

Parental Motivational Practice, Parent Involvement, and Students' Choice of Study Field in College

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Abstract

This study analyzes data of the Educational Longitudinal Study of 2002 to examine the association between parental provision of task-extrinsic rewards for academic performance, parent involvement in students' learning, and students' choice of study field in college. Results show that frequent receipt of task-extrinsic rewards for good grades from parents lowers students' probability of selecting STEM major in college by up to 12 percentage points compared to never or rarely receiving such rewards from parents. Results also show that this association is only statistically significant for high frequency of parental external rewards, and moderate frequency does not exert similar effect. The lowered likelihood of STEM enrollment for students frequently exposed to parental task-extrinsic rewards adds to the evidence that external rewards could have adverse effect on students that lasts into college.

Keywords: *parental involvement; motivation; college student; college major choice*

1. Introduction

Traditional attempts to understand college students' decision making have often focused on students' external contexts, environmental constraints, and rational action. The notion of student-choice construct by St. John, Paulsen, and colleagues (Paulsen & St. John, 1997; St. John, 1994a; St. John, Asker, & Hu, 2001; St. John, Paulsen, & Starkey, 1996), the structure of predictors of college major choice by Crisp, Nora, and Taggart (2009), and the conceptual model of college choice by Perna (2006) are examples of viewing college students' choice as reaction to the social, financial, and educational environment. These frameworks emphasize the roles played by students' pre-college academic preparation and college education experiences, and environmental factors such as characteristics of institution and financial aid policy.

Research on college students' choice of study field has mostly followed this tradition and focused on students' reaction to external factors such as high school experiences (Federman, 2007), influences of role models (Rask & Bailey, 2002), financial considerations (St. John, 1994b), and expectations of the outcome (Lent, Lopez, & Bieschke, 1993). A smaller body of research has examined the psychological aspects of the decision making mechanism. Such research has been guided by Holland's vocational choice theory, which argues that students make educational and vocational decisions based on their personality type (Holland 1966a, 1966b, 1997). Students evaluate the educational or vocational environments and choose one that is the most congruent with their personality. The goal is to choose an environment that rewards one's skills, competencies, and preferred activities. While this theory takes into account students' personal preferences and interests, its emphasis is still on students' relation with the external environment. While the relevance of external factors is obvious, it should not be overlooked that students' choice of study field is first and foremost a choice of and a commitment to learning. Research has shown that external factors related reasons, such as materialism and pragmatism, are frequently cited by students as rationale of choosing science, mathematics, and engineering (SME) majors; however, these pragmatic considerations do not hold as strong as reasons such as intrinsic interest in the discipline itself (Seymour & Hewitt, 1997). Factors related to students' learning preferences, motivation, and behaviors should also be taken into account to better understand the mechanism of students' choice of study field.

The influence of parenting on children's learning behaviors and outcome has been well documented in the literature.

Parenting style, parental motivational practices, and parent involvement have been shown to be related to a wide range of outcomes such as academic motivation, attitude, self-regulation, academic achievement, and studying behaviors such as time spent studying (Baumrind, 1991; Gonzalez, Holbein, & Quilter, 2002; Gottfried, Marcoulides, Gottfried, & Oliver, 2009; Nokali, Bachman, & Votruba-Drzal, 2010; Purdie, Carroll, & Roche, 2004). Research suggests that certain parenting behaviors, such as increased involvement, encouraging interest in learning, and supporting children's autonomy tend to positively influence children's development and lead to higher academic achievement and more studying, while parenting behaviors such as task-extrinsic motivational practices and little involvement in children's activities tend to result in undesirable outcomes such as decline in intrinsic motivation (Cooper & Lindsay, 2000; Gottfried et al., 2009).

Research has suggested that the influence of parenting continues into college, and is associated with college students' academic motivation and adjustment (Davis, Winsler, & Winsler, 2006; Greenberger, Lessard, Chen, & Farruggia, 2008; Strage & Brandt, 1999; Turner, Chandler, & Heffer, 2009). This line of research has mostly focused on the lasting effects of parenting styles on college students' academic motivation. Less attention has been paid to observed student academic behaviors such as study habits, persistence and education decision making. Since academic motivation is strongly associated with educational behaviors and outcomes (Deci, Vallerand, Pelletier, & Pelletier, 1991), it is plausible that parenting practices are also related to college students' educational behaviors.

The purpose of this study is to examine the relationship between parenting practices and college students' choice of study field. Specifically, parental motivational practices and parent involvement are of interest in terms of their relationship with students' decision on college major. Relevant literature on parental practices and involvement, motivation and education outcomes, and college students' choice of study field is reviewed in the following subsections, before research design, findings, and discussion are presented.

1.1 Parenting Motivational Practices and Parent Involvement

Research has identified two types of parental motivational practices (Gottfried et al., 2009). Task-intrinsic practices refer to parents' encouragement of children's pleasure, engagement, and persistence in learning, while task-extrinsic practices refer to parents' provision of external rewards or punishments contingent on children's task performance. The positive influence of task-intrinsic practices on children's intrinsic motivation for learning is commonly recognized (Deci, Koestner, & Ryan, 1999; Gottfried et al., 2009); however, controversy exists regarding the effect of external rewards (Dev, 1997). The nature of rewards varies significantly across studies. Psychological research mostly examine short term extrinsic rewards in laboratory settings or focus on motivation as outcome of extrinsic rewards (e.g., Cameron, Pierce, Banko, & Gear, 2005), while education studies tend to focus on the long term relation between parenting behaviors and children's learning and motivation in real-life scenarios (Baker, 2003; Cooper & Lindsay, 2000). Experimental psychologists represented by Deci and colleagues concluded that extrinsic rewards undermined intrinsic motivation for learning (Deci, Koestner, & Ryan, 2001; Gottfried, Fleming, & Gottfried, 1994; Gottfried et al., 2009), while those represented by Cameron and colleagues argued for the opposite and showed that achievement-based rewards in fact increased students' intrinsic motivation for learning (Cameron et al., 2005), or that rewards as motivator at least did not have negative effect on intrinsic motivation (McGinnis, Friman, & Carlyon, 1999; Selart, Nordstrom, Kuvaas, & Takemura, 2008).

Results of observational studies on the effects of external rewards are also inconsistent. The association between college students' history of external rewards for academic performance and negative outcomes such as academic entitlement has been reported (Greenberger et al., 2008), suggesting adverse effect of task-extrinsic rewards. On the other hand, some have argued that the effect of external rewards is not necessarily adverse and could depend on students' perception of the reward. Flora and Flora's (1999) study on the effects of extrinsic reinforcement for reading during childhood on observed reading habits of college students suggests that earlier experiences of extrinsic rewards do not seem to undermine intrinsic interest for learning; instead, such experiences set the conditions where intrinsic motivation could develop. Similarly, it has been argued that intrinsically motivated students tend to perceive the benefit of external rewards as motivator more positively than extrinsically motivated students, and tend to treat external reward as augmentation of intrinsic motivation (Davis et al., 2006; Hennessey & Zbikowski, 1993). Furthermore, the effects of external rewards on motivation and achievement are argued to be differential by gender and academic ability (Davis et al., 2006; Leuven, Oosterbeek, & Van der Klaauw, 2010).

Findings of the positive role of parent involvement in students' learning and academic performance have been relatively consistent (Gonzalez et al., 2002). Parent involvement, such as helping with homework, discussing school work and learning activities, providing advice on educational decisions, and attending school activities, etc. (Desimone, 1999; Lee & Bowen, 2006; Spera, 2005), have been shown to be positively related to students' learning

behaviors, time spent on studying, educational aspirations, motivation, and academic achievement (Gonzalez-DeHass, Willems, & Holbein, 2005). Research has shown that both parent-initiated and school-initiated parent involvement are related to positive student outcomes (Spera, 2005), although the effects of parent involvement practices tend to differ by race and economic status (Desimone, 1999; Lee & Bowen, 2006). While there are numerous forms of parent involvement practices, involvement in students' learning activities at home is perceived by students and teachers to be more important to academic achievement than parent involvement at school (DePlanty, Coulter-Kern, & Duchane, 2007).

Academic motivation and achievement have been the most frequently examined outcomes of parental motivational practices and parent involvement. While some studies have examined students' educational aspirations (Gonzalez-DeHass et al., 2005), little is known about whether parental motivational practices and involvement are associated with students' educational decision making such as the choice of educational path or college major.

1.2 Motivation and Education

The strong association between motivation and educational behaviors and outcomes has been widely recognized (Deci et al., 1991; Deci et al., 2001; Dev, 1997). Intrinsic motivation leads people to engage in activities for the pleasure and satisfaction of doing so, without the necessity of being rewarded or constrained externally. On the other hand, external motivation is formed by external stimulus and leads to instrumental behaviors. Activities performed based on external motivation are not engaged in for their own sake, but are instrumental to separable consequences. They are engaged in either to avoid adversity or to gain rewards not related to the activities (Deci et al., 1991). In education, intrinsically motivated learners engage in learning because they enjoy doing so and are satisfied by the process of learning, while extrinsically motivated learners engage in learning to avoid punishment, to gain immediate rewards, or to achieve personal goals.

The advantage of intrinsic motivation for learning over extrinsic motivation is obvious and multifaceted (Lei, 2010). Intrinsically motivated college students engage in activities that enhance learning, such as participating in discussion, reviewing course materials, and applying knowledge, while externally motivated students exert only minimal effort needed to complete learning tasks, and tend to stop or slow down learning when rewards are no longer or not immediately available (Lei, 2010). Compared to extrinsically motivated individuals, intrinsically motivated college students are more likely to pursue an academic activity based on personal interests, to overcome obstacles or failures in learning, and to engage in deep learning (Lei, 2010). In other words, intrinsically motivated students are more willing to learn, and enjoy learning more than extrinsically motivated students. Among both adolescents and college students, intrinsic motivation has been shown to directly predict student effort, persistence, and academic performance, and to influence students' perceived competence, which in turn influences academic achievement (Davis et al., 2006; Ferrer-Caja & Weiss, 2000; Goldberg & Cornell, 1998).

Despite the disadvantages of extrinsic motivation, it has been argued that it could play positive role in generating not only situational, but also individual interests; it could also enhance the internalization and integration processes of extrinsic stimulus, so that students who originally lack internal interests in learning could be motivated to learn (Hidi & Harackiewicz, 2000). Empirical evidence has supported this notion, showing that both intrinsic and extrinsic motivation are positively related to educational goals (Davis et al., 2006). The controversy of whether intrinsic and extrinsic motivation should be treated as a strict dichotomy persists (Deci et al., 1991; Hidi & Harackiewicz, 2000).

Given the advantages of intrinsic motivation in promoting learning, educators and parents are long urged to encourage students' intrinsic motivation. It is argued that authoritative parenting such as encouraging children's autonomy could increase intrinsic motivation and enhance education outcomes, while external stimulus such as tangible rewards could have destructive effect on students' will to learn for learning's sake (Hassandra, Goudas, & Chroni, 2003; Lei, 2010; Strage & Brandt, 1999).

1.3 College Students' Choice of Study Field

As discussed above, research on college students' choice of study field has mainly focused on external factors such as family structure, influences of role model, and financial aid policy (Cohen & Hanno, 1993; Hackett, 1989; Rask & Bailey, 2002; Staniec, 2004; Worthington & Higgs, 2003). In terms of factors related to learning, most research has focused on students' academic preparation, self-assessment of major field competence, and self-efficacy in certain disciplines (Correll, 2001; Hackett, 1985; Trusty & Ng, 2000). Little attention has been paid to the role played by parenting practices or to students' tendency to learning. Using descriptive student survey data, Pearson and Dellman-Jenkins (1997) concluded that college students did not perceive parents as major influence in choosing field of study. However, their data do not reveal parenting practices such as encouraging autonomy or promoting intrinsic

motivation for learning. Little is known regarding whether college students' early experience of parenting practices is associated with their choice of study field.

1.4 Purpose of the Current Study

The current study aims to examine the potential relation between early experiences of parenting practices and college students' educational decision making. The research question guiding this study is: Are parental motivational practices and parent involvement associated with students' choice of field of study in college? Using longitudinal data, the current study examines the relationship between observed behaviors of parents and students, namely students' history of receiving task-extrinsic rewards for academic performance, parents' involvement in students' studies by discussing school courses, and students' decision of major in college. Specifically, this study examines students' choice of study field in science, technology, engineering, and mathematics (STEM) or non-STEM majors. Given the abstract nature of STEM studies and the higher level of efforts needed to achieve the same academic success in STEM courses compared to non-STEM disciplines (Drew, 2011; Rampell, 2012), the selection of STEM majors indicates stronger commitment to learning. Based on previous finding of negative effects of external rewards on intrinsic motivation for learning, the negative effect of the lack of intrinsic motivation on desired learning behaviors, and given the demanding nature of STEM studies, it is hypothesized that parents' provision of task-extrinsic rewards for academic performance is negatively correlated to college students' STEM enrollment.

2. Methods

2.1 Sample

The data of the Educational Longitudinal Study of 2002 (ELS:2002) by the National Center for Education Statistics (NCES) are used for the purpose of this study. ELS: 2002 is a longitudinal study designed to monitor the progress of a nationally representative sample of students from tenth grade through higher education and further into the workforce. This dataset is suitable for this study because it provides longitudinal data on students' early experiences with parents and on students' college experiences. Information collected includes demographics, family background, experiences with parents, school characteristics and experiences, academic achievement, and college experiences. This study uses the first three waves of data collection (collected in 2002, 2004, and 2006, respectively), which followed students from high school to college. Additional data are drawn from the Integrated Postsecondary Education Data System (IPEDS), which provides information on institutional major offerings. The analysis is limited to participants who attended college that offered STEM majors at the time of the third wave data collection. A total of 4,380 participants are included in the analysis sample.

2.2 Measures

A dichotomous outcome variable is created based on the categorical variable of college major provided by the ELS dataset and indicates students' STEM or non-STEM major choice. The definition of STEM adopted by this study includes mathematics, natural sciences, engineering, and computer/information sciences (Chen & Weko, 2009) and excludes social/behavior sciences. Parental motivational practice is measured by a categorical variable of the frequency of students' receipt of special privileges given for good grades by parents. The three levels are never or rarely (reference group), sometimes, and often. Parent involvement in students' school work is measured by a categorical variable of how often students discussed school courses with parents. The three levels are never (reference group), sometimes, and often.

A range of covariates are included in the analysis to control for potential confounding factors between students' major choice and experiences of parenting practices. Factors controlled for include gender (reference group is male), race, family socioeconomic status (SES), whether English is student's native language, parents' expectation for children's education level, students' own expectation for education level, high school math preparation, students' consideration of being able to find employment, selectivity of institution, and role played by financial constraint on college choice. Race is categorized into five groups, namely white (reference group), Asian, black, Hispanic, and others. Family SES is a composite continuous variable provided by the ELS dataset that incorporates parents' education, occupation, and family income. Whether English is students' native language is a dichotomous variable indicating students' first language (reference group is no). Parents' expectations for highest education level is a categorical variable, and has three levels, namely below college (reference group), college education up to Bachelor's degree, and graduate degree. Students' own expectations for highest education level has two levels, namely college education up to Bachelor's degree (reference group) and graduate degree. Although students were given the option of 'below college' in this survey item, no one selected this option. High school math preparation is measured by students' highest SAT math

score, which is a continuous variable provided by the ELS dataset. The dataset adopts a concordance between ACT and SAT scores to provide maximum coverage. Therefore, for students who had only taken ACT tests, values for SAT scores are available. Institutional selectivity is a categorical variable with four levels, namely not classified (reference group), inclusive, moderately selective, and highly selective. Students' consideration of finding employment is a dichotomous variable indicating students' perceived importance of being able to find steady work, and the two levels are not important or somewhat important (reference group) and very important. Finally, a dichotomous variable indicates whether student chose college for cost considerations (reference group is no).

2.3 Statistical Analysis

Logistic regression is used to estimate the association between choosing a STEM major in college and the independent and control variables. Logistic regression accounts for the nature of dichotomous outcome variable and estimates the linear relationship between the explanatory variables and the log of odds of the event. Since the outcome is the log of the odds, or odds ratio from exponentiating the estimates, the interpretation of the estimates of logistic regression is not as straightforward as that of linear regression. In this study, the method proposed by Liberman (2005) is adopted to understand the implications of odds ratio for probability.

3. Findings

3.1 Descriptive Statistics

Table 1 presents descriptive statistics of the sample. It can be seen that about one fifth of the respondents selected STEM major in college. In terms of the frequency of receiving privileges for good grades from parents, the distribution among the three categories is almost identical, with about one third of respondents in each group. Half of the students sometimes discussed school courses with parents, and 38% often did so. Only 12% of the students never discussed course work with parents. Female students constitute the majority of the sample (56%). In terms of racial distribution, white students are the majority of the sample (64%), followed by Asian (13%), black (11%), and Hispanic (8%) students. The majority of students' native language is English (85%). Most parents expected their children to obtain graduate degree (58%), and 41% of parents expected children to have undergraduate education. Only 1% of parents didn't expect their children to at least attend college. Students' own educational expectation is even higher. All respondents expected to have some college education, with 33% expecting to have undergraduate education, and 67% expecting to have graduate education. Most students found it very important to be able to find steady job (87%), and half of the students chose their institution for cost considerations. In terms of institutional selectivity, 40% of the respondents attended highly selective institutions, and 45% attended moderately selective institutions.

Table 1. Descriptive Statistics

Variable	Mean or proportion	Standard Deviation
STEM major (1=yes)	.23	
How often parents gave privileges as a reward for good grades		
Never or rarely	.34	
Sometimes	.35	
Often	.31	
How often discussed school courses with parents		
Never	.12	
Sometimes	.50	
Often	.38	
Female	.56	
Race		
White	.64	
Asian	.13	
Black	.11	
Hispanic	.08	
Others	.04	
Family SES	.41	.69
English is student's native language (1=yes)	.85	

Parents' expectation of highest education		
Lower than college	.01	
College, up to Bachelor's	.41	
Graduate degree	.58	
Students' expectation of highest education		
College, up to Bachelor's	.33	
Graduate degree	.67	
Highest SAT math score	539	105
Importance of being able to find steady work		
Not important or somewhat important	.13	
Very important	.87	
Institutional selectivity		
Not classified	.05	
Inclusive	.10	
Moderately selective	.45	
Highly selective	.40	
Chose college for cost (1=yes)	.50	

Note. N=4380.

It can be seen that most parents and students had high expectations for education level, and most students found skill marketability to be very important. Cost considerations influenced half of the respondents' choice of college to attend, indicating the importance of financial constraints. Two thirds of the respondents' parents at least sometimes gave special privileges for good grades, suggesting that provision of task-extrinsic rewards for academic performance was a rather common practice among parents. Most students have had some discussion with parents about school course work at least at moderate frequency, and only 12% of the respondents never did so.

3.2 Logistic Regression Results

Table 2 presents the results of the logistic regression. For students who often received special privileges from parents as reward for good grades, the odds of selecting STEM major in college is 61% of that of students who never or rarely received privileges for good grades from parents ($p < .001$). For students with a moderate frequency of receiving privileges from parents for good grades, the odds of selecting STEM major does not differ significantly from the reference group. The frequency of discussing school courses with parents, on the other hand, does not show statistical significant association with the decision of college major. Unsurprisingly, female students' odds of selecting STEM major is lower than that of male students (estimated odds ratio is 0.35, $p < .001$). It is noteworthy that both black and Hispanic students' odds of majoring in STEM fields are higher than that of white students. The odds of black students is more than twice as that of white students (estimated odds ratio is 2.12, $p < .001$), and the odds of Hispanic students is 38% higher than that of white students (estimated odds ratio is 1.38, $p < .10$). Asian students and students of other race/ethnicity do not differ significantly in the odds of selecting STEM major.

Family SES is negatively correlated with the likelihood of choosing STEM major in college (estimated odds ratio is 0.82, $p = .09$), suggesting that students from higher SES backgrounds are less likely to major in STEM fields. Students' native language has no statistically significant correlation with the odds of selecting STEM or non-STEM major, suggesting that students' immigrant background does not seem to matter in their college major choice. Parents' and students' expectation for highest education level do not predict STEM enrollment, while SAT math score is positively correlated with the likelihood of majoring in STEM fields (estimated odds ratio is 1.01, $p < .001$). Students' perceived importance of being able to find steady employment, whether students chose college for cost consideration, and the selectivity of institution do not predict the odds of selecting STEM major.

Table 2. Logistic Regression Results

Variable	Estimate	Std. Error	Estimated odds ratio
How often parents gave privileges as a reward for good grades: (reference group: never or rarely)			
Sometimes	-.12	.11	0.89
Often	-.50***	.13	0.61
How often discussed school courses with parents: (reference group: never)			
Sometimes	-.04	.15	0.96
Often	.19	.16	1.21
Female	-1.04***	.09	0.35
Race (reference group: white)			
Asian	.12	.18	1.13
Black	.75***	.17	2.12
Hispanic	.32 ⁺	.19	1.38
Others	.36	.24	1.44
Family SES	-.20*	.08	0.82
English is student's native language	-.24	.18	0.79
Parents' expectation of highest education: (reference group: lower than college)			
College, up to Bachelor's	-.22	.60	0.80
Graduate degree	.01	.60	1.01
Students' expectation of highest education: (reference group: college, up to Bachelor's)			
Graduate degree	.14	.11	1.15
Highest SAT math score	.006***	.001	1.01
Importance of being able to find steady work: (reference group: not or somewhat important)			
Very important	.20	.15	1.05
Institutional selectivity: (reference group: not classified)			
Inclusive	-.09	.27	0.91
Moderately selective	-.13	.23	0.87
Highly selective	-.20	.23	0.82
Chose college for cost	.05	.11	1.05

Note. + $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$ (N=4,380).

While the direction of the predictors' correlation with the likelihood of majoring in STEM fields is straightforward, the magnitude of the correlation is less clear. This is due to the fact that logistic regression yields the estimated odds ratio, not in terms of probability which is much easier to interpret. Odds ratio is the ratio of the odds of the event occurring for two groups differing on the independent variable (Scott, 2008). For example, the odds ratio of female compared to the reference group, which is male, is 0.35, meaning that female students' odds of the event, namely selecting STEM major in college, is 35% as much as male students' odds of the event. However, this does not mean that the probability of females enrolling in STEM majors is 35% of the probability of males doing so, or that males are about three times more likely to select STEM majors as females. Odds ratio by itself does not reveal the comparison or difference between the two groups on the probability of the same event. To overcome this limitation and better understand the magnitude of the predictors, the method proposed by Liberman (2005) is adopted to transform odds ratio into difference in probability.

According to Liberman (2005), each odds ratio corresponds to a family of probability pairs with different relative risks, and the difference between the lower and the higher probabilities within each probability pair is the change in the probability of interest when the independent variable's value changes from the reference value to another value. Since odds ratio is the product of two relative risks that describe the same effect, the square root of the odds ratio is the relative risk of the centered case, which presents the probability pair with the largest difference. Therefore, taking

the square root of the estimated odds ratio allows the calculation of the maximum possible difference in probability of the event for two values of the independent variable.

Table 3 presents the calculated maximum difference in probability for the significant independent variables. It can be seen that frequently receiving special privileges as reward for good grades from parents lowers the probability of selecting STEM major in college by up to 12 percentage points compared to never or rarely receiving such privileges from parents. Being female lowers the probability of majoring in STEM fields by up to 26 percentage points compared to being male. Compared to being white, being black increases the probability of selecting STEM major by up to 19 percentage points, and being Hispanic increases the probability of selecting STEM major by up to 8 percentage points. For each one unit increase in students' family SES, the probability of selecting STEM major lowers by up to five percentage points, and for each one point increase in SAT math score, the probability of majoring in STEM increases by up to 0.2 percentage points.

Overall, students' demographics including gender, race, and socioeconomic status, students' math preparation, and students' history of receiving task-extrinsic rewards for academic performance play significant roles in the likelihood of selecting STEM majors in college.

Table 3. Odds ratio and Maximum Difference in Probability of Selected Predictors

Variable	Estimate [Std. Error]	Estimated odds ratio	Maximum difference in probability
How often parents gave privileges as a reward for good grades: (reference group: never or rarely)			
Often	-.50*** [.13]	0.61	0.12
Female	-1.04*** [.09]	0.35	0.26
Race (reference group: white)			
Black	.75*** [.17]	2.12	0.19
Hispanic	.32 ⁺ [.19]	1.38	0.08
Family SES	-.20* [.08]	0.82	0.05
Highest SAT math score	.006*** [.001]	1.01	0.002

Note. ⁺ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$ (N=4,380).

4. Discussion

This study examines the association among observed parenting and student behaviors regarding external rewards, parental involvement in children's studies, and students' choice of study field in college. Finding suggests that frequent provision of task-extrinsic reward for good academic performance by parents lowers the probability of selecting STEM majors in college, controlling for academic preparation, demographics, and family socioeconomic status. This agrees with the hypothesis that giving external rewards for good grades is negatively correlated to STEM enrollment. The lowered likelihood of STEM enrollment for students frequently exposed to parental task-extrinsic rewards adds to the evidence that external rewards could have adverse effect that lasts into college, as suggested by previous observational research on academic entitlement among college students (Greenberger et al., 2008).

Since this study is observational, students' motivation for college education is not measured. Therefore, findings of this study do not add direct evidence to the debate on the effects of external rewards on intrinsic motivation in the experimental psychology literature (e.g., Deci et al., 2001; Cameron et al., 2005; Gottfried et al., 2009). Nevertheless, this study does show that observed student learning behavior (in this case, choice of STEM major in college) is statistically significantly associated with the provision of task-extrinsic rewards, and the correlation is negative. One plausible explanation of the lowered probability of STEM enrollment is that parents' frequent provision of special privileges has negatively affected children's intrinsic motivation for learning, which in turn has led to students' lowered commitment to stringent learning tasks such as STEM studies. Given the observational nature of this study,

the measurement of the latent link connecting the observed behaviors, namely changes (or the lack thereof) in students' motivation, is not measured and beyond the scope of this investigation. Therefore, this study does not provide definite explanation of the observed student behavior.

It is noteworthy that the frequency of providing task-extrinsic reward matters, since students who have only 'sometimes' received special privileges for good grades from parents do not differ significantly from those who have never or rarely received such rewards in the likelihood of choosing STEM majors. Only when the frequency of external rewards intensifies to 'often' does the difference in students' later educational behavior (major choice) emerge. This finding suggests that moderate frequency of task-extrinsic rewards from parents does not exert the same effect on students as exerted by high frequency of external rewards by parents. One plausible explanation is that moderate provision of task-extrinsic rewards sets the conditions where intrinsic motivation could develop (Flora & Flora, 1999), or exerts positive influences such as generating individual interests and enhancing educational goals (Davis et al., 2006; Hidi & Harackiewicz, 2000). On the other hand, it is also possible that the magnitude of moderate amount of external rewards by parents is not strong enough to be reflected in students' behaviors, even though the nature of the effects is the same as that of frequent external rewards. Again, the proof of these plausible explanations is beyond the scope of this study due to the nature of an observational study.

Findings of this study suggest that provision of task-extrinsic rewards for academic performance by parents matters for students' educational behavior, but only when the frequency of such rewards is high. The question then arises, what is the specific definition of 'high frequency'? In other words, how should a parent safely draw the line between 'often' and 'sometimes' when considering external rewards? Given the design of the ELS:2002 survey instrument used to collect the data analyzed by this study, this question could not be confidently answered based on evidence from this study and should be investigated in future research.

While previous studies consistently suggest that parental involvement is positively associated with desired educational outcomes, finding of this study shows no statistical significant association between parents' discussion of school courses and students' major choice. This result holds for all three levels of discussion frequency. While provision of privilege for good grades is generally initiated by parents, discussion with parents about course work could be initiated by either students or parents, and requires participation from both sides. It is possible that discussion with parents provides specific assistance to students' course work rather than influencing students' motivation for learning.

5. Conclusion and Implications

It can be concluded from the findings of this study that frequent provision of task-extrinsic rewards by parents predicts students' education outcome observed years after the presence of such parenting practice. Given the national representativeness of the study sample, this finding is generalizable to the student population on the national level. It should be emphasized that the frequency of providing task-extrinsic rewards by parents is relevant, suggesting that such rewards only matter when they have become a parenting pattern. This suggests that providing task-extrinsic rewards is not necessarily something to avoid by parents; however, it matters when providing and receiving such rewards become habitual.

5.1 Implications for Future Research

This observational study reveals the association between frequent provision of task-extrinsic rewards by parents and lowered likelihood of selecting STEM major in college. It provides a starting point for further investigation into the effects of parental motivational practices such as the usage of external rewards on students' educational behaviors, especially in the long term. Future research is needed to better understand the mechanism behind the observed association. A key link is measured motivation of students. While it is plausible that intrinsic motivation for learning plays a role in the observed correlation, it needs to be proved by examining the relationship between measured motivation and observed behaviors of parents and students. Specifically, two lines of research could deepen the understanding on this topic. The first involves the connecting of students' history of receiving task-extrinsic rewards and measured intrinsic motivation of college students. The latter involves the connecting of measured intrinsic motivation of college students and their educational decisions such as selection of STEM or non-STEM major. Both require the combination of psychological measurement and observed longitudinal data.

Since the frequency of parental provision of external rewards is shown to be relevant in its relation with students' educational behavior (choice of major), further research is needed to better understand the intensity of parental motivational practices. Quantitative instead of qualitative measurement of the frequency of parental external rewards

is essential in this aspect. For example, collecting data from students and/or parents regarding the numerical range of frequency of external rewards could yield valuable information about the intensity of external rewards, and minimize data bias caused by inconsistent understanding of qualitative terms such as 'sometimes' and 'often'. A more definite understanding of the reward frequency could also shed light on the effects of task-extrinsic reward by parents.

This study also provides a starting point to examine STEM enrollment from the perspective of motivation for learning. Future research could build on the findings of this study to further ask questions such as, could students' tendency for choosing STEM majors in college be cultivated through parenting practices from a young age; and does students' intrinsic motivation for learning in general influence their major choice.

5.2 Implications for Practice

The implication of this study's findings for parenting is that effects of frequent provision of task-extrinsic rewards could be reflected not only in aspects such as academic achievement and educational aspirations, but also in students' educational decision making even years after the parental practices. Based on this finding, schools and educators could help parents better understand the long-term influence of parenting practices, and potentially help parents adopt parenting behaviors that are mostly likely to exert positive influences on children's educational outcomes. Policy makers and higher education institutions could reassess the strategies used to promote STEM enrollment, and guide more attention to be paid to students' motivations for and interests in learning in general in addition to the common focus on cultivating students' interests in STEM related disciplines.

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