to gather it. Of course, some colleges might be in a position to use information to intervene at the student level—for example, as MDC has done with its senior advisors—but caution is warranted with respect to how the information is used.

This suggests a final implication for colleges: *Any initiative or intervention developed as part of a plan to target supports using noncognitive measures should be informed by both theory and practice*. Theory supports understanding of the mechanism by which a particular noncognitive skill or behavior is linked to students' success (and conversely, how it might be linked to failure); this understanding is critical for designing appropriate programmatic responses. At the same time, responses must be feasible in practice and at scale for significant positive outcomes to result. Among the resources required for colleges to understand and apply the lessons from theory and practice, perhaps the most critical are time and space to digest information and develop plans in such a way that stakeholders throughout the institution understand and own the solutions they develop.

## **B. Implications for the Foundation**

The implications of our findings for the Foundation flow from the implications for colleges. First, *the Marakon tool has potential to support applied segmentation approaches*. One potential advantage of the Marakon survey tool is that it could require relatively fewer resources to administer than other instruments, especially if it were made available at no cost to colleges. In comparison to the instruments described in the literature (which averaged 35 items), the Marakon tool is a relatively short questionnaire (with 24 noncognitively oriented items in its most basic form, in addition to 7 demographic background items), so it could require less time and effort from student respondents. As noted, experts expressed some skepticism about short instruments that measure multiple constructs, but they acknowledged a trade-off between

questionnaire length and resources required for administration and data processing. And because the Marakon tool was developed explicitly for segmentation, colleges using it would presumably not have to conduct exploratory analysis to classify individual students within a given segment. This would be especially useful to colleges without extensive resources for institutional research.

Nevertheless, *there is a need to better understand the validity, reliability, and predictive power of the Marakon segmentation tool.* This is especially important if the tool is to be used to develop or support individual-level interventions based on its categorization of a given student. Even for universal approaches, however, it is important to know that the tool can accurately describe the student population and predict the relative success of segments. Moreover, a fuller understanding of the tool's psychometric properties could position it better for adoption by colleges considering various instruments. Although development of the tool included correlational analyses of postsecondary stop- and drop-out within a national sample, it is as yet unclear whether the tool can be used to predict completion or other critical outcomes such as course passage or credit accumulation at any particular college. Similarly, the stability of a student's membership in a given segment over time—absent intervention—is unclear. Such questions can be addressed through careful study of students' outcomes at the four colleges that are piloting the tool.

Finally, *the potential to learn from the college pilots hinges, in part, on the colleges having adequate resources to develop appropriate programmatic approaches.* The Foundation's support in the current phase of the project has helped to provide the scarce commodity of time and space for early planning, but the colleges are just now at the precipice of acting on the information generated by the Marakon tool. Appropriate interventions are not obvious—as noted, they require careful consideration of the theory and practice, as well as dedicated attention from multiple stakeholders within each institution. The colleges have a strong start in developing action plans, but much remains to be done if programs are to yield the hoped-for positive results in a way that is sustainable and scalable. Moreover, measurable improvement in students' outcomes will require *time*, in addition to the programmatic approaches that the colleges are developing.

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## APPENDIX A

### OVERVIEW OF THE MARAKON SURVEY TOOL

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The Marakon survey tool includes 31 items, organized into seven sections:

- Three introductory items to identify the student and college.
- Two sections of five items each, focusing on students' internal perspectives. Each item poses a statement reflecting attitudes toward college, to which the student responds on a 10-point, Likert-type scale of agreement, with 1 = strongly disagree and 10 = strongly agree.
- Two sections of three items each, focusing on students' external barriers. Students are instructed to identify which of the items is the most challenging and which is the least challenging in successfully completing [their] degree.
- A section on "Responsibilities Outside of School" with two items, asking how many hours the respondent works in a week and if he or she has dependents.
- A background section with four items on students' demographic characteristics.

Colleges administering the tool can add items to the introductory and background sections.

Marakon developed this short version of the tool after fielding a longer instrument among a national sample of 8,000 current college students and 2,000 recent noncompleters from two- and four-year, public and private, degree-granting institutions in the United States. In its analyses, Marakon weighted the data to ensure representation by gender, age, race/ethnicity, income, U.S. region, enrollment status, and proportion of program completed. Marakon used data reduction and classification techniques to arrive at a 15-segment solution, including 8 internal perspectives segments and 7 external barriers segments. Based on its analyses, Marakon then reduced the instrument to include the minimum number of items to predict (with at least 80 percent accuracy) a student's correct placement in a segment.

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