# What We Talk about When We Talk about Rigor: Examining Conceptions of Academic Rigor

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# What We Talk About When We Talk About Rigor: Examining Conceptions of Academic Rigor

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## Abstract

Academic rigor has long been considered important for students' learning and development in higher education. However, findings about students' outcomes from previous studies of rigor are mixed, in part because of varying conceptions of what constitutes rigor. In quantitative research, rigor is often operationalized in one of two ways: through students' workload in courses or through their instructors' expectations for course learning in the form of cognitive challenge. This study employed data from a multi-institutional, longitudinal study of undergraduates in the United States to examine the relationship of both conceptions of rigor with students' cognitive development, including their critical thinking skills and two measures of self-motivated learning (need for cognition and positive attitudes towards literacy). Workload was related to four-year growth in positive attitudes about reading and writing, while cognitive challenge was related to self-motivated learning in year one and all three aspects of cognitive development in year four. In particular, the amount of reading that students completed was the only measure of workload positively associated with outcomes, while both challenge in class and in exams and assignments played a role. These findings have implications for instructors, instructional developers, institutional leaders, and researchers in higher education.



Keywords: academic rigor, critical thinking, lifelong learning, cognitive development, instructional practices

# What We Talk About When We Talk About Rigor: Examining Conceptions of Academic Rigor

Academic rigor constitutes an enduring issue in higher education. Attention paid to academic rigor dots the history of higher education in the United States. For example, historian Lawrence R. Veysey (1965) estimated that the majority of the five hundred institutions of higher education that existed in the United States in 1903 did not warrant being called a college and that only about a dozen were of the "first rank." He viewed improvement in the rigor of U.S. higher education as difficult because of uncertainties about the seriousness of undergraduate education. These uncertainties took the form of debates over the substantive meaning of seriousness and the lack of agreement on how "serious" undergraduate education should be made (Veysey, 1965). The pronouncements of the 1947 President's Commission on Higher Education (the Truman Commission) provide another example of the attention paid to academic rigor in the history of U.S. higher education as it viewed the development of academically rigorous content as one of the nation's highest priorities (Francis, 2018). Lattuca and Stark (2011) espouse an additional perspective by stating that "cycles of relaxed curricular requirements to provide more choice for students give way to cycles of tightened requirements to increase 'rigor'" (p. 57).

More recent attention to academic rigor springs from the assertion of Arum and Roksa (2011) that "many contemporary college academic programs are not particularly rigorous or demanding" (p. 31). This emphasis on rigor in the "grand narrative" of higher education emanates from the widespread concern that students are not developing the cognitive skills and habits necessary to be lifelong learners (Bok, 2013). Such assertions by researchers shape the way that higher education is viewed by organizational stakeholders, including educational leaders, policymakers, and the public, which has profound implications for policies and practice.

As such, it is crucial to consider the different ways that scholars define and operationalize rigor, especially when exploring the influence of rigor on students' cognitive skills and traits, as well as other valued markers of college student success.

There are two primary approaches to defining academic rigor: course workload demands and expectations for course learning in the form of cognitive challenge. Workload demands include the number of hours students spend completing course readings, writing papers, and studying (Kuh et al., 2005). This conception emphasizes the amount of academic work students do outside of class, based theoretically on the investment of psychological and physical energy required to complete this work (Astin, 1984; Kuh, 2008).

Expectations for course learning in the form of cognitive challenges operationalizes rigor as course practices and assignments that require students to demonstrate higher-order thinking about course content rather than just recall and recognition, as higher-order thinking entails an understanding of course content that include its analysis, synthesis, and evaluation (Braxton & Nordvall, 1985; Nordvall & Braxton, 1996). Specifically, higher-order thinking involves such activities as the comparison and contrast of course content, the presentation of the strengths and weaknesses of a particular argument or point of view, and the development and defense of arguments for or against a particular point of view. More recently, scholars have argued that rigorous instructional practices that create cognitive challenge ask students to practice thinking in more complex ways, promoting students' use of deep approaches to learning (Bowman & Culver, 2018; Campbell & Dortch, 2018; Nelson-Laird et al., 2014). This conception of academic rigor suggests that academically rigorous coursework presents a cognitive challenge to students through an emphasis on a higher-order understanding of course content, promoting their use of deep approaches to learning.

In a mixed methods study of how postsecondary instructors perceive and implement academic rigor, researchers asked instructors to rank the importance of several indicators of rigor, with items that reflected both conceptions of academic rigor (Draeger et al., 2013). They found that instructors identified items relating to cognitive challenge as much more important markers of rigor compared to the items related to workload, ultimately defining academic rigor as the overlap of "active learning, meaningful content, higher-order thinking, and appropriate expectations" (p. 272). At the same time, some empirical and theoretical support exists for the influence of both conceptions of academic rigor on the cognitive development of college students. We discuss such empirical support in the next section of this paper, followed by an in-depth discussion of the theoretical frameworks underpinning each conception.

## Review of Empirical Support for Both Conceptions of Academic Rigor

Some research affords empirical support for the course workload conception of academic rigor. More specifically, Carini, Kuh and Klein (2006) found a positive relationship between the amount of assigned reading and writing and students' critical thinking skills, measured using a cognitive and performance tested developed by Rand that included a combination of six different 90-minute critical thinking and performance problems. The authors derived their findings from a sample of 1,058 students at 14 four-year colleges and universities. Further empirical support comes from the research of Arum and Roksa (2011) that used a sample of 2,322 students enrolled at 24 four-year colleges and universities. They found that a combination of course requirements that include more than forty pages per week of reading and more than twenty pages of writing during a semester enhanced the critical thinking, complex reasoning, and writing skills of students as measured using the Collegiate Learning Assessment (CLA). However, Arum and Roksa point out that neither the reading nor writing requirements alone sufficed, suggesting that

it may be the cumulative effect of students' total workload, rather than any individual component of it, that benefits students' cognitive skills.

Research also provides empirical backing for the cognitive challenge conception of academic rigor. From three studies conducted using students enrolled at a single university, Renaud and Murray (2007) conclude higher-order questions in exams and assignments make development of students' critical thinking more likely, even within the confines of a single semester; they used the Watson-Glaser Critical Thinking Appraisal to assess critical thinking. Using a quasi-experimental design, Barnett and Francis (2012) found that students who took quizzes with two or three essay questions that required critical thinking about a chapter scored higher on their critical thinking abilities that students who were assigned to two other experimental conditions. In addition to their examination of the association between indices of course workload and critical thinking, Carini and colleagues (2006) also found a small, positive relationship between the frequency of inclusion of higher-order thinking skills in coursework and critical thinking skills.

Moreover, more recent research by Culver, Braxton and Pascarella (2019) also offers empirical support for the association of cognitive challenge with students' critical thinking skills, measured using the Collegiate Assessment of Academic Proficiency Critical Thinking Test, as well as with two indices of students' self-motivated learning dispositions: need for cognition and positive attitudes towards literacy. In addition to examining a cumulative measure of cognitive challenge, the authors also separately tested in-class challenge and challenging assignments and exams that convey an expectation for a higher-order understanding of course content. They found that the composite measure of academic rigor had significant positive net associations with both end-of-first-year need for cognition and positive attitudes towards literacy. By the end of

the fourth year, academic rigor had net, positive associations not only with need for cognition and positive attitudes towards literacy, but also with critical thinking skills. They also found that in-class rigor was significantly related to first-year positive attitudes toward literacy and fourth-year need for cognition. Assignment rigor had a significant association only with end-of-fourth-year positive attitude towards literacy. Examined separately, neither in-class rigor nor assignment rigor had a significant relationship to critical thinking at either timepoint included in the study. The findings of their study suggest that each type of cognitive challenge may be more beneficial for students at a different point in their college education.

To sum up, both conceptions of academic rigor garner empirical support using various cognitive and performance tests of critical thinking, which avoid many of the pitfalls associated with students' self-reported cognitive growth (Bowman, 2010, 2011; Porter, 2013). The existence of empirical support for each conception raises a fundamental question: how does each conception of academic rigor perform with respect to students' cognitive skills and self-motivated learning dispositions? Although Carini and colleagues (2006) included both conceptions of academic rigor in their study, the purpose of their study was much broader (concentrating on numerous forms of student engagement), they only examined the measures separately, and the outcomes they examined were specific to academic achievement. As a consequence, a need exists for research that explicitly focuses on the question of whether one conception of academic rigor out-performs the other in terms of students' cognitive development. The current study addresses this need for research by conducting a simultaneous test of both conceptions of rigor. In doing so, it also builds on the work of Culver, Braxton and Pascarella (2019) by using the same data and the same measures of students' cognitive skills and traits to examine both conceptions of rigor. Further, based on their findings that benefits to

critical thinking and self-motivated learning dispositions were sometimes driven by one specific form of cognitive challenge (in class or in assignments), we also separately examined the different components of workload. Specifically, the study addressed the following questions:

1. To what extent are two conceptions of academic rigor, workload and cognitive challenge, related to students' development of need for cognition (NFC), positive attitudes towards literacy (PAL), and critical thinking skills (CT) after the first and fourth years of college?
2. To what extent are three individual components of workload (amount of reading, writing, and studying) related to students' development of NFC, PAL, and CT after the first and fourth years of college?
3. To what extent are three components of workload and two components of cognitive challenge related to students' development of NFC, PAL, and CT after the first and fourth years of college?

We provide a conceptual framework to posit relationships between workload and development of need for cognition, positive attitudes towards literacy, and critical thinking skills as well as the relationships between cognitive challenge and these cognitive outcomes. In addition to positing these relationships, the formulations of this conceptual framework provide a frame of reference for a discussion of the findings of this study.

## Theoretical and Conceptual Framework

A number of existing conceptual models and frameworks provide schemas for understanding the impact of college (e.g., Astin, 1984; Pascarella, 1985; Weidman, 1989; Pascarella & Terenzini, 2005) that take into account the influence of students' precollege experiences and individual traits, characteristics of the postsecondary institution attended, and

other college academic and non-academic experiences, including course-level academic rigor defined in terms of workload and cognitive challenge. These models view the impact of college as a longitudinal process. This common theme forms the core of our overarching conceptual framework and guides our attempt to estimate the association of these two conceptions of academic rigor with measures of critical thinking and self-motivated learning. Nevertheless, we advance different conceptual frameworks for each conception of academic rigor within the context of the previously described overarching conceptual framework.

**Framework for Course Workload and Cognitive Development**

Astin (1984) proposed a theory of involvement that accounts for various student outcomes. To elaborate, involvement requires the investment of psychological and physical energy in various general and specific focal entities. Involvement is a continuous concept as students invest in varying degrees of psychological and physical energy in different focal entities. Moreover, Astin asserts that students' involvement is proportional to their learning and development: "The extent to which students can achieve particular developmental goals is a direct function of the time and effort they devote to activities designed to produce these gains" (p. 301).

We extend the formulations of this theory to account for the influence of course workload as a conception of rigor on the development of need for cognition, positive attitudes towards literacy, and critical thinking skills. To elaborate, course instructors determine the workload required for the courses they teach. Course requirements include reading assignments directly related to the content of a course and writing assignments that demonstrate learning, as well as other assessments of learning, such as exams. These types of requirements are easily expressed as the number of books assigned as course readings and the required number of pages written for

graded course assignments over the course of a semester. Further, completing reading and writing assignments and preparing for exams all necessitate students' investment of time studying outside of class. As a result, students' course workload increases as their instructors assign a greater amount of course readings, written papers, and other types of assessments that require students to invest more time studying outside of class.

Accordingly, the greater the workload of the course, the greater the level of psychological and physical energy the student must invest. In turn, students' learning and cognitive development stems from the amount of involvement and engagement required by the workload of their courses. This direct connection is articulated by Kuh (2008):

> The more students study a subject, the more they know about it, and the more students practice and get feedback from faculty and staff members on their writing and collaborative problem solving, the deeper they come to understand what they are learning and the more adept they become at managing complexity, tolerating ambiguity, and working with people from different backgrounds or with different views (p. 5).

Thus, course workload provides evidence of academic rigor because of the involvement it requires of students. In turn, academically rigorous courses promote students' learning and development, including helping them develop self-motivated learning dispositions such as need for cognition and positive attitude towards literacy, as well improving their critical thinking skills.

**Framework for Cognitive Challenge and Cognitive Development**

Instructors determine the level of the academic rigor in coursework through the cognitive complexity implicit in course activities (Braxton & Nordvall, 1985). These activities consist of assigned course readings, methods of assessment, and the level of discourse used and expected

during lecture and discussion. In-class practices, exams, and assignments that ask students to compare and contrast course content, as well as those that ask students to critique, to analyze, and to create and defend arguments all require higher-order levels of understanding, functioning as forms of training and practice in higher-order thinking. These cognitive tasks also fit conceptions of critical thinking (Furedy & Furedy, 1985), and scholarship demonstrates that explicit training in higher-order thinking approaches promotes development of critical thinking skills (Reed & Kromrey, 2001; Renaud and Murray, 2007; Barnett and Francis, 2012; Wyre, 2012). Moreover, assignments and in-class practices that convey an expectation for a higher-order understanding of course content also influence how students study (Scouller, 1998), promoting students' use of deep approaches to learning (Biggs, 1979; Entwistle, 2010; Marton & Saljö, 1976). Whereas surface-level learning entails rote memorization of course content (Entwistle, 2010), deep-level learning results from instructions or questions that require higher-order understanding of course content. Therefore, expectations for higher-order understanding can influence students' critical thinking skills and their self-motivated learning dispositions related to thinking, reading, and writing. This assertion finds empirical support in the positive relationship between deep learning approaches and self-motivated lifetime learning (Kirby et al., 2010).

## Methods

This study used the Wabash National Study of Liberal Arts Education (WNS), which included three cohorts of full-time, first-time students who entered college in 2006, 2007, and 2008. The sample contained 46 four-year colleges and universities; these institutions exhibit a wide range of selectivity, tuition costs, and geographic diversity in the U.S. (a full list of participating institutions is available here: https://centerofinquiry.org/wabash-national-study-

participants/). However, the sample of institutions can in no way be considered a nationally representative probability sample of American postsecondary institutions. There are two major reasons that led to this limitation in the external validity of the study. First, the data collection process required a substantial commitment of time and resources at each participating institution. Therefore, we selected only those institutions that responded positively to a national call for institutions that wished to participate in a study of the effects of liberal arts education, while simultaneously agreeing to commit the substantial time and resources required. Second, because of the study purpose, students attending liberal arts institutions were purposefully oversampled. For each cohort, data was collected in three waves: the beginning of the first year (Time 1), the end of the first year (Time 2), and the end of the fourth year (Time 3). Data collection at Time 1 included the WNS precollege survey instrument, which asked students to provide information on demographics, family background characteristics, and a number of precollege experiences, with a focus on academic and social experiences in high school. At Time 2 and Time 3, data were collected using both the WNS Student Experiences Survey and the National Survey of Student Engagement student survey. Students provided information about a number of college experiences, their levels of engagement, and their exposure to academically rigorous practices. In addition, at each time point, students completed a number of cognitive and psychosocial instruments measuring outcomes associated with a liberal arts education, including measures of need for cognition (NFC), positive attitudes towards literacy (PAL), and critical thinking skills (CT), providing longitudinal information about these outcomes.

Data collection took about an hour and a half at each timepoint, and because of cognitive effort required by the CT instrument, researchers randomly assigned half of the sample to complete this measure; the other half of the sample completed a similarly demanding moral

reasoning test. Data collection was administered and conducted by the American College Testing Program (ACT), concluding in 2012. Among the 16,717 students attending four-year institutions who participated at Time 1, response rates were 50.7 percent at Time 2 and 37.3 percent at Time 3 (with a continued response rate of 73.6 percent from Time 2 to Time 3).

**Analytic Sample**

In order to examine the two conceptions of academic rigor longitudinally, the analytic sample for each outcome was limited to students who completed that outcome at both follow-up time points (2,744 for NFC, 2,852 for PAL, and 1,281 for CT). Missing information on independent variables ranged from 0 percent to 35 percent; therefore, multiple imputation using chained equations (MICE) was used to handle missing data. Examination of Monte Carlo error estimates determined that 20 imputations were adequate to obtain stable MICE results (White et al., 2011). MICE introduces random variation to each imputed data set, resulting in larger standard errors compared to single-imputation approaches, which reduces the likelihood of Type I error (Collins et al., 2001). Outcomes were included in the imputation equations; however, imputed values of the dependent variables were removed before analyses, as imputing outcomes adds no information and may add noise to results (von Hippel, 2007). MICE was conducted separately to examine critical thinking, as only half of the Wabash sample completed the CAAP instrument.

In addition, a multi-level sample weighting algorithm was implemented. Institution-level weights accounted for the differential probability of being included in the study, as students were randomly sampled at larger institutions while all students at smaller institutions were invited to participate. Individual-level weights were created based on the sex, race/ethnicity, and standardized test scores of students who participated in WNS and institutionally-reported IPEDS

data specific to the cohort year(s) of participation. Separate individual-level weights were created for the first year and fourth year in order to make the WNS sample more representative of students attending participating institutions at each time point. The use of individual-level weights can be particularly helpful to address the underrepresentation of students from minoritized groups in the analytic sample, as these students may be less likely to participate and to complete follow up data collections. The combined multi-level weights were normalized with a mean of 1.0 to maintain the analytic sample size (for more information about constructing and applying sampling weights, see Biemer & Christ, 2008; Groves et al., 2009; Rabe-Hesketh & Skrondal, 2006). Within the weighted analytic samples, 50 percent attended liberal arts institutions, 32 percent attended research universities, and 18 percent attended regional institutions. Additionally, 60 percent were female, 8 percent were Asian American/Pacific Islander, 6 percent were Black/African American, and 6 percent were Latino/Hispanic.

## Variables

**Dependent Variables.** The dependent variables included in this study represent three dimensions of students' cognitive traits and skills: enjoyment of thinking, enjoyment of engaging in literacy-related activities, and critical thinking skills. Enjoyment of thinking was measured using the 18-item Need for Cognition scale (NFC). This instrument was developed by Cacioppo and Petty (1982), who conceptualized need for cognition as "the tendency for an individual to engage in and enjoy thinking" (p. 116). Students with higher scores on NFC are more likely to be motivated to apply their thinking skills, to engage in thinking activities, and to enjoy the thinking process. The internal consistency reliability of NFC is 0.89. Enjoyment of engaging in literacy-related activities was measured using the Positive Attitudes Towards Literacy scale (PAL), which encompasses students' enjoyment of such literacy activities as reading poetry and

literature, reading scientific and historical material, and expressing ideas in writing (Pascarella, 2008). PAL has an internal consistency reliability of .71 and is correlated with the cumulative number of unassigned books read and library use during college, as well as reading comprehensions skills after three years of college (Bray et al., 2004).

Critical thinking skills were measured using the CAAP Critical Thinking Test, a 40-minute, 32-item instrument developed by ACT that measures a student's ability to analyze, evaluate, clarify, and extend arguments. This instrument is highly correlated with other measures of critical thinking like the Watson Glaser Critical Thinking Appraisal (Pascarella et al., 1995), has high internal consistency reliabilities, ranging between 0.81 and 0.82 among multiple populations of first-year students, and has well-documented content and predictive validity (ACT, 2010).

**Independent Variables.** The independent variables of interest were composite measures representing two conceptions of academic rigor used in the literature: course workload demands and cognitive challenge. Course workload demands included (1) total number of pages of assigned writing completed and (2) assigned books read this year, as well as (3) the number of hours spent studying per week, measured using several items from the National Survey of Student Engagement student survey. Total number of pages of assigned writing was calculated using three variables measuring the number of papers written that were fewer than 5 pages, between 5-19 pages, and 20 or more pages in length, using syntax provided by the Center for Postsecondary Research (2020). The number of assigned books read and number of hours spent studying were each measured with a single item. To account for different response scales, as well as potential disciplinary differences in requirements for reading, writing, and studying, these

items were standardized and then averaged to represent the total course workload demands that students completed.

Expectations for course learning in the form of cognitive challenges that require higher order thinking were measured using two scales that disaggregated cognitive challenge in class and in assignments. Two items comprised the in-class scale, measuring the frequency with which instructors asked students to point out any fallacies in basic ideas, principles, or points of view presented in the course and the frequency with which instructors asked students to argue for or against a particular point view. This scale has internal consistency reliability at 0.71 at both time points. Challenging assignments includes three items measuring how often exams or assignments required students to engage cognitively: to compare or contrast topics or ideas from a course, to point out the strengths and weaknesses of a particular argument or point of view, and to argue for or against a particular point of view and defend their argument. This scale has internal consistency reliability of 0.81 - 0.84. All scale items asked students to describe experiences in class or at this college; thus, students responded based on first-year experiences at Time 2, and based on their aggregate undergraduate experiences at Time 3.

Based on our conceptual framework, we also included a plethora of variables to account for other potential influences on students' cognitive development during college. As students' background characteristics often predict their participation and outcomes (e.g., Kinzie et al., 2007; Radford et al., 2010), models included students' race/ethnicity, sex, highest level of parental education, precollege standardized test scores, and the precollege measure of the associated outcome. Three institutional characteristics that have been previously found to be related to students' learning experiences and outcomes (Seifert et al., 2008; Seifert et al., 2010) were also included: institutional type, average educational expenditures during study

participation, and WNSLAE cohort of participation. Models also included students' potential participation in a number of high-impact practices (Kuh, 2008) that would likely shape the environment for course workload demands and cognitive challenge, including honors programs, first year seminars, learning communities, undergraduate research experiences, course-based service learning, and diversity course experiences, as well as the quality of students' interactions with instructors outside of class. Engagement in these academically-oriented experiences were measured at Time 2 for first-year analyses and at Time 3 for fourth-year analyses. To account for disciplinary differences in pedagogic approaches, including norms around workload and cognitive challenge (Braxton, 1995; Braxton et al., 1998), first-year models included intended major and fourth-year models included college major. Additionally, as students mostly fulfill general education requirements in their first year, institutional records were used to create a scale measuring the paradigmatic development of courses taken by each student based on Biglan's (1973) categorization of hard and soft disciplines (Kilgo et al., 2017). In addition, to further account for students' behaviors and attitudes, we included measures of students' academic motivation, average grades, and time spent working for pay. Full descriptions and descriptive statistics for all variables included in this study are available from the authors.

**Analysis**

Analyses were performed in several steps using OLS regression; continuous variables were standardized to facilitate meaningful comparisons of regression estimates. First, to examine the comparative relationship between each conception of academic rigor and students' cognitive development, regression estimates were generated that included workload, challenge, and control variables on each of the three outcome variables for the end of students' first and fourth years of college. As a second step, to examine whether individual components of workload demands were

related to cognitive development, we entered the three workload items simultaneously with controls into each outcome model to see whether one measure of workload may be more influential, net of the other workload measures. Next, we entered the three workload items with the two challenge subscales to see whether the relationships found for workload persisted. Finally, given that exams and assignments that are cognitively challenging may require longer papers, greater amounts of reading, and more time studying, we also examined the potential interaction of challenging assignments with each of the components of workload.

All analyses accounted for potential issues related to the clustering and nesting of students within cohorts and institutions by utilizing a Stata clustering command (svy), which adjusts for the possibility of artificially reduced standard errors that may increase the probability of a Type I error (rejecting a true null hypothesis) (Groves et al., 2009). The variance inflation factor across all models ranged from 1.02 to 2.91, well below maximum recommended thresholds (Myers, 1990; Stevens, 2002).

## Limitations

The present study includes some limitations. Institutional participation in WNSLAE was limited to institutions located in the United States with a stated commitment to liberal arts education, so these institutions are not representative of all colleges and universities. Therefore, results of this study may not necessarily be generalizable to all colleges and universities or all college students. Additionally, this study uses an existing dataset where measures of critical thinking skills, need for cognition, positive attitudes towards literacy, workload demands, and cognitive challenge were pre-determined by researchers who designed WNSLAE. As such, this study's interpretation is limited to these specific measures. Further, included measures of workload and cognitive challenge stem from students' self-

reported perceptions of how often they studied, how many papers they wrote, and how often they experienced certain cognitively challenging instructional practices; students may be challenged to accurately report these behaviors, especially when the asked to recall behaviors over a prolonged period of time (Porter, 2011; Ross, 1989). Therefore, these items may not represent objective measures of students' behaviors or experiences.

## Results and Discussion

The estimated net general effects of the composite workload and cognitive challenge measures on students' positive attitude towards literacy activities, need for cognition, and critical thinking skills are summarized in Table 1. Following Harel's (2009) recommendations for calculating $R^2$ in multiply imputed data, these regression models (i.e., workload, cognitive challenge, and covariates) explained between 47 and 63 percent of the variance in the dependent measures at the end of the first year in college and between 46 and 58 percent of the variance in the dependent variables at the end of the fourth year of college.

The composite cognitive challenge measure has positive associations with all three outcomes, with significant results for positive attitudes toward literacy (PAL) and need for cognition (NFC) at the end of both the first and fourth year and significant results for end-of-fourth-year critical thinking (CT). In comparison, course workload only shows a positive association end-of-fourth-year PAL. This finding contrasts with the positive association of course workload with critical thinking found by Arum and Roksa (2011) and by Carini and colleagues (2006). Although differences in the measurement of critical thinking may account for this discrepancy, a more compelling explanation springs from our study's simultaneous test of both conceptions of academic rigor.

In all cases, the estimated net effects of both conceptions of rigor ranged between small and medium (Mayhew et al., 2016). Further, the results for cognitive challenge are quite similar in magnitude to those found by Culver, Braxton, and Pascarella (2019). Given that this study also included the workload conception of rigor, whereas the earlier study by Culver and colleagues did not, the similarity of results suggests that the role of cognitive challenge in promoting students' development of self-motivated learning dispositions and critical thinking skills may not be dependent on the amount of work required in their courses. As the formulations of this study's conceptual framework suggest, cognitive challenge connotes an expectation for a higher-order understanding of course content which affects how students study (Scouller, 1998), prompting students' use of deep approaches to learning (Biggs, 1979; Entwistle, 2010; Marton & Saljö, 1976). Thus, it may be that it is the quality of students' studying efforts, rather than the quantity, which promotes their cognitive development.

Table 2 presents results for the individual components of course workload. Among these components, the only aspects of workload that is significantly and positively related to the outcomes is the number of books read, with positive associations with PAL at both time points and with end-of-first-year NFC. It is not surprising that greater amounts of reading are associated with greater enjoyment of reading; it may be that students who enjoy reading are more likely to complete more reading for class or that reading for class promotes' students' enjoyment of literacy activities. Additionally, the positive association of reading with NFC aligns with the results of previous research that found that students with higher NFC tended to spend more time reading each day (Turner & Croucher, 2014) and to have better comprehension of texts (Dai & Wang, 2007). Learning through reading may also spark students' interest in course content, facilitating deep thinking and helping them develop curiosity as a habit of mind. In contrast, the

number of hours spent studying bears a negative association with end-of-first-year PAL. Given that time studying is net of the number of pages read and written, this negative relationship may reflect students' surface learning approaches, including repeated "rereading" of materials for rote memorization (Entwistle, 2010), which may reflect diminished enjoyment in reading.

When workload components are considered net of the components of cognitive challenge, as shown in Table 3, the positive links of number of books read with end-of-first-year and end-of-fourth-year PAL persist, as does the positive association with first-year NFC; the negative association of hours spent studying with end-of-first-year PAL persists as well. Interestingly, these results suggest that a greater amount of assigned course reading is related to students' self-motivated learning dispositions regardless of the amount of cognitive challenge it presents. Further, as we also controlled for the paradigmatic development of students' coursework and their intended major, these findings likely do not reflect disciplinary differences in course reading norms such as assigning textbooks versus novels. Given the self-paced, flexible nature of reading, these findings align with the work of Deci and Ryan (1985), who argued that autonomy promotes engagement and self-motivated learning.

At the same time, Table 3 also demonstrates that, net of the components of workload, in-class cognitive challenge is related to end-of-first-year PAL and end-of-fourth-year NFC, while challenging exams and assignments are positively related to both PAL and CT at the end of the fourth year. These results are also comparable to those of the Culver et al. (2019) study, in which the same significant relationships were found with one exception. The previous study did not report significant findings in any year for CT in terms of either in-class or assignment rigor. In contrast, the results of our study reflect a small effect size for the relationship of cognitively challenging assignments and exams with students' end-of-fourth-year CT, net of the components

of workload. These findings suggest that, in the earlier study, cognitively challenging exams and assignments likely reflected the relationship of workload with critical thinking, so that once we accounted for students' time studying, as well as their reading and writing, the relationship of cognitively challenging assignments is revealed.

Additionally, we found no significant interactions between cognitively challenging exams and assignments and any of the workload components for any of the three outcomes. These results suggest that instructors can benefit students' development of cognitive skills and traits through cognitive challenge without necessarily increasing their workload.

## Implications for Practice, Research and Theory

We offer three interrelated conclusions derived from the pattern of our research findings. First, we simultaneously tested the associations between both conceptions of academic rigor and three different aspects of students' cognitive development. The results of these tests afford additional empirical support for each of these two distinctly different conceptions of academic rigor. However, our simultaneous tests of these two distinct conceptions of rigor offer more extensive empirical affirmation for cognitive challenge. Consequently, we conclude that cognitive challenge outpaces course workload. These findings align with the argument made by Kuh et al. (2005) that what is important is "whether the amount and nature of the work stretches students to previously unrealized levels of student effort, understanding and accomplishment" (p. 178). In fact, cognitive challenge outperforms course workload when examined as composite measures and when we look at the individual components.

To elaborate, cognitive challenge exhibits a pervasive association with the cognitive development of undergraduate college students. Such pervasiveness pertains to both the types of development as well as when theses associations occur. Apart from critical thinking (CT), a

relationship delayed until the end of the fourth year, the statistically significant positive associations with our two measures of self-motivated learning, positive attitudes towards literacy (PAL) and need for cognition (NFC), transpire at the end of both the first and fourth year. In contrast, a limited association transpires for the composite measure of course workload with students' cognitive development, a relationship limited to one form of self-motivated learning and to when it occurs. Specifically, composite workload shows a statistically significant positive relationship with PAL delayed until the fourth year.

With regard to specific aspects of both conceptions of academic rigor, one of three components of workload show a positive link to indicators of students' self-motivated learning habits whereas both specific aspects of cognitive challenge bear relationships to students' development of these traits. Specifically, in terms of workload, the number of books read shows a positive connection with both measures of self-motivated learning dispositions: PAL at both time points and first year NFC. In comparison, in-class cognitive challenge exhibits positive relationships to PAL at the end of the first year and NFC at the end of the fourth year. In addition, cognitively challenging course exams and assignments show positive connections with both PAL and CT in the fourth year.

Given that our simultaneous test of both conceptions of academic rigor provide additional empirical backing for both conceptions, we posit that college and university instructors can employ rigorous practices among undergraduate college students with different background characteristics across a range of colleges and universities based their goals for the development of cognitive skills and self-motivated learning habits. As measures of students' self-motivated learning dispositions, NFC and PAL plumb some aims of higher education, including helping students become lifelong learners. At the same time, the development of critical thinking skills

stands as a goal central to the mission of most colleges and universities (Mayhew et al., 2016). Moreover, critical thinking constitutes a common purpose of higher education among college and university instructors (Lattuca & Stark, 2011). As cognitively challenging exams and assignments was the only component of either conception of academic rigor that was significantly related to students' critical thinking skills, we advance our third conclusion that these course practices provide a path to fostering students' development of critical thinking skills over four years, likely reflecting a cumulative effect as students were asked to reflect on the assignments and exams they had encountered throughout college.

**Implications for Practice**

By simultaneously examining two conceptions of academic rigor—one defined through students' workload and the other defined through the cognitive challenge of instructional practices—we are able to offer implications for practice focused on improving the academic rigor of students' coursework to benefit their cognitive development. The primary implication involves institutional efforts to provide instructors with the knowledge and skills to develop courses where content, discourse in class, and course assessments require a higher-order understanding of course content. Two recommendations for institutional practice spring forth from this assertion.

Because many college instructors do not receive training for college teaching as a part of their graduate socialization process (Austin, 2002), they may lack the knowledge and skills to develop in-class questions, course examinations and assignments that require a higher-order understanding of course content. Accordingly, we recommend that instructional development centers, programs, and professionals offer workshops or seminars on creating cognitive challenge that is developmentally appropriate and inclusive.

Teaching well requires focus, commitment, and an expenditure of considerable energy (Bess, 2000). This assertion aptly applies to the development of course activities and materials that require a higher-order understanding of course content as their development requires the expenditure of effort by instructors. To motivate instructors to expend the necessary effort to develop such course materials, faculty personnel decisions, including continued appointment, salary, promotions, and tenure, could assign greater value to such activities. These recommendations stem from the view that postsecondary instructors will be motivated to expend the required effort to develop cognitively challenging courses if they perceive that their efforts will be rewarded through institutional recognition and increased status, continued employment, and financial gain (Braxton, 2008).

**Implications for Future Research**

We also advance two recommendations for further research on the two conceptions of academic rigor. First, although our findings indicate the links between course workload and development of self-motivated learning are less extensive than those of cognitive challenge, some faculty members may choose to continue to view academic rigor as a matter of course workload. However, the academic discipline of a course may shape norms related to the amount and type of assigned reading in a course, especially since disciplines differ in their proclivity towards literature, textbooks, and journal articles. Hard science disciplines (e.g. chemistry) display a greater orientation towards journal articles whereas books receive greater attention by the humanities and social sciences (Biglan, 1973; Wanner et al., 1981). The academic discipline of a course may also constrain the use of course activities that require higher-order understanding of course content as research shows that faculty in such disciplines as history and sociology tend to ask more questions requiring the synthesis of course content on their examinations than do

faculty members in such disciplines as biology and chemistry (Braxton & Nordvall, 1988; Kilgo et al., 2017). Thus, future research could focus on whether there are systematic differences across disciplines in how instructors conceive of and implement academic rigor. Future research can also explore whether the relationships of each conception of rigor with students' cognitive development vary by discipline.

In addition to cognitive skills and dispositions, researchers could also entail the simultaneous tests of both conceptions of academic rigor with other desired outcomes of college. For instance, scholars could examine other measures of student learning such as the development of verbal and quantitative skills, including the Graduate Record Examination, the Medical College Admissions Test (MCAT) and the Law School Admissions Test (LSAT) (Mayhew et al., 2016), as well as students' academic achievement and degree attainment. Similarly, future research could explore the relationship of each conception of rigor with students' psychosocial development, including their sense of belonging, resiliency, and growth mindset, which Baldwin et al. (2020) refer to as learning mindsets. Research using these different measures in simultaneous tests of course workload and cognitive challenge might yield a different pattern of findings than we describe herein.

Finally, as both conceptions of academic rigor stem from notions of students' engagement and effort, future research could examine whether the two conceptions of rigor might advantage students differently based on their individual traits and backgrounds. Similarly, given that the data used in this study is about a decade old, research that explores each conception of rigor among today's more diverse postsecondary population is particularly important for equity. For instance, low-income students are more likely than their wealthier counterparts to work for pay, to commute to campus, and to have family responsibilities while

attending college (Kezar et al., 2015), all of which are time commitments. Thus, courses with demanding workloads may present significant obstacles to success for these students.

### Implications for Theory

This study's findings offer empirical support for the conceptual and theoretical framework for this study. This study's finding of a positive relationship between the number of books read in a course and positive attitudes towards literacy and need for cognition occurring at the end of students' first year of college provides some empirical support for the assertion that such self-motivated learning outcomes occur because of the level of psychological and physical energy that a student must expend in reading books for a course. This assertion constitutes a fundamental formulation of the workload as rigor segment of this study's conceptual framework. This assertion also constitutes a fundamental tenet of Astin's (1984) theory of involvement. As such, the findings of this study join the ranks of a multitude of other studies that provide empirical affirmation for Astin's theory of involvement. In their extensive review of the literature, Mayhew et al. (2016) offer such evidence.

This study's findings also offer empirical affirmation for the formulations of the cognitive challenge conceptual framework that posits that assignments and in-class practices that express an expectation for a higher-order understanding of course content influence how students study (Scouller, 1998) and encourage their engagement in deep approaches to learning (Biggs, 1979; Entwistle, 2010; Marton & Saljö, 1976). This study's pattern of findings that show a pervasive relationship between composite cognitive challenge, including both of its specific components, and the three aspects of cognitive development (positive attitudes towards literacy, need for cognition, and critical thinking) provides such empirical backing.

## Closing Thoughts

In this study, the use of a longitudinal, multi-institutional, and comprehensive dataset supported our comparison of two conceptions of academic rigor: one based on workload and the other based on cognitive challenge. In general, results suggest that cognitively challenging instructional practices are more beneficial for students' development of self-motivated learning dispositions and critical thinking skills in their first year of college and after four years of college. Further, as these results were net of course workload, this study provides evidence that promoting students' cognitive development by challenging them cognitively does not require students to commit intensive amounts of time and effort to complete readings or write long papers.

This study presents several recommendations for instructors and scholars in higher education. While measures such as the number of books read may be less applicable today given instructors' increasing usage of free and low-cost alternatives to textbooks, the concepts underlying our findings likely remain true: students' cognitive development is best fostered through constructively challenging coursework rather than strenuous workloads. The recent COVID-19 pandemic has highlighted the opportunity gap (Pendakur, 2016) that many students face, including inequitable access to internet, technology, quiet spaces to learn, and time. At the same time, since most courses moved online, students nationally have reported feeling overwhelmed from an increased workload (Barre, 2021). From these perspectives, asking students to do cognitively challenging work rather than giving them a heavy workload is an equity imperative. As such, academic rigor as a higher-order understanding of course content also requires attention by institutional leaders. Especially as cognitive challenge may be more difficult to implement and measure compared to workload, administrators and policymakers should consider how to assess the level of cognitive challenge students experience in their

courses in order to support student success, as a means of examining institutional quality, and as an approach to rewarding instructors' use of cognitively challenge instructional practices.

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Table 1. Standardized regression coefficients for the relationship of two scaled conceptions of rigor with critical thinking, need for cognition, and positive attitude towards literacy after first and fourth year of college

| | Positive Attitudes Towards Literacy | | Need for Cognition | | Critical Thinking | |
|---|---|---|---|---|---|---|
| | First Year | Fourth Year | First Year | Fourth Year | First Year | Fourth Year |
| | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) | β (SE) |
| Workload | .01 | .05** | .01 | .03 | .01 | .02 |
| | (.02) | (.01) | (.03) | (.02) | (.02) | (.02) |
| Cognitive challenge | .08** | .08** | .04* | .09*** | .00 | .05* |
| | (.02) | (.02) | (.01) | (.02) | (.02) | (.02) |

*Note.* All models included controls for institutional type, average educational expenditures during study years, and WNSLAE cohort, as well as students' sex, race/ethnicity, parental education, and ACT/SAT ability and the precollege measure of each outcome. First-year models included additional controls for high school interactions with teachers; first-year experiences and traits (student-instructor contact, paradigmatic development of coursework, intended major, academic motivation, average grades, diversity course experiences, and time spent working for pay); and first-year participation in an honors program, first-year seminar, learning community, service learning, and research with instructors. Fourth-year models included additional controls for fourth-year experiences and traits (student-instructor contact, college major, academic motivation, average grades, diversity course experiences, and time spent working for pay); and college participation in an honors program, learning community, service learning, and research with instructors.

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 2. Standardized regression coefficients for the relationship of individual components of the workload conception of rigor with critical thinking, need for cognition, and positive attitude towards literacy after first and fourth year of college

| | Positive Attitudes Towards Literacy | | Need for Cognition | | Critical Thinking | |
|---|---|---|---|---|---|---|
| | First Year β (SE) | Fourth Year β (SE) | First Year β (SE) | Fourth Year β (SE) | First Year β (SE) | Fourth Year β (SE) |
| Workload | | | | | | |
| Number of pages written | .00 | .03 | .00 | .01 | -.02 | -.01 |
| | (.02) | (.02) | (.02) | (.02) | (.02) | (.02) |
| Number of books read | .06** | .05** | .03* | .03 | .00 | .02 |
| | (.02) | (.02) | (.01) | (.02) | (.02) | (.03) |
| Hours spent studying | -.05* | .01 | .00 | .01 | .03 | .04 |
| | (.02) | (.01) | (.02) | (.01) | (.02) | (.03) |

*Note.* All models included controls for institutional type, average educational expenditures during study years, and WNSLAE cohort, as well as students' sex, race/ethnicity, parental education, and ACT/SAT ability and the precollege measure of each outcome. First-year models included additional controls for high school interactions with teachers; first-year experiences and traits (student-instructor contact, paradigmatic development of coursework, intended major, academic motivation, average grades, diversity course experiences, and time spent working for pay); and first-year participation in an honors program, first-year seminar, learning community, service learning, and research with instructors. Fourth-year models included additional controls for fourth-year experiences and traits (student-instructor contact, college major, academic motivation, average grades, diversity course experiences, and time spent working for pay); and college participation in an honors program, learning community, service learning, and research with instructors.

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3. Standardized regression coefficients for the relationship of individual components of two conceptions of rigor with critical thinking, need for cognition, and positive attitude towards literacy after first and fourth year of college

| | Positive Attitudes Towards Literacy | | Need for Cognition | | Critical Thinking | |
|---|---|---|---|---|---|---|
| | First Year β (SE) | Fourth Year β (SE) | First Year β (SE) | Fourth Year β (SE) | First Year β (SE) | Fourth Year β (SE) |
| Workload | | | | | | |
| Number of pages written | .00 | .02 | -.01 | .00 | -.02 | .02 |
| | (.02) | (.03) | (.03) | (.02) | (.02) | (.02) |
| Number of books read | .05** | .04* | .02* | .02 | .00 | .01 |
| | (.02) | (.02) | (.01) | (.02) | (.02) | (.02) |
| Hours spent studying | -.04* | .01 | .00 | .01 | .03 | .03 |
| | (.03) | (.01) | (.02) | (.02) | (.02) | (.03) |
| Cognitive challenge | | | | | | |
| In-class challenge | .07** | .01 | .02 | .08*** | .01 | .02 |
| | (.02) | (.01) | (.02) | (.01) | (.02) | (.02) |
| Challenging exams and assignments | .01 | .08* | .02 | .02 | -.01 | .05* |
| | (.02) | (.03) | (.02) | (.02) | (.02) | (.02) |

*Note.* All models included controls for institutional type, average educational expenditures during study years, and WNSLAE cohort, as well as students' sex, race/ethnicity, parental education, and ACT/SAT ability and the precollege measure of each outcome. First-year models included additional controls for high school interactions with teachers; first-year experiences and traits (student-instructor contact, paradigmatic development of coursework, intended major, academic motivation, average grades, diversity course experiences, and time spent working for pay); and first-year participation in an honors program, first-year seminar, learning community, service learning, and research with instructors. Fourth-year models included additional controls for fourth-year experiences and traits (student-instructor contact, college major, academic motivation, average grades, diversity course experiences, and time spent working for pay); and college participation in an honors program, learning community, service learning, and research with instructors.

* $p < .05$, ** $p < .01$, *** $p < .001$