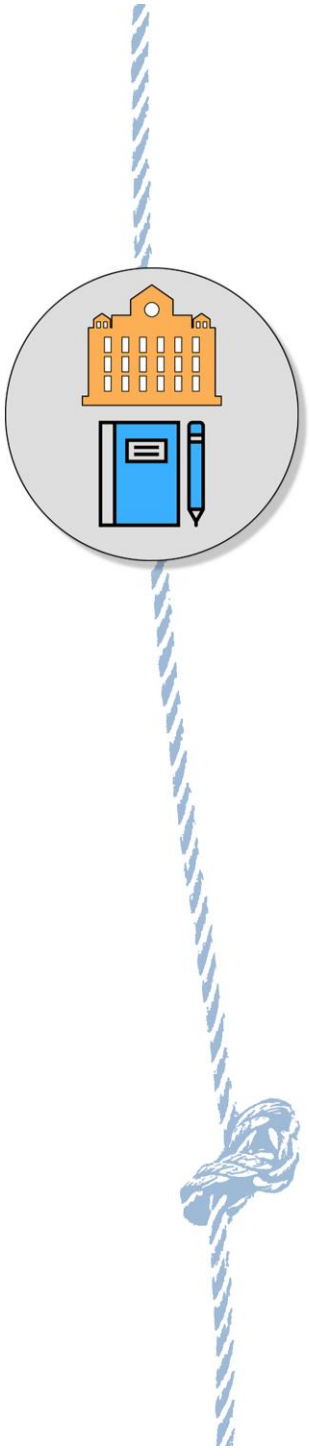

# UNRAVELING THE KNOT

Understanding the Diverse Postsecondary Pathways of Toronto High School Students

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## Contents

## Executive Summary

We addressed three research objectives by examining data from the Toronto District School Board. These data were from a cohort of students (*N*=16,364) that were in Grade 9 in 2006 and were followed for eight years, until fall 2014. Included in these data were Ontario postsecondary application and enrolment information.

Our research objectives and findings were as follows:

1. To what extent are students graduating high school and directly entering college or university?
    - Forty-seven percent of the cohort transitioned directly from high school to university, while 13% transitioned directly from high school to college. Over an additional three years of application cycles, 3% more students moved to postsecondary.

2. How can we look at movement between different postsecondary programs and institutions? Students may start at a college and move to a different college, or change programs within the same institution. What factors are associated with such movements?
    - Eighty-five percent of students who confirmed a postsecondary place in 2011 were at the same institution in 2014.
    - Only 3% had changed institutions.
    - Among college students in the data set, 19% had confirmed university at an earlier date.
    - In terms of students who appeared to have "reverse transferred" from university to college, exploratory analysis suggested that they were more likely to be from lower socioeconomic groups and be racialized (particularly Black, South Asian, or Southeast Asian).
    - In terms of movement within college, 81% stayed in the same college and program, 8% changed programs within the same college, 5% went to similar programs at different colleges, and 6% went to different programs at different colleges.
    - The only factor associated with college movement was duration of study; the longer students remained enrolled, the more likely they were to make some sort of movement.

3. How do pathways vary by individual characteristics? Using an intersectionality framework, which understands race, class, gender, and special education needs status to be inextricably linked to the educational outcomes of young people, we investigated how these factors predicted postsecondary STEM pathways (Science, Technology, Engineering, and Mathematics) in particular.
    - Race was associated with the five program pathways, with East Asians

representing 40% of university STEM enrollments and Blacks comprising only 7%.

- There was strong male representation in STEM, and the gap was bigger at the college level (25% women, 75% men) than the university level (42% women, 58% men).
- Social class was strongly associated with program of study, with high status parental occupations being associated with university STEM and non-STEM pathways.
- Students with special education needs were more likely to be in college non-STEM programs.
- Academic program of study in Grade 9/10 was more strongly related to university STEM and non-STEM than applied programs of study, which were more likely to be found in the college pathways.
- In terms of multivariate analyses, parental occupational status had a strong negative association with university STEM for Black students and a weak negative association with university STEM for East Asian students. Parental occupational status had a strong negative association with college STEM for East Asian students.

Our findings revealed the importance of examining the ways that race, sex, class, and special education needs affect postsecondary pathways and movements within these pathways. We have uncovered some important correlates associated with transfer and program choice. Social class and race were found to have associations with these pathways, particularly with regard to reverse transfer and STEM program choice.

In the case of the former, reverse transfer among certain racialized and lower SES groups may signal unpreparedness (or lack of social and cultural capital) for university environments. Programs targeting "First Generation" students at the university level may assist in retaining such students, but it is probably the case that more social and cultural capital development at the high school level would make such transitions less awkward for traditionally underrepresented students.

Our findings regarding the negative association between parental occupational status and university STEM pathways for Blacks may be indicative of the lack of perceived support and social networks within these academic areas. If, as suggested by American research, high status Blacks are rejecting STEM due to segregated social networks, much more must be done at the university level to recruit and create inclusive environments for racialized students in the sciences and beyond.

## Introduction

For increasing numbers of students in Canada, the "traditional" pathway of moving seamlessly from high school directly into postsecondary education (PSE) and continuing uninterrupted through to PSE graduation is no longer the norm (Kerr, McCloy, & Liu, 2010). So-called "non-traditional pathways," which involve gap years, temporary program interruptions, and changes in program and/or institution, are becoming regular features of the PSE experience across the country. According to the National Graduates Survey 2013 conducted by Statistics Canada, only 53% of those who graduated with a baccalaureate degree in 2010 entered their program directly from high school. Of those who graduated from a college program, only 28% entered directly from high school. For both college and bachelors program graduates, over 30% had previously completed some other form of PSE (Ferguson & Wang, 2014, pp. 7-8).

Disentangling the web or "knot" of pathways that students take, with particular attention to the transfer of students between institutions, is a topic that has received little attention, particularly in the Canadian context. Understanding the pathways students choose or are forced to take is crucial in order to design appropriate policy and support mechanisms to ensure all students succeed in PSE. A "one size fits all" approach to movement through the postsecondary landscape based on the traditional pathway model throws up frustrating obstacles to the growing number of students who no longer fit this mould.

In the following sections, we review the research literature on transitions from secondary to PSE ("transition") and mobility across and within PSE ("transfer"). Because our focus is on Canadian students and institutions, we draw heavily, though not exclusively, on research funded by the Ontario Council on Articulation and Transfer (ONCAT). ONCAT was established in 2011 in order to "enhance student pathways and reduce barriers for students looking to transfer among Ontario's 45 public postsecondary institutions" (ONCAT, n.d.a) by creating a knowledge base to facilitate the transfer of credits between institutions. Because transition and transfer is an under-researched area of higher education in Canada, ONCAT studies represent an important emerging resource for research and policy direction.

In the process of reviewing research literature on transition and transfer in Ontario, we identified four key themes, which will be explored in the following sections: 1) personal/social characteristics of transitioning and transferring students; 2) academic performance of transitioning and transferring students; 3) credit transfer systems; and 4) institutional support, practices and policies related to transition and transfer.

## Who Transitions and Who Transfers? Characteristics of Transitioning and Transferring Students

Students who transition directly from high school into PSE (direct entry high school or DEHS) in Ontario tend to be young (aged below 19), female, single with no children, from middle to high income families, non-Aboriginal, and declare no disabilities (Sattler 2010; Decock et al., 2011; Acai & Newton, 2015). Research, particularly from ONCAT-supported projects, has shown that transferring students have comparatively more diverse demographics (Blais & Harper, 2013). Though still more likely to be female, transferring students are also older on average and show greater variability in age than their DEHS counterparts (Durham College, 2013a; Finnie et al., 2012). For example, transfer students at Confederation College were mainly between the ages of 20 and 23, but could be as young as 18 and as old as 60 (Confederation College, 2012). Transferring students are also more likely than DEHS students to be of Aboriginal descent, to be the first generation in their families to seek higher education (ONCAT, 2013; Stewart & Martinello, 2012), or to have a disability (Sattler, 2010). Because they tend to be older, transferring students are also more likely to be married, have children and work full- or part-time, and therefore tend to experience higher levels of external pressures (e.g., work–study conflicts) than transitioning students (Coffey et al., 2012; Kennett & Maki, 2014).

The literature indicates that there are a variety of reasons students delay entry into PSE or begin in one institution and transfer to another. A minority of students cited dissatisfaction with their previous program, but more common reasons related to employment and potential future earnings (ONCAT 2013,). Interestingly, these reasons were cited in both college-to-university transfers and university-to-college transfers. University credentials are increasingly in demand from employers (Manfredi, 2015), and some professional qualifications can only be obtained through a university program, such as the BScN required in order to be a Registered Nurse (Mallette, Cutrara, Choiniere, Rogers, & Umana, 2015), providing strong incentive for college-to-university transfers. College programs, however, are consistently seen to provide practical, hands-on experience – an advantage in both university and the job market – providing incentive for college experience either before or after university (Durham College 2013a; Gorman, Phelps, & Carley, 2012).

For many students, college is a more accessible option than university for financial, academic, logistical and geographic reasons. Colleges of Applied Arts and Technology (CAATs) are more numerous and more spread out than Ontario's universities, which is particularly important for students in the north of the province. College tuition is also lower than university tuition. Statistics Canada reported that the average Canadian undergraduate paid $6,373 in tuition fees for the 2016/2017 academic year, with Ontario students paying the highest fees at $8,114 (Statistics Canada, 2016). Average annual college tuition fees in Ontario range from $2,400 to $6,100, depending on the program and qualification offered (Ontario Colleges, n.d.). This tuition gap is compounded by the fact that most university degrees are four years, whereas college programs are generally one to two years. Previous research has shown that "for students from the lowest income categories in Canada, the participation rate is about 50 percent greater in colleges than in universities" (Kerr, McCloy, & Liu, 2010, p.12). Some participants in ONCAT research also felt that college study was more flexible and therefore allowed for more time to

spend in paid work (Confederation College, 2012) – a necessity for many students, especially those from low-income brackets. In addition to students from low-income backgrounds, students who are Aboriginal, have a disability, or whose parents did not participate in PSE are all more likely to attend a college than a university and have higher proportions among college transfer students than in the direct applicant population (Kerr, McCloy, & Liu, 2010; Sattler, 2010).

ONCAT projects conducted over the past six years corroborate these findings. In short, transferring is an option that somewhat mitigates issues of access for under-represented groups in PSE. The "traditional" pathway is often not an option for those who face obstacles to full-time university study directly out of high school, such as low income, poor previous academic performance, family or work obligations, disabilities that require additional resources to accommodate or cause periods of absence, or geographic location.

**Reverse transfers.** Much of the research on transfer has focused on college-to-university pathways, with college programs often seen as stepping stones to university programs. Based on data from college and university graduate satisfaction surveys, however, Kerr, McCloy, and Liu (2010) reported that university-to-college pathways, or reverse transfers, are also increasing, though in general less quickly than college-to-university transfers. The profile of students with previous university experience entering college programs is slightly different than those who transfer from college to university. Reverse transfer students tend to be over 25 years old, speak a first language other than French or English, and enrol in narrow and applied (as opposed to general or preparatory) courses.

The goals of these students are largely focused on workforce entry; they are therefore drawn to the practical experience offered by college programs (Kerr, McCloy, & Liu, 2010). For example, focus group data from students who transferred from Lakehead University to Confederation College indicated that career preparation and time to pursue part-time work while studying were significant advantages to studying at college rather than university (Confederation College, 2012). Students with previous university experience who transferred to the Ontario College of Art and Design (OCAD) reported making the decision to transfer in order to enter a more "applied" program with a more art-focused curriculum, which would lead to greater employment opportunities (Fisher et al., 2012). Wilson (2009) pointed out that Canada has a large and growing immigrant population, and that students with university degrees who are now enrolled in college programs may likely be foreign professionals looking to gain credentials recognized in Canada.

Goldrick-Rab and Pfeffer (2009) found that reverse transfer is also more commonly observed among students from low socioeconomic backgrounds compared to those from advantaged backgrounds, who tend to engage in lateral transfer (i.e., mobility from university to university). This could be partly attributed to the comparatively lower cost of college programs. The authors also attribute this finding to the poorer academic

performance of low SES students, which they link to lower levels of parental educational attainment.

Wilson (2009) noted that while reverse transfer appears to be a growing phenomenon in the Ontario postsecondary landscape, it is difficult to get an accurate idea of the extent of this growth. Very little research has looked into student transfer from university to college, resulting in a paucity of data on the subject. One study from the early 1990s found that the majority of Alberta students who transferred to colleges or technical institutions came from universities (Vaala, 1991), but there seems to have been little attempt to follow these trends consistently. Motivations for transferring from university to college have also not yet been researched systematically.

## Comparative Performance of Transitioning and Transferring Students

A number of ONCAT-funded projects have investigated the comparative performances of transferring and transitioning students, paying particular attention to two indicators: Grade Point Average (GPA) and persistence/graduation. Stewart and Martinello (2012) found that compared to transitioning students, the academic performance of college-to-university transfer students was very similar to that of DEHS students in the first two years of study. However, in the latter two years, transfer students performed significantly less well and were much less likely to persist to the final year of their studies. This finding seems to support the common conception that transfer students underperform in university, something Gorman et al. (2012) found to be a source of concern for college-to-university transfer students even prior to transfer. Some proposed explanations for this underperformance include an unsatisfactory college-to-university transfer experience (Confederation College, 2012); partial completion of a college diploma (Lakehead University, 2012); receiving only the minimum or lower than minimum transfer credits (Coffey et al., 2012; Lakehead University, 2012); studying part-time after transfer (Finnie et al., 2012; Lakehead University, 2012); or not receiving the required level of support from the universities to which they transferred (Carleton University, 2013; Durham College, 2014). Transfer students from Algonquin College to the University of Ottawa were considerably more likely to leave than DEHS students (Finnie et al., 2012), but the study's authors were unable to account for this difference with reference to any of the explanatory variables included in the analysis – age, gender, high school grades, rural/urban origin, and program choice.

Stewart and Martinello's (2012) results represent a minority among the ONCAT research projects in terms of GPA. Indeed, the overall findings suggest that transfer students performed at least as well academically as DEHS students, and in some cases outperformed them. A study that focused on the degree completion and general academic performance of students who transferred from George Brown College, Humber College, and Seneca College to Woodsworth College in the Faculty of Arts and Science at the University of Toronto (Shook et al., 2016) found that "Diploma to Degree" (transferring) students perform similarly to the general Arts and Science population at the University of

Toronto in terms of persistence to degree completion and GPA after transfer. Though transfer students from Conestoga College described university workloads as more demanding than their college workloads, they nevertheless had higher GPAs than non-transfer students (Gorman, Phelps, & Carley, 2012). College to university transfer students at Trent University, Wilfred Laurier University, and the University of Ontario Institute of Technology (OUIT) also outperformed their non-transferring counterparts in terms of GPA.

**Persistence among transfer students**. Results for persistence are more mixed across ONCAT's research, but this can be attributed at least in part to the greater diversity that characterizes the transferring population. A summary of ONCAT research up to 2013 reported slightly below average persistence rates overall for transfer students as opposed to DEHS students, but it cautioned that this overall trend masks some important variations. Some studies have identified transfer cohorts that show strong retention (ONCAT, 2013). For example, there appears to be a link between persistence and age. Studies from OUIT and Trent University suggested that older students face more demands on their time because they are more likely to have work and family obligations in addition to their studies (Drewes et al., 2012; Coffey et al., 2012). Part-time study was therefore more common among older students, and part-time students had significantly lower retention rates than full-time students (ONCAT, 2013).

**Retaining transfer students.** The ONCAT-funded projects suggest that one pathway to greater retention of transfer students lies in the features of the transfer program itself (Usher & Jarvey, 2012). As mentioned above, college-to-university transfer students outperformed other groups of students in much of the ONCAT research thus far (Confederation College, 2012; Gorman et al., 2012; Drewes et al., 2012; Gerhardt, Arai, Carroll, & Ackerman, 2012; Drewes et al., 2012). There were three studies that differentiated between types of transfer students – those who transferred under "block transfer" or "articulated agreements," those who transferred with other credits (either college or university), and those who transferred without any credits. Block transfers or articulated agreements refer to prearranged agreements between institutions in which specified diplomas or sets of courses, usually gained with a minimum GPA, at one institution are considered equivalent to specified courses at another institution. For example, a student transferring to Lakehead University with a diploma and the required average in Business Administration from a college with which such an agreement exists receives a block of credits for the first and second year and is able to transfer directly into the third year of a four-year Business Administration degree. A "bridging program" is a highly integrated type of articulated agreement in which transfer from a college program to a university degree is built into the structure of the college program; the program is designed so that students move from one to the other. Students can transfer credits outside of a block transfer or bridging program, but courses are considered on a more individual basis, and there is no guarantee that previous learning will be recognized. When transferring to a university, college courses are less likely to be recognized and credited than courses from another university.

**Types of transfer students**. The findings from studies that differentiate between types of transfer students are especially salient in the discussion of academic success and retention. In a project focused on college-to-university transfers at Lakehead University, students with college diplomas or who participated in block transfer programs had retention rates similar to DEHS students and higher than both students who transferred with credits outside a block program and those who transferred with no credits. The block transfer students also had higher graduation rates than all the other categories and outperformed them academically (Lakehead University, 2012). A study at Trent University examined academic performance and dropout rates, comparing DEHS students, CAAT students transferring under an articulation agreement and CAAT students transferring outside an articulation agreement. Transfer students outside an articulation agreement had grade averages and dropout rates similar to those of DEHS students, but transfer students under an articulation agreement performed significantly better on both measures (Drewes et al., 2012). Nursing students in a bridging program at OUIT, which represented an articulated transfer agreement between the college Licensed Practical Nursing program and the university BScN program required to become a Registered Nurse, also performed at a "significantly superior level" in comparison to direct entry students (Coffey, Lindsay, & Sproul, 2012).

The success of these students can be partly attributed to the strength of the transfer model, which was highly planned and facilitated by the institutions involved. This model incorporated early academic advising and experience of university life into the program, allowing the students to make a better informed decision about whether to pursue degree studies (Shook et al., 2016). The literature suggests the importance of a well-planned, clear, and properly administered and supervised transfer program in ensuring the persistence and academic success of college-to-university transfer students, a topic that will be explored further in the next section (Drewes et al., 2012; Durham College, 2013b; Gorman et al., 2012; Kennett & Maki, 2014). The importance of transfer program design and implementation is demonstrated most compellingly by the work of Drewes et al. (2012). CAAT students who transferred to Trent University under an articulated agreement not only significantly outperformed all other categories of students – including university transfer students, non-articulated transfer students, and direct entrants (transitioning students) – they were also least likely to drop out, even when individual student characteristics were controlled.

## Credit Transfer

Ontario is a relative latecomer to facilitating transfers across postsecondary institutions. British Columbia, Alberta, and Quebec, for example, have a stronger history of established credit transfer systems that facilitates inter-institutional mobility and correspondingly show greater student mobility than the other Canadian provinces, despite BC and Alberta having far fewer public postsecondary institutions than Ontario (Kerr, McCloy, & Liu, 2010). The establishment of ONCAT followed a number of calls and reviews by the Ontario government, beginning in the early 1990s, for more discussion

and collaboration between provincial PSE institutions in order to ease the transfer process and create more opportunity for mobility.

ONCAT's research thus far indicates that the proportion of students who transfer between postsecondary institutions varies considerably, depending on the location of the post-transfer institution, the existence of collaborative "Diploma to Degree" programs offered by pre- and post-transfer institutions, and the nature of the academic fields students wish to enter (ONCAT, 2013). Across these variations, however, students identify credit recognition and transfer as one of the most important aspects of the transfer experience – that is, to what extent the work they have completed at one institution counts toward the completion of their diploma/degree at another institution.

Several ONCAT-funded projects have investigated the transferability of credits between postsecondary institutions in Ontario, particularly for students who transfer from colleges to universities (Arnold & Woodhead, 2015; Fisher et al., 2012; Sidhu et al., 2016; Usher & Jarvey, 2012). Some of the most prominent factors found to influence the number of transfer credits earned by all groups of transferring students include the particular field of specialization, professional certification requirements (if applicable), and the existence of "highly aligned programs" that reflect articulation agreements between colleges and universities (Drewes et al., 2012; ONCAT, 2013).

**Satisfaction with the transfer process.** A theme of dissatisfaction with the transfer process is apparent across the ONCAT research projects, centring on issues of expectation and communication. On average, college-to-university transfer students receive fewer transfer credits than university-to-college and university-to-university transfer students (Confederation College, 2012; Fisher et al., 2012; Stewart & Martinello, 2012). Though some researchers attempt to justify this via the differential nature of academic expectations across institutions (e.g. Dills & Hernandez-Julian, 2008), the majority of ONCAT-funded projects have found no reason to discount the value of credits earned at colleges. Indeed, as mentioned above, these studies have shown that college-to-university transfer students tend to perform as well or better than those who earned their previous credits at universities (Coffey et al., 2012; Confederation College, 2012; Drewes et al., 2012; Lakehead University, 2016). This has led many college-to-university transfer students to be less satisfied with the transfer process than university-to-university transfer students, largely due to disappointed expectations about the transferability of their college credits to universities (Confederation College, 2012; Fisher et al., 2012; Gerhardt et al., 2013). Participants in a study of transfer students at Wilfred Laurier University reported frustration with the "seemingly arbitrary manner" in which credits were approved (Gerhardt et al., 2012), and similar objections were made about the subjective nature of credit approval at the Ontario College of Art and Design (OCAD) (Fisher et al., 2012).

Students' level of satisfaction with transferring across postsecondary institutions was also found to be directly related to the perceived ease of the transfer process (Blais & Harper, 2013; Carleton University, 2013; Durham College, 2016); transfer wait times (Confederation College, 2012); communication of admissions decisions (Durham

College, 2014; Usher & Jarvey, 2012); and the requirements associated with earning transfer credits (Arnold & Woodhead, 2015; Confederation College, 2012; ONCAT, 2013). The common thread across these factors is communication, and it is the most important predictor of student satisfaction with the transfer process. Those institutions and transfer programs that overtly and comprehensively communicate the requirements associated with inter-institutional transfer, that are well-planned and properly administered, and that provide students with the rationale for their admissions decisions were rated the highest by transferring students (Arnold, 2012; Durham College, 2014; Fisher et al., 2012).

The most commonly reported frustration in the ONCAT research was a lack of clear, readily available, and comprehensive information about transfer requirements and the transfer process. For transfer students at Wilfred Laurier, OCAD, Lakehead University, Durham College, and Centennial College, information on credit transfer was difficult to locate, and staff were often unavailable to answer questions or did not provide information in a timely manner. Finding accurate course descriptions and syllabi in order to determine equivalency of courses, especially for courses no longer offered, was time consuming and sometimes led to dead ends. Applications to the institution and application for credit transfer most often had to be done separately, resulting in students submitting the same or substantially similar materials and paperwork twice, and decisions often had slow turnaround times.

It is important to note that students' perceptions of their chances of success in the new institution, ease of inter-institutional transfer, and the possibility of earning transfer credits are decisive factors that shape the pathways Ontario students take in their postsecondary educational careers. For some transfer students at Wilfred Laurier, credit approval was important enough to students to be cited as a reason for choosing one program over another. In other words, some students would choose to attend whichever institution gave them the highest number of credits for their college work, so it was important that this information be available before applications were made.

A study from the Ontario Institute for Studies in Education at the University of Toronto referred to "transfer literacy," which is "the ability to comprehend credit transfer procedures, policies and outcomes" (Arnold, 2012, p. 8). Students with transfer literacy have access to the knowledge they need to make decisions about transfers that will minimize the time and effort spent on the transfer process and maximize the value of their previous academic work and finances. A high degree of transfer literacy depends on the availability and clarity of information regarding transfer policy and procedure.

Using document analysis of materials from government, agencies and educational institutions from 1999-2012 and focus group data from institutional administrators from colleges and universities across Ontario, the researcher identified the most successful transfer pathways as those that were defined by well-publicized articulation agreements. Students were informed during their diploma studies about the requirements and transfer expectations they would face during the process. This goes some way to explaining the

comparative success of students who transfer under such agreements, as discussed in the previous section, and we will return to this concept in the next section.

## Institutional Support, Practices and Policies around Transition and Transfer

The recurring theme of complexity and confusion associated with inter-institutional transfer processes has been exacerbated by the absence of collaboration between institutions (ONCAT, 2013). Each institution has its own policies and procedures, which do not necessarily make reference to the policies and procedures of other institutions. This has resulted in misunderstandings over degree expectations, inconsistency in defining terms, and opaque grading procedures. The lack of communication makes it difficult to evaluate the experiences and learning of transferring students and to translate these into appropriate credits, particularly in a timely fashion. This represents a significant obstacle to student mobility in the postsecondary landscape in Ontario.

Student experiences with the transfer process as explored in the ONCAT projects highlight the importance of ensuring that admission standards, as well as prerequisites, appropriately reflect the academic demands of the programs students wish to enter (Arnold, 2012; Durham College, 2013b; Durham College, 2013a). Students are generally more satisfied with the transfer process if their pre-transfer programs have provided them with adequate preparation to enhance their academic performance (Coffey et al., 2012; Gorman et al., 2012; Shook et al., 2016) and if social integration into their new postsecondary environment has been facilitated (Durham College, 2013b; Durham College, 2014). Four ONCAT-funded projects conducted by Durham College (2013a; 2013b; 2014; 2016) have attested to the importance of program-relatedness in ensuring student satisfaction, not only during the transfer process, but also post-transfer and even after degree completion.

These issues are related to stakeholders' knowledge and perceptions of the transfer process, which are influenced by the availability, completeness, and comprehensibility of information about the transfer process (ONCAT, 2013; Usher & Jarvey, 2012). A comprehensive report conducted by the Association of Registrars of the Universities and Colleges of Canada (ARUCC) and the Pan-Canadian Consortium on Admissions and Transfer (PCCAT) suggested that based on the examination of current transfer-related practices of postsecondary institutions in Canada, there are many ambiguities associated with *defining* the different facets of the transfer process (Duklas, Maki, Pesaro, & Brady, 2014). Among these, prerequisite courses and/or programs, transfer credit standards, and transcript/GPA conversion methods seem to be the most important sources of confusion and ambiguity for both students and administrators involved in the transfer process.

Based on ONCAT's findings, many researchers have proposed ways through which the transfer process could be improved, specifically by increasing transferring students' knowledge about the transfer process. In one of the most comprehensive studies of

student experiences about the credit transfer process in Ontario, Usher and Jarvey (2012) found that

> colleges with the most positive responses: 1) provided detailed information about the transfer process; 2) streamlined credit transfer processes; 3) provided support to students experiencing difficulty obtaining course outlines or course descriptions; 4) assess applications in one week or less; 5) provided justifications for both assessment results and policy positions; and 6) demonstrated a culture of effective service. (p. 9)

Usher and Jarvey's (2012) recommendations are reflected in other ONCAT-funded projects (Arnold & Woodhead, 2015; Durham College, 2016), substantiating the need for policies and practices that are widely and conveniently available, intelligible to all stakeholders, and that ensure the provision of timely admissions decisions to transferring students.

In more practical terms, some studies strongly advocated making information about credits and transfer – including policy, course descriptions and syllabi, application information, wait times, past decisions, etc. – available in a central place, preferably online. Another recommendation was to make more university representatives available to handle transfer process enquiries, particularly during the application and registration periods, in order to ensure they are made in a timely fashion. Yet another suggestion was to streamline the paperwork associated with credit transfer by making it part of the application package as opposed to a separate process. Given the success of students transferring under articulated and block agreements, the creation of more of these types of programs is heavily favoured by researchers.

Moreover, it was recommended that colleges and universities target orientation and support services with the unique needs and demographics of transfer students in mind. Transfer students can sometimes feel disconnected from their post-transfer institution or experience something of a "transfer shock" as they move between the different cultures of the college and the university (Blais & Harper, 2013). A study at Carleton University suggested creating a staff position specifically to coordinate programs and support services for students in non-traditional pathways (Carleton University, 2013). Peer mentoring was also suggested as a way of easing the transition (Carleton University, 2013; Arnold & Woodhead, 2015).

The establishment of ONCAT was a significant step forward in this process. As a resource for both students and institutions, it continues to develop a knowledge base of information regarding the transfer process of its member institutions. It is not, however, a governing body and relies on voluntary participation. In a recent report, ONCAT set out its *Principles for Credit Transfer Policies and Procedures*, which centre on three goals: 1) "Students should have the information they need to make informed decisions about the transfer process"; 2) "Students can expect to be treated equitably by all member institutions"; and 3) "All members acknowledge and respect the primary jurisdiction of each institution for transfer policy and academic integrity" (ONCAT, n.d.b, pp. 1-2). The

first and second goals encourage transparency and accessibility of information, which are facilitated by ONCAT's online databases, as well as equitable treatment of pupils. The third goal emphasizes the fact that each institution is still responsible for its own transfer policy and procedure.

ONCAT also advocates for a more robust research agenda that attempts to track transfer students and their pathways across the province or across multiple institutions, rather than the more common study of individual institutions. ONCAT continues to support research into this area; however, the majority of its projects still focus on the transfer process at individual institutions or pairs of institutions. An overall picture is therefore still lacking.

## Research Objectives

As established above and contrary to popular conjecture on the topic, the "traditional" pathway of moving from high school seamlessly through to a postsecondary program is no longer a "typical" pathway – and, arguably, "nontraditional pathways" have actually been the norm for some time. The reality is that students take years off, step out of programs temporarily, change programs, and change institutions. Our project aimed to disentangle the web or "knot" of pathways students take, as well as to focus on the transfer of students between institutions – a topic that has received little attention, particularly in the Canadian context.

The goals of our analysis were made attainable by our having access to a unique data set of students who were in Grade 9 in 2006 and for whom we have eight successive years of data. These data included administrative data from the Toronto District School Board, student participation in the 2006 Toronto District School Board Student Census (which carries information on self-reported race, parental characteristics, and various attitudinal items), and five years of college and university application data.

We had three general objectives in this report:

- The first was to examine direct transitions out of high school to college or university. To what extent are students graduating high school and directly entering college or university?
- The second objective was to disentangle the disparate pathways that students take along the way. These pathways involve movement between different postsecondary programs and institutions. Students may start at a college and move to a different college, or change programs within the same institution. We were able to use our data to look at what sorts of patterns exist for program or institutional shifts, as well as completion.
- The third objective was to examine how these pathways vary by individual characteristics. We used an intersectionality framework, which understands race, class, gender, and special education need status to be inextricably linked to the educational outcomes of young people.

## Data and Research Method

The data set was constructed by Robert S. Brown using Toronto District School Board (TDSB) accessible data sources and focuses on a specific Grade 9 cohort from 2006. The various TDSB cohort studies followed Grade 9 students as they progressed through secondary education into PSE. In the standard TDSB Grade 9 cohort studies, students were followed for five years after the beginning of Grade 9. However, for the specific cohort on which we focused, data were available for eight years. The cohort study we drew upon utilized the "pilot," a more comprehensive study that looked at students who started Grade 9 in fall 2006 and were followed for eight years (instead of the typical five), until fall 2014. Most importantly for the purposes of our research, these eight years included five years after graduation. This allowed for a more complete examination of the transition from secondary to post-secondary. It also allowed for an examination of other postsecondary pathways, such as those that have gap years or those that move through different PSE institutions during this time period.

There were 16,364 students in the 2006 Grade 9 cohort study. In addition to TSDB data on these students, which contained rich demographic information, this was the first TDSB cohort that participated in the TDSB student census. Thus, using these data, it was possible to link cohort information from the TDSB's Student Information System (SIS) to Student Census responses. Additionally, it was possible to link this information with five successive years of information from the Ontario universities and college applications services (OUAC and OCAS). For this study, we examined the 2010, 2011, 2012, 2013 and 2014 application cycles. Information was matched to confirmations – that is, instances in which students confirmed an offer of admission from an Ontario college or university between 2010 and 2014. The OUAC and OCAS data also provided us with information on the students' destination institution and their program choice. Our more detailed analyses of college movement were facilitated by the detailed enrolment data that were provided to us by OCAS (we could not analyze university transfers due to data restrictions). The richness of these data, along with the large sample size and relatively current nature of the data (ending in 2014), were heretofore unprecedented in the literature documenting postsecondary transitions of Ontario youth.

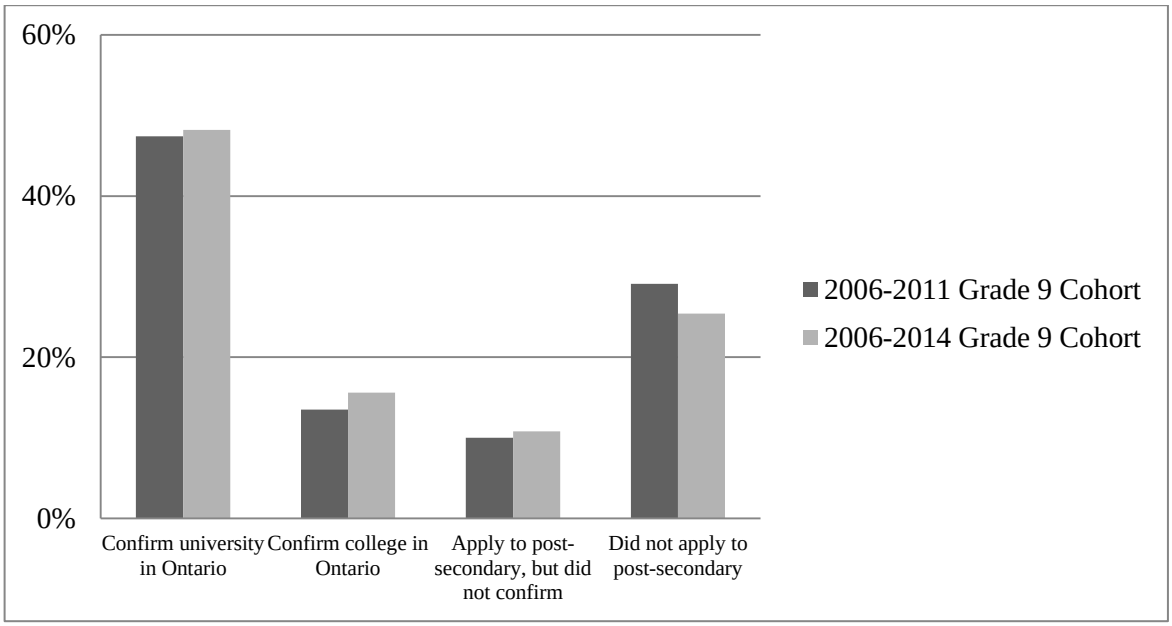
## Results

### Objective 1. Exploring direct transitions out of high school to college and university

In general, the TDSB cohort studies have documented increasing direct transitions from high school into PSE, which is part of a larger trend throughout the world. In the 10 years of TDSB cohort studies, transitions from high school to university increased from 43% to 50%, and transitions from high school to college increased from 13% to 18%. That being said, there was still a considerable group of students in Ontario who applied to but did not

enter PSE (at least directly), and some who did not apply at all. This includes both high school graduates and non-graduates.
We looked at applications made by students in the 2006 cohort to Ontario university and colleges application centres from 2010 (when students were in their fourth year of high school) into the 2014 application cycle (when the few remaining students were in their eighth year of high school) for a nearly complete picture of their direct transition to PSE. Figure 1 shows the difference between five and eight years. By the end of five years of high school, 47.4% of students confirmed an offer of admission from an Ontario university, while 13.5% confirmed an offer from an Ontario college. By the end of eight years, the proportion of university-bound students had increased to 48.2% and college-bound students had increased to 15.6% – a total increase of 2.9%.

**Figure 1: PSE Status as of Fall 2011 and Fall 2014, Grade 9 Cohort of Fall 2006**




Although our data did not allow us to explore the reasons behind the 3% increase between five and eight years of high school, we can speculate. In some cases, students take longer than five years to finish high school, and will then apply to PSE. In other cases, students may return for a necessary course or two (through the regular day school, summer school or night school) before gaining the prerequisites needed for PSE. A number also take time off for travel and/or work before making the decision to go to PSE. Note that most university-bound students transition in Year 4 of high school, while most college-bound students transition in Years 5-7.

**The importance of Grade 9 credit accumulation.** Even with the timelines extended from five to eight years, the importance of Grade 9 credit accumulation for postsecondary access cannot be understated; generally, students who complete fewer than eight credits in Grade 9 have a quite limited chance of confirming university, although they will graduate secondary school. Of the students in Grade 9 who completed eight credits, 59%

confirmed an offer of admission from an Ontario university (nearly all confirmed by Year 5); of those completing seven credits, only 15% confirmed university; and only 4% of those completing six or fewer credits confirmed university (see Table 1).

### Table 1: Post-secondary Confirmations by Grade 9 Credit Accumulation, 2006-2014 Grade 9 Cohort

| Grade 9 Credit Accumulation | Confirm university in Ontario | Confirm college in Ontario | Applied to postsecondary, but did not confirm | Did not apply to postsecondary |
|---|---|---|---|---|
| 6 or fewer credits (high risk) | 3.6% | 14.5% | 6.9% | 75.1% |
| 7 credits (medium risk) | 15.2% | 28.2% | 13.1% | 43.5% |
| 8 or more credits (low risk) | 59.3% | 15.6% | 11.2% | 25.4% |

We captured eight years of information about the Ontario applications, but this did not show our students' entire history of postsecondary access. For one thing, it did not follow students who went into a postsecondary institution outside Ontario, which we estimated to be three to four percent of the cohort. Secondly, it included students who confirm an offer of admission from a public Ontario postsecondary institution; however, in some cases, students who confirm an offer will not follow through, while others who may be on waiting lists may enter at the last minute, and still others may attend private colleges. There are also some smaller postsecondary institutions that are not part of the Ontario applications process (e.g., Royal Military College in Kingston).

## Summary

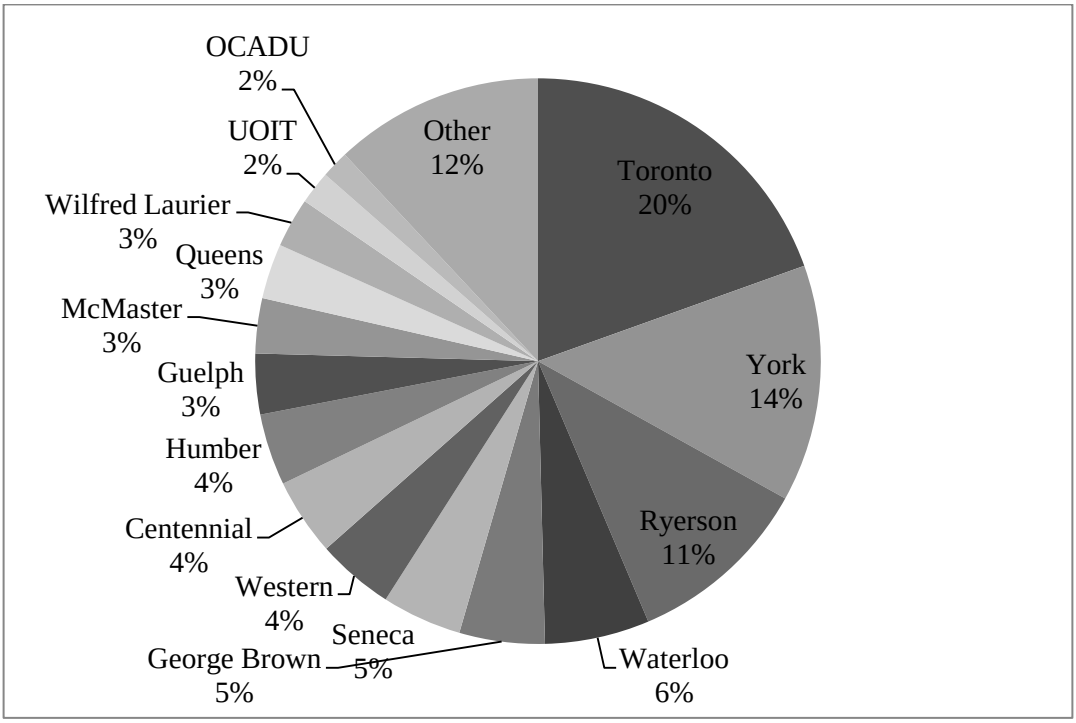
The goal of this section was to examine direct transitions out of high school to college and university. We found that around 47% transition "directly" from high school to university and 13.5% transition "directly" from high school to college. We used five years of college and university application data to account for 5-year graduation rates, as the context of high school in Ontario makes it somewhat difficult to pinpoint "direct transitions" given that so many students take a "victory lap" (Brady & Allingham, 2010). Eight-year graduation rates increased this rate only slightly, adding an additional 3% of students in PSE. We also argued that Grade 9 credit accumulation played a major part in the transition pathways observed in later years.

## Objective 2: Disentangling the disparate pathways that students take along the way

Our second objective was to examine the pathways that students take during their acquisition of PSE. By using the TDSB cohort, we were able to examine the first records of students in PSE in 2014. Figure 2 displays instances of confirmation in a PSE institution that we had for the cohort members in 2014 (and the end of eight years of data). As our above analyses show, the differences between 2011 and 2014 were negligible (accounting for an additional 3% of students). For this reason, we have focused on PSE confirmations to 2014 instead of providing separate analyses of 2011 and 2014, which show very little difference. Of those in the cohort, around half (48.2%) confirmed an offer from an Ontario university, 15.2% confirmed an offer from an Ontario college, and nearly 11% applied to PSE but did not receive an offer. Around a quarter (25.4%) of the cohort did not apply to PSE. These are the same numbers that were displayed in Figure 1.

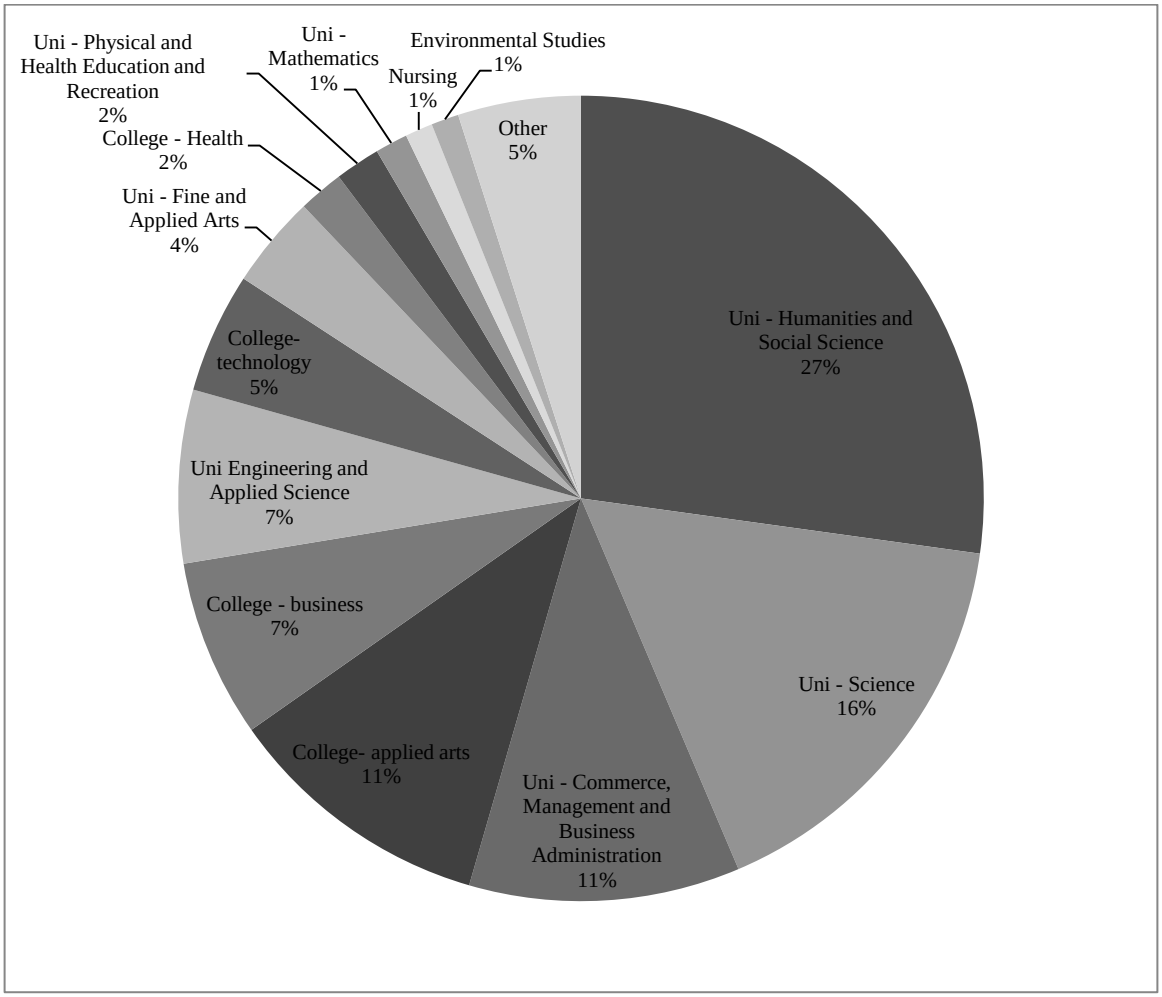
**Destination institution.** Unsurprisingly, of the students that did confirm a PSE offer by 2014, a majority chose Toronto-based institutions (Figure 2): University of Toronto (19.7%), York University (13.9%), Ryerson (10.8%), George Brown (4.2%), Seneca (5.3%), Centennial College (5.1%), Humber (4.6%), and OCAD University (1.5%). The largest confirmation destinations outside of the Greater Toronto Area (GTA) were Western (4.5%), Guelph (3.6%), and McMaster (3.2%).

### Figure 2. Destinations of Cohort by 2011



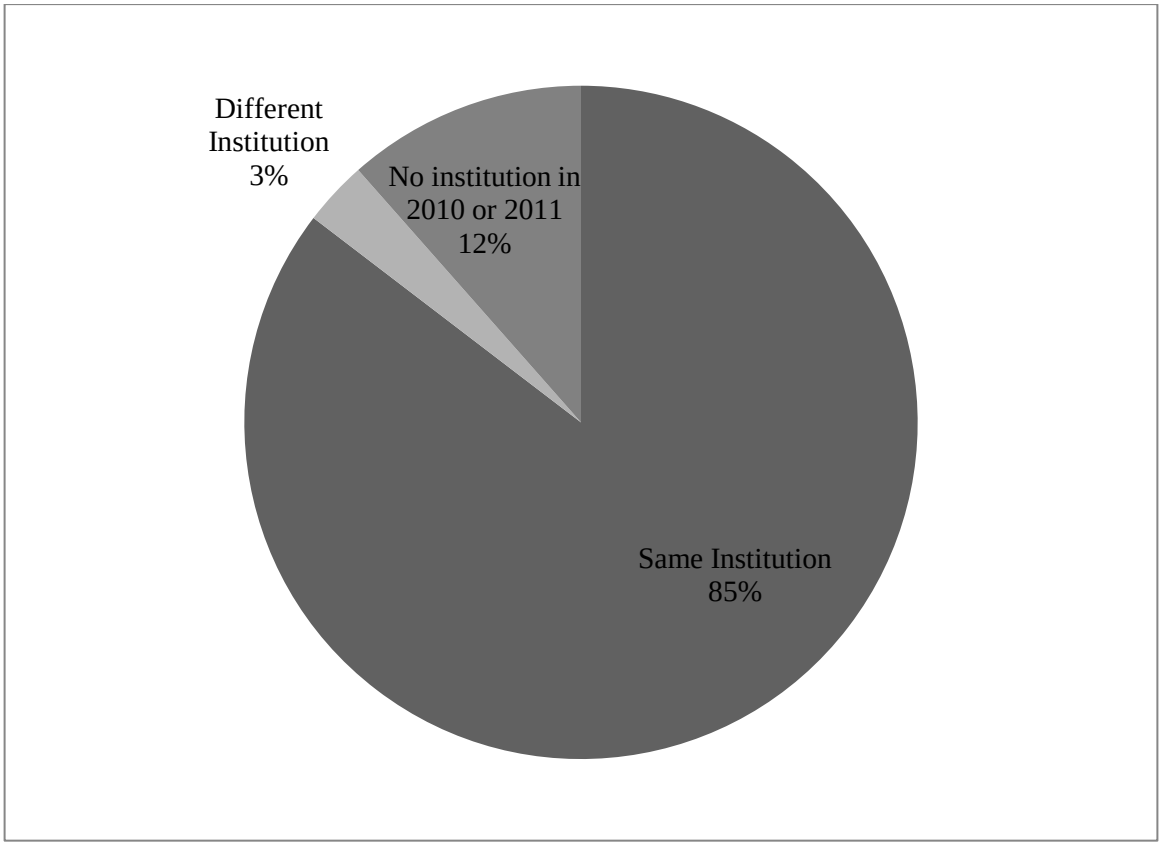
**Program of Study**. Next, we turn to program of study. Students confirm offers from thousands of very specific programs offered by Ontario universities and colleges. OCAS and OUAC group these specific programs under broader subject categories – e.g., "Engineering and Applied Science" for universities or "Technology" for colleges. Figure 3 displays the PSE programs of study in which cohort members were enrolled in 2014. The largest programs of study were university general arts (27%), university science (16.3%), university business (6.9%), and college applied arts (6.9%).

### Figure 3. Destination PSE Areas of Study, 2011




**Transitions over two time periods**. We now turn to comparisons between 2011 and 2014 institutional data. As displayed in Figure 4, between 2011 and 2014, 85.3% of the cohort was observed in the same PSE institution, while 3.1% were observed in a different PSE institution. An additional 11.5% reported no PSE institution in 2010/2011, but were observed in PSE in 2014.

## Figure 4. Transitions between 2011 and 2014




It is the 3.1% (*N*=327) that represent either transitions or errors in the PSE confirmation data. For the 327 students who transitioned to a different institution from the TDSB, there are three possible explanations:

1) Students confirmed one institution by spring 2011, but did not actually attend. Instead, these students went to another institution a bit later (by the end of the 2014 application cycle). An example could be a student who confirmed going to Western in 2011, but did not actually go through the final steps that would have resulted in the student attending classes (i.e., paying for the courses for the first half of the year, paying for residence, moving to London). However, the same student might have confirmed an offer from York in 2012, and would therefore have shown up as a York student in our final 2014 data.

2) Students confirmed an offer by 2011, attended, but then withdrew and applied to a different institution by 2014.

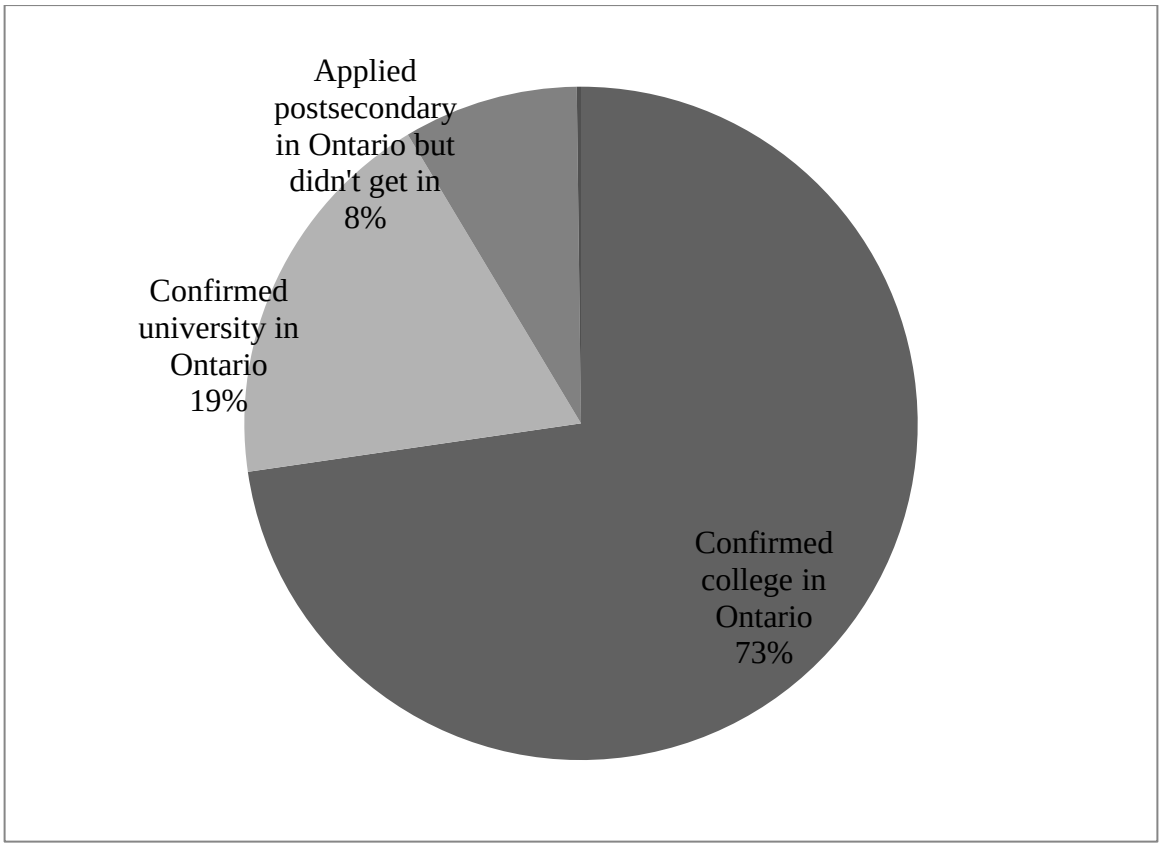
3) Students transferred to another institution by 2014. To use our Western-York example, the student could have gone to Western in 2011, withdrawn, and then gone to York in 2012-2014; or could have transferred to York from

Western. Generally, we would not receive the information on university transfers from OUAC, but there is a grey area between direct and indirect transfers if the student changes just a year or two after leaving high school, and it is possible, albeit unlikely, that the student may end up as a "direct" transfer twice within a few years.

We cannot provide exact details on what the specific reasons for this are; in any case, 3% is not, in itself, a major part of the picture. However, as we will see, there are many of these seemingly minor changes in the transition process, which collectively are more important than the individual parts. In terms of the 12% that had no institution in 2010 or 2011, these were the students who only enrolled in college by 2014.

**TDSB cohort members later present in OCAS data**. For the next part of the analysis, we focused only on the Ontario Colleges data, as we did not have access to detailed university enrolment data. Our analyses focused on 3,130 students from the TDSB cohort who were later found in the OCAS data set, indicating that they had enrolled in college. Figure 5 links the original PSE confirmation data that were obtained for the students prior to their appearance in the OCAS data.

### Figure 5. Cohort members in OCAS data in 2014



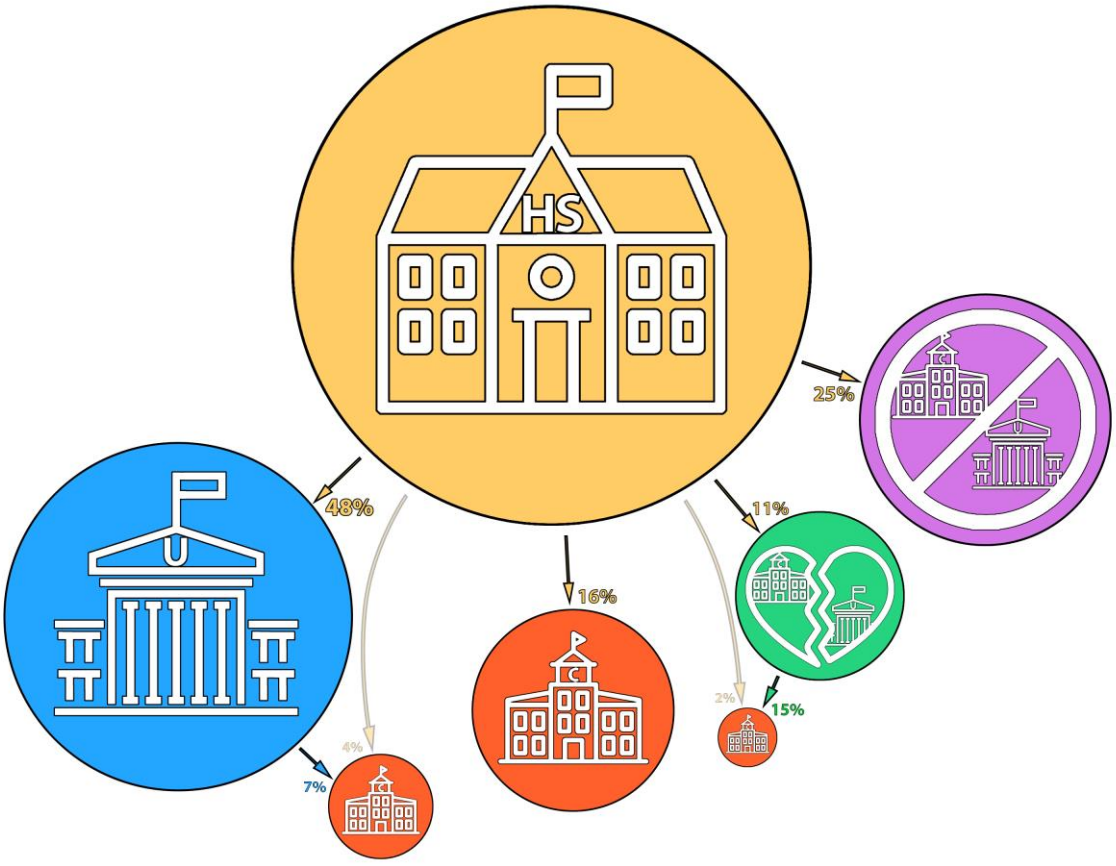
When the OCAS college enrolment data up to 2014 were examined in relation to the cohort data, we found 3,130 TDSB cohort members. Our original confirmation information on these students, however, indicated that less than three quarters of these students had been recorded as "confirming college" by 2011. We also observed that around 20% (*N*=586) had been recorded as originally "confirming university," while just under 10% (*N*=263) had been recorded as applying to postsecondary but not getting in.

These discrepancies can be interpreted in at least three ways:

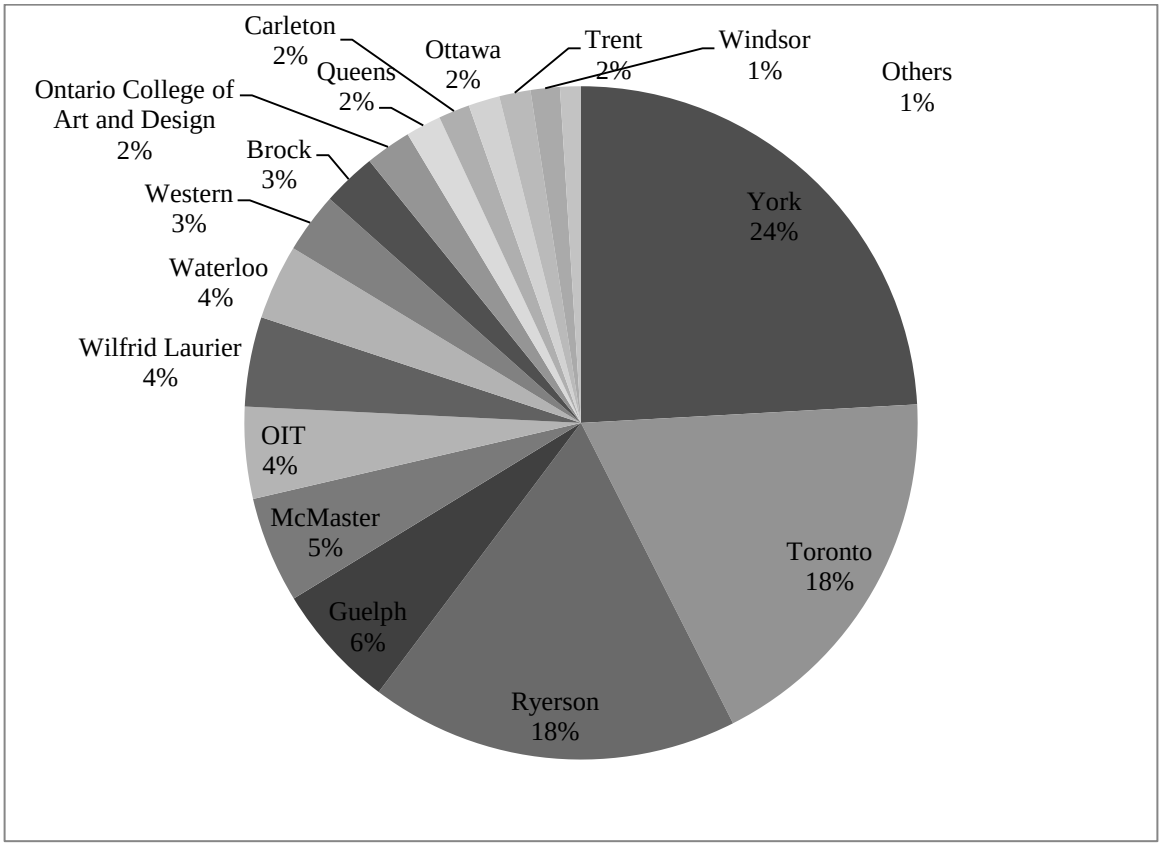
1) as university students transferring to college,
2) as late offers being given to students who had originally not been offered a place, and
3) as the imperfect relationship between confirmation and enrolment data.

The different pathways and eventual destinations of these students is illustrated in Diagram 1.

### Diagram 1. All Pathways of Students between 2011 and 2015.

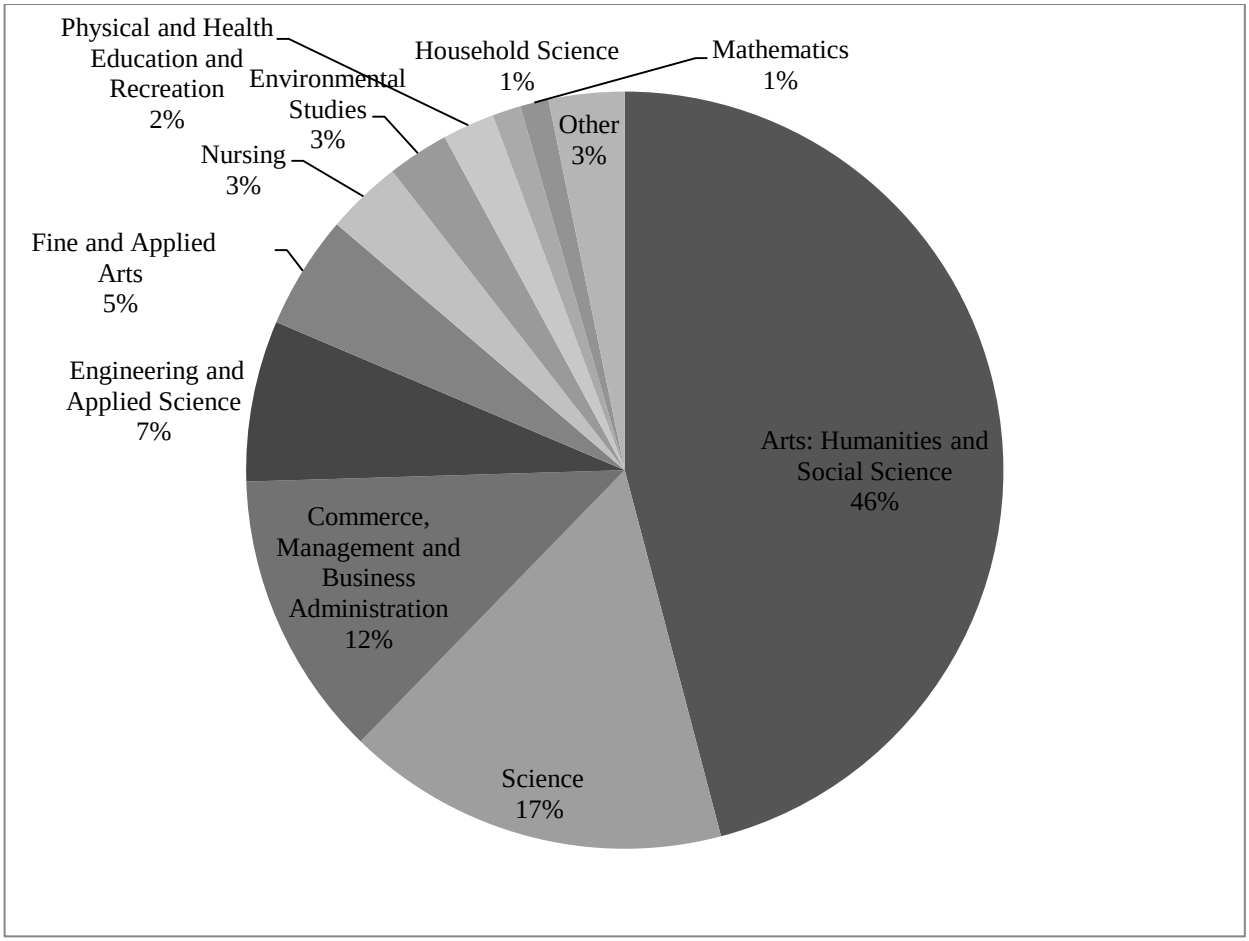


## Figure 6. Original University Confirmations of Students Who Transferred to College



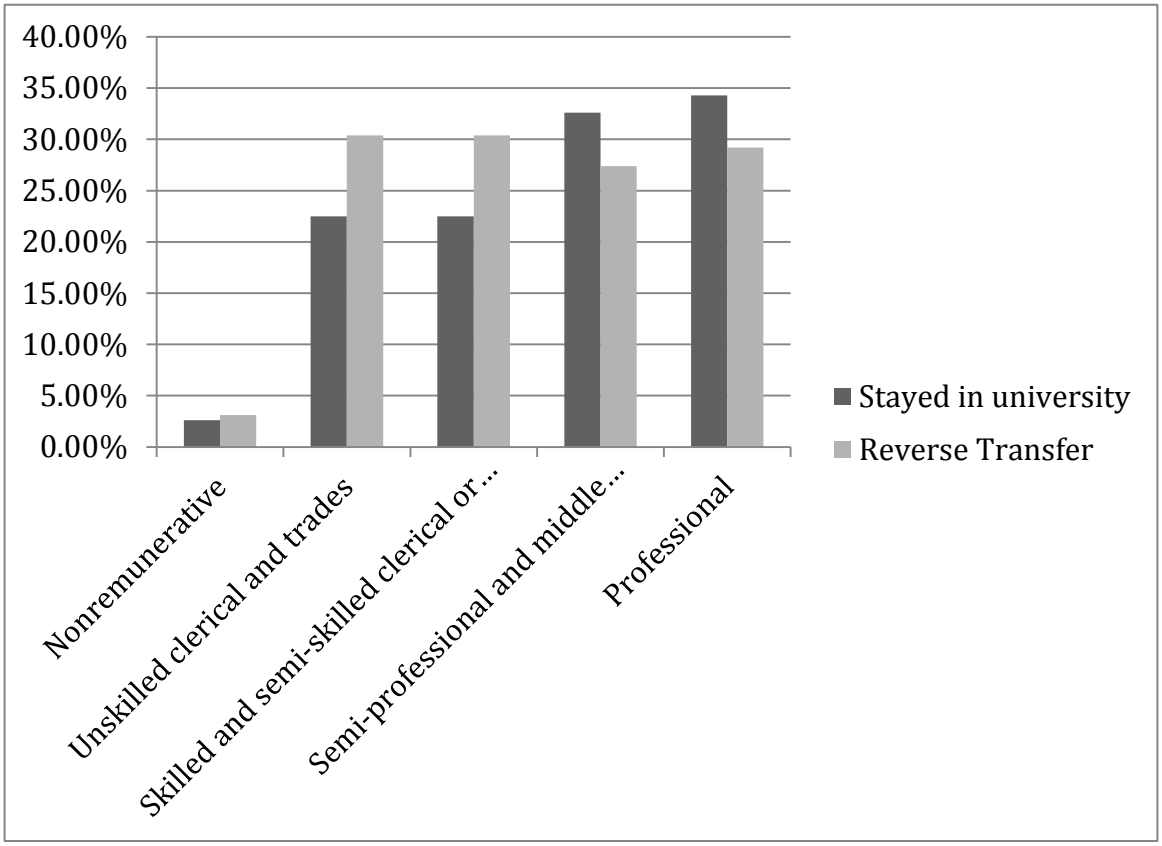

**Where did university-to-college transfer students start their PSE?** Examining the 586 cohort members who had originally confirmed university (Figure 6), we can see that the data indicate the largest proportion of students who were later in the college system had originally confirmed one of three Toronto universities: 24% had originally confirmed York University, 18% University of Toronto, and 18% Ryerson. The next largest transfers were from Guelph (6%) and McMaster (5%), while Waterloo, UOIT, and Wilfred Laurier each had 4% of the TDSB cohort university confirmations later found in Ontario colleges. In the case of the large proportion of transfers from York University, one possible explanation may be that at least some of the students transferred to Seneca College, which has a physical campus within the York University Keele campus.

## Figure 7. University Programs of Study Prior to College Transfer (*N*=586)



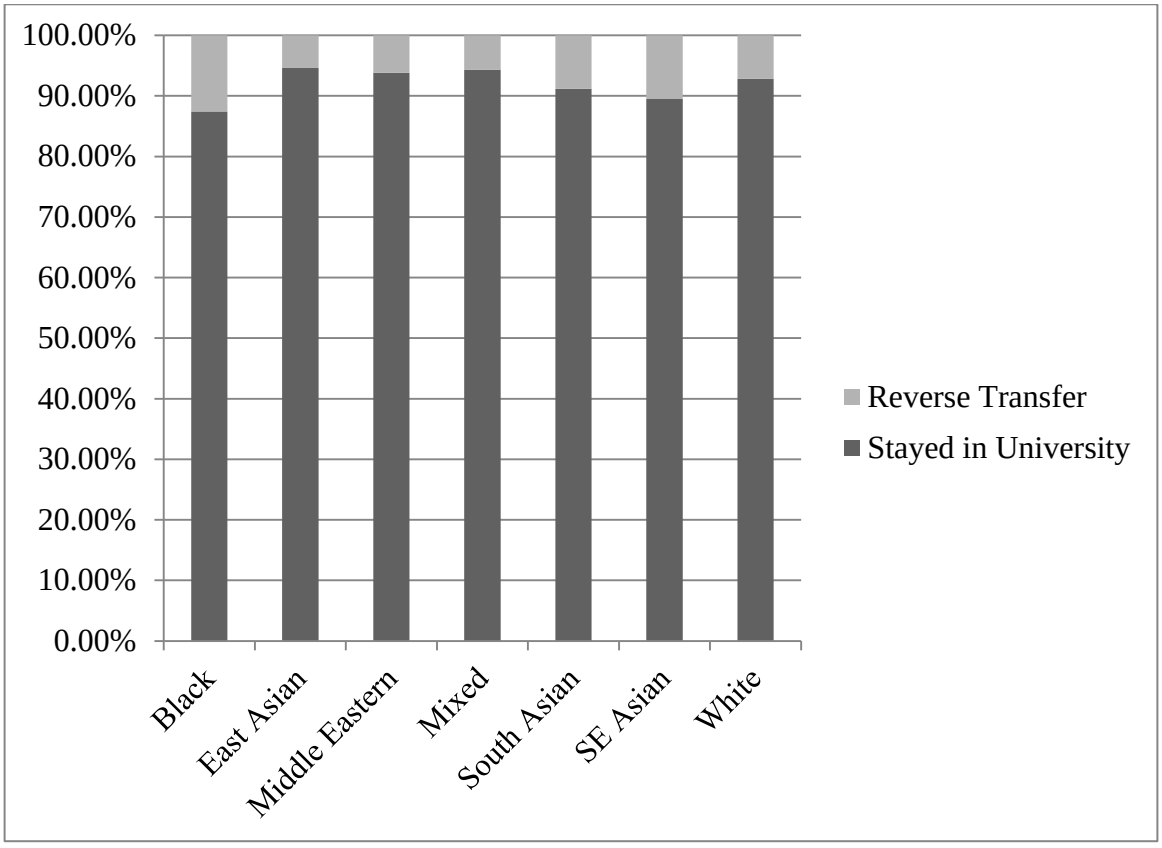

In terms of the university programs of study that the college transfer students arrived from (Figure 7), nearly half began in a general arts program at a university, while around 16 percent were in general science programs. The next largest categories were business (12%) and engineering (7%).

**Figure 8. Association between Reverse Transfer and Parental Occupation**




**Correlates of reverse transfer.** We will now briefly examine whether self-identified sex, race, and socioeconomic status are associated with reverse transfer. In examining the association between sex and reverse transfer, no association was found ($\chi^2$=0.526, *df*=1, *p*<0.491). However, as illustrated in Figure 8, some association was found between social class and reverse transfer ($\chi^2$=18.186, *df*=4, *p*<0.001), with more reverse transfer occurring in lower SES groups, consistent with the literature reviewed at the beginning of this report.

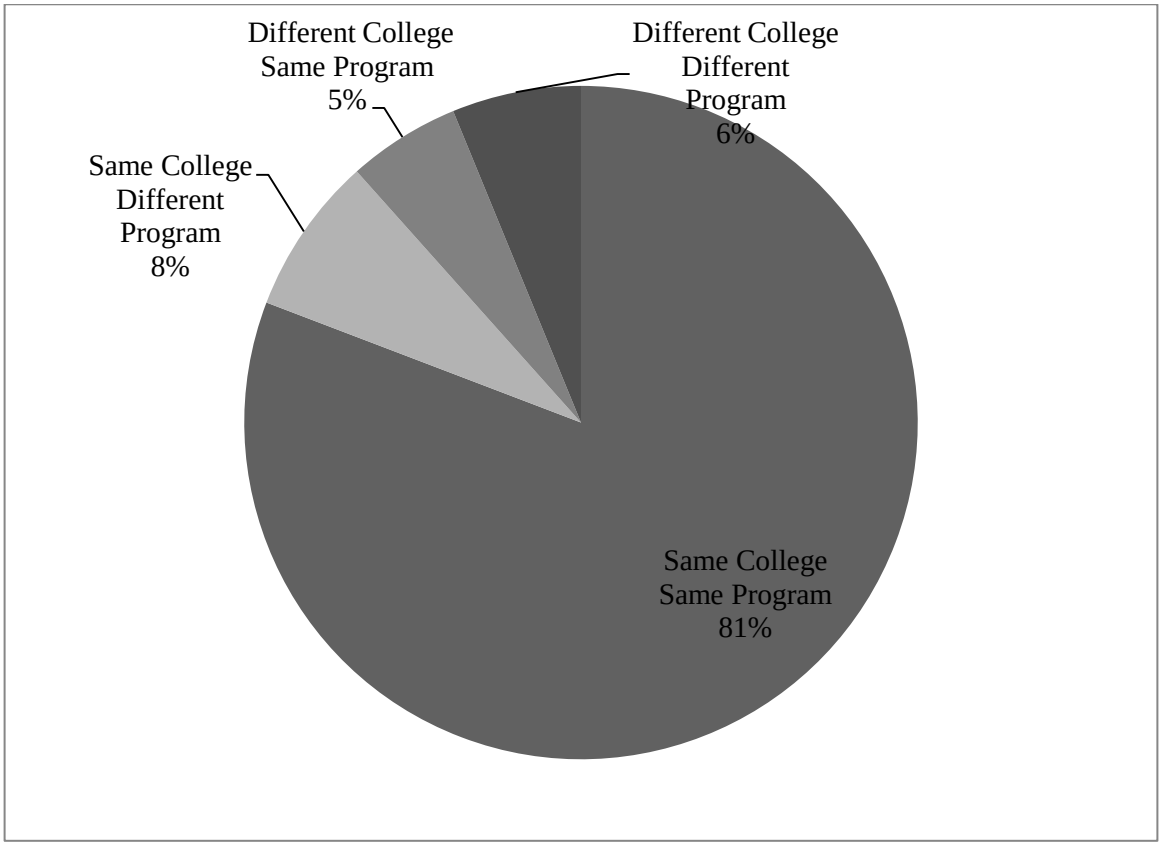
**Figure 9. Association between Race and Reverse Transfer**




Exploratory analysis of self-identified race and reverse transfer also revealed a statistically significant association ($\chi^2$=40.327, *df*=0, *p*<0.000), indicating that Black, South Asian and Southeast Asian students may be more likely to reverse transfer.

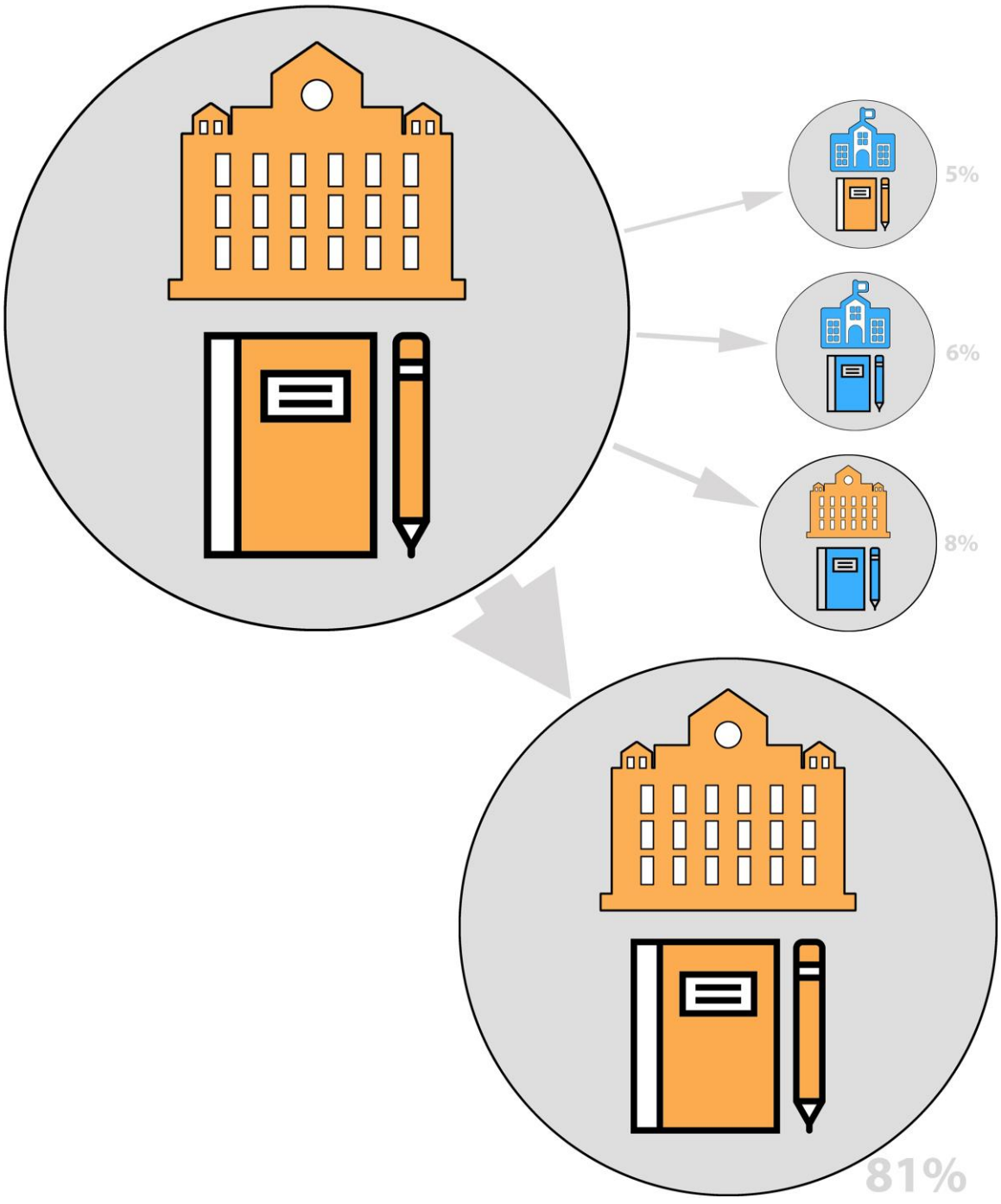
**Movement of the cohort within the college system**. We now turn to the movements of the cohort within colleges. We examined this by comparing the first college attended by the student to the last college attended by the student over our time frame of college progress (fall 2010 to fall 2015).

## Figure 10. Movement within College (*N*=3,130)




As displayed in Figure 10, the vast majority of cohort members who entered college stayed in the same college and same program. However, 8% were in a different college and different program, 5% were in the same college but different program, while 6% were in both different colleges and different programs. Diagram 2 depicts the movements that the original 3,130 college students made between students' first and last year in college within our time frame of fall 2010 to fall 2015. Students started, and left, at different times of the academic year over the five years of our analysis.

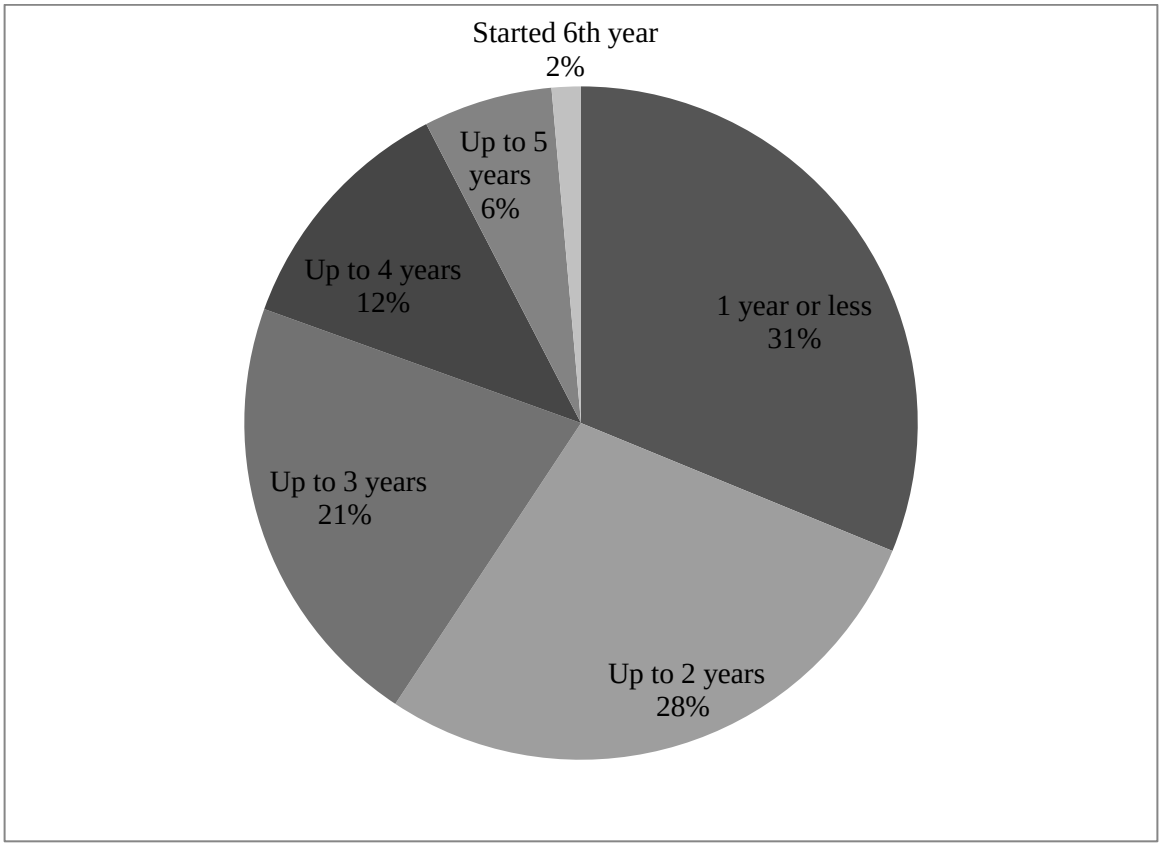
## Diagram 2: Movement of College Enrollees



**Duration of enrolment**. We now turn to the duration of college enrolment. The OCAS data allowed us to observe the number of academic years that a student has been present over the time of our study (fall 2010 to fall 2015). As noted earlier, students entered and exited college at different times, and the duration of their enrolment was calculated by comparing their last date of enrolment to their first enrolment date.

Figure 11 indicates that around a third of students (31.2%) were enrolled for one year or less, while 28.1% were enrolled for up to two years. Given that many college certificates are one year in duration and that many college programs are two years, the enrolment duration of nearly 60% of the college-going cohort appears to be an appropriate length of time. Just over a fifth of students (21.2%) were enrolled up to three years, and just over 10% for up to four years (11.9%). A small percentage (6.2%) were present five years after initial enrolment, and a handful (1.4%) were recorded as being enrolled in a sixth year. These figures do not necessarily mean that the students were continually enrolled, since it was possible that they may have entered college, exited college, and then re-entered over the five years of our analysis.

**Figure 11. Duration of College Enrolment, *N*=3,130**



**Associations with College Movement.** We now turn to the relationship between college movement and other correlated factors. We begin by examining how college movement is associated with duration of enrolment. After performing a cross-tabulation of these two characteristics, we found the association to be statistically significant ($\chi^2$=639.30, *df*=15, *p*<0.000). Figure 12 illustrates this association with a stacked bar chart. The general pattern in this association is that the longer the college duration, the more likely it was that the student changed program of study, institution, or both. In the third bar ("Up to Three Years"), students would have been college enrolled for a period longer than the typical certificate or diploma, which is where the increase in the checkered bar (representing changing colleges) is observed. The longer the duration, the less likely the student was to have stayed in the original college and program.

**Figure 12. Relationship between Duration and College Movement, *N*=3,130**

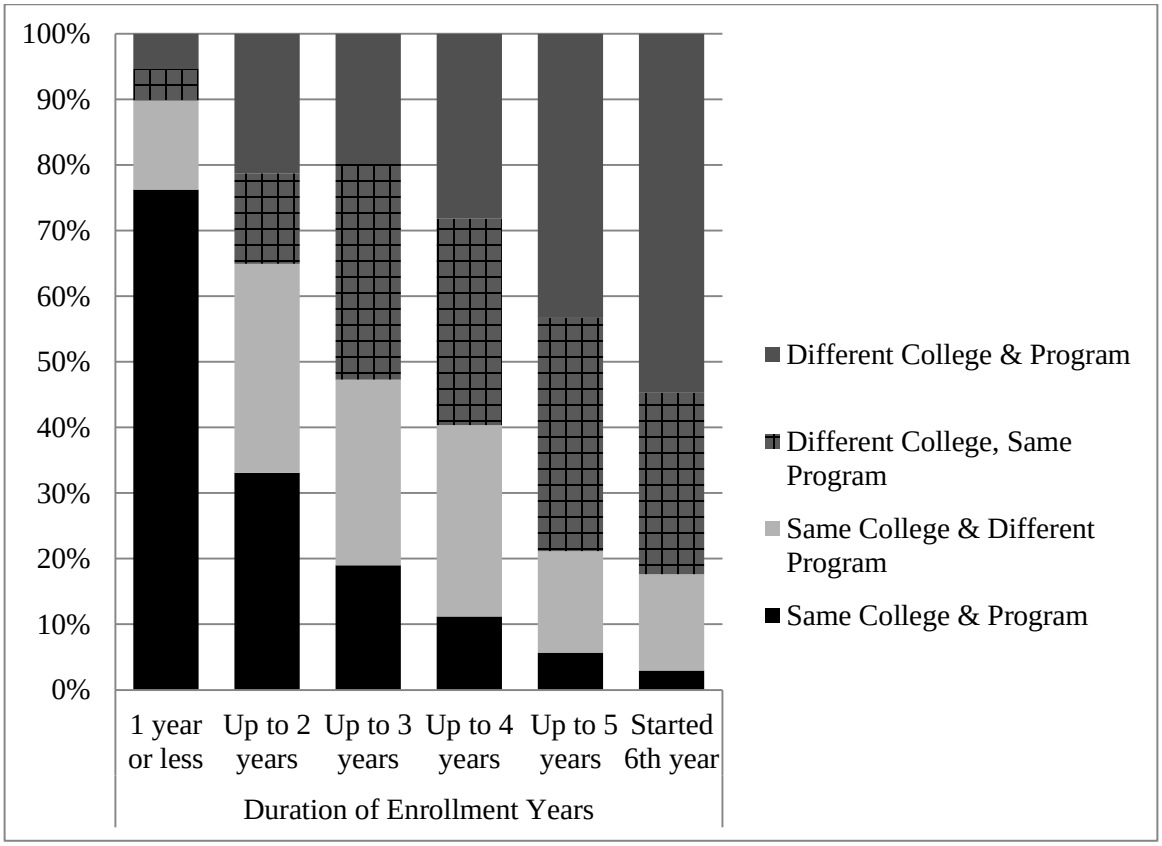
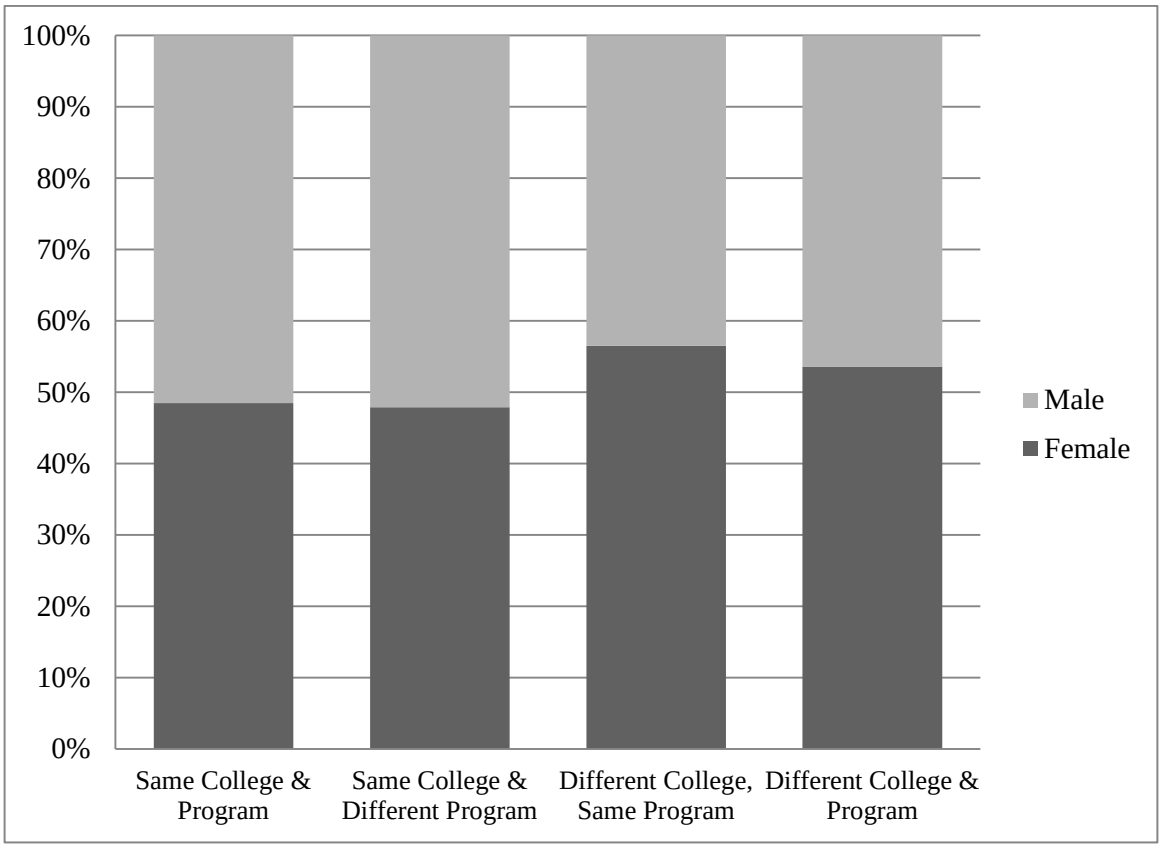
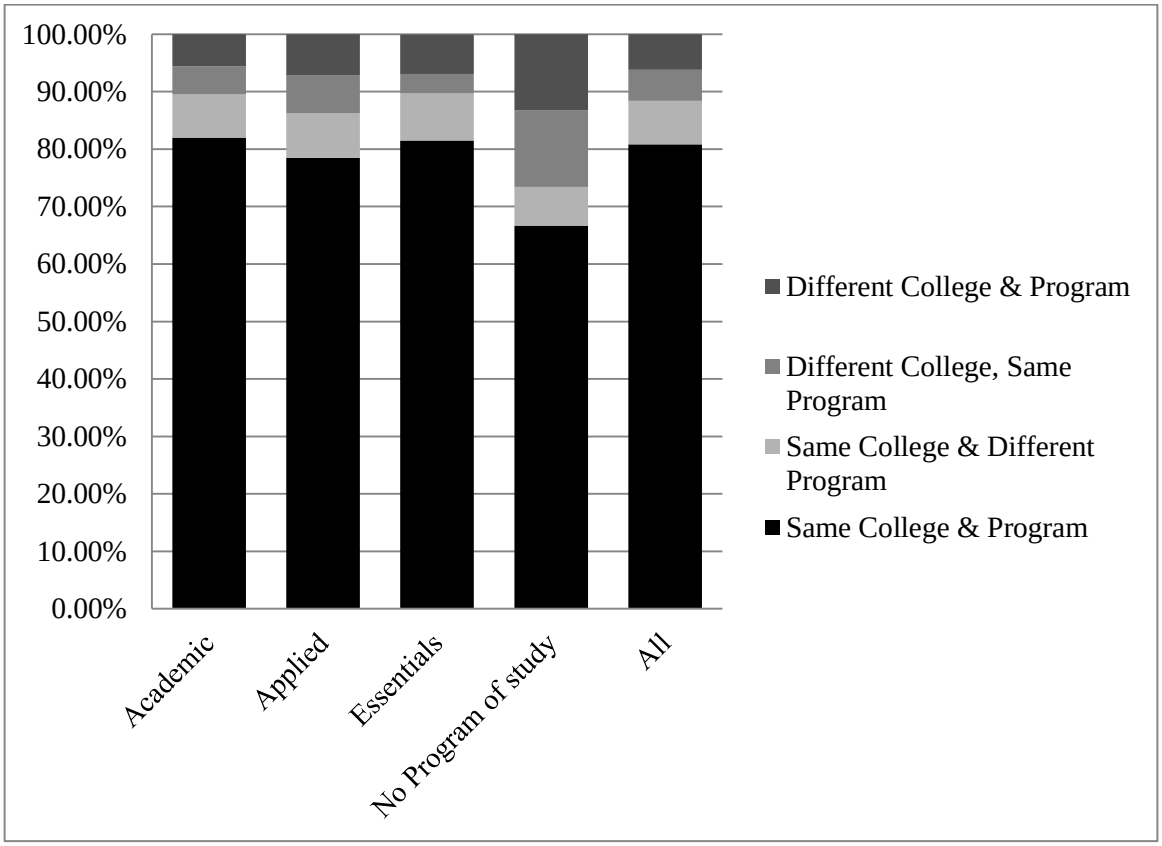


**Figure 13. Association between Sex and College Movement, *N*=3,130**




In Figure 13, we illustrate the association between sex and college movement ($\chi^2$=5.822, *df*=3, *p*=0.121), which did not achieve statistical significance. However, we observed a small female preference (56.5% versus 43.5%, *N*=194) for moving colleges but staying in the same general program type.

## Figure 14. Association between Grade 9/10 Program of Study and College Movement




We will now examine Grade 9/10 program of study (i.e. academic, applied, essentials) and its relationship with college movement. Measures of association revealed no statistically significant associations ($\chi^2$=11.954, *df*=9, *p*=0.216. Thus, program of study in Grade 9/10 was not found to be associated more or less with any kind of college or program change that we could measure in our data (Figure 14).

Our previous research has indicated that students with special education needs were more likely to choose a college pathway over a university pathway (Robson, Anisef, Brown, & Parekh, 2014). We therefore examined the associations between special education needs and program duration ($\chi^2$=5.302, *df*=5, *p*=0.380) as well as between special education needs and college movement ($\chi^2$=0.929, *df*=3, *p*=0.819), and found that special education needs was not associated with either of these variables.

## Summary

In this section, we sought to disentangle the pathways that students take in PSE. Our findings are summarized below.

- The majority of cohort members who confirmed PSE chose a Toronto-based PSE institution – 47% of the cohort confirmed one of the four universities in Toronto and 19% confirmed a college in Toronto, comprising 66% of the PSE-going cohort members.
- The largest areas of study were university humanities and social sciences (27%), university sciences (16%), university business and commerce (11%), and college applied arts (11%).
- The vast majority (85%) of students who confirmed a PSE place in 2011 were at the same institution in 2014. Only 3% had changed institution. Additionally, 12% of students who had not confirmed PSE in 2011 had confirmed an institution by 2014.
- In terms of students who appeared to have reverse transferred from university to college, exploratory analysis suggests that they were more likely to be from lower SES groups and be racialized (particularly Black, South Asian, or Southeast Asian.

Focusing only on TDSB cohort members in the 2014 OCAS (college) data set (*N*=3,130):

- 73% had confirmed college at an earlier date;
- 19% had confirmed university at an earlier date;
- 8% had previously applied to PSE in Ontario but did not get in; and
- just under half (45%) of the 327 who were recorded as confirming university but later appeared in college had originally confirmed one of the four universities in Toronto. Nearly half of the 327 students (46%) had originally confirmed a university arts program.

In terms of movement of cohort members while enrolled at college, 81% stayed in the same college and same program, 8% changed programs within the same college, 5% went to similar programs at different colleges, and 6% went to different programs at different colleges.

In terms of correlates of college movement, we examined duration of study, sex, Grade 9 program of study, and special education needs, and we found that only duration of study

was significantly associated with college movement. Unsurprisingly, students who were enrolled longer were more likely to change program or institution (or both). We also found a small preference among female students for moving colleges to take a similar program.

## Objective 3. How do pathways vary by individual characteristics?

The last part of our analyses examine how PSE pathways differ by individual characteristics. Using an intersectionality framework (Collins, 2015), we focus on race, sex, and family socioeconomic status (SES) as individual characteristics that can shape – alone and in their combinations – the educational outcomes of youth.

Other research conducted by members of our research team (Robson, Anisef, Brown & Parehk, 2014; Robson, Anisef, Brown & George, forthcoming) has demonstrated the general differences in individual characteristics as they pertain to college or university confirmations. We aimed to extend this research by looking more closely at program choice within university and college.

### Data

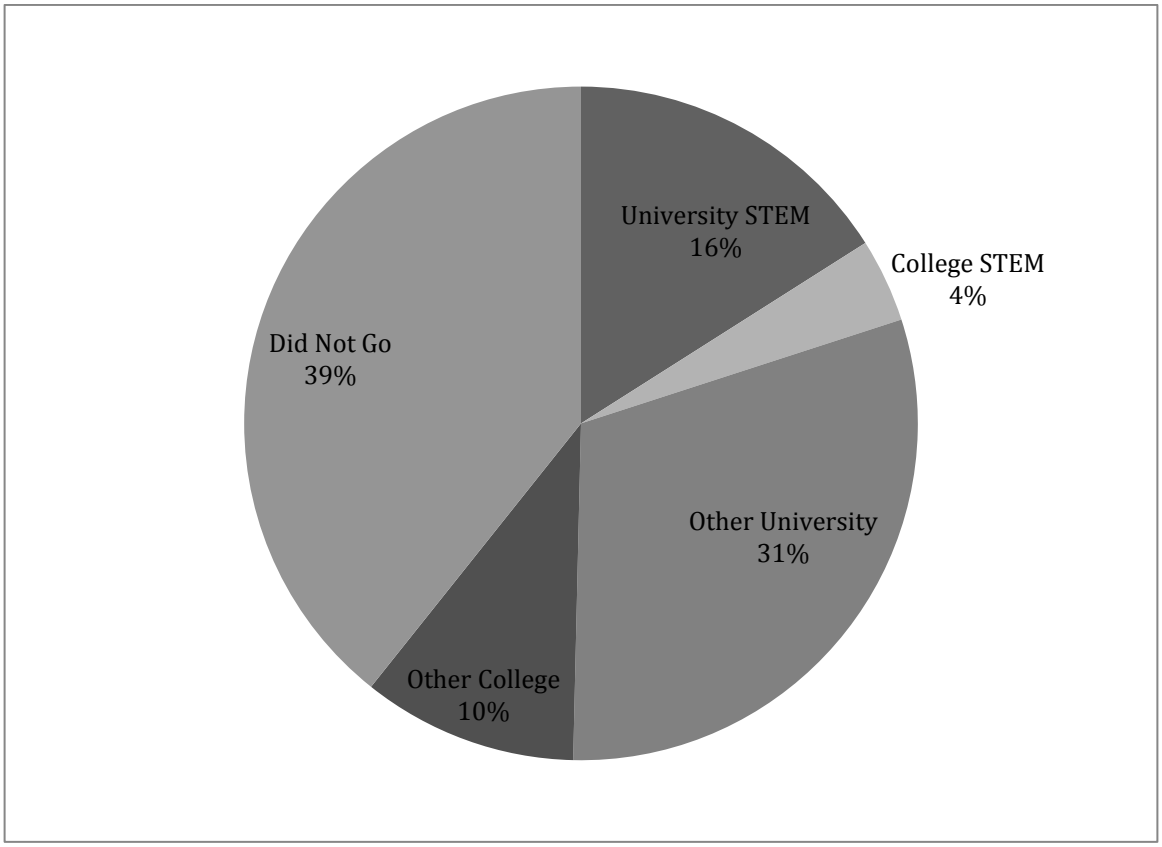
The data we used include the postsecondary program of study (key subject area) taken by students in the 2006-2014 TDSB cohort study, as illustrated earlier in Figure 3. In the analyses presented below, we focus on program of study as the outcome variable of interest. As the number of programs of study were in excess of 20, grouping them into more manageable subsets was deemed necessary. Here, we extend our extant knowledge about the general conceptual relationship between intersectionality and PSE by considering the determinants of STEM (Science, Technology, Engineering, and Mathematics) pathways.

Previous research has indicated that a number of factors affect students' decisions and ability to pursue STEM pathways from secondary to postsecondary education. Gender has been an important focus, as many STEM career fields tend to be dominated by men. Efforts to encourage young women to take math and sciences in secondary school have met with some success, but research shows that even when female students take advanced math courses in high school, they are still less likely to pursue STEM programs into PSE and beyond (Tyson et al., 2007; You, 2013). Parental education (Maple & Stage, 1991), secondary school culture, i.e. whether the school is STEM-focused (Wisall, 2014), and student perception of ability (Wang, 2012) have also been shown to influence STEM pathways. A recent study of Toronto secondary students found that non-academic factors – such as gender, place of birth, average income, and neighbourhood characteristics – and academic factors such as level of STEM courses taken in secondary school and GPA all played a role in students' decisions to apply to and register for university STEM programs (Dooley, Payne, Steffler, & Wagner, 2016). Being female and Canadian-born had a significant negative effect, though the magnitude of the effect was marginal. Being from a low-income neighbourhood also had a negative effect, but this was not statistically

significant. The authors found that the most significant predictor of pursuing STEM university courses was having taken advanced STEM courses in secondary school beyond the point at which the subjects became optional, and the effect increased as GPA went up.

Research on STEM pathways tends to be U.S.-based and tends to focus on university programs, but there is evidence to suggest that colleges are providing an increasingly important avenue for pursuing STEM postsecondary education and careers (Horn, Neville, & Griffith, 2006). As mentioned in the literature review section, colleges represent a potential alternative for those groups underrepresented in PSE, such as students from low-income backgrounds, Aboriginal students or students with disabilities. Little is known, however, about the non-linear pathways of students pursing STEM programs, particularly in Canada.

**Figure 15. Pathways of TDSB Cohort**




The dependent variable of interest had five possible values: 1) University STEM, 2) College STEM, 3) University Other, 4) College Other, and 5) no PSE. We also examined a number of other variables in the analyses, including race, sex, social class, and a number of control variables.

In our analyses, we examined both university and college STEM pathways. University STEM pathways were operationalized by combining the "Science," "Engineering and Applied Science," "Mathematics," and "Nursing" pathways of study into a dichotomous variable. As illustrated in Figure 13, the proportion of the cohort enrolled in a university STEM program was 16%. College STEM pathways were operationalized by combining "Health" and "Technology" programs of study. The proportion of the cohort enrolled in a college STEM program was 4%. We also created categories for non-STEM university and college programs, as well as for students who did not enrol in PSE. Students in non-STEM university programs accounted for 31% of the sample, while students in non-STEM college programs comprised 10% of the sample. Just under 40% of the sample did not confirm PSE (Figure 15).

*Self-identified race* (as reported by the student in the TDSB Student Census in fall 2006) was measured with a seven-category nominal variable with the following categories: Black (which includes Black African, Black Caribbean, and Black Canadian), Middle Eastern, East Asian, South Asian, Southeast Asian, Mixed, and White. Although Aboriginal students are a part of the TDSB census, their sample sizes are not large enough to include in analysis.

*Sex* was dichotomously coded so that female was equal to 1 and male was equal to 0.

*Social class* was operationalized by a variable that measured the occupational status of the parent. Originally, student respondents were asked the occupation of their parents, which was then recoded to a five-category variable with the following values: 1, "Non Remunerative"; 2, "Unskilled clerical and trades"; 3, "Skilled and semi-skilled clerical or trade"; 4, "Semi-professional and middle management"; and 5, "Professional and senior management."

We controlled for other correlates of PSE pathways, which have been established by others (de Broucker, 2005; Cheung, 2007) as being key determinants in the PSE pathways of Canadian youth. We included these so as not to overstate the relationship between our intersectionality variables of interest and the dependent variable. These controls include:

> *Special education needs*. A student was coded "1" if he or she had a special education need.
>
> *Parental postsecondary education*: A student was coded "1" if his or her parent had college or university education.
>
> *Academic program of study*: This variable measured whether the student was in a majority "academic" program of study (i.e. stream) in Grade 9. The variable was coded 1 if the student was taking majority academic courses and 0 if otherwise (i.e., in mostly applied or essentials courses).
>
> *Enjoyment of school.* This variable measured the extent to which the student

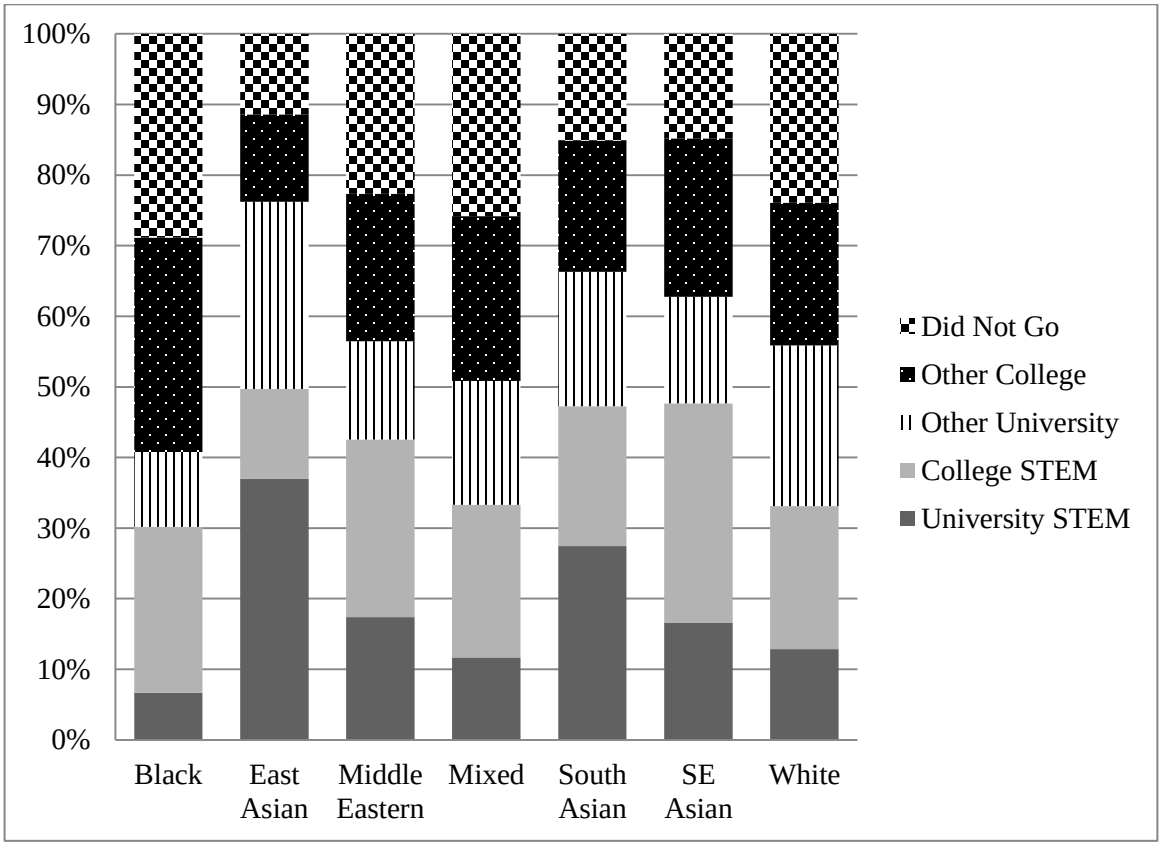
reported enjoying school in the Student Census, which was measured on a Likert scale where 1 was equal to "rarely or never" and 5 was equal to "all of the time."

*Average mark in all courses.* This variable was measured by the administrative records that contained the average school marks of secondary courses taken up to August 31 2011, when students should have completed their fifth year of secondary study. Many would have left the TDSB prior this time, since the majority of graduates left by the end of June 2010.

## Bivariate associations

We now turn to bivariate associations between university and college STEM pathways and other individual characteristics. We begin our bivariate analyses by examining the relationship between our intersectionality indicators (race, sex, and social class) and program of study. Figure 16 illustrates the relationship between self-identified race and program of study ($\chi^2$=1700, *df*=28, *p*=0.000).

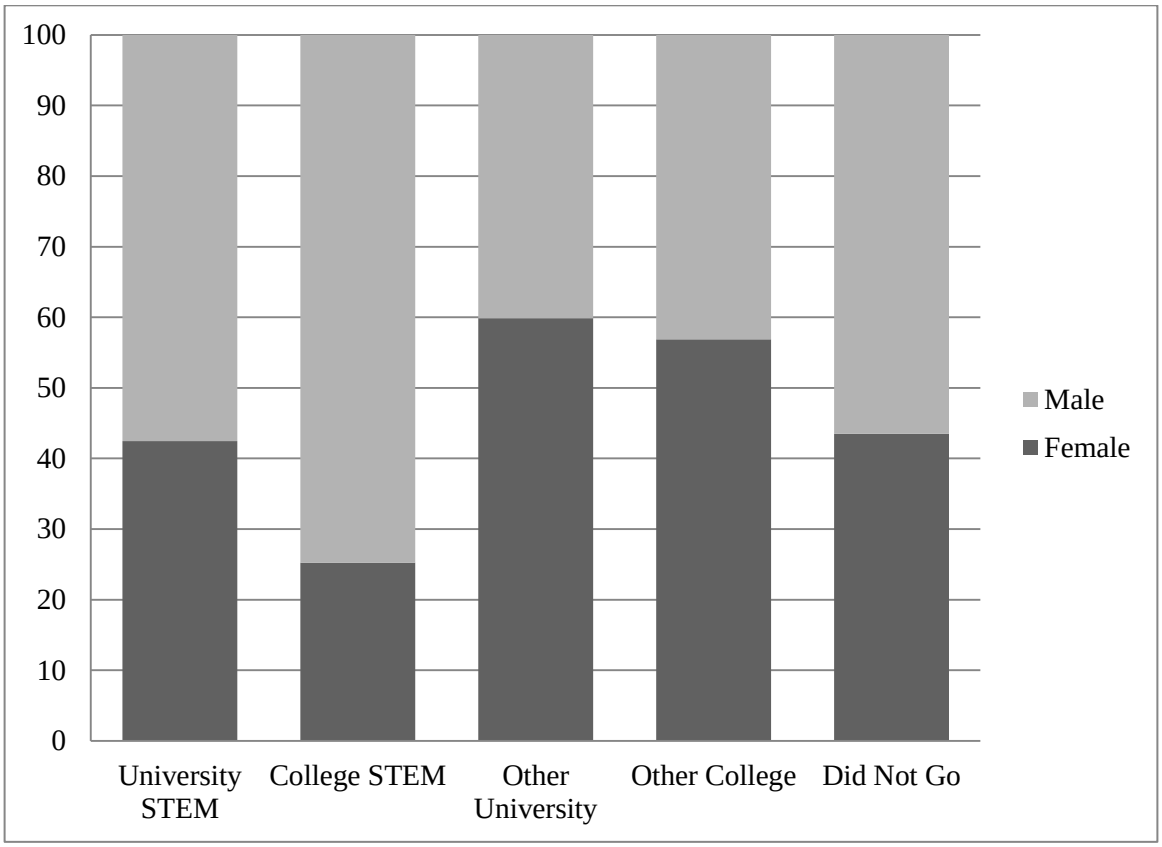
### Figure 16. Program of Study by Self-Identified Race



**Self-identified race and program of study**. The bars in Figure 16 illustrate the different proportions of self-identified race in the various programs of study. If there were no racial differences, all the subsections of the bars would be equal across all racial groups. We can see, however, that the areas associated with university STEM are very different across the groups, with over 35% of East Asian students in such programs and less than 10% of blacks. Conversely, nearly 15% of Black students and just under 13% of East Asian students were in college STEM programs. When the bottom two bars of Figure 16 are considered together, around half of all students in Asian racial groups are in either university or college STEM programs. Whites, blacks, and mixed students enter STEM (either university or college) at around 30%.

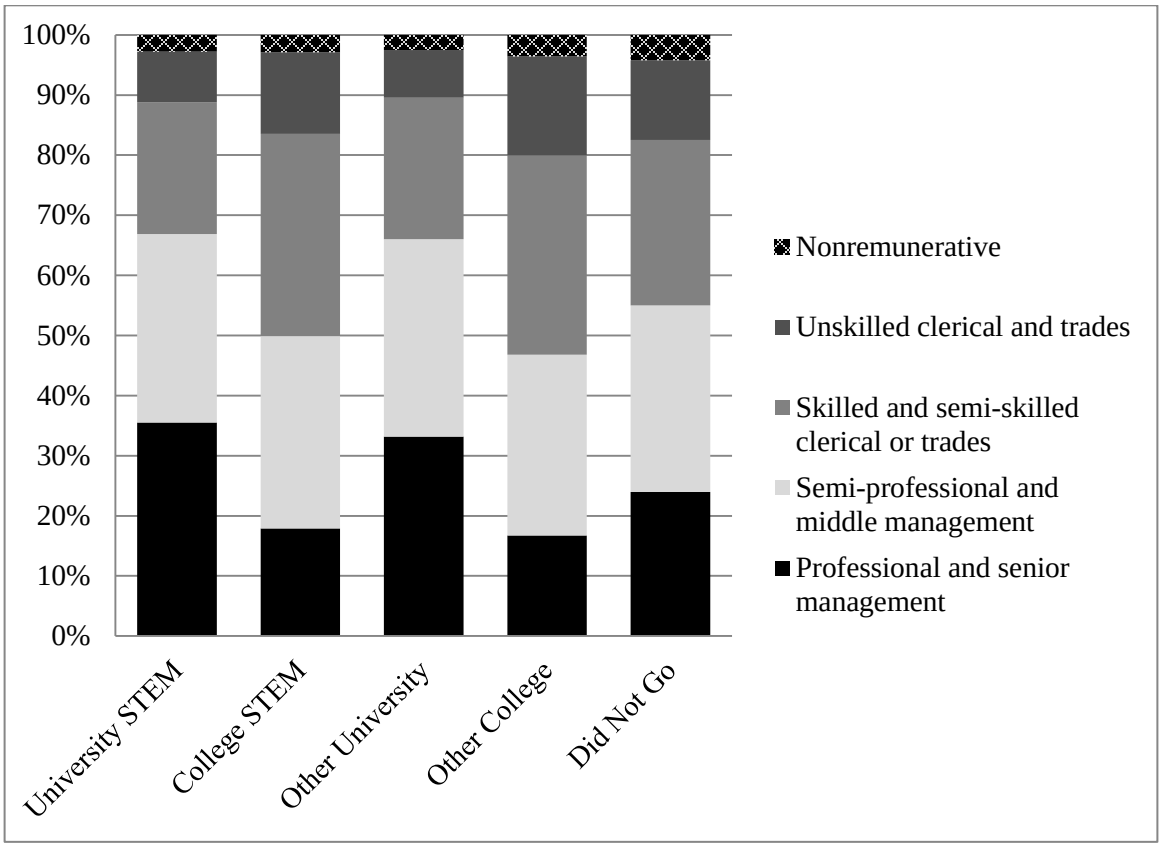
**Sex and program of study**. Figure 17 illustrates the association between sex and the five pathways we are considering ($\chi^2$=527.10, *df*=4, *p*=0.000). Clearly, there are male preferences to STEM program pathways, a finding that has been demonstrated repeatedly in previous research. Interestingly, the gap is bigger at the college level (25% women, 75% men) than at the university level (42% women, 58% men).

**Figure 17. Sex by Program of Study**




**Social class and program of study**. Figure 18 illustrates the association between social class (as operationalized by parental occupation) and the programs of study examined here ($\chi^2$=336.89, *df*=16, *p*=0.000). Clearly, the highest parental occupation category was associated with both university STEM and non-STEM pathways. The two highest occupational categories accounted for almost 70% of students in university STEM and non-STEM programs. College STEM and non-STEM students had more class origins from the category "Skilled and semi-skilled clerical or trades."

## Figure 18. Association between Social Class and Program of Study




**Other bivariate associations**. We also examined the associations between program of study and 1) parental PSE, 2) special education needs, and 3) Grade 9/10 program of study.

Figure 19 illustrates how parental PSE is associated with program of study ($\chi^2$=296.48, *df*=4, *p*=0.000), showing that students in university STEM and university non-STEM were more likely to have parents who had PSE than students in either college pathway.

## Figure 19. Parental PSE by Student's Program of Study

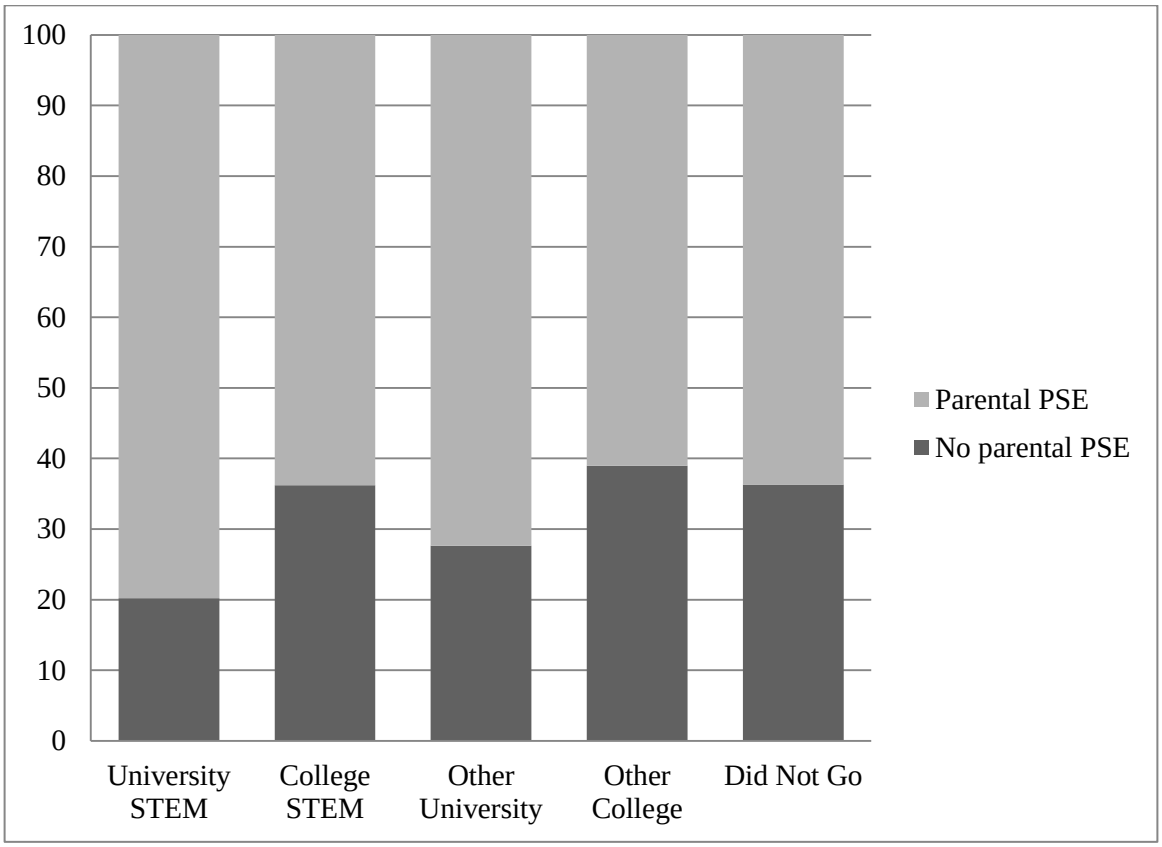
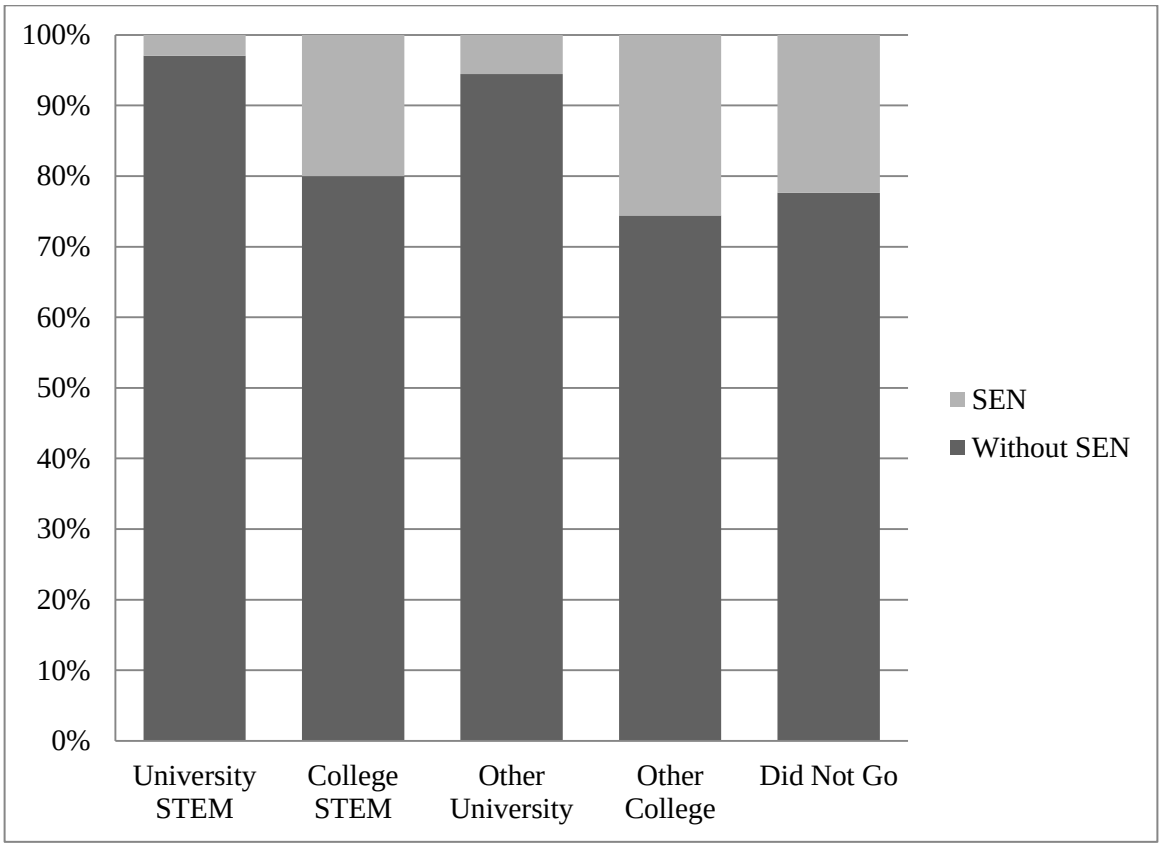


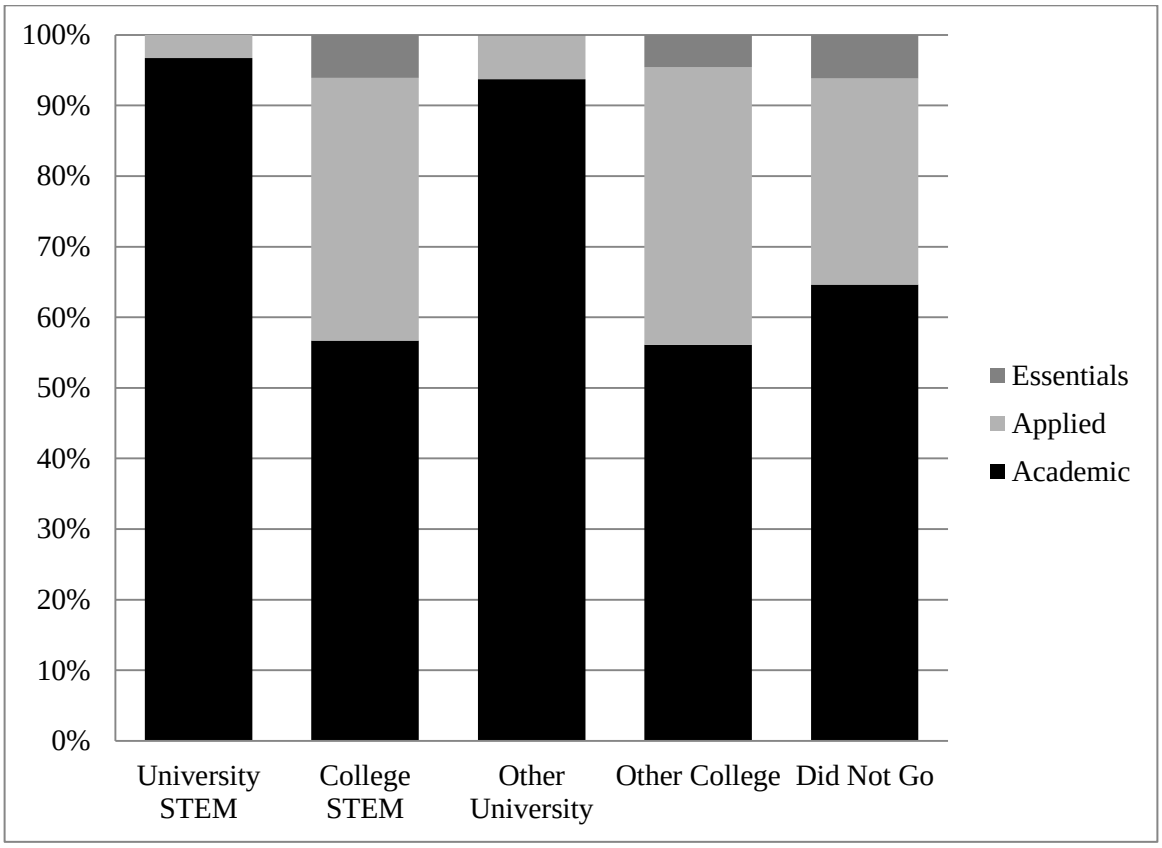

Figure 20 displays the association between the programs of study examined here and special education needs ($\chi^2$=1100, *df*=4, *p*=0.000), clearly illustrating that students with special education needs are more likely to be in a college pathway than a university pathway.

## Figure 20. Special Education Needs by Program of Study




Finally, Figure 21 ($\chi^2$=310, *df*=4, *p*=0.000) reveals the association between Grade 9/10 program of study and the PSE program pathways we considered. Nearly 97% of university STEM students and 93% of university non-STEM students had academic programs of study in Grades 9/10, while around 55% of students in both college pathways were in majority academic courses. Far more students in the college pathways had taken applied courses of study in high school – 37% in the case of college STEM and 40% in other college pathways.

## Figure 21. Grade 9/10 Academic Program and PSE Program of Study




### Multivariate models

In our predictive models, we used multinomial logistic regression, as the nature of our dependent variable was nominal and contained more than two categories. We did not use multilevel modelling because when we fitted a random intercepts model (allowing for clustering by schools), the ICC was only 3%, indicating that differences between schools were not accounting for much variance in the model. We opted for a simpler model, eliminating random intercepts.

In keeping with our intersectionality framework, the concepts of race, sex and class were of key importance. Intersectionality was operationalized by using the statistical interactions between sex and race and between race and parental occupational status. An intersectionality approach recognizes the *interplay* of multiple sites of disadvantage/advantage that may more fully explain the outcomes of young people. Interaction terms allow us to explore this potential interplay of multiple sites of disadvantage.

Interaction terms are often alternatively called multiplicative terms or moderators. Interactions were used to explore one aspect of intersectionality theory. While intersectionality theory argues that these two characteristics affect the life chances of individuals, the theory also suggests that their unique combinations will have differential

effects, depending upon subgroup membership. Such a statistical application allows us to operationalize different intersectional ties of students so as to examine how different combinations of fixed characteristics can affect their educational outcomes (McCall, 2005). As our research question involved the exploration of the potential of differential effects of known factors that predict student pathways, interaction effects were seen as a statistically sound way of examining such hypotheses. We were able to examine, for example, whether the effect of social class (operationalized here as parental occupation) differentially impacts the program of study by race. We were also able to examine whether the effect of sex on program of study is different by race.

We chose to present the multivariate analyses in a single model with "did not attend PSE" as the reference category for the dependent variable. All variables and interactions were added in the model. The output for a multinomial logistic regression with a five-category dependent variable and several independent variables is very lengthy, and instead of presenting the full regression output in this discussion, we refer interested readers to Appendix 1, where the full model is presented in its entirety.

In Table 2, the results of the effects of race and its composite interaction terms on predicting STEM and non-STEM programs are summarized. Only self-identified race categories with statistically significant findings are presented. A "+" denotes a statistically significant positive effect, while "-" indicates a significant negative effect. In the case of self-identified Blacks, the main effect of being Black on university STEM was positive, while the interaction between *Black X Parental Occupation* was negative. The interaction between *Black X Sex* was only statistically significant in predicting college STEM. In the case of East Asians, the main effect of race was positive in all pathways (indicating that East Asians were more likely than Whites to attend all of these programs compared to no PSE). However, for the interaction with parental occupation, the association was significant and negative for both university pathways and for college STEM. For South Asians, there was a positive main effect of race (relative to Whites) for all pathways except college STEM, while the interaction with parental occupation was negative for the non-STEM pathways. Finally, in the case of Southeast Asians, the interaction between race and sex was significant and positive for the non-STEM college pathway.

## Table 2. Summary of Statistically Significant Effects for *Race*, *Race X Sex* and *Race X Parental Occupation* in Predicting Postsecondary Pathway±

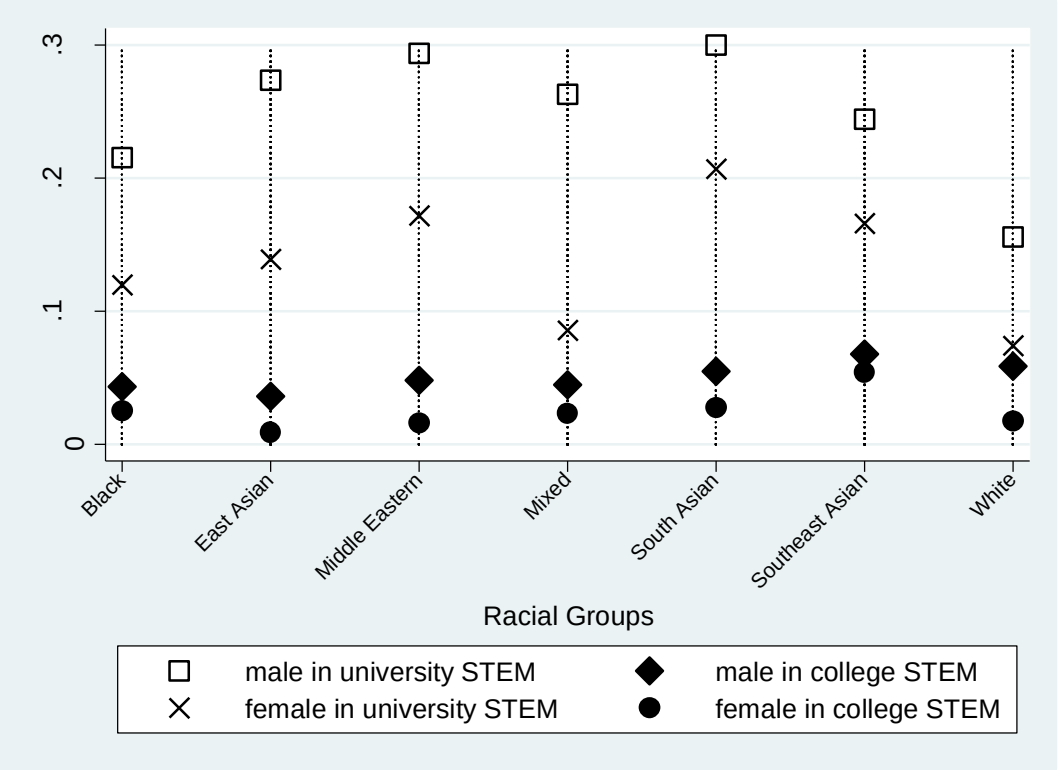
| Determinant* | UNI-STEM | COL-STEM | UNI-OTHER | COL-OTHER |
|---|---|---|---|---|
| **Black**<br>***X Sex***<br>***X Parental Occupation*** | +<br><br>- | <br>+ | | |
| **East Asian**<br>***X Parental Occupation*** | +<br>- | +<br>- | +<br>- | + |
| **South Asian**<br>***X Parental Occupation*** | + | | +<br>- | +<br>- |
| **Southeast Asian**<br>***X Sex*** | | | | <br>+ |

±Reference category of dependent variable: Did not attend PSE, * Reference is white male.

It must be emphasized that when interaction terms are included in estimations, the meaning of the main effects of the composite variables changes. The overall "effect" of race and sex needs to be calculated with the main effects of the composite variables as well as the interaction term, something that is difficult to "eyeball." Thus, we provide the predicted probabilities in the form of data visualizations in Figures 22 and 23, focusing on STEM pathways.

In Figure 22, it is clear that Blacks, East Asians and Southeast Asians have higher predicted probabilities of attending university STEM than their White counterparts (as corroborated in Table 2). The sex interaction that was significant here was for Black females in college STEM. The finding may be statistically significant ($p<0.05$), but it is not a particularly striking substantive finding, as the visualization does not illustrate any obvious deviation from the larger sex and race trends. The gap between Black males and females in college STEM is, however, noticeably narrower than it is for Whites.

**Figure 22. Predictive Margins of Interactions of Race and Sex on STEM Enrolment**



## Figure 23. Predictive Margins of Interactions of Race and Class on University STEM and College Enrolment

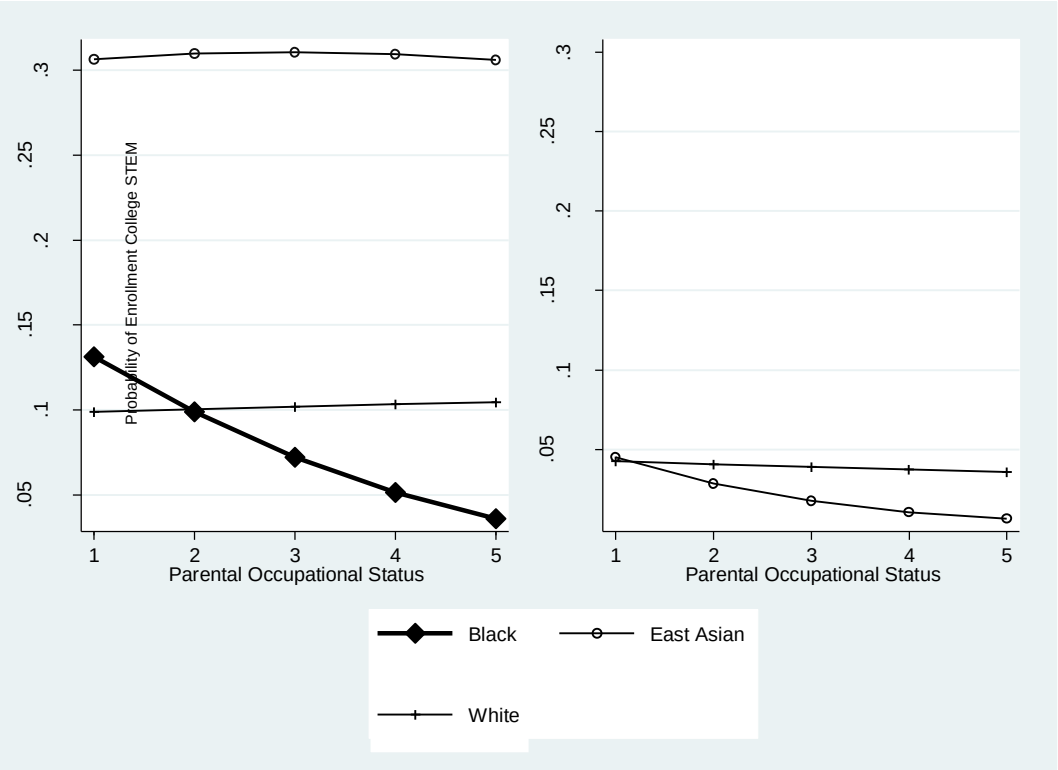



Figure 23 illustrates the statistical significant interactions between race and social class in predicting university and college STEM pathways. Not all racial groups are plotted, as some were not significantly different than Whites (the reference category). Note that in Table 2, the interaction for race and parental occupation was significant in the case of university STEM for Blacks and East Asians. As illustrated in the left panel of Figure 23, the line associated with Black students is strongly negative, indicating that university STEM and parental occupation are negatively associated – in other words, the higher the occupational prestige of the parent, the less likely the student is to go on to university STEM. In the case of East Asians, the relationship was somewhat curved, slightly increasing up to the middle occupational group but gradually decreasing after that point. However, East Asians, regardless of parental occupation, had the highest predicted probabilities of university STEM of all groups, while the opposite was true for Blacks in all categories apart from the lowest parental occupation grouping. According to Table 2, the single race interaction that was statistically significant in predicting college STEM (i.e. the right panel) was for East Asians. As illustrated in the figure, East Asians had the lowest predicted probabilities of attending college STEM, and this was strongly and negatively associated with parental occupation status. *It should be noted, however, that findings associated with Blacks and East Asians must be interpreted with caution, as their estimations are associated with fairly high standard errors (See Appendix 1).*

## Summary

In this section, we examined how individual characteristics affected PSE program choice. We conceptualized program choice in terms of STEM focus: university STEM, college STEM, university non-STEM, college non-STEM, and no PSE. In particular, we focused on race, sex, and social class – alone and in combination. We also controlled for several established correlates of PSE pathways in Canada.

In the TDSB cohort data, 16% of cohort members confirmed university STEM, 4% confirmed college STEM, 31% other university, 10% other college, and 39% did not go on to PSE.

Our bivariate analyses indicated that:

- Self-identified race was associated with the five program pathways, with East Asians representing 40% of enrollments and Blacks comprising only 7%.
- Consistent with other research, there was a strong male preference for STEM, and the gap was bigger at the college level (25% women, 75% men) than the university level (42% women, 58% men).
- Social class (operationalized by parental occupation) was strongly associated with program of study, with high status parental occupations being associated with university STEM and non-STEM pathways. Similarly, parental postsecondary education was also associated with a preference for university pathways.
- Students with special education needs were more likely to be in college non-STEM programs.
- Academic program of study in Grade 9/10 was more strongly related to university STEM and non-STEM than applied programs of study, which were more likely to be associated with the college pathways.

Analyses of race, sex, and class in our multivariate analyses revealed that Black, East Asian, and South Asian students were more likely to attend university STEM programs than Whites. An overall negative effect of female on STEM (college and university) was also observed. In terms of STEM pathways, parental occupation did not have a significant main effect; in fact, it only achieved statistical significance in the interaction terms. When graphed, it was found that:

- Parental occupational status had a strong negative association with university STEM for Black students and a weak negative association with university STEM for East Asian students.
- Parental occupational status had a strong negative association with college STEM for East Asian students.
- The standard errors associated with the estimates for Black and East Asian students were sizeable, indicating that caution must be taken when interpreting these findings.

## Discussion

The objectives of our analyses were to examine 1) direct and indirect transitions to PSE, 2) pathways within postsecondary, and 3) determinants of transition to program type (which we conceptualized as STEM and non-STEM).

We found that 47% of our cohort transitioned "directly" from high school to university and around 13% transitioned "directly" from high school to college. We used 5- and 8-year high school graduation data because it is difficult to know when a student has completed high school. The differences between the two strategies accounted for only 3% difference overall, suggesting that the vast majority those who will transition to PSE will do so within five years of starting high school.

We found that a majority of the students in our cohort (65%) chose a Toronto-based PSE institution, with study areas clustered mainly in the general arts and sciences, and less so in university business and college applied arts. When examining transitions between 2011 and 2014, we found that 85% of students were at the same institution, but of the 15% that were not, 3% had changed institution and 12% were in a PSE institution in 2014 but had no affiliation in 2011. Our data did not allow us to specifically understand what happened to these students, but they may represent – to some extent – transfers from institution to institution, as well as errors in the application centre confirmation data.

Focusing only on cohort members who went to an Ontario college (*N*=3,130), we were able to examine transfers in a bit more detail. We found that 19% of the cohort appeared to have "reverse transferred" from university to college, having appeared in university confirmation data prior to college enrolment data. The majority of these students came from York University, University of Toronto and Ryerson, with nearly half having been enrolled in a general arts degree program. Reverse transfer students were found to be disproportionately from lower SES backgrounds and self-identified as Black, South Asian, or Southeast Asian. We did not find sex differences, and because our cohort is more or less the same age, we did not find that students who reverse-transferred were "older," as previous studies have found.

In terms of movement within the college system, we found that around 20% of the cohort in the college system did report shifts – 8% changed program within the same college, while 11% changed colleges altogether. In terms of the factors associated with college movement, duration of enrolment was found to be negatively associated; the longer the enrolment duration (particularly after two years), the greater the likelihood that a student had moved programs or colleges. High school program of study, sex, and special education needs were not associated with college movement.

When focusing on the determinants of PSE pathways, we extended our previous analyses by looking in more detail at area of study. Focusing on STEM and non-STEM pathways, both at the college and university levels, we examined how individual characteristics affected these outcomes. The bivariate associations indicated differences by race, social class, parental PSE and special education needs. In particular, Blacks were

underrepresented in STEM, while East Asians, South Asians and Southeast Asianshad high representation, particularly in college pathways. College STEM programs were more heavily male than university STEM programs, while parental PSE and high social class were strongly associated with the STEM and non-STEM university pathways. Students who were in applied programs of study in Grade 9/10 or those with special education needs were more likely to be found in college pathways.

Our multivariate analysis examining the ideas around intersectionality revealed significant main effects of race for Blacks, East Asians and South Asians, as well as interactions around race and sex and race and parental occupation.[1] In terms of pathways, controlling for the other variables in the model, the predicted probabilities showed distinct differences in the likelihood of program enrolment by race and class. In particular, white students were less likely than other groups to be in university STEM. The most curious results were arguably the plotted predictive margins illustrating the association between race and class on STEM enrolment (Figure 23). These displayed a negative trajectory for Black students at the university level and a negative trajectory for East Asian student at the college level. In the latter case, the lower prestige of college STEM programs would account for the negative association with parental social class and likelihood of enrolment for East Asians. For Black students, however, the strong negative association between parental occupation status and university STEM is confusing. A weak negative association for East Asians can also be observed, but the path is definitely much flatter. We have chosen to be cautious about overemphasizing this finding because of the high standard errors associated with the main effects for Blacks (Appendix 1). Black students accounted for over 12% of the sample, and the parental occupational statuses are well-distributed, so it is unclear what is driving this finding.

Perhaps part of this finding may be explained by recent US research by Beasley (2012), who found that there was reluctance among talented and highly qualified Black students at elite American universities to pursue careers in STEM. Beasley argued that the range of majors among Black students at elite US colleges was less diverse than among White students, and that Black students' social networks within PSE institutions were segregated. Beasley (2012) also argued that Black students were wary about racism that they would encounter in White-dominated professions (i.e., STEM) and were more likely to fear making mistakes in STEM-related courses. The subjects in Beasley's study indicated that they aspired to careers that would help them "give back" to the Black communities that had been so supportive of their successes. Similarly, the U.S. Department of Education (2015) has reported that Historically Black Universities and Colleges, while comprising only three percent of PSE institutions, actually account for 27% of African Americans who obtain STEM undergraduate degrees. This also signals that it is the wider educational environment – not disinterest in STEM careers – that is steering American Blacks away from such fields. The same may be true of the Canadian context.

[1] Other racial subgroups are not discussed as their findings were not statistically significant.

## Limitations and Recommendations

Our study has revealed that the pathways of high school students can be varied and complex – and influenced by various individual characteristics. In particular, it was found that individual characteristics can affect reverse transfer, college mobility, and program choice. We were, however, limited insofar as the types of generalizations that could be made. Our data reflected a specific Toronto cohort and are therefore not likely to be representative of Ontario students as a population. We also had very limited information on university pathways beyond confirmation, as we were not privy to the cohort's enrolment experiences within universities in the same way were are able to access college data. Such restrictions on data access and usage necessarily limit the types of processes and relationships that can be explored, hindering our ability to understand the wider scope of student mobility. While the case of reverse transfer is interesting, the larger trend of transferring from college to university could be explored here.

We have, however, uncovered some important correlates associated with transfer and program choice. Social class and race were found to have important associations with these concepts, particularly with regard to reverse transfer and STEM program choice. In the case of the former, reverse transfer among certain racialized and lower SES groups may signal unpreparedness (or lack of social and cultural capital) for university environments. Programs targeting "First Generation" students at the university level may assist in retaining such students, but it is probably the case that more social and cultural capital development at the high school level would make such transitions less awkward for traditionally underrepresented students. Programs like the "Life After High School" project (Ford et al., 2016) have demonstrated mixed outcomes, with no long-term benefits for interventions that "nudge" secondary students to apply to postsecondary, but the program was universal in its target and did not specifically target students who were less likely to apply. College coach programs in Chicago that target racialized and underrepresented youth, however, have demonstrated success in increasing applications among Blacks and Latinos (Stephan, 2013).

The negative association between parental occupation and STEM university program among Blacks definitely warrants further investigation. If it indeed the case, as suggested by Beasley (2012), that high status Blacks are rejecting STEM due to segregated social networks, much more must be done at the university level to create inclusive environments for racialized students in the sciences and beyond.

## REFERENCES


Acai, A., & Newton, G. (2015). A comparison of factors related to university students' learning: college-transfer and direct-entry from high school students. *Canadian Journal of Higher Education*, *45*(2), 168-192.

Arnold, C. H. (2012). *Transfer literacy: Assessing informational symmetries and asymmetries.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2012-2_ChristineArnold-Transfer-literacy-assessing-informational-symmetries-and-asymmetries.pdf

Arnold, C. H., & Woodhead, S. (2015). *Transferability expectations and realities: Analysis of incoming Centennial College learner expectations, realities and self-adjusted perceptions.* Toronto: Ontario Council on Articulation and Transfer. Retrieved from http://www.oncat.ca/files_docs/content/pdf/en /oncat_research_reports/2013-02-Centennial-Transferability-Expectations-and-Realities.pdf

Beasley, M. A. (2012). *Opting Out: Losing the Potential of America's Young Black Elite.* Chicago: University of Chicago Press.

Blais, C., & Harper, M. (2013). *Tracking student success for credit transfer students at Laurentian.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2013-05-Final-Report-Laurentian-Tracking-Student-Success-for-Credit-Transfer-Students-at-Laurentian.pdf

Brady, P., & Allingham, P. (2010). Pathways to university: The victory lap phenomenon in Ontario. *Canadian Journal of Educational Administration and Policy*, *113*, 1-25.

Carleton University. (2013). *Supporting the success of transfer students: Benchmarking project*. Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2013-04-Final-Report-Support-the-Success-of-Transfer-Students.pdf

Cheung, S. (2007). *Education decisions of Canadian youth*. Toronto: Higher Education Quality Council of Ontario.

Coffey, S., Lindsay, G., & Sproul, S. (2012). *Three-partner collaborative evaluation of student transition, performance, experience, and outcomes in practical nursing (PN)-nursing degree (BSCN) bridging education: Executive Summary.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca /files_docs/content/pdf/en/oncat_research_reports/2012-19-EXEC-SUM-UOIT-Nursing.pdf

Collins, P. H. (2015). Intersectionality's definitional dilemmas. *Annual Review of Sociology, 41*, 1–20.

Confederation College. (2012). *Measures of student success and student experience following university/college transfers in Northwestern Ontario: Final Report.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2012-5-Confederation-Measures-student-success-experience-following-university-college-transfers-northwestern-Ontario.pdf

De Broucker, P. (2005). *Getting there and staying there: Low-income students and post-secondary education*. Ottawa: Canadian Policy Research Network.

Decock, H., McCloy, U., Liu, S., & Hu, B. (2011). *The transfer experience of Ontario colleges who further their education – an analysis of Ontario's college graduate satisfaction survey*. Toronto: Higher Education Quality Council of Ontario.

Dills, A. K., & Hernandez-Julian, R. (2008). Transfer college quality and student performance. *Eastern Economic Journal, 34*, 172-189.

Dooley, M., Payne, A., Steffler, M., & Wagner, J. (2016). *Understanding the STEM pathways through high school and into university programs*. Toronto: Higher Education Quality Council of Ontario.

Drewes, T., Maki, K., Lew, K., Willson, M., & Stringham, K. (2012). *An analysis of CAAT transfer students' academic performance at Trent University.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca /files_docs/content/pdf/en/oncat_research_reports/2012-18-FINAL-REPORT-Analysis-CAAT-transfer-students-academic-performance-Trent.pdf

Duklas, J., Maki, K., Pesaro, J., & Brady, J. (2014). *ARUCC PCCAT transcript and transfer credit nomenclature study: An examination of current practices at Canadian postsecondary organizations.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content /pdf/en/oncat_research_reports/2014-35%20ARUCC-PCCAT-Transcript-Transfer-Credit-Nomenclature-Study-EN.pdf

Durham College. (2013a). *Understanding student experiences and graduate outcomes for Durham College Graduate Certificate programs*. Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content /pdf/en/oncat_research_reports/2012-8-Durham-Understanding-student-experiences-graduate-outcomes-Durham-College-graduate-certificate-programs.pdf

Durham College. (2013b). *Understanding student experiences and graduate outcomes for Durham College Fast Track programs.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf

/en/oncat_research_reports/2012-7-Durham-Understanding-student-experiences-graduate-outcomes-Durham-College-fast-track-programs.pdf

Durham College. (2014). *Assessing the effectiveness of Ontario College Preparatory programs offered at Durham College.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf /en/oncat_research_reports/2013-08-Durham-Assessing-the-Effectiveness-of-Ontario-College-Preparatory-Programs-Offered-at-Durham-College.pdf

Durham College. (2016). *Credit where credit is due: Understanding the credit transfer experience at Ontario colleges.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en /oncat_research_reports/2014-31-Final-Report-Credit-where-credit-is-due-understanding-credit-transfer-in-Ontario-Colleges.pdf

Ferguson, S., & Wang, S. (2014, November). *Graduating in Canada: profile, labour market outcomes and student debt of the class of 2009-2010*. Retrieved from Statistics Canada website: http://www.statcan.gc.ca/pub/81-595-m/81-595-m2014101-eng.pdf

Finnie, R., Pavlic, D., Childs, S., Diaz, V. E., Mercier, P., & Lewrey, W. (2012). *Transfer student persistence at Algonquin College and University of Ottawa.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/index_en.php?page=research

Fisher, D., Nay, E., Wilson, M., & Wood, L. (2012). *Pathways and barriers to art and design undergraduate education for students with previous college and university experience.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2012-13-OCADU-Pathways-barriers-art-design-undergrad-education-students-previous-college-university.pdf

Ford, R., Kwakye, I., Hui, S. W., & Oreopoulos, P. (2016). Long-term impacts of supporting all students leaving high school to apply to college or university. Toronto: Social Research and Demonstration Corporation. Retrieved from https://www.researchgate.net/profile/Reuben_Ford/publication/305429471_Long-term_impacts_of_supporting_all_students_leaving_high_school_to_apply_to_college_or_university/links/578e63ba08ae81b4466ec622.pdf

Gerhardt, K., Arai, B., Carroll, M., & Ackerman, M. (2012). *Postsecondary student mobility from college to university: Experience and policy.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs /content/pdf/en/oncat_research_reports/2012-12-Laurier-Postsecondary-student-mobility-college-university-experience-policy.pdf

Goldrick-Rab, S., & Pfeffer, F. T. (2009). Beyond access: Explaining socioeconomic differences in college transfer. *Sociology of Education, 82*(2), 101-125.

Gorman, G., Phelps, C., & Carley, R. (2012). *Exploring the success and challenges of Diploma to Degree transfer students.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content /pdf/en/oncat_research_reports/2012-4-Conestoga-Exploring-successes-challenges-diploma-degree-transfer.pdf

Horn, L., Neville, S., & Griffith, J. (2006). *Profile of undergraduates in U.S. postsecondary education institutions: 2003-04*. Washington, DC: National Center for Education Statistics.

Janiga, S. J., & Costenbader, V. (2002). The transition from high school to postsecondary education for students with learning disabilities: A survey of college service coordinators. *Journal of Learning Disabilities, 35*(5), 462-479.

Kennett, D. J., & Maki, K. (2014). *Academic resourcefulness and transfer student success: Direct entry, college transfer, and university transfer student comparisons.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2013-06-Trent-Academic-Resourcefulness-and-Transfer-Student-Success.pdf

Kerr, A., McCloy, U., & Liu, S. (2010). *Forging pathways: students who transfer between Ontario Colleges and Universities*. Retrieved from Higher Education Quality Council of Ontario website: http://www.heqco.ca/SiteCollectionDocuments /ForgingPathwaysENG.pdf

Lakehead University. (2012). *Student success after transfer from college to Lakehead University.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2012-11-FINAL-REPORT-Lakehead-Student-success-after-transfer-college-Lakehead.pdf

Lakehead University. (2016). *Final report: Transitioning to university: Best practices for college transfer bridging courses.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en /oncat_research_reports/2015-01-Final-Report-Transitioning-to-University-Best-Practises-for-College-Transfer-Bridging-Courses.pdf

Mallette, C., Cutrara, K.P., Choiniere, J., Rogers, M., & Umana, C. (2015). *Transfer pathways: Strategies for success in the transition from college to university in BScN collaborative programs*. Toronto: York University. Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs /content/pdf/en/oncat_research_reports/2012-23-Final-Report-York-University-Transfer-Pathways-Strategies-for-Success-in-the-Transition-from-College-to-University-in-BScn-Collab-Programs.pdf

Manfredi, C. (2015, December 7). College versus university? A false dichotomy. *McGill Reporter*. Montreal: McGill University. Retrieved from http://publications.mcgill.ca /reporter/2015/12/college-versus-university-a-false-dichotomy/

Maple, S., & Stage, F. (1991). Influences of the choice of math/science major by gender and ethnicity. *American Educational Research Journal*, *28*(1), 37-60.

McCall, L. (2005). The complexity of intersectionality. *Signs*, *30*(3), 1771-1800.

Ontario Colleges. (n.d.). *Paying for college: tuition and financial assistance*. Retrieved from http://www.ontariocolleges.ca/colleges/paying-for-college

Ontario Council on Articulation and Transfer. (n.d.a). *About Us*. Retrieved from http://www.oncat.ca/index_en.php?page=about

Ontario Council on Articulation and Transfer. (n.d.b). *Principles for credit transfer policies and procedures*. Retrieved from https://www.ontransfer.ca /files_docs/content/pdf/en/Institutional_Profiles/Principles_for_Credit_Transfer.pdf

Ontario Council on Articulation and Transfer. (2013). *Summary of ONCAT-funded pathways and transfer research.* Retrieved from http://www.oncat.ca/files_docs /content/pdf/en/oncat_research_reports/ONCAT-research-summary-2013-ENGLISH.pdf

Sattler, P. (2010). *From postsecondary application to the labour market: the pathways of under-represented groups*. Retrieved from Higher Education Quality Council of Ontario website: http://www.heqco.ca/sitecollectiondocuments/pse_eng.pdf

Sidhu, R., Lin, S., Munro, Y., Smith, R., Parna, J., & De Oca Sarasua, E. (2016). *Are excess credits for college-to-university transfer students a concern? A case study within the Ontario context.* Retrieved from http://www.oncat.ca/files_docs/content /pdf/en/oncat_research_reports/2014-32-Final-Report-Excess-Credit-Study-at-York-University.pdf

Shook, C., Norman, C., & Guyatt, J. (2016). *Assessing determinants of academic success for college to university transfer in the diploma to degree program: Executive Summary.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2015-07-Final-Report-The-Governing-Council-of-UofT-Assessing-Determinants-of-Academic-Success-for-College-to-University-Transfer.pdf

Statistics Canada. (2016). Tuition fees for degree programs 2016/2017. *The Daily*, 2016-09-07. Retrieved from http://www.statcan.gc.ca/daily-quotidien/160907/dq160907a-eng.htm

Stephan, J. L. (2013). Social capital and the college enrollment process: How can a school program make a difference? *Teachers College Record, 115*(4), 1-39.

Stewart, J., & Martinello, F. (2012). *Transfer students in Ontario: How are they faring?* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2012-1-Brock-Transfer-students-in-Ontario-how-are-they-faring.pdf

Tyson, W., Lee, R., Borman, K., & Hason, M. (2007). Science, technology, engineering and mathematics (STEM) pathways: high school science and math coursework and postsecondary degree attainment. *Journal of Education for Students Placed at Risk, 12*(3), 243-270.

U.S. Department of Education. (2016). *Fact Sheet. Spurring African-American STEM Degree Completion.* Retrieved from https://www.ed.gov/news/press-releases/fact-sheet-spurring-african-american-stem-degree-completion

Usher, A., & Jarvey, P. (2012). *Student experiences in credit transfer at Ontario colleges: Final report.* Retrieved from Ontario Council on Articulation and Transfer website: http://www.oncat.ca/files_docs/content/pdf/en/oncat_research_reports/2012-3-CollegesOntario-Student-experiences-credit-transfer-Ontario-colleges-EN.pdf

Vaala, L. (1991). Attending two-year college after attending a four-year university in Alberta, Canada. *Community College Review, 18*(4), 13-20.

Wang, X. (2012). *Modeling student choice of STEM fields of postsecondary study: testing a conceptual framework of motivation, high school learning and postsecondary context of support*. Working Paper, School of Education, University of Wisconsin-Madison.

Wilson, D. N. (2009). Reverse transfer constraints upon planning post secondary programs. In R. L. Raby & E. J. Valeau (Eds.), *Community College Models: Globalization and Higher Education Reform* (pp. 401-416). New York: Springer.

Wisall, M., Stiefel, L., Schwartz, A., & Boccardo, J. (2014). Does attending a STEM high school improve student performance? Evidence from New York City. *Economic of Education Review 40*(13), 93-105.

You, S. (2013). Gender and ethnic differences in precollege mathematics coursework related to science, technology, engineering and mathematics (STEM) pathways. *School Effectiveness and School Improvement, 24*(1), 64-86.

**Appendix 1**. Multinomial Logistic Regression Model of Postsecondary Program Path on Race, Sex, Class, Interactions and Controls (Reference= No Postsecondary) *N*=11,040

| | **University STEM** | | | **College STEM** | | | **Other University** | | | **Other College** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Self-Identified Race (White=reference)* | RRR | | SE | RRR | | SE | RRR | | SE | RRR | | SE |
| Black | 11.166 | *** | 6.250 | 0.760 | | 0.458 | 1.200 | | 0.468 | 1.014 | | 0.372 |
| East Asian | 11.472 | *** | 4.844 | 7.389 | ** | 4.746 | 6.868 | *** | 2.221 | 2.607 | * | 1.152 |
| Middle Eastern | 2.022 | | 1.286 | 0.927 | | 0.671 | 1.204 | | 0.544 | 1.746 | | 0.836 |
| Mixed | 2.653 | | 1.871 | 1.054 | | 0.890 | 0.788 | | 0.394 | 0.584 | | 0.321 |
| South Asian | 7.732 | *** | 2.976 | 1.384 | | 0.667 | 3.508 | *** | 0.993 | 2.680 | ** | 0.889 |
| Southeast Asian | 1.633 | | 1.310 | 2.308 | | 2.023 | 1.276 | | 0.793 | 1.963 | | 1.292 |
| *Female (1=yes)* | 0.400 | *** | 0.049 | 0.286 | *** | 0.056 | 1.118 | | 0.092 | 1.578 | *** | 0.176 |
| *Race X Sex Interactions* | | | | | | | | | | | | |
| Black X female | 1.337 | | 0.422 | 2.260 | * | 0.828 | 1.259 | | 0.261 | 1.342 | | 0.273 |
| East Asian X female | 0.786 | | 0.154 | 0.732 | | 0.374 | 0.826 | | 0.133 | 0.637 | | 0.156 |
| Middle Eastern X female | 1.005 | | 0.360 | 0.978 | | 0.598 | 0.992 | | 0.274 | 0.569 | | 0.193 |
| Mixed X female | 0.555 | | 0.186 | 1.760 | | 0.853 | 1.076 | | 0.262 | 1.525 | | 0.467 |
| South Asian X female | 1.377 | | 0.259 | 1.713 | | 0.533 | 0.990 | | 0.148 | 1.040 | | 0.203 |
| Southeast Asian X female | 1.595 | | 0.636 | 2.646 | | 1.366 | 1.359 | | 0.447 | 0.454 | * | 0.169 |
| *Parental Occupation* | 1.068 | | 0.072 | 0.976 | | 0.081 | 1.091 | * | 0.048 | 0.939 | | 0.051 |
| *Race X Parental Occupation* | | | | | | | | | | | | |
| Black X PO | 0.600 | ** | 0.089 | 1.003 | | 0.165 | 0.930 | | 0.092 | 1.037 | | 0.101 |
| East Asian X PO | 0.746 | ** | 0.074 | 0.521 | *** | 0.097 | 0.706 | *** | 0.055 | 0.866 | | 0.097 |
| Middle Eastern X PO | 1.153 | | 0.177 | 1.038 | | 0.206 | 1.020 | | 0.113 | 0.925 | | 0.122 |
| Mixed X PO | 0.976 | | 0.163 | 0.933 | | 0.205 | 1.075 | | 0.126 | 1.103 | | 0.147 |
| South Asian X PO | 0.851 | | 0.079 | 0.986 | | 0.127 | 0.814 | ** | 0.058 | 0.819 | * | 0.074 |
| Southeast Asian X PO | 1.104 | | 0.233 | 0.895 | | 0.225 | 0.947 | | 0.157 | 1.131 | | 0.208 |
| *Parental PSE* | 1.319 | ** | 0.111 | 0.953 | | 0.108 | 0.967 | | 0.059 | 0.846 | * | 0.061 |
| *Has Special Education Need* | 0.640 | ** | 0.107 | 0.994 | | 0.144 | 0.748 | ** | 0.076 | 1.346 | ** | 0.122 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Academic Program of Study Grade 9/10* | 5.358 | *** | 0.876 | 0.790 | | 0.099 | 4.355 | *** | 0.415 | 0.877 | | 0.072 |
| *Average Marks* | 1.191 | *** | 0.006 | 1.025 | *** | 0.005 | 1.100 | *** | 0.003 | 1.010 | ** | 0.003 |
| *Whether Enjoys School* | 1.122 | ** | 0.047 | 1.028 | | 0.060 | 1.011 | | 0.031 | 0.991 | | 0.037 |
| Constant | 0.000 | *** | 0.000 | 0.034 | *** | 0.015 | 0.000 | *** | 0.000 | 0.143 | *** | 0.040 |
| Log Likelihood | -12183 | | | | | | | | | | | |
| Pseudo R squared | 0.2027 | | | | | | | | | | | |

***$p$<0.001, **$p$<0.01, *$p$<0.05