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Explaining gender-typed educational choice in adolescence:
The role of social identity, self-concept, goals, grades, and interests

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Abstract

In most industrialized countries, there are substantial gender differences in field of study, resulting in gender segregated labor markets. The present research ($N = 457$, M age = 14.98) investigated a diverse range of predictors of Swedish adolescents' choice of preparatory (STEM; humanistic) and terminal (e.g., electrician; health care) programs. The results revealed that social identity related variables (same-gender friendship networks, belonging, and adherence to gender stereotypes) mattered primarily for choice of gender-typed terminal programs, whereas academic self-concept and grades positively predicted selecting STEM and negatively predicted choice of gender-typed terminal programs for both girls and boys. Subject-specific interests were the most powerful and robust predictors overall and mediated the effects of academic self-concept and to a lesser extent social identity variables. The results illuminate the interaction between perceived barriers, opportunities, and interests in determining educational choice, the need to consider gender-typical choice for high-skilled and low-skilled career paths separately, and the importance of jointly considering a multitude of predictors that are typically studied in different fields.

Keywords: educational choice, STEM, gender, social identity, academic self-concept, interests.

The gender segregation on the labor market remains large. The horizontal segregation (referring to occupation type) is qualitatively similar in several industrialized countries, with health and childcare being female-dominated, whereas engineering, computer science, and construction (among others) are male-dominated domains. Although women have increasingly entered traditionally male-dominated occupations (with the exception of some manual labor occupations, e.g., carpenter, electrician), men are as likely as ever to avoid careers that are female-typed (Hegewisch, Liepmann, Hayes, & Hartmann, 2010; Löfström, 2005).

This gender divide has important consequences. At the macro level, it makes way for gender disparities in wages (Hegewisch et al., 2010; Petersen & Morgan, 1995). At a psychological level, it may solidify and strengthen gender norms, which could restrain individuals from pursuing their true ambitions and thereby affect their work satisfaction and general well-being (Heller, Watson, & Ilies, 2004; Lent & Brown 2008). In addition to this, organizations risk missing out on the advantages that gender diversity in the workforce can bring in terms of organizational performance (Krishnan & Park, 2005).

In the literature on occupational gender segregation, a lot of attention has been on the role of discrimination. However, recent evidence from field experiments suggests that gender discrimination in hiring is quite small overall (e.g., Bertrand & Mullanaithan, 2004; Carlsson, 2011; Riach & Rich, 2002). Moreover, even if gender discrimination in the hiring process were more widespread, this would not alone be sufficient for explaining the horizontal gender segregation on the labor market. This is because the gender differentiation starts in school, as boys and girls enroll in different courses (Watt, 2008). Gender is one of the main predictors of educational choices (e.g., Parker et al., 2012), and children as young as 6-8 years old begin to sort occupations based on gender role traditions (Gottfredson, 1981; Helwig, 2004).

As in the case of occupational gender segregation, women are underrepresented in fields of study such as engineering, mathematics, and computer science, while men are underrepresented in education, humanities, and health fields. Even in countries where women are well represented in elite sectors of education, large gender differences across field of study remain (Bradley, 2000; Jonsson, 1999). Importantly, many future career opportunities will be constrained by these early choices (Smyth & Steinmetz, 2008). For example, taking less math courses at school can often limit later access to math-intensive higher education.

What, then, are the reasons for the differential self-selection of men and women with regard to field of study? The answer seems to lie primarily in the roles of interests and motivation rather than ability, because girls and boys with similar abilities generally follow gender-typical choice patterns (Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Jonsson, 1999). More specifically, there are gender differences in participation in math and language courses and related career aspirations, which are explained by motivation over and above the effect of differences in achievement (Watt, 2008). An extensive review of research on why women are underrepresented in the top of math-intensive fields concluded that gender differences in preferences constitute the most powerful explanatory factor (Ceci, Williams, & Barnett, 2009). In particular, women's interests tend to be more people-oriented while men's interests are more things-oriented (Lippa, 1998, 2005). These gender differences have been observed across many countries (see Fouad, 2007; Su, Rounds, and Armstrong, 2009, for reviews), develop early in childhood (Ruble, Martin, & Berenbaum, 2006), and are quite stable over time (Hansen, 1988).

Several vocational theories have also proposed that perceived barriers to career attainment play a key role in transforming interests into action (e.g., Gottfredson, 1981; Jonsson, 1999; Lent & Brown, 1996). According to Gottfredson's theory of circumscription and compromise (TCC; 1981), aspirations arise from the combination of perceived barriers,

opportunities to attain a certain type of career, and interests. Perceptions of external barriers (e.g., anticipated unemployment) could leave a certain career choice unapproachable, resulting in a compromise whereby occupational aspirations are adjusted (Armstrong & Crombie, 2000; Tsousides & Jome, 2008). Previous research has showed that perceived barriers may also involve social psychological factors, such as the risk of losing friendships (Sinclair, Carlsson, & Björklund, 2014), the risk of being perceived as gender deviant (Sinclair & Carlsson, 2013), and self-doubts about not having what it takes to pursue a certain career, including a weak academic self-concept (evaluation of one's general ability in a domain; Parker et al. 2012). In addition to this, external barriers in the form of grades that limit access to popular educational programs and schools are important to take into consideration (Jonsson 1999; Ma & Johnson, 2008; Schoon, Ross, & Martin, 2007).

Furthermore, influential theories on vocational and educational choice, such as the Social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994) and the Expectancy-value theory (EVT; Eccles & Wigfield, 2002), propose that interests are a proximal explanation of career related choices. Interests are in turn, according to the SCCT's interest model, shaped by self-efficacy beliefs and outcome expectations (Lent, Brown, & Hackett, 1994). Interests may also be shaped by social psychological factors. For example, individuals who experience threats related to belonging or negative stereotypes may lose interest in, and become “disidentified” with, an academic domain, so that it is no longer linked to their self identity and values (Steele, 1997, p. 614). Indeed, recent work suggests that gendered interests are impacted by internalized gender stereotypes. For example, Bian, Leslie, and Cimpian (2017) found that a gender difference emerged at around the age of six, such that girls believed that members of their own gender are very smart to a lesser extent than boys did. Around the same age, girls started to lose interest in activities described as “for children who are really, really smart”, and this effect was mediated by gendered perceptions of brilliance.

Rationale and Aims of the Present Research

In order to understand why educational and occupational gender segregation remains large, we need to consider the role of self-selection into gender traditional careers. Previous research has suggested that there are multiple explanations, such as self-efficacy (Dickerson & Taylor, 2000), gender role conformity (Hackett & Betz, 1981), fear of being negatively stereotyped (Bergeron, Block, & Echtenkamp, 2006), and gender differences in the endorsement of communal goals (Diekman, Clark, Johnston, Brown, & Steinberg, 2011). However, previous studies have often focused on educational and occupational interests or aspirations in adult populations, rather than the actual behavior (educational choice) of adolescents. Moreover, the focus has primarily been on why women are less likely to pursue STEM (science, technology, engineering, and mathematics) fields, whereas we still know little about why men do not pursue female-typed career paths (Lee, Lawson, & McHale, 2015; Ochsensfeld, 2016). Finally, most past studies have focused on one or a few particular explanations of gendered career paths rather than jointly considering a multitude of factors, such as interests, goals, social identity, and ability, to determine how they are related to each other and which ones are most important.

In the present research, we sought to address these issues. We took a range of psychological factors into consideration, collecting self-reports of social identity variables, achievement goals, academic self-concept, and interests among adolescent boys and girls in Sweden. We subsequently followed up by collecting information about the participants' high school applications, admissions, and grades from archival records.

Entry into upper secondary education (the final stage of secondary education) occurs around the age of 15-16 in most OECD countries (OECD, 2013). Several of these countries are similar also in that some programs are “terminal”, meaning that students can start working after graduation, while others are “preparatory”, meaning that they prepare students for

tertiary education. In Sweden, adolescents apply for upper secondary education at the age of 15, and the choice of a high school program in part determines future access to higher education. Examples of areas that the national programs offer specialization in are social or natural sciences (preparatory), and construction or restaurant work (terminal). The system is similar in many other European countries (e.g., Denmark, Germany, Belgium, Spain, and Italy). It also resembles the U.S. high school system in that some courses are mandatory while others allow for specialization.

In the current study, we divide the outcome variable (choice of high-school program) into four categories, consisting of fields of study that are qualitatively similar: traditionally male-typed programs that are preparatory (STEM), male-typed programs that are terminal (e.g., construction, electrician), female-typed programs that are preparatory (social sciences and humanities), and terminal female-typed programs (e.g., health care, childcare). These categories correspond well to previous findings showing educational gender segregation along both a humanistic-scientific divide and a care-technical divide (Barone, 2011).

We expected that factors relating to social identity would be particularly important for choice of gender-typed terminal programs, because gender disparities are largest in fields that prepare for manual or low-skilled occupations (Löfström, 2005), and thus factors related to gender (e.g., adherence to gender stereotypes) should matter more for these programs. By contrast, achievement goals and academic self-concept should be more important for preparatory programs that make way for higher education and specialization. We also looked into the possibility that some factors exert their influence on gender-typed educational choice through shaping gendered interests (i.e., that interests mediate their effects on educational choice). Below, we briefly introduce the specific predictors that we took into consideration in this research.

Self-stereotyping: Adherence to Gender Stereotypes

Women are generally stereotyped as being warmer and more communal than men are, while men tend to be seen as being more competent and agentic than women (Prentice & Carranza, 2002). Self-stereotyping refers to a process through which an individual internalizes a stereotype, and this process can be either chronic (reflecting dispositional tendencies) or functional (shifting depending on the context; Burkley & Blanton, 2009). Women are nowadays similar to men in the way that they describe themselves in terms of agentic traits (e.g., assertive, ambitious) although some studies report lingering gender differences (e.g., Guimond, Chatard, Martinot, Crisp, & Redersdorff, 2006). Substantial gender differences in self-reported communion (e.g., caring, helpful) do, however, seem to persist (Twenge, 1997, 2001) and may help explain why men select nurturing occupations to a much lesser extent than women do. For example, gender-traditional choice may be a consequence of a fit between perceived occupational roles and gender stereotypes (Heilman, 1983), and men's selective self-stereotyping in cognitive domains is associated with their academic self-schemas (Oswald & Lindstedt, 2006). We therefore expected self-stereotyping to predict gender-typed choice of education in general, and choice of terminal programs, which are heavily gender segregated, in particular.

Gender Identity Concerns

The term gender identity is often used to refer to individuals' thoughts and feelings about their membership in a gender category (Tobin et al., 2010). For example, the theory of multifactorial gender identity suggests that people tend to have a general conception of themselves as "masculine" or "feminine" (Spence, 1993), which develops early and is central to their sense of self and rather stable over time. Even though most people have a gender identity, individuals may be more or less concerned with whether they are typical for their gender category or if they risk being perceived as gender deviant. Previous research suggests that adolescents high in such concerns tend to prefer more gender typical occupations

(Sinclair & Carlsson, 2013). We thus expected to find that adolescents with strong gender identity concerns are especially likely to select gender-typed educational paths, in particular the most gender segregated (terminal) programs.

Belonging and Friendship

People tend to seek out environments where they feel that they are accepted and that they belong (Baumeister & Leary, 1995). For example, Master, Cheryan, and Meltzoff (2016) found that adolescent girls' weaker sense of belonging mediated the effect of gender on interest in taking a computer science course. Similarly, Cheryan and Plaut (2010) found that perceived similarity to people in the field was a better explanation of women's weaker interest in computer science and men's weaker interest in English than expectations of success and social identity threat were. These findings make sense from a social identity perspective, which suggests that feelings of belonging arise from perceptions of being similar to other ingroup members (Easterbrook & Vignoles 2013). Belonging may be particularly important in adolescence, which is a period marked by increased sensitivity to social evaluation (Somerville, 2013). Because the fundamental desire to belong can be met by approaching the ingroup, we anticipate that adolescents who expect to fit in more in programs that are dominated by their own gender group are more likely to select a gender-typed program, in particular the more gender segregated (terminal) programs.

We also considered the role of gendered friendship networks and friendship priorities. Because social needs are so powerful (Baumeister & Leary, 1995), a desire to stay close to their friends may motivate some adolescents to rethink their educational choice. Indeed, recent findings suggest that some individuals may even be willing to compromise their career aspirations for the sake of securing friendships (Sinclair, Carlsson, & Björklund, 2014). Because people tend to have primarily same-gender friends, such career compromises translate into an increased probability of selecting a gender-traditional program. Accordingly,

we expected that prioritizing to be with friends, and having more same-gender friends, would predict selecting gender-typed programs, especially terminal programs.

Achievement Goals, Self-concept, and Interests

Goals are internal representations of desired states (Austin & Vancouver, 1996), and as such, they influence cognitions, affect, and behavior. A classical suggestion is that women tend to value interpersonal goals more than men do, while men tend to value achievement goals more (e.g., Morgan, Isaac, & Sansone, 2001). Such goals can involve aspiring to earn a good income and achieving high professional status, and this might help explain why men are more drawn to STEM fields, which are associated with greater prestige and higher income (Eccles, 1994). However, research on gender differences in occupational aspirations, prestige, and status has provided mixed results (Heek Lee & Rojewski, 2009). Nevertheless, adolescents differ in their achievement motivation and in the goals that they set for themselves (Shin & Ryan, 2014), and we thus expected achievement goals to predict selection of STEM programs and to negatively predict selection of terminal programs.

Academic self-concept refers to an individual's evaluation of his or her own general or domain-specific ability (Bong & Skaalvik, 2003; Marsh, 1986). High school students' academic self-concept has been linked to career choices in previous studies (Schoon & Eccles, 2014). For example, math self-concept predicts math-intensive college major choice (Guo et al., 2015) and a lower likelihood of selecting verbal-intensive majors (Parker et al., 2012). Gender differences in math self-concept have also partially mediated gender differences in STEM selection when controlling for prior achievement (Guo et al., 2015). Because academic self-concepts may be based on achievement experiences but also on gender socialization processes, they are considered important for understanding gender differences in educational choice (Eccles, 1994; Shapka, Domene, & Keating, 2008).

In the current study, we measured both general academic self-concept (concerning school performance) and subject-specific academic self-concept (e.g. math, social sciences). Because students with a strong academic self-concept should be more likely to aim for higher education rather than a vocational path (Parker et al., 2012), we expected general academic self-concept to predict choice of STEM and negatively predict choice of a terminal program. Furthermore, we expected math, science, and technology self-concepts and interests to predict choice of a STEM program, and language and social science self-concepts and interests to predict choice of humanities/social science programs.

In addition to academic self-concept, it is also possible that self-esteem matters. Although the direction of causal links between self-esteem and academic achievement has been debated, Whitesell et al. (2009) showed in a longitudinal study that self-esteem predicts adolescents' subsequent academic achievement. Because healthy self-esteem is associated with, for example, coping skills and persistence when facing challenges (Koch, 2006), it is possible that students with higher self-esteem become better prepared to succeed in school and set higher goals for themselves. We therefore looked into the possibility that self-esteem predicts entering STEM programs and negatively predicts selection of terminal programs.

Overview of Research

In sum, we hypothesized that general academic self-concept, achievement goals, self-esteem, and grade point average positively predict applying for a STEM program and negatively predict applying for a terminal program. We hypothesized furthermore that interest in mathematics, natural sciences, and technology, academic self-concept for these subjects, and grades in STEM subjects predict applying for a STEM program, that interest and academic self-concept with regard to social sciences and language, and grades in humanistic subjects, predict applying for a humanistic program, and that grades in practical subjects predict applying for a terminal program. These hypotheses were the same for boys and girls.

We had gender specific hypotheses only for the social identity variables. For boys, we hypothesized that masculinity, (low) femininity, gender identity concerns, friendship priorities, sense of belonging with boys, and proportion of male friends positively predict applying for a terminal male-typed program and applying for a STEM program and negatively predict applying for a humanistic program. For girls, we hypothesized that femininity, (low) masculinity, gender identity concerns, friendship priorities, sense of belonging with girls, and proportion of female friends positively predict applying for a terminal female-typed program and a humanistic program and negatively predict applying for a STEM program.

In addition to testing these hypotheses, we conducted a series of exploratory analyses. We investigated which of the aforementioned predictors were the strongest and most robust, and how much variance in educational choices they accounted for, when they were categorized into five groups: (1) general self-concept and goals, (2) social identity, (3) subject-specific interests, (4) subject-specific academic self-concept, and (5) grades. We also constructed an integrated model that included predictors from all of these categories, and we used this model to investigate whether the subject-specific interests mediated the effects of academic self-concept and social identity on educational choices.

Method

Participants

The participants were 457 adolescents in 9th grade from 8 different schools (and 26 different classes) located in the south of Sweden (190 girls and 266 boys), age range 13-16, $M_{\text{age}} = 14.98$, $SD = .35$) who received no compensation for their participation. We coded mother's occupation and found that 33.6% of the participants reported a high-skilled occupation, 43.4% reported a low-skilled occupation or that the mother was a student or business owner, 16.7% did not provide a distinct description (e.g., "school" or "office"), and the remaining 6.4% did not respond. For fathers, the proportions were similar: 29.2% high-

skilled, 46.7% low-skilled/student/own business, 16.2% unclear, and 7.0% missing. This clearly indicates that our sample was heterogeneous in terms of socioeconomic status.

A sample size of 200 is commonly seen as a goal when conducting Structural Equation Modeling (Kenny, 2015). Calculations of *post hoc* power for RMSEA (Preacher & Coffman, 2006) indicated that we had consistently near 100% power to detect a poor fitting model. A standard power analysis run in G*power 3.1.9 indicated that our sample gave us 80% power to detect an effect of $|\rho| = .15$ for men and $|\rho| = .18$ for women at a 5% significance level.

Materials and Procedure

For reasons of transparency, we report all measures in the order they were presented in the study and all data exclusions (if any).

We estimated internal reliability both in terms of the standard, widely used Cronbach's alpha (α) coefficient and in terms of the McDonald's omega (hierarchical) coefficient (ω_h), which is a stricter estimate of internal reliability in only taking the covariation between items that represents a general factor into account (Zinbarg, Revelle, Yovel, & Li, 2005).

Initial data collection. The first wave of data collection took place a few months prior to the time that the participating adolescents applied to high school. Consent was obtained from head masters and teachers in each school. The participants were informed that participation was voluntary, that they had the right to quit at any time, and that the data would be handled confidentially. We then asked for their civic registration number (similar to social security number) to be able to link them to the admission information that we were to collect later on.

The participants went on to report which program they intended to apply for from their first choice down to fifth choice. Next, general academic self-concept was captured with three items taken from the Self-Description Questionnaire (Marsh & O'Neill, 1984; validated with eight graders by Brunner et al., 2010): "I learn things quickly in most school subjects", "I do well on tests in most school subjects", and "I'm good at most school subjects" (1 = *do not*

agree at all, 7 = completely agree; $\alpha = .89$, $\omega_h = .89$ for girls; $\alpha = .88$, $\omega_h = .88$ for boys).

Subject-specific self-concept and interests were assessed through ratings of two items: “I’m interested in math” and “I’m good at math” (previously shown to work well in adolescent samples, see Parker et al., 2012). The same questions were included for technology, languages, natural science, social science; 1 = *do not agree at all*, 7 = *completely agree*).

The participants also rated the importance of selecting a program that gives access to higher education, and how certain they felt of their upcoming high school choice (1 = *not at all certain*, 7 = *very certain*). Achievement goals were measured with two items adapted from a scale that was developed and validated by Malouff et al. (1990) and previously used with adolescent samples (e.g., Caraway, Tucker, Reinke, & Hall, 2003): “I spend a lot of time thinking about what I want to work with in the future”, and “I set goals for things I want to attain in the future”, as well as two items that were constructed for the present study: “It’s important to me to get a job that pays well” and “It’s important to aim high when planning for future education and work”, (1 = *do not agree at all*, 7 = *completely agree*; $\alpha = .73$, $\omega_h = .61$ for girls; $\alpha = .72$, $\omega_h = .63$ for boys).

Next, the perceived importance of friends was measured with two items that were selected based on previous studies with adolescent samples (Sinclair, Carlsson, & Björklund, 2014): “How important do you find attending the same program as one of your friends?” (1 = *not at all important*, 7 = *very important*) and “Imagine that your best friend applied to a program that you had not intended to apply for; would you consider applying for the same program as your friend?” (1 = *absolutely not*, 7 = *absolutely*; $\alpha = .74$, $\omega_h = .74$ for girls; $\alpha = .77$, $\omega_h = .78$ for boys), and two items that we constructed for the present study: “How important do you find attending a program where you know somebody?”, and “How important do you find attending a program where you think that you could easily make new friends?” (1 = *not at all important*, 7 = *very important*). The participants also indicated how

many male friends they had compared to female friends (1 = *mostly female friends*, 7 = *mostly male friends*).

Self-stereotyping was measured with a short version of the Children's sex role inventory (developed and validated with children up to the seventh grade by Boldizar, 1991).

Femininity was measured with five items, including "When someone's feelings have been hurt, I try to make them feel better" and "I'm good at understanding other people's problems" ($\alpha = .71$, $\omega_h = .64$ for girls; $\alpha = .76$, $\omega_h = .70$ for boys). Masculinity was measured with six items, including "I would rather do things on my own way than ask others for help" and "I can get people to do what I want them to do most of the time" ($\alpha = .77$, $\omega_h = .72$ for girls; $\alpha = .73$, $\omega_h = .56$ for boys). The participants responded on a seven-point Likert scale (1 = *do not agree at all*, 7 = *completely agree*).

Next, we constructed three items to measure belonging depending on the gender distribution in the program: "I think I would be most comfortable in a program with...", "I think I would fit in if I enrolled in a program with...", and "I think that I would be treated badly in a program with ..." (1 = *mostly girls*, 7 = *mostly boys*). This last item was dropped due to poor reliability (for the remaining two items, $\alpha = .83$ for girls, $\alpha = .79$ for boys).

Gender identity concerns were captured with two items that were selected from previous studies using adolescent samples (Sinclair & Carlsson, 2013); girls rated how important it was for them to feel feminine and that others perceive them as feminine, while boys were asked the same two questions about masculinity (1 = *not at all important*, 7 = *very important*; $\alpha = .85$ for girls, $\alpha = .82$ for boys).

Self-esteem was measured with the six item version of the well-established Rosenberg Self-Esteem Scale, which is frequently used with adolescent samples (Rosenberg, 1989; Rosenberg, Schooler, Schoenbach, & Rosenberg, 1995; Supple; Su, Plunkett, Peterson, & Bush, 2013), including "I feel I have a number of good qualities" and "I am able to do things

as well as most other people” (1 = *do not agree at all*, 7 = *completely agree*; $\alpha = .83$, $\omega_h = .68$ for girls; $\alpha = .82$, $\omega_h = .69$ for boys).

Last, the participants reported their parents’ line of work (to confirm that we obtained a diverse sample concerning socioeconomic background), their gender, and age.

Follow-up. We obtained admission information from archival records, including which programs the participants applied to (first choice of boys: $n = 90$ for natural sciences, $n = 49$ for humanities, $n = 55$ for terminal male, $n = 22$ for terminal female, $n = 36$ for economics; first choice of girls: $n = 46$ for natural sciences, $n = 84$ for humanities, $n = 6$ for terminal male, $n = 36$ for terminal female, $n = 15$ for economics) and which programs they got accepted to (boys: $n = 78$ for natural sciences, $n = 51$ for humanities, $n = 48$ for terminal male, $n = 26$ for terminal female, $n = 33$ for economics; girls: $n = 43$ for natural sciences, $n = 83$ for humanities, $n = 3$ for terminal male, $n = 31$ for terminal female, $n = 18$ for economics). We focus on educational choice rather than eventual acceptance into study programs henceforth.

We also obtained grade point averages (GPA) and subject-specific grades from archival records. We calculated scores for grades related to STEM (mathematics, physics, biology, chemistry, and technology; $\alpha = .96$, $\omega_h = .93$ for girls; $\alpha = .95$, $\omega_h = .94$ for boys), humanistic subjects (religion, geography, history, Swedish, English, and social studies; $\alpha = .96$, $\omega_h = .96$ for girls; $\alpha = .95$, $\omega_h = .89$ for boys), and practical subjects (handicraft, arts, home education, music, and physical education; $\alpha = .80$, $\omega_h = .69$ for girls; $\alpha = .78$, $\omega_h = .71$ for boys).

Data Preparations

We followed both international (APA) and local ethical guidelines when collecting and storing the data. Two participants did not report their civic registration number, and we were therefore unable to obtain information about their high school admissions and grades from archival records.

Statistical Analyses

We analyzed the data through Structural Equation Modeling (SEM). This technique is superior to a standard regression framework because it allows us to represent variables as latent constructs and take their measurement error into account (Kline, 2005). We ran SEM in AMOS 23.0, basing calculations on the covariance matrix and the maximum likelihood method. All variables that were measured with more than one item (i.e., general academic self-concept, achievement goals, self-esteem, friendship priorities, belonging, gender identity concerns, femininity, masculinity, and grades in STEM, humanistic, and practical subjects) were represented by latent factors with each of their items as indicators; the other variables were manifest. We dummy coded educational choice into four different outcome variables: having (vs. not having) applied to (1) a STEM program, (2) a humanistic program, (3) a terminal male-typed program, and (4) a terminal female-typed program. All models we tested included these four outcome variables. We used a multiple-group model, calculating parameter estimates separately for men and for women. Because very few girls chose terminal male-typed programs and very few boys chose terminal female-typed programs, we do not report results on terminal female-typed programs for boys or terminal male-typed programs for girls.

We analyzed the data in three different stages. In the first stage, we tested our hypotheses, analyzing each of the predictors one by one. The following two stages were exploratory. In the second stage, we assessed how much variance of educational choices different kinds of predictors account for and which predictors matter most by constructing models for five different groups of predictors: (1) self-concept and goals (academic self-concept, self-esteem, and achievement goals), (2) social identity (masculinity, femininity, belonging, friendship priorities, gender identity concerns, and proportion of female friends), (3) subject specific interests, (4) subject specific academic self-concept, and (5) grades (grade point average, STEM subjects, humanities, and practical subjects). In the third stage, we

constructed a more comprehensive model that incorporated variables from all five groups and we used this model to investigate whether the effects of self-concept and social identity variables on educational choices were mediated by interests by estimating indirect paths.

[Insert Table 1]

Correlations between the predictors are displayed in Table 1. For the sake of simplicity, the three STEM subjects—mathematics, natural sciences, and technology—were grouped and girls' scores on belonging with boys and proportion of male friends were reversed to form indices of belonging with, and proportion of, same-gender peers only in this table.

The correlations between grade point average and subject-specific grades were very strong ($.84 \leq r \leq .94$), and the correlations between grades in STEM, humanistic, and practical subjects were almost as strong ($.73 \leq r \leq .86$). Although the combined model for grades had adequate fit when we included all four predictors (see Table 2), inspection of the covariances between the predictors ($\phi = .87-.96$), the path coefficients, and the squared multiple correlations revealed excessive multicollinearity. We therefore dropped this model.

When we built the full integrative model, we excluded subject-specific academic self-concepts because self-concept and interest with regard to the same subject consistently correlated very strongly ($.71 \leq r \leq .82$), and the self-concept variables had basically the same but weaker associations with educational choice, and slightly more overlap, than the interest variables did. We excluded subject-specific grades for the same reason. We excluded gender identity concerns, because this variable did not correlate at all with educational choice. We also considered excluding grade point average due to its strong correlation with general academic self-concept, but we kept it, because the parameter estimates were the same for the majority of the predictors whether it was included or not (except that effects of general academic self-concept on choice of terminal male-typed programs among boys and STEM

programs among girls were rendered insignificant by the inclusion of grades; see Supplementary Figures 1-2).

We investigated mediations using a simplified version of the integrated model in which the five interest variables were specified to be mediators of the effects of academic self-concept and social identity on educational choices. Self-esteem and achievement goals were excluded from this model, because neither of these predictors had any effect on educational choice independent of academic self-concept.

We assessed the measurement models in terms of χ^2 tests of goodness of fit and the Root Mean Square Error of Approximation (RMSEA), which estimates parsimony-adjusted fit in relation to a perfect model, with 90% confidence intervals. We do not report the Comparative Fit Index (CFI) because RMSEA of the independence model was below .158 in numerous cases, which means that CFI is not meaningful (Kenny, 2015). According to widespread conventions an RMSEA of .06 or lower indicates adequate model fit (Hu & Bentler, 1999). Fit statistics for all of the structural equation models are displayed in Table 2. The model fit was consistently adequate or close to adequate. Although a few factor loadings were a bit low, we did not drop any items, because the latent factor represents only the variance shared among the items.

[Insert Table 2]

We used saturated structural models, estimating covariances between the error terms of all predictors and between the error terms of all outcome variables (the fit was therefore the same when the hypothesized structural model was included, see Table 2). We report standardized coefficients for direct paths and unstandardized coefficients for indirect paths (summing those that run through the three STEM subjects and those that run through the two humanistic subjects respectively) with bias-corrected 95% bootstrap confidence intervals generated through 20000 resamples.

To avoid capitalizing on chance, we adjusted significance levels sequentially through Holm's (1979) modified Bonferroni correction for one gender at a time. We also tried removing multivariate outliers based on their Mahalanobis distance ($p < .001$, Tabachnick & Fidell, 2013) to gauge the robustness of the results. We present the results without exclusions after concluding that the exclusions would not have altered the results.

Results

The estimates of relations between each predictor and choice of educational programs are displayed in Table 3 (for boys) and Table 4 (for girls). The amounts of variance accounted for by each group of variables are displayed in Table 5.

[Insert Tables 3-5]

General Self-concept and Goals

Consistent with our hypotheses, general academic self-concept was indeed associated with the tendency to choose a STEM program and to not choose a terminal gender-congruent program for both boys and girls ($p < .001$; corrected p -threshold: .001). Achievement goals did, consistent with our hypotheses, negatively predict choosing a terminal male-typed program among boys ($p = .005$) and a terminal female-typed program among girls ($p = .009$) and positively predicted choosing a STEM program among girls ($p = .003$), but these effects were marginally above the threshold of significance when we controlled for multiple testing (corrected p -threshold: .002). Self-esteem was negatively associated with choosing a terminal male-typed program among boys ($p < .001$; corrected p -threshold: .001), consistent with our hypotheses, but had no other effect on educational choice (see Tables 3-4).

The correlations between the three predictors were moderate to strong (see Table 1). When we included all three, general academic self-concept still had significant effects for boys and STEM ($\gamma = .34[.17, .50]$, $p < .001$), boys and terminal male-typed programs ($\gamma = -.40[-.55, -.24]$, $p < .001$), girls and STEM ($\gamma = .41[.20, .58]$, $p < .001$), and girls and terminal

female-typed program ($\gamma = -.30[-.49, -.09]$, $p = .002$). Neither achievement goals ($|\gamma| \leq .12$, $p \geq .20$) nor self-esteem ($|\gamma| \leq .13$, $p \geq .14$) had any significant effect on educational choice when all three variables were included in the model. As shown in Table 5, the three variables together accounted for around 10-20% of the variance in choice of STEM and terminal programs among both boys and girls.

Social Identity

Among boys, sense of belonging with boys (vs. girls) had a significant effect on choosing a terminal male-typed program ($p < .001$; corrected p -threshold: .001), consistent with our hypotheses. Except for a negative effect of femininity on choosing a terminal male-typed program ($p = .047$) that did not hold up when we adjusted for multiple testing (corrected p -threshold: .002), no other effect of any social identity variable on educational choice reached significance among boys, contrary to our hypotheses.

Among girls, proportion of male (vs. female) friends had a negative effect on choosing a STEM program ($p = .002$) and a positive effect on choosing a terminal female-typed program ($p = .003$), contrary to our hypotheses, and these effects were marginally significant when we adjusted for multiple testing (corrected p -threshold: .002). The effect of proportion of male friends on choosing a humanistic program among girls was in the negative direction, as we had hypothesized, but did not reach significance ($p = .101$). Masculinity had a negative effect on choosing a terminal female-typed program ($p = .006$) in line with our hypotheses and friendship priorities had a negative effect on choosing a humanistic program ($p = .031$) contrary to our hypotheses, but none of these effects held up when we adjusted for multiple testing (corrected p -threshold: .002), and no other effect of any social identity variable was significant (see Tables 3-4).

Sense of belonging with boys (vs. girls) correlated strongly with proportion of male friends among girls ($r = .50$). The other correlations among the six predictors were weak to

medium-sized (see Table 1). When we included all six predictors in the model, the effects of belonging with boys ($\gamma = .23[.10, .37]$, $p = .001$) and low femininity ($\gamma = -.16[-.31, .00]$, $p = .047$) on choice of a terminal male-typed program were the strongest among boys, followed by the effect of low belonging with boys on choosing a humanistic program ($\gamma = -.13[-.26, .01]$, $p = .077$). For girls, the effects of low masculinity ($\gamma = -.22[-.39, -.06]$, $p = .009$), proportion of male relative to female friends ($\gamma = .39[.22, .55]$, $p < .001$), and lack of belonging with boys ($\gamma = -.28[-.47, -.08]$, $p = .007$) on choice of a terminal female-typed program were the strongest, along with the effects of masculinity ($\gamma = .15[-.02, .32]$, $p = .089$), a low proportion of male (vs. female) friends ($\gamma = -.26[-.44, -.09]$, $p = .003$), and friendship priorities ($\gamma = .14[-.01, .30]$, $p = .073$) on choice of a STEM program, and the effects of a low proportion of male relative to female friends ($\gamma = -.19[-.37, -.01]$, $p = .033$) and friendship priorities ($\gamma = -.15[-.31, .01]$, $p = .065$) on choice of a humanistic program. As shown in Table 5, the social identity variables accounted for most variance in choice of terminal programs (roughly 10-15%) and more variance overall for girls than for boys.

Subject-specific Interests

As we had hypothesized, interest in mathematics, natural sciences, and technology consistently predicted choice of a STEM program and interest in the social sciences predicted choice of a humanistic program among both girls and boys ($p < .001$; corrected p -threshold: .001). Interest in language predicted choice of a humanistic program among boys ($p = .031$), but this effect was not significant when we adjusted for multiple testing (corrected p -threshold: .002) and it was not significant for girls (see Tables 3-4).

Interest in the natural sciences, mathematics, and technology were fairly strongly correlated with each other ($.37 \leq r \leq .57$), and slightly less correlated with interest in languages ($.25 \leq r \leq .43$) and social sciences ($-.03 \leq r \leq .31$), which in turn were moderately correlated with each other ($r = .25/.35$). When we included all five predictors in the model,

interest in the natural sciences still had a strong effect on choice of a STEM program among both boys ($\gamma = .40[.26, .54]$) and girls ($\gamma = .60[.46, .74]$, $p < .001$), interest in technology had a moderate effect on choice of a STEM program among boys ($\gamma = .24[.12, .36]$, $p < .001$) but a marginally significant effect among girls ($\gamma = .12[-.03, .26]$, $p = .055$), interest in mathematics had a weak effect on choice of a STEM program among boys ($\gamma = .15[.03, .28]$, $p = .016$) but not girls ($\gamma = .05[-.10, .19]$, $p = .49$), and interest in the social sciences had substantial effects on choice of a humanistic program among both boys ($\gamma = .36[.23, .48]$) and girls ($\gamma = .39[.26, .51]$, $p < .001$). The effect of interest in language on choice of a humanistic program was marginally significant (uncorrected) among boys ($\gamma = .14[.01, .26]$, $p = .027$) but not girls ($\gamma = -.03[-.18, .11]$, $p = .65$). Together, interests accounted for around 40% of variance in choice of STEM programs and 16-23% in choice of humanistic and terminal programs (see Table 5).

Subject-specific Academic Self-concept

The results with regard to subject-specific academic self-concept were extremely similar to those obtained for subject-specific interests. As we had hypothesized, academic self-concept for mathematics, natural sciences, and technology predicted choice of a STEM program and academic self-concept for the social sciences predicted choice of a humanistic program among both girls and boys ($p < .001$; corrected p -threshold: .001). Interest in language predicted choice of a humanistic program among boys ($p = .020$) in line with our hypotheses, but this effect was not significant when adjusting for multiple testing (corrected p -threshold: .002) and did not emerge for girls (see Tables 3-4).

Academic self-concept for the natural sciences, mathematics, and technology were strongly correlated with each other ($.42 \leq r \leq .70$), and fairly strongly correlated with academic self-concept for languages ($.30 \leq r \leq .49$) and social sciences ($.26 \leq r \leq .57$), which in turn were also strongly correlated with each other ($r = .38/.39$). When we included all five predictors in the model, the results were again highly similar to those we obtained for subject-

specific interests. Natural science self-concept still had a strong effect on choice of a STEM program among both boys ($\gamma = .44[.29, .59]$) and girls ($\gamma = .41[.23, .57]$, $p < .001$), technology self-concept had a weaker effect on choice of a STEM program among both boys ($\gamma = .17[.04, .30]$, $p = .004$) and girls ($\gamma = .20[.05, .34]$, $p = .008$), math self-concept had a similar effect on choice of a STEM program among boys ($\gamma = .18[.05, .31]$, $p = .005$) but not girls ($\gamma = .10[-.08, .26]$, $p = .26$), and social science self-concept had substantial effects on choice of a humanistic program among both boys ($\gamma = .39[.25, .52]$) and girls ($\gamma = .43[.28, .58]$, $p < .001$). The effect of academic self-concept for language on choice of a humanistic program was significant (uncorrected) among boys ($\gamma = .16[.02, .29]$, $p = .015$) but not girls ($\gamma = -.07[-.23, .07]$, $p = .36$). Together, subject-specific academic self-concepts accounted for around 30% of variance in choice of STEM programs and around 16-22% in choice of humanistic and terminal programs (see Table 5).

Grades

Consistent with our hypotheses, grade point average predicted choosing a STEM program and not choosing a terminal program, and grades in STEM subjects predicted choosing a STEM program, among both girls and boys ($p < .001$; corrected p -threshold: .001). Contrary to our hypotheses however, grades in humanistic subjects did not predict choosing a humanistic program, and grades in practical subjects did not predict choosing a terminal program—rather, all of the variables representing grades showed a similar pattern. Grade point average accounted for around 10-20% of the variance in choice of STEM and terminal programs among both boys and girls (see Table 5), and these estimates were virtually identical when we tried integrating the different variables *post hoc* into one common factor.

The Full Integrative Model

As shown in Figure 1, which illustrates the results of testing the full integrative model among boys, interests were by far the most prominent predictors for boys, especially for

choice of preparatory programs. Choice of a STEM program was predicted by greater interest in the STEM subjects and lower interest in the humanistic subjects, while the opposite was true for choice of a humanistic program. However, choice of a terminal male-typed program was predicted only by lack of interest in the social sciences, low grade point average, and strong sense of belonging with boys relative to girls.

[Insert Figure 1]

For girls, interests also played an important role, but so did grades and a few of the social identity variables, as shown in Figure 2. Choice of a STEM program was significantly predicted by interest in the natural sciences, lack of interest in the social sciences, and strong friendship priorities. Choice of a humanistic program was predicted by grade point average, interest in the social sciences, lack of interest in mathematics, and a low proportion of male (vs. female) friends. Choice of a terminal female-typed program was predicted by low grade point average, low sense of belonging with boys (vs. girls), high proportion of male (vs. female) friends, and lack of interest in the natural and social sciences.

[Insert Figure 2]

As shown in Table 5, the integrated model accounted for nearly half of the variance in choice of a STEM program and roughly a fourth to a third of the variance in choice of humanistic and terminal programs.

Furthermore, we found very clear and consistent evidence that the effects of general academic self-concept on educational choice were mediated by interests. The effect on choice of a STEM program was mediated both by greater interest in STEM subjects (boys: indirect effect = .161[.112, .221]; girls: indirect effect = .129[.087, .183], $p < .001$) and by lower interest in humanistic subjects (boys: indirect effect = -.052[-.095, -.022], $p < .001$; girls: indirect effect: -.034[-.069, -.010], $p = .005$). Conversely, the effect on choice of a humanistic program was mediated by greater interest in humanistic subjects (boys: indirect effect =

.064[.037, .100], $p < .001$; girls: indirect effect = .056[.010, .108], $p = .016$) and lower interest in STEM subjects (boys: indirect effect = -.099[-.146, -.063]; girls: indirect effect = -.077[-.134, -.032], $p \leq .002$).

We found much less evidence of indirect effects of social identity variables on educational choice through interests in STEM and humanistic subjects. Even though we investigated a multitude of indirect paths (five predictors, two mediators, and three outcome variables per gender), only a handful were even marginally significant. Among boys, the only indirect effects that reached significance were those of belonging on choice of a terminal male-typed program through interest in humanistic subjects (indirect effect = .011[.000, .034], $p = .047$) and femininity on choice of a STEM program through interest in STEM subjects (indirect effect = .046 [.000, .092], $p = .049$). Even though social identity variables were more important for girls overall, the effects of these variables on educational choices were predominantly direct rather than mediated by interests (see Supplementary Figures 3-4, which illustrate the mediation models). Only the (negative) indirect effect of friendship priorities on choosing a STEM program through interest in humanistic subjects reached significance (indirect effect = -.013[-.032, .000], $p = .044$). Complete documentation of mediations is available in supplementary materials.

Discussion

Gender disparities in vocational orientation is a topic of long-standing interest to scholars from many different disciplines, and a range of different explanations for these disparities has been advanced. However, previous work has mainly focused on educational or occupational interests or aspirations among young adults, rather than the actual educational choices that lead boys and girls down different educational and career paths in the first place. Moreover, the majority of this research has focused exclusively on why women are less likely than men to pursue a career in STEM, while ignoring the large gender differences in choice of low-

skilled career paths. Finally, proposed predictors have usually been investigated one by one or a few at a time, which makes it difficult to evaluate the extent to which they contribute independently and complement each other in explaining different educational outcomes.

In the current research, we investigated predictors of educational choices in a socio-economically diverse sample of Swedish adolescents when they were de facto engaged in making these choices. We sought to do this in an integrative way, taking into consideration a broad range of different explanatory factors that have traditionally been segregated along disciplinary boundaries (interests, social identity, academic self-concept, self-esteem, achievement goals, and grades), as well as choices of both gender-typical preparatory (STEM and humanistic) and gender-typical terminal (e.g., construction and nursing) programs.

As we had expected, general academic self-concept was an important predictor of educational choice among both girls and boys. Our findings suggest that a consequence of a weak academic self-concept can be gender-typical choice in the form of terminal education, which often leads to low-skilled occupations, whereas a strong academic self-concept opens up for selecting a STEM path. We found, moreover, that general academic self-concept correlated strongly with GPA, suggesting that it reflects realistic perceptions of personal performance. Low grades (regardless of subject) in turn predicted choice of terminal programs and not choosing STEM fairly strongly for both genders. These results are consistent with theories suggesting that actual performance is crucial for general academic self-concept (Rottinghaus, Larson, & Borgen, 2003).

The results also provided partial support for our hypotheses about the role of achievement goals (particularly for girls) and self-esteem (particularly for boys). However, these effects were no longer statistically significant when we adjusted for general academic self-concept. This suggests that when adolescents contemplate whether to choose a STEM

path or not, a tendency to set challenging goals or to feel self-confident in general is not enough to offset the feeling of being an under-achiever at school.

Although these findings suggest that academic self-concept is important for gender disparities in educational choices among adolescents, interests were, as could be expected on the basis of past research (Su, Rounds, & Armstrong, 2009; Paßler & Hell, 2012; Volodina & Nagy, 2016) and theory (Lent, Brown, & Hackett, 1994), even more crucial. Interests in STEM and social sciences were by far the strongest predictors of choosing a STEM or humanistic program respectively, especially among boys. These effects remained strong even when we controlled for all other variables, while the effects of many other variables failed to hold up when we controlled for interests. This suggests that interests make up the best proximal explanation of educational choice (at least for preparatory programs) and that some other variables may exert their effect on educational choices by way of altering interests. This pattern is consistent with theories suggesting that threats to belonging and self-concept may lead to decreased motivation and disidentification with the academic domain (Cokley, 2002; Steele, James, & Barnett, 2002).

Especially academic self-concept was closely intertwined with interests. In fact, subject-specific academic self-concepts were so strongly correlated with the respective subject-specific interests that it was not meaningful to treat these two groups of predictors as distinct—for example, the sense of being good at math was very strongly intertwined with interest in math. Furthermore, the effects of general academic self-concept on choosing STEM and humanistic programs were mediated by interest in STEM and humanistic subjects respectively, suggesting that a strong academic self-concept stimulates the choice to enroll in preparatory education by virtue of strengthening (or preventing loss of) interest in academic subjects. This finding is in line with the SCCT (Lent, Brown, & Hackett, 1994), which suggests that self-efficacy is closely tied to, and shapes, interests.

We also found indications that the effects of some aspects of social identity (sense of belonging for boys and friendship priorities for girls) on educational choice may be mediated by interests. This finding is much less clear, however, because the effects were neither strong nor consistent, and the rest of the social identity variables did not exhibit similar effects. For the most part, our results failed to support the notion that the effects of social identity on educational choices are mediated by interests (Bian, Leslie, & Cimpian, 2017). At the same time, it seems quite likely that we would have found more evidence for mediation in this case if we would have taken interests in practical subjects into consideration as well, because factors relating to social identity primarily predicted choice of the heavily gender segregated terminal programs.

We found that having a stronger sense of belonging tied to one's own gender group predicted choosing gender-typed terminal programs, and this finding was quite robust (more so than other results pertaining to social identity variables), persisting among both genders when we controlled for other predictors. This finding provides clear evidence that a sense of belonging is indeed an important explanation behind self-selection of certain environments that may contribute to gender differences in educational paths (Cheryan & Plaut, 2010; Master, Cheryan, & Meltzoff, 2016). Our findings add to previous work on general belonging by examining the role of belonging with one's own gender group (relative to the other gender), showing that this kind of gendered belonging can influence gender-typed low-skilled career paths.

We also found that, among girls, having more same-gender (relative to other-gender) friends predicted choosing a humanistic program when we controlled for the other predictors. This finding adds to previous work on the role of gendered networks in reinforcing gender differences in educational choice (Sinclair, Carlsson, & Björklund, 2014), suggesting that these may be particularly crucial for girls' choice of pursuing a career in humanistic

occupations. However, it may also be the case that girls who aim for higher education in general, regardless of whether it is gender-typed or not, tend to have more female friends, because we found surprising effects of proportion of male friends on *lower* likelihood to choose a STEM program and *greater* likelihood to choose a terminal female-typed program. For boys, we found no effects at all of gendered friendship networks on educational choice. Additionally, the variable measuring importance placed on friendship produced results that were mixed and unclear.

Taken together, these results suggest that peer effects on gender-typed educational choice are to a greater extent driven by preference for being in a male- or female-dominated program than by the actual proportion of same- vs. opposite-gender friends or the prioritization of friendship in general, possibly because the latter variables are more influenced by extraneous environmental factors. More generally, interests and preferences regarding subjects and programs appear to be particularly crucial proximal determinants of educational choices, with effects that remain robust when a multitude of other factors are taken into consideration. But there is a need for more research to understand when and how adolescents also adjust their choices in accordance with their friendship networks and how this might intersect with the sense of belonging with same- and opposite-gender peers. It is possible, for example, that using a better measure of friendship networks than the single item we used in the current research will yield new insights.

There was, furthermore, modest and partial support for the importance of adherence to gender stereotypes that portray women as more communal and men as more agentic. Girls who described themselves as low in masculinity and boys who described themselves as low in femininity were somewhat more likely to select gender-typed terminal programs. These findings tentatively suggest that adherence to gender stereotypes may provide a better explanation for selecting gender-typed low-skilled rather than high-skilled career paths.

However, the effects were weak and did not hold up when we controlled for all the other predictors. In addition, gender identity concerns did not predict educational choices at all, which is surprising given past studies on occupational preferences (Sinclair & Carlsson, 2013). These results also point to a need for further research.

Overall, with the exception of belonging, results regarding the social identity variables were mixed. However, it seems to be the case that social identity was more important for the educational choices of girls than they were for boys. At the same time, although interests were a strong predictor of educational choice for both genders, they were not as strong for girls. This could perhaps be explained by well-established gender differences in self-reported communion (Twenge, 1997, 2001), and relational values and self-construal, with women generally being more likely than men to define themselves in terms of close relationships (i.e., relational-interdependent self-construal; Cross, Bacon, & Morris, 2000) and therefore perhaps less likely to act autonomously on their personal interests.

Contrary to our expectations, although choice of humanistic programs was related to interests and subject-specific self-concepts, it was not closely tied to general academic self-concept, grades, or social identity variables. This raises the possibility that other explanations than those taken into consideration in the current research may be more relevant for these choices, such as for example perceived similarity to people in the field (Cheryan & Plaut, 2010). Because most of the research in this area has focused predominantly on gender disparities in choice of STEM programs, it is quite possible that predictors that are particularly important for choice of humanistic programs have been overlooked in past research. There is a need for more research on why adolescents venture onto a humanistic career path.

In sum, our findings are for the most part consistent with Gottfredson's theory of circumscription and compromise (1981), in the sense that perceived barriers (such as a weak

academic self-concept or a weak sense of belonging in contexts dominated by the other gender), opportunities to attain a certain type of career (such as grades), and interests are combined in producing career related aspirations. Furthermore, in line with the SCCT interest model (Lent, Brown, & Hackett, 1994), our findings also illustrate the role of interests as a proximal explanation of educational choices and a route through which other psychological factors may operate.

Practical Implications

Our findings highlight the need to consider gender-typical choice for high- and low-skilled career paths separately. Clearly, social identity factors appear to be more important for explaining choice of gender-typed low-skilled rather than high-skilled career paths, while academic interests, grades, and academic self-concept were crucial particularly to the pursuit of a STEM path. Strategies for promoting increased gender balance in preparatory and terminal programs and for promoting the pursuit of different career paths in general need to take these differences into consideration.

Our findings suggest that it may be especially important to target the sense of belonging when promoting less gender-typical educational choices in the low-skilled domain. One means of strengthening the sense of belonging in environments where one's gender is in a minority is exposure to high-achieving peers who belong to the gender ingroup, for example through peer-mentoring programs (Dasgupta, 2011). In fact, as peer-mentoring programs have the potential to strengthen both belonging and academic self-concept, they might promote interests that are less gender-traditional in both low-skilled and high-skilled domains.

When it comes to encouraging the pursuit of a STEM path, our findings suggest that it is particularly crucial to help students develop a sense of mastery and boosting their actual performance, in order to stimulate their interest in STEM subjects and make a STEM path practically viable. However, some studies suggest that this is easier said than done. For

example, Hübner et al. (2017) analyzed the effects of a reform in Germany that introduced mandatory enrollment in advanced math classes for all students. Although they found that gender differences in math achievement had decreased after the reform, gender differences in math self-concept and vocational interests were even larger after the reform than before, and gender differences in choice of field of study remained the same. This outcome is consistent with the finding that adolescents with similar abilities tend to follow gender-typical choice patterns (Benbow et al., 2000). The very strong link that we found between academic self-concept and interests further suggests that seeking to promote intrinsic interest in academic subjects may be a more viable strategy for strengthening academic self-concept than forcing students to take these subjects. This may be true especially for girls, who in the current study seemed to choose programs based less on their interests and more on social identity than the boys did. If we can promote genuine interest in gender non-traditional subjects, then perhaps that will help us reduce the gender disparities in educational choices and ultimately in career choices.

To conclude, the present research suggests that a “one size solution” that fits all may not be advisable, as different practical solutions may vary in their suitability depending on whether students aspire to pursue preparatory or terminal education. Nevertheless, a general approach might be to encourage adolescents to explore a wider set of interests and to raise awareness of available career options (Fouad, 1995). Our findings suggest that it may be particularly important to support girls in allowing their interests, rather than social identity, to guide their educational choices.

Limitations and Directions for Future Research

The results of the current study provide further evidence of the key role played by interests in gender-typed career choice. However, the measure of interests that we used focused solely on interest in academic subjects. If we had taken interests in practical subjects

into consideration as well, it is possible that we would have found more evidence for mediation of social identity variables, as these primarily predicted choice of the heavily gender segregated terminal (practical) programs. Besides interests in practical subjects, taking measures of vocational interests into consideration as well would provide a more complete understanding of how interests affect educational choice (Volodina & Nagy, 2016).

Furthermore, we measured interests and subject specific self-concept with only one item per academic subject. Although single item measures of academic concept (Parker et al., 2012) and interests (e.g., Cheryan & Plaut, 2010) have previously been found useful, they are not ideal since they increase measurement error (Cohen, Cohen, Aiken, & West, 2003).

A more substantial limitation of the current research is that we only measured predictors of educational choices at one time point, which prevents us from making causal inferences about the unfolding relationships between different predictors. Studying the interactions between different kinds of causal factors longitudinally would be a very useful next step. It would be particularly useful to follow the development of interests over time in order to investigate their malleability and their responsiveness to environmental factors.

In addition to this, although our sample was diverse in terms of socio-economic characteristics, and the pattern of educational and occupational gender segregation is similar in most industrialized countries, it is possible that the vast cultural differences in terms of, for example, self-expression values and traditionalism (Inglehart & Welzel, 2010) play an important role for the effects of interests and gender stereotypes. Future research will ideally investigate how educational choices come to fruition over time across diverse cultural contexts.

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PREDICTING GENDER-TYPED EDUCATIONAL CHOICE

Table 1.

Correlations between predictor variables among all participants

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Academic self-concept																
2. Achievement goals	.35***															
3. Self-esteem	.42***	.27***														
4. Friendship priorities	-.06	.11*	-.01													
5. Belonging with same-gender peers	-.07	.07	-.04	.15**												
6. Gender identity concerns	.17***	.31***	.18***	.18***	-.08#											
7. Proportion same gender friends	.19***	.00	.14**	.07	.32***	.10*										
8. Femininity	.22***	.28***	.08	.17***	-.07	.14**	-.12*									
9. Masculinity	.23***	.35***	.22***	.12**	-.11*	.09	-.11*	.32***								
10. Access to higher education	.45***	.41***	.17***	.04	.16***	.14**	.10*	.23***	.15***							
11. Interest in STEM subjects	.54***	.27***	.24***	-.03	.14**	.07	-.04	.12*	.15***	.38***						
12. Interest in social sciences	.39***	.32***	.18***	.07	.09#	.08	-.03	.22***	.17***	.43***	.16***					
13. Interest in language	.33***	.24***	.09#	.09	-.01	.09	-.08	.27***	.20***	.33***	.36***	.33***				
14. Self-concept STEM subjects	.71***	.31***	.35***	-.09#	.16***	.11*	-.08	.11*	.20***	.39***	.86***	.21***	.32***			
15. Self-concept social sciences	.61***	.36***	.33***	.00	.09	.13**	-.09	.23***	.27***	.44***	.30***	.81***	.36***	.45***		
16. Self-concept language	.49***	.31***	.18***	.07	.05	.18***	-.07	.23***	.25***	.35***	.33***	.29***	.75***	.42***	.39***	
17. Grade point average	.61***	.14**	.09	-.20***	.13**	.01	-.09#	.21***	.11*	.40***	.45***	.28***	.31***	.55***	.46***	.34***

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$, # $p \leq .10$.

Table 2.

Fit statistics of all tested structural equation models

	χ^2	df	p	RMSEA [90% CI]	$ \lambda $
Academic self-concept	32.1	16	.010	.047[.022, .071]	$\geq .79$
Achievement goals	117.2	28	< .001	.084[.068, .100]	$\geq .45$
Self esteem	159.6	58	< .001	.062[.051, .074]	$\geq .34$
Friendship priorities	24.2	28	< .001	< .001[.000, .030]	$\geq .39$
Belonging	3.05	6	.80	< .001[.000, .039]	$\geq .66$
Gender identity	159.6	58	< .001	.062[.051, .074]	$\geq .34$
Masculinity	133.6	58	< .001	.054[.042, .066]	$\geq .27$
Femininity	56.3	42	< .001	.027[.000, .045]	$\geq .48$
Grade STEM subjects	75.9	42	< .001	.042[.026, .057]	$\geq .81$
Grade humanities	125.1	58	< .001	.050[.038, .063]	$\geq .71$
Grade practical subjects	84.4	42	< .001	.047[.032, .062]	$\geq .52$
General self-concept and goals all variables	516.2	204	< .001	.058[.052, .064]	$\geq .34$
Social identity all variables	731.5	424	< .001	.040[.035, .045]	$\geq .19$
Grades all variables	704.9	332	< .001	.050[.045, .055]	$\geq .63$
Full integrative model	2246.5	1274	< .001	.041[.038, .044]	$\geq .19$
Mediation model	659.3	310	< .001	.050[.044, .055]	$\geq .23$

Note. RMSEA = Root Mean Square Error of Approximation; $|\lambda|$ = absolute factor loading.

Table 3.

Standardized paths from predictors to educational choice for boys

	STEM	Humanities	Terminal male
Academic self-concept	.30[.18, .42]***	.08[-.04, .21]	-.43[-.53, -.32]***
Achievement goals	.11[-.03, .25]	.14[.00, .28]#	-.21[-.37, -.06]**
Self-esteem	.12[-.01, .23]#	.04[-.11, .18]	-.25[-.37, -.14]***
Friendship priorities	-.01[-.14, .12]	.02[-.11, .15]	.11[-.02, .24]#
Belonging with boys (vs. girls)	.01[-.11, .13]	-.10[-.25, .05]	.23[.09, .36]***
Gender identity concerns	.10[-.04, .24]#	-.02[-.16, .12]	.01[-.12, .11]
Proportion male friends	.01[-.11, .13]	.03[-.10, .14]	-.02[-.15, .10]
Femininity	.07 [-.07, .21]	.05[-.09, .18]	-.14[-.27, -.01]*
Masculinity	-.09[-.21, .05]	.11[-.03, .24]#	.02[-.11, .15]
Access to higher education	.30[.20, .39]***	.11[.00, .21]#	-.40[-.51, -.28]***
Interest in technology	.45[.34, .54]***	-.24[-.35, -.13]***	-.18[-.29, -.06]**
Interest in natural sciences	.50[.39, .59]***	-.15[-.24, -.05]*	-.29[-.38, -.19]***
Interest in mathematics	.41[.31, .51]***	-.16[-.27, -.05]**	-.26[-.38, -.15]***
Interest in social sciences	-.04[-.16, .07]	.32[.20, .43]***	-.33[-.42, -.24]***
Interest in language	.06[-.06, .19]	.13[.01, .25]*	-.17[-.27, -.06]**
Self-concept technology	.36[.24, .46]***	-.16[-.26, -.03]*	-.19[-.31, -.08]***
Self-concept natural sciences	.44[.34, .54]***	-.07[-.18, .04]	-.34[-.44, -.24]***
Self-concept mathematics	.40[.29, .49]***	-.11[-.22, -.01]#	-.32[-.43, -.21]***
Self-concept social sciences	.07[-.05, .18]	.24[.13, .34]***	-.39[-.48, -.29]***
Self-concept language	.08[-.04, .21]	.14[.02, .26]*	-.21[-.32, -.10]***
Grade point average	.35[.26, .45]***	.01[-.10, .11]	-.43[-.53, -.34]***
Grade STEM subjects	.38[.28, .49]***	-.09[-.21, .03]	-.39[-.47, -.31]***
Grade humanistic subjects	.30[.19, .41]***	.04[-.08, .15]	-.43[-.51, -.35]***
Grade practical subjects	.33[.21, .45]***	.02[-.11, .15]	-.39[-.50, -.30]***

Note. *** $p < .001$, ** $p < .01$, * $p < .05$, # $p < .10$

Table 4.

Standardized paths from predictors to educational choice for girls

	STEM	Humanities	Terminal female
Academic self-concept	.40[.28, .50]***	-.06[-.21, .08]	-.31[-.44, -.16]***
Achievement goals	.25[.10, .40]**	-.11[-.28, .05]	-.22[-.40, -.04]**
Self-esteem	.11[-.06, .27]	-.08[-.23, .07]	-.10[-.25, .06]
Friendship priorities	.14[-.04, .31]#	-.16[-.30, -.02]*	.03[-.11, .19]
Belonging with boys (vs. girls)	-.09[-.25, .07]	.05[-.11, .20]	-.11[-.26, .08]
Gender identity concerns	.02[-.13, .14]	-.11[-.25, .07]#	.04[-.09, .17]
Proportion male friends	-.22[-.35, -.09]**	-.12[-.25, .02]#	.21[.05, .38]**
Femininity	-.01[-.20, .17]	.04[-.14, .21]	-.08[-.26, .10]
Masculinity	.10[-.06, .27]	-.01[-.16, .15]	-.22[-.36, -.05]**
Access to higher education	.29[.19, .37]***	.03[-.12, .16]	-.25[-.40, -.11]***
Interest in technology	.41[.28, .53]***	-.23[-.36, -.10]***	-.14[-.26, -.02]#
Interest in natural sciences	.65[.55, .72]***	-.23[-.36, -.10]***	-.28[-.39, -.16]***
Interest in mathematics	.39[.26, .51]***	-.23[-.36, -.08]***	-.22[-.34, -.08]**
Interest in social sciences	-.07[-.21, .06]	.33[.20, .45]***	-.32[-.44, -.19]***
Interest in language	.22[.07, .36]**	-.07[-.21, .07]	-.14[-.28, .01]#
Self-concept technology	.44[.32, .54]***	-.27[-.39, -.13]***	-.14[-.27, -.02]*
Self-concept natural sciences	.52[.41, .61]***	-.15[-.28, -.01]*	-.32[-.43, -.21]***
Self-concept mathematics	.40[.27, .50]***	-.19[-.33, -.05]**	-.27[-.40, -.15]***
Self-concept social sciences	.06[-.08, .20]	.25[.11, .37]***	-.35[-.48, -.22]***
Self-concept language	.26[.12, .39]***	-.07[-.22, -.07]	-.19[-.31, -.06]**
Grade point average	.31[.17, .45]***	.08[-.06, .22]	-.36[-.47, -.25]***
Grade STEM subjects	.32[.18, .47]***	.04[-.11, .18]	-.34[-.45, -.24]***
Grade humanistic subjects	.27[.13, .41]***	.10[-.04, .24]	-.35[-.46, -.24]***
Grade practical subjects	.28[.11, .44]***	.09[-.07, .24]	-.34[-.48, -.21]***

Note. *** $p < .001$, ** $p < .01$, * $p < .05$, # $p < .10$

Table 5.

Variance of educational choices that each group of predictors accounted for among boys and girls

	STEM	Humanities	Terminal male (boys)/female (girls)
Boys			
General self-concept and goals	9.2%	1.5%	18.5%
Social identity	2.4%	3.1%	9.3%
Subject-specific interests	36.8%	21.1%	16.2%
Subject-specific self-concept	30.3%	16.4%	18.8%
Grade point average	12.5%	0.0%	18.4%
Full integrative model	38.6%	24.6%	28.3%
Girls			
General self-concept and goals	17.4%	1.5%	10.5%
Social identity	8.6%	5.5%	15.6%
Subject-specific interests	45.8%	22.5%	15.8%
Subject-specific self-concept	33.0%	22.2%	16.7%
Grade point average	9.7%/	0.7%	12.8%
Full integrative model	50.6%	34.0%	27.4%

Figure 1. Full integrative model of predictors of educational choices among boys. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$, # $p \leq .10$. Covariances between predictors and between dependent variables are omitted.

Figure 2. Full integrative model of predictors of educational choices among girls. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$, # $p \leq .10$. Covariances between predictors and between dependent variables are omitted.