Patterns of math and English self-concepts as motivation for college major selection

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ABSTRACT

A variable and person-centered approach was applied to understand the development of cross domain self-concepts of ability, patterns of math and English self-concepts of ability throughout adolescence, and their associations with college major. An expectancy-value perspective was integrated with dimensional comparison theory to understand how math and English self-concepts of ability relate to one another over time and within a person. Regression analysis identified a positive association of math self-concept throughout adolescence with math-related majors and a negative association of English self-concept with math-related majors. Cluster analysis classified students into six to seven patterns of varying math and English self-concepts of ability. Stereotypical gender differences were observed in cluster membership, with women overrepresented in high English clusters and males over represented in high math clusters. Cluster membership was predictive of the math-related college majors. Students who were higher in math self concept of ability relative to English were overrepresented in math intensive majors. Findings support the importance of considering intraindividual hierarchies and ipsative relationships when studying the development of self-concept of ability and academic choices.

What influences students' decisions about whether to pursue a math intensive college major or a field of study requiring more language arts skills? Why do men and women have unequal representation in math intensive majors like engineering and technology? Researchers have offered many explanations to these questions that often focus on differences in academic abilities, academic self-concepts, and academic values. A large body of literature has found that math competence, by itself, is not the primary factor explaining college major choice and cannot explain gender disparities (Ceci, Williams, & Barnett, 2009; Lindberg, Hyde, Petersen, & Linn, 2010). Therefore, any sufficient explanation must include considerations beyond academic achievement. Researchers interested in academic motivation have identified ability beliefs and subjective task values as primary predictors of academic choices, above and beyond math competence and performance (Guo, Marsh, Morin, Parker, & Kaur, 2015; Marsh & Yeung, 1997; Simpkins, Davis-Kean, & Eccles, 2006; Wigfield & Eccles, 2000).

Expectancy-value theory (EVT) posits that individuals' ability beliefs and subjective task values related to various academic tasks predict academic choices, performance, and engagement across these tasks (Eccles, 2009; Eccles et al., 1983). Complementing EVT research, the internal-external frame of reference (I/E) model of academic self-concept and its newer extension, dimensional comparison theory (DCT), states that students compare their achievement between domains when making conclusions about their relative abilities (Marsh, 1986, 1990; Marsh et al., 2014; Möller & Marsh, 2013). Therefore, higher math achievement can lead to lower verbal self-concept, and higher verbal achievement can lead to lower math self-concept (Skaalvik & Skaalvik, 2002). Although this theory is well established, the effect of cross domain influences on future academic choices has not been studied extensively.

Most studies that have investigated the role of self-concept of ability (SCA) on academic choices have focused only on a single domain such as math or English (e.g., Archambault, Eccles, & Vida, 2010; Musu-Gillette, Wigfield, Harring, & Eccles, 2015). However, evidence from both expectancy-value theory and dimensional comparison theory suggests that cross subject area domain comparisons might influence the development of academic ability self-concepts in specific subject areas and thus also influence academic choices such as college major and occupation. When choosing which occupation to prepare for or which college major to take, one's relative SCA and subjective task values may be more important than the absolute values for the various options by themselves. Although at a between person level, the person with the highest math SCA may be more likely to major in math-intensive field than a person with a lower math SCA, at the individual level, it is likely to be relative SCA across different subject areas (e.g., math versus language) that most influences major choice.

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To date, only a handful of studies have simultaneously considered multiple subject areas, and the results support the hypothesis that cross subject area comparisons help explain both individual and group differences in academic choices and gender differences (e.g., Wang, Eccles, & Kenny, 2013). However, most of these studies are not longitudinal, and the development of SCA over time across domains and its association with college major selection have not been studied to date. The present study builds on the existing literature by longitudinally investigating the development of academic ability beliefs of math and English in synchrony with each other throughout adolescence, and the extent to which these ability beliefs at various points of adolescence predict later college major selection. Additionally, we investigate gender differences in the development of academic ability self-concepts and choices of college major. By studying underlying patterns of math and English self-concepts of ability and their relation to choice of college major, we combine expectancy-value theory and dimensional comparison theory to better understand how individual students may or may not come to identify as "math" people (meaning they identify as more of a math oriented person than an English oriented person).

1. Theoretical framework

According to expectancy-value theory, achievement-related choices are directly influenced psychologically by relative expectations of succeeding in a task and the relative subjective task value associated with the task, compared to other options. Expectations for success reflect the perceived competence that an individual has in his or her ability to succeed in a domain in the near and distant future. Because expectancy for success and self-concept of ability within specific subject areas load highly on the same factor, we refer to these two highly related constructs with the term self-concept of ability when referring to perceived competence and personal efficacy. Self-concepts of ability are domain specific rather than global in nature (Marsh et al., 2015; Wigfield et al., 1997). For example, students may perceive themselves as competent in math, but not in English. Students assess their own skills by comparing their performances with those of other people and with their own performances across domains (Eccles, 2009). Furthermore, self-concepts are hierarchical in nature. For example, although a student may get high grades in multiple subjects, he or she may still feel more competent in one subject over another (e.g., math over English). Academic choices are made from a variety of options, and understanding the hierarchy of ability self-concepts is essential in understanding why a student would make one academic choice over another (Eccles, 2011).

Another theory focused on the development of self-concept of ability is the dimensional comparison theory, an extension of the internal-external frame of reference theory of self-concept (Möller & Marsh, 2013). According to the I/E model, self-concept of ability in a particular domain is informed in relation to internal and external frames of reference. The external frame of reference primarily reflects various types of social comparisons, such as when a student compares his or her perceived ability in a subject relative to the perceived ability of peers in the same subject. The internal frame of reference refers to how a student internally contrasts performance in one subject against his performance in another school subject. These internal, dimensional comparisons can result in a decreased SCA in one domain because of high achievement in another domain (Niepel, Brunner, & Preckel, 2014). For example, a student with high math achievement and low English achievement will likely develop a much higher math self-concept of ability than a student with high math achievement and even higher English achievement (Möller & Marsh, 2013). Generally, the better students perceive themselves at math, the less competent they perceive themselves at another subject like English, relative to their math SCA. DCT further adds that the farther apart two subjects are in content the larger the contrast effect will be. For example, math and English cross domain comparisons will likely be significantly more negative (contrasting) than nearer domains like math and physics,

which will be less negative or possibly even positive (assimilation).

2. SCA, college major, and gender differences

Many longitudinal studies have investigated SCA and subjective task value components in predicting academic choices such as math course taking behavior (Musu-Gillette et al., 2015; Simpkins et al., 2006). However, most studies that have investigated the role of SCA on academic choices have focused on analyzing a single domain, usually mathematics. Consistently, math self-concept of ability predicts high school math course taking behavior (Meece, Wigfield, & Eccles, 1990; Simpkins et al., 2006; Updegraff, Eccles, Barber, & O'Brien, 1996).

Decisions about college major based on self-concepts of ability and task values likely begin to form years before entry into college, possibly as early as 6th grade (Eccles, Vida, & Barber, 2004). A few studies have investigated the extent to which high school ability self-concepts predict college major. In a recent study investigating growth trajectories of math self-concept of ability from fourth grade to college, students who maintained a high SCA in math had a 75% probability of being in a math intensive major (Musu-Gillette et al., 2015). This study did not consider the possible influence of other domains of self-concept such as English on college major.

A few recent studies have considered the dual roles of math and English ability and self-concepts of ability in determining academic choices. In an international study of American and German high school students, cross domain self-concepts in high school and gender were predictive of high school course selection, with the German sample having larger SCA and stereotypical gender differences (Nagy, Garrett, Trautwein, Cortina, Baumert, & Eccles, 2008). German students who were high in English self-concept were less likely to take advanced math courses and German students high in math self-concept were less likely to take advanced English courses. In another study looking at math and English ability and self-concepts in 12th grade and their associations with college major choice, students with high math and moderate verbal abilities were more likely to select a STEM career than students in the high math and high verbal ability group (Wang et al., 2013). Women were more likely to be in the high math/high verbal group, possibly indicating that women had more choices based on their ability beliefs across multiple subjects. The authors suggested that frame of reference effects should be further investigated in subsequent studies. Lauermann, Chow, and Eccles (2015) also investigated the cross-domain effects of self-concepts and values in math and English, and found the combination of high perceived ability in both math and English led to a lower probability of math and science careers compared to students with high SCA in math and lower SCA in English. Although these studies looked at math and English self-concepts together, the analyses were cross-sectional and thus could not consider change over time in math and English self-concepts.

3. The present study

Researchers have recently expressed the need for more longitudinal analyses on self-concepts of ability across domains and concerns that analyses that only consider one domain such as math may be inadequate for understanding college major and occupation choices (Lauermann et al., 2015). This seems to be especially true when gender is considered, as prior research has found females to be consistently higher in English SCA than males (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002), which may result in more females selecting majors requiring high verbal skills. Unfortunately, despite a significant amount of research stating the importance of understanding the interplay of domain specific self-concepts when studying academic choice, the literature on the subject has been sparse and limited by cross-sectional designs.

In the present study, we seek to expand upon and address these concerns by using a longitudinal study of math and English self-concept