INVESTIGATING THE METHODOLOGICAL APPLICABILITY OF INTERSECTIONALITY TO PHYSICAL ACTIVITY AND SMOKING IN CANADA

by

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Abstract

BACKGROUND: In Canada, substantial health inequities have been documented by income, education, gender, race, and sexuality. Researchers examining such inequities have typically employed 'additive' analyses where these variables are treated independently of one another. Some scholars have argued that the additive approach cannot fully illuminate health inequities by class, gender, race, and sexuality, calling for 'multiplicative' approaches inspired by intersectionality theory to replace additive approaches.

PURPOSE: I investigate the applicability of intersectionality theory for explicating two health practices - physical exercise and smoking - using Canadian data. I predict that intersections of classism, patriarchy, racism, and heterosexism at macro levels of Canadian society affect the incidence of exercise and smoking at the individual level, in the case of physical exercise as a desirable pursuit which is facilitated by the privilege that accrues to multiple dominant-group identities and in the case of smoking as a coping mechanism for dealing with the oppressive stressors that accrue to multiple subordinate-group identities.

METHODS: Informed by the theoretical underpinnings of current intersectional scholarship, I compare the ability of the additive and intersectional approaches to explicate these two health practices in Canada. Using nationally-representative data from the Canadian Community Health Survey Cycles 2.1 and 3.1 and binary logistic regression modelling, I examine and compare the main effects of class, race, gender, and sexuality (additivity) and then four-, three-, and two-way interaction effects between class, race, gender, and sexuality (multiplicativity) as predictors of physical activity and smoking.

RESULTS: I find that results from the additive models are consistent with previous empirical research on physical activity and smoking. The interaction models produce statically significant

three- and two-way interactions for physical activity and smoking that are complex in nature and consistent with some but not all of the predictions derived from intersectionality theory.

CONCLUSION: This study challenges prevailing understandings of social causes of health behaviours by class, gender, race, and sexuality that have been generated by additive modes of analysis. The study also suggests that, in regard to physical activity and smoking, some but perhaps not all tenets of intersectionality are potentially useful in explaining these health practices.

Preface

This dissertation is an original intellectual product of the author, H.Abichahine. This research was approved by the Behavioural Research Ethics Board at the University of British Columbia (BREB Number: H11-03300). The author, H.Abichahine, is an approved researcher on Gerry Veenstra's project, *Intersectionality and Health in Canada*, which requires access to the Canadian Community Health Survey in the Research Data Centre at the University of British Columbia.

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Dedication

To my parents

Chapter 1: Introduction

1.1 Theoretical Landscape

Health researchers typically seek to answer three questions: Why do health disparities exist? Why do they persist over time? What can be done to significantly reduce or eliminate them? (Weber and Parra-Medina, 2003). Traditionally these questions have been addressed from the biomedical perspective which tends to focus on disease manifested within individual people (Cockerham, 2007; Weber, 2006; Weber & Parra-Medina, 2003). When examining variables such as race, gender, class and sexuality as determinants of illness or disease, biomedical researchers have typically employed additive analyses in which these inequality variables are treated independently of each other (Weber, 2006). In Canada, for example, substantial health inequities[1] have been documented by income (Ross & Roberts, 1999; Humphries & Doorslaer, 2000), education (Mustard, Derksen, Berthelot, Wolfson, & Roos, 1997), gender (Denton, Prus, & Walters, 2004; Janzen & Muhajarine, 2003; Spitzer, 2005), race (James, Bernard, Benjamin, Llyod, & Turner, 2010; Shah, 2004; Veenstra, 2009), and sexuality (Veenstra, 2011).

However, attempts to ameliorate these kinds of health inequities have largely failed (Cockerham, 2007; Frankish, Veenstra, & Moulton, 1999; James et al., 2010; Weber & Parra-Medina, 2003), suggesting that the theoretical and ontological underpinnings of the research may

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[1]Building off the distinction articulated by Frohlich, Ross, and Richmond (2006), throughout this thesis I use the term inequity. As opposed to inequality or disparity, terms referring to unequal distribution or quantifiable difference, inequity "refers to fairness or the application of general principles of justice to correct or supplement the law" (Frohlich, Ross, & Richmond, 2006, p.133) and stresses intrinsic injustice associated with health inequalities.

not be adequate to the task of thoroughly illuminating the nature of social inequities along these lines and their effects on health. Broadly, "there has been a gradual recognition in the inadequacy of analysing various social divisions…as spate, internally homogenous, social categories" (Yuval-Davis, 2006, p.206). With regards to health inequities, Warner and Brown (2011) argue that treating axes of inequities separately has "potentially obscured important differences in how health is produced and maintained, undermining efforts to eliminate health disparities" (p.1236). In reaction to the continued existence of health inequities, a number of health researchers have advocated for a shift in the ways that health inequities are theorized and analytically investigated (Weber, 2006). Some scholars have called for the application of intersectionality theory to the study of health inequities by income, education, gender, race, and sexuality (Hankivsky, de Leeuw, Lee, Vissandjee, & Khanlou, 2011; Hankivsky & Christoffersen, 2008; Weber & Parra-Medina, 2003).

Broadly speaking, intersectionality is concerned with "interlocking systems of oppression [and] multiples axes of inequality" (Berger & Guidroz, 2009, p.1). Although the term was formally established by Crenshaw (1991), some of the principles which are now associated with intersectionality were discussed much earlier by feminist scholars. In her seminal book, *Ain't I a Woman?* (1981), bell hooks criticizes analyses which examine single identity categories, highlighting their inability to explicate complex social locations (Yuval-Davis, 2006). In its earliest incarnations[2], intersectionality scholarship was driven by the notion that "the experiences and struggles of women of colour fell between the cracks of both feminist and anti-racist discourse" (Davis, 2008, p.68). The theory contextualizes systems of oppression based on a

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[2] For an in-depth discussion of earlier contributions to the development and dissemination of intersectionality, see Berger and Guidroz (2009).

number of axes of inequalities including, but not limited to, class, gender, race, and sexuality; intersectionality investigates "mutually enforcing effects of various social locations and experiences of domination and oppression" (Hankivsky & Christoffersen, 2008, p.272). Intersectionality theorist examine the connections between classism, patriarchy, racism, and heterosexism at the macro level and explore the impacts of social structures, as well as individual social locations, on the creation, maintenance, and reproduction of social inequities (Dhamoon & Hankivsky, 2011).

Intersectionality theory represents an alternative approach to the biomedical perspective on health and its determinants (Weber, 2006) since biomedical researchers "seldom consider how health is distributed when these three social status categories are considered simultaneously" (Jackson & Williams, 2006, p.131). As outlined by Yuval-Davis (2006), intersectionality is a "major analytical tool that challenges hegemonic approaches to the study of stratification" (p.201). When applied to health, intersectionality theory addresses the "complex social positions arising from intersections...and [pays] attention to health inequalities that accrue to them" (Veenstra, 2011, p.3). As articulated by Weber & Parra-Medina (2003), intersectionality "provides promising avenues for expanding our knowledge of health disparities and of identifying new ways of going about eliminating the persistent and pervasive social inequalities...as well as the health disparities that accompany them" (p.221). However, despite a growing consensus on the insufficiency of current approaches to studying health inequities in Canada (Dhamoon & Hankivsky, 2011; Hankivsky & Cormier, 2009), there is a marked absence of research that uses intersectionality to explore the degree to which health inheres to intersections between class, gender, race, and sexuality. In particular, very few Canadian health researchers have investigated the degree to which good or poor health accrues to intersections of multiple axes of inequality.

To date, Veenstra (2011) presents one of the very few studies to draw explicitly on feminist scholarship of intersectionality of race, gender, class, and sexual orientation to investigate health inequities in Canada using quantitative research methods. His research draws attention to the need for health scholars to investigate interactional effects of multiple axes of inequality in order to better understand the complex ways in which social determinants interact to affect the health of people living in Canada. This thesis builds upon Veenstra's (2011) intersectional research by investigating the applicability of intersectionality theory for understanding two health practices - physical exercise and smoking - using Canadian data. I explore the ways in which class, gender, race, and sexuality interact to influence the incidence of physical exercise and smoking using data from Cycles 2.1 and 3.1 of Statistics Canada's nationally representative *Canadian Community Health Survey*. Informed by the theoretical underpinnings of current intersectionality scholarship, I compare the ability of the additive and intersectional (or interactional) approaches to explicate these two health practices in Canada. I do so by investigating four-, three-, and two-way interaction effects between class, race, gender, and sexuality as predictors of physical activity and smoking. I predict that the intersections of classism, racism, patriarchy, and heterosexism at macro levels of Canadian society can affect the incidence of exercise and smoking at the individual level, in the instance of physical exercise as a desirable pursuit which is facilitated by the privilege that accrues to multiple dominant-group identities and in the case of smoking as a coping mechanism for dealing with the oppressive stressors that accrue to multiple subordinate-group identities. In the next chapter, I outline some of the key tenets of intersectionality and then summarize the small body of quantitative intersectional health research in Canada. I conclude by describing national trends in physical activity and smoking and providing rationales for applying an intersectional approach to investigating these health behaviours.

Chapter 2: Background

2.1 Intersectionality Theory

Intersectionality theory has been developed by feminist and antiracism scholars over the past three decades. The overarching goal of intersectionality is to establish understandings of "the nature and consequences" (Weber, 2006, p.22) of systems of inequality. Through intersectionality, social inequalities, privilege, oppression, and power can be studied simultaneously (Hankivsky et al., 2010; Weber, 2006). Intersectionality is primarily concerned with the "race-class-gender matrix ... interlocking systems of oppression, [and] multiples axes of inequality" (Berger & Guidroz, 2009, p.1). A research approach which is inspired by the principal ideas associated with intersectionality investigates the complicated effects of systems of oppression and the implications for resulting social identities (Weber, 2006; Jackson & Williams, 2006). Accordingly, intersectionality contextualizes systems of oppression and guides social analysis to investigate "mutually enforcing effects of various social locations and experiences of domination and oppression" (Hankivsky & Christoffersen, 2008, p.272). Unlike a traditional theory that submits a formal set of propositions meant to offer explanatory power in social analyses, intersectionality is a constellation of principles and key assumptions which provide a framework for investigating social phenomena (Veenstra, 2011).

Intersectionality encompasses three key assumptions which speak to the mutually constitutive natures of axes of inequity: (1) *simultaneity*, (2) *multiplicativity,* and (3) *multiple jeopardy.* The principle of simultaneity indicates that axes of inequity, and the social identities which they produce, must be investigated together because complex social identities are present during any given social interaction (Hankivsky & Cormier, 2009). As asserted by Collins (1993), researchers must "see the connections between the categories of analysis...[and] shift...discourse

away from additive analyses of oppression" (p.26). The principle of simultaneity is an essential element of intersectionality because it guides researchers to conduct analyses that necessarily include multiple axes of inequity (Hankivsky & Christofferson, 2008). Moreover, intersectionality scholars do not assume that any given axis of inequity is more or less important in a social analysis; this principle reiterates the assumption of simultaneity (Hankivsky & Christofferson, 2008).

The second central principle of intersectionality, *multiplicativity*, can be directly contrasted with additive understandings of social identities and axes of inequity (Hankivsky & Cormier, 2009). Multiplicativity means that axes of inequity intersect to create distinct social identities, such as "well-educated, rich, gay man of colour", that are not merely a sum of parts, a sum of individual racialized, gendered, and/or class-based identities (Collins, 1993). In this vein, an intersectional approach does not reduce axes of inequities to independent variables nor does it advance additive analyses (Veenstra, 2011). Rather, guided by the principle of multiplicativity, intersectionality directs researchers toward multiplicative and interactional analyses (Berger & Guidroz, 2009; Hankivsky & Cormier, 2009).

The final principle, *multiple jeopardy*, is an evolved kind of double or triple jeopardy; it is the notion that when disadvantaged or privileged identities are experienced simultaneously, they produce an "inordinate, or even more than additive" (Veenstra, 2011, p.2) degree of marginalization or disadvantage. This principle reiterates the notion that additive analyses cannot account for complexities of social identities and power relations.

As outlined by Kirsch (1999), new research questions "invite different research methodologies" (p.7). Intersectionality, as a new conceptual framework, invites new research questions and methods. However, though intersectionality has developed as a prominent framework in feminist scholarship, there is limited literature documenting the "*way* to study

intersectionality" (McCall, 2005, p.1771). In response, McCall (2005) outlines three overarching methodological approaches used to investigate the key tenets of intersectionality. As she describes, "[a]ll three attempt to satisfy the demand for complexity and, as a result, face the need to manage complexity" (p.1773). Accordingly, each approach is explained primarily with respect to their perspective towards categories, namely, how they "use analytical categories to explore the complexity of intersectionality in social life" (McCall, 2005, p.1773). The three perspectives are *intra-categorical complexity, anti-categorical complexity*, and *inter-categorical complexity* (McCall, 2005). In the context of health inequities research, the vast majority of intersectional studies use the last approach. However, it is important to define the first two approaches in order to understand the unique contribution of inter-categorical complexity to health inequities research.

Intra-categorical complexity laid the foundation for the study of intersectionality (McCall, 2005). Intra-categorical research unveils in great detail the circumstances and experience of people at a particular complex social location; it has the capacity to investigate unique social identities located at intersections of multiple axes of inequalities (McCall, 2005). However, the approach also recognizes the "stable and even durable relationships that social categories represent...though it maintains a critical stance toward categories" (McCall, 2005, p.1774). In this approach, "traditional categories are used initially to name previously unstudied groups at various points of intersection, but the research is equally interested in revealing - and indeed cannot avoid - the range of diversity and difference within the group" (McCall, 2005, p.1782). In short, intra-categorical complexity calls into question the material and discursive significance of categories while simultaneously focusing on the ways in which they are "produced, experienced, reproduced and resisted in everyday life" (McCall, 2005, p.1783).

Anti-categorical complexity "deconstructs analytical categories" (McCall, 2005, p.1773). This approach is guided by the notion that social life is "too irreducibly complex...to make fixed categories anything but simplifying social fictions that produce inequalities in the process of producing differences" (McCall, 2005, p.1773). Anti-categorical research problematizes the use of social categories and challenges their discursive nature (McCall, 2005). Examples of anti-categorical research include ethnographic representation and narrative studies. The former focuses on the "complexity of a single individual's life and the complicated nature of the researcher's relationship to the individual/subject" (McCall, 2005, p.1779) Narrative studies consider an individual, or their experience, as the subject of study and seek to "extrapolate illustratively to the broader social location embodied by the individual" (McCall, 2005, p.1981). In short, methods used to explore anti-categorical complexity explicitly provide space for heterogeneity of experience and explore complex social locations without essentializing an individual's experiences to that of a larger group.

The *inter-categorical complexity* approach deviates substantially from both anti-categorical and intra-categorical complexity (McCall, 2005). This approach strategically *uses* categories rather than rejects them as in anti-categorical complexity (McCall, 2005). Inter-categorical complexity, also called the categorical approach, requires that "scholars provisionally adopt existing analytical categories to document relationships of inequality among social groups and changing configurations of inequality along multiple and conflicting dimensions" (McCall, 2005, p.1773). McCall (2005) argues that the categorical approach:

> "focuses on the complexity of relationships among multiple social groups within and across analytical categories and not on complexities within single social groups, single categories, or both. The subject is multigroup, and the method is systematically comparative .... It is not the intersection of race, class, and gender in a single social group

that is of interest but the relationships among the social groups defined by the entire set of groups constituting each category" (p.1987).

McCall (2005) maintains that, unlike the intra-categorical approach which begins with "a single social group, event, or concept and works its way outward to analytically unravel one by one the influence of gender, race, class, and so on, the categorical approach begins with an analysis of the elements first" (p.1787). While categorical approach is less common amongst feminist scholars (McCall, 2005), it has been used to study health inequities. In the following section, I discuss quantitative health research which is explicitly inspired by intersectionality.

Few prior Canadian quantitative studies have sought to explore health inequities through a distinctly intersectional approach. James et al. (2010) and Veenstra (2011) represent the research which has done so in the Canadian context and serve as analytical and methodological references to the current study. James et al.'s (2010) *Racism, Violence and Health Project* is an example of health research which differs drastically from the bio-medical mode of inquiry. An intersectional approach is evident in the research questions asked, the methodologies used to explore said questions, and the discussions which ensue. Loosely guided by sociological, feminist and critical race theories, James et al. (2010) offer insight into the complicated web of factors which interact to affect the health of African Canadians. The authors explore the various ways in which racism, at the individual- and institutional-levels, affects health (James et al., 2010). By applying an intersectional approach, the authors effectively problematize the notion that Black communities throughout Canada are homogenous and face the same health challenges (James et al., 2010).

James et al. (2010) employ a mix-methods approach, conducting in-depth interviews and quantitative analysis of a large survey examining a number of statistical interactions. The research reflects an inter-categorical complexity approach, and as such their research approach is

multi-group and comparative. By considering the complexities among black men and women, as well as rich and poor black individuals, for example, James et al. (2010) compare the relationships between several social groups, an approach that is indicative of inter-categorical research. As a result, their approach to quantitative analysis does not share "the emphasis on independent, discrete variables within epidemiological models [that] limits their explanatory capacity for disentangling complex phenomena" (Schulz & Mullings, 2006, p.7). Unlike traditional, bio-medical research on race and health that typically explores health through racial differences [3] or by socioeconomic status, James et al. (2010) critically engage with, and investigate, multiple axes of inequity.

Important consequences of working within an intersectional framework can be observed in James et al.'s (2010) discussion of their findings and policy implications. The authors consider the ways that racism affects, and is simultaneously affected by, education, income, immigration, culture, occupation, housing, and social networks (James et al., 2010). Despite not explicitly referencing intersectionality theory, James et al. (2010) reveal the simultaneous and multiplicative effects of a number of axes of inequity on the health of African Canadians. Moreover, the policy recommendations and implications presented by James et al. (2010) reflect a categorical intersectional approach. Their suggestions directly oppose individual-level

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[3] See Wu, Noh, Kaspar, and Schimmele (2003) and Chiu, Austin, Manuel, and Tu (2010) for examples of traditional, bio-medical research on race, ethnicity, and health. In the latter study, for instance, ethnicity is treated as an independent factor without assessing the interactions between it and SES, gender, and sexual orientation.

interventions[4] which, the authors argue, systematically reinforce stereotypes and negatively impact the health of African Canadians (James et al., 2010).

Like James et al. (2010), Veenstra (2011) outlines the need for health scholars to investigate interactional effects of axes of inequality in order to better understand the complex ways in which social determinants simultaneously affect the health of people living in Canada. As mentioned earlier, Veenstra (2011) presents the only study to draw on feminist scholarship of intersectionality of race, gender, class, and sexual orientation to investigate health disparities in Canada using quantitative methods. His research reflects the inter-categorical complexity approach to studying intersectionality. Veenstra (2011) explicitly outlines his theoretical orientation as intersectional and applies the principles of "simultaneity," "multiplicativity," "directionality" and "multiple jeopardy" to explore inequities of self-rated health.[5] To investigate the four tenets of intersectionality, Veenstra (2011) conducts an additive analysis which is contrasted to an intersectional analysis that considers two- and three-way statistical interactions between the inequality variables. Veenstra (2011) finds that "each axis of inequality interacted significantly with at least one other" (p.1), supporting the principles of simultaneity and multiplicativity. However, Veenstra (2011) also finds that some groups which are disadvantaged

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[4] Chiu et al.'s (2010) study is an example of bio-medical research on race, ethnicity, and health that showcases the individual-level interventions and policy implications produced through traditional additive analyses. The authors advocate for interventions which target distinct "ethnicities" in order to produce "ethnically tailored strategies for preventing cardiovascular risk factors in Canada" (Chiu et al., 2010, p.306).

[5] See Idler and Benyamini (1997) for a review of the consistency and reliability of self-rated health as a measure of mortality in Canada, the U.S.A., and internationally.

along several axes of inequities experience mitigating effects that lead to better self-rated health, inconsistent with the principles of directionality and multiple jeopardy.

Veenstra (2011) concludes that an "intersectionality theory best suited for explicating health inequalities in Canada should be theoretically capable of accommodating axes intersections of multiples kinds and qualities" (p.10). Importantly, Veenstra (2011) emphasizes the need for health inequities to be studied using both quantitative and qualitative methods in order to better understand the complex ways in which axes of inequalities interact to affect health. Veenstra's (2011) study is evidence for the need to further explore the compatibilities and incompatibilities of intersectionality and quantitative data analysis**.**

2.2   Health Practices

The health consequences of physical inactivity and smoking have been extensively documented. Countless studies suggest that exercise improves overall physical and mental health and decreases stress while physical inactivity has been linked to early onsets of chronic illnesses and physical disabilities (Health Canada, 2007). Research links smoking to more than two dozen undesirable health outcomes such as coronary heart disease; lung, mouth, and kidney cancer; asthma; and high cholesterol (Chen, Dales, Krewsi, & Breithaupt, 1999; Health Canada, 2007; Samet, 2001). Exercise and smoking are, therefore, pressing health concerns in Canada. Thus, given the fact that current research indicates the existence of differences in both health practices by gender, race, and class (Cockerham, 2007; Health Canada 2007), they provide an ideal platform on which to explore the applicability and utility of intersectionality theory in quantitative health research.

2.2.1 Physical Activity in Canada

Physical activity, or exercise, is a health behaviour which is ideal for exploring the applicability of intersectionality to health inequities research. There is a substantial body of literature outlining the health benefits of physical activity as well as health risks associated with lack of exercise (Health Canada, 2007, Warburton, Katzmarzyk, Rhodes, & Shephard, 2007; World Health Organization, 2012). Exercise is widely understood as a "modifiable risk factor for cardiovascular disease ... diabetes mellitus, cancer (colon and breast), obesity, hypertension, bone and joint diseases (osteoporosis and osteoarthritis) and depression," (Warburton, Nicol, & Bredin, 2006, p.801). Moreover, research has suggested that there is a "graded linear relation between the volume of physical activity and health status, such that the most physically active people are at the lowest risk" (Warburton et al., 2006, p.807). Consequently, Health Canada (2007) has developed physical activity guidelines which have proven to reduce negative health risks associated with physical inactivity (Warburton et al., 2006).

Patterns of health-benefiting or optimal levels of physical activity follow sociological understandings of social stratification. Evidence from the Canadian Community Health Survey suggests that men are more likely to reach adequate levels of exercise than women while higher educational attainment and household income are each associated with higher levels of physical activity (Canadian Fitness & Lifestyle Research Institute, 2009). Therefore, physical activity may be facilitated by privilege in Canadian society. In other words, individuals with higher socioeconomic status or men are more likely to be physically active than their less-privileged counterparts (poor individuals or women), likely due to access and availability of resources and factors such as leisure time, sense of control in the workplace, and childcare.

2. 2. 2 Smoking in Canada

The negative health effects of smoking, as well differences in rates of smoking by race, gender, and class in North America, have been important subjects of sociological and public health inquiry. Research highlights a social patterning of smoking which suggests that "tobacco use is not a random, individual decision completely independent of social structural influences" (Cockerham, 2007, p.3). In line with sociological understandings of social stratification, the following patterns exist in Canada: poverty is increasingly associated with smoking for men and women (Health Canada, 2007), low-income men are more likely to smoke than their middle- and high-income counterparts (Voigt, 2010), and Aboriginal populations have significantly higher smoking rates than other Canadians (Heath Canada, 2005). Furthermore, while men smoke more than women on average, the gender gap has steadily been narrowing as smoking rates of men have reduced at a greater pace than have smoking rates of women (Tanguay, 2004). When examined along race and class axes of inequality, Canadian smoking trends demonstrate unequal prevalence of smoking – and, in the case of gender, smoking cessation – for marginalized populations (i.e. Aboriginals, people with low-income, and women).

While the majority of research has focused on the axes of inequality as they individually affect smoking, few studies have investigated the mechanisms through which gender, race, and class interact and simultaneous affect patterns of smoking (Graham, 1998; Barbeau, Krieger, & Soobader, 2004). In order to account for the complexities and interconnectedness of gender, race, and class on smoking, there is a need for research to systematically assess the interactions of these axes of inequalities. As articulated by intersectionality scholars, Schulz and Mullings (2006), an intersectional approach may be able to "move beyond documenting relationships toward apprehending the ways that these relationships are created and maintained," (p.7). With regards to smoking as a coping mechanism, an intersectional approach is especially relevant in

order to explore the nature of oppressive stressors which ensue from the interconnectedness of axes of inequities and the unique social positions which arise from these intersections. In other words, smoking presents a distinct opportunity to investigate the ways in which classism, patriarchy, racism, and heterosexism act in tandem to not only create individual-level stressors but to also influence the mechanisms through which individuals deal with oppression and its resulting stress.

Chapter 3: Methods

3.1 Introduction

The purpose of this chapter is three-fold: to provide a rationale for the analytical strategy, to describe the data used in the present study, and to explain the statistical methods employed to explore the applicability of intersectionality to two health behaviours - physical activity and smoking - in the Canadian context.

3.2 Analytical Strategy

Given the limited amount of quantitative intersectional health research, I draw on Veenstra's (2011) two-stage analytical strategy in order to explore the applicability of intersectionality to health behaviours, with a particular focus on the effects of class, gender, sexual orientation, and race on physical activity and smoking. First, for each dependent variable, I generate an additive regression model comprised of gender, sexual orientation, race [6], two measures of class (educational attainment and household income), age, marital status, and immigration status as independent variables. The additive model sets the stage for a direct contrast between additive and multiplicative methods of analyses in the context of health behaviours.

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[6] In this these, I measure race as "visible minority" versus "white," thereby illuminating the privilege that is systematically associated with whiteness in the Canadian context. However, I recognize that this binary categorization is a simplification of complex social phenomena. A more comprehensive exploration of race and the embodiment of racialized identities would offer a more nuanced understanding of the interaction of race and other axes of inequities.

In the second stage, I model four-, three-, and two-way interactions between gender, sexual orientation, race, educational attainment, and household income in order to explore the intersectional assumptions of simultaneity and multiplicativity. Where statistically appropriate, I examine all possible four-, three-, and two-way interactions, such as Race X Gender, Race X Education, and Gender X Race X Household Income, with the exception of interactions containing both measures of class. In order to explore an interaction effect between race and gender on smoking, for example, I create the following multivariate regression models: Race + Gender + Educational Attainment + Household Income + [Race x Gender] = Smoking Status. The final term, Race X Gender, reflects an interaction or multiplicative term and speaks to whether the effect of race on smoking is different for men and women (or, similarly, whether the gender effect on smoking differs by racial identity). I report all statistically significant four-, three-, and two-way interactions in regression models for both dependent variables. (Note that I do not examine a two-way interaction between X1 and X2 when a three-way interaction that includes X1 and X2 is statistically significant.) For each statistically significant interaction, I also plot and compare the predicted probabilities for the complex locations of interest generated by additive and multiplicative models. This enables me to examine the intersectional assumption of multiple jeopardy.

3.3   Data

In order to investigate the applicability of intersectionality to health behaviours in the Canadian context, I combine data from waves 2.1 and 3.1 of the Canadian Community Health Survey (CCHS) collected by Statistic Canada in 2003 and 2005, respectively. The CCHS is a nation-wide, cross-sectional survey exploring issues of physical, mental, and emotional health and well-being targeting house-dwellers living in Canada 12 years of age or older. The CCHS's surveyed

population does not include people living on Indian Reserves, Crown Lands, individuals in remote regions of the country, homeless persons, and individuals affiliated with the Canadian Armed Forces. The survey is organized by provincial and territorial health regions. Data are collected using a multistage sampling design which randomly selects a sample of households followed by random selection of one person from each dwelling. The response rates for the CCHS are high: 80.6% for wave 2.1 (n=131,535) and 79.0% for wave 3.1 (n=135,573).

The current study is concerned with individuals over the age of 25 (n=149,574). I disregarded a total of 117,534 cases from the combined data set by selecting respondents over the age of 25 and employing list-wise deletion for all respondents with missing data. Table 1 reports the socio-demographic characteristics of the over-25 sample in which all cases with missing data have been dropped. 13.9% (n=20,791) of the sample had obtained a bachelor degree or higher and 14.3% (n=21,389) of the population had a household income under $20,000. The sample consists of 46.3% (n=69,253) males and 91.6% (n=137,010) identified as White. Approximately 1.7% (n=2,543) of the sample identified as homosexual or bisexual. Approximately 21.4% (n=32,009) of the sample claimed to be a daily smoker and 50.7% (n=75,834) of the sample was deemed to be inactive.

3.4   Measures

3.4.1   Dependent Variables

I assess two health behaviours: *physical activity* and *smoking*. *Physical activity* is assessed according to the CCHS's Physical Activity Index (PAI) with categories "active," "moderately active," and "inactive." The CCHS defines physical activity in terms of average daily energy expenditure and is calculated using body weight and participation in various activities. The PAI

is measured through a succession of questions regarding types of physical activities respondents engage in and length of time in each activity. Respondents are asked the following question: "Have you done any of the following in the past 3 months...walking for exercise, gardening or yard work, swimming, bicycling, popular or social dance, home exercises, ice hockey, ice skating, in-line skating or rollerblading, jogging or running, golfing, exercise class or aerobics, downhill skiing or snowboarding, bowling, baseball or softball, tennis, weight-training, volleyball, basketball, soccer, any other?" Additionally, respondents are asked how frequently they participate in each activity and the average length of time spent on one activity in a single episode of activity. The PAI is then calculated using these data which are weighted according to the metabolic equivalent task (MET) value assigned to each activity (Courneya, Katzmarzyk, & Bacon, 2008).

An average daily energy expenditure - measured as kilocalories per kilogram of body weight per day - is calculated and the following scale is the result: 3.0+ kilocalories per kilogram of bodyweight (KKD) is considered "active," 1.5 - 2.9 KKD is considered "moderately active" and less than 1.5 KKD is considered "inactive." This index reflects physical activity guidelines adopted by Health Canada as well as the Institute of Medicine and American Cancer Society (Courneya, Katzmarzyk, & Bacon, 2008). Accordingly, the PAI classifies an average daily energy expenditure of 3.0 KKD as the minimum amount of physical activity required for cardiovascular health benefit. For my analyses, I code the Physical Activity Index as a dummy variable: "inactive" and "moderately active" are coded "0" and "active" is coded "1."

Smoking status is measured using the CCHS's derived smoking variable that assesses the type of smoker based on the respondents smoking habits. I code "daily" and "occasional," as "1" (current smokers) and "former daily," "former occasional," and "never smoked" as "0."

3.4.2   Independent Variables

Class is assessed using two measures: household income and highest educational attainment of the respondent. Household income is derived from the following question: "What is your best estimate of the total income, before taxes and deductions, of all household members from all sources in the past 12 months?" The responses are coded as follow: "less than $20,000" is "1," "$20,000 to $39,999" is "2," "$40,000 to $59,999" is "3," "$60,000 to $79,000" is "4," and "$80,000 or more" is "5." *Highest educational attainment* is categorized as follows: "less than secondary school" is "1," "secondary school graduate" is "2," "post-secondary school diploma or certificate" is "3," "bachelor's degree" is "4," and "more than bachelor's degree" is "5."

Gender is a dichotomous variable coded "1" for "female" and "0" for "male." *Sexual orientation* is assessed from the following question: "Do you consider yourself to be heterosexual? (If needed: sexual relations with people of the opposite sex); homosexual, that is lesbian or gay, or bisexual? (If needed: sexual relations with people your own sex); bisexual? (If needed: sexual relations with people of both sexes). I created a dichotomous sexuality variable which I coded 1 for "not heterosexual" and 0 for "heterosexual."

In the CCHS, *race* is assessed with the following two questions: (1) "Are you: White? Chinese? South Asian (e.g., East India, Pakistani, Sri Lankan)? Black? Filipino? Latin American? Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)? Arab? West Asian (e.g., Afghan, Iranian)? Japanese? Korean? Aboriginal (North American Indian, Metis, or Inuit)? Other – specify." For the purposes of this study, I recode the race variable such that White is "0," and Visible Minority is "1."

Immigration status is coded as follows: "born in Canada" is "1," "immigrated to Canada 20 years ago or more" is "2," "immigrated to Canada 10 to 19 years ago" is "3," and "immigrated to Canada 9 or fewer years ago" is "4." I calculate this variable using the CCHS's

questions regarding country of birth and time spent living in Canada since immigration. *Age in years* is a continuous variable and *Marital Status* is categorized as "now married," "common-law," "widowed," "separated," "divorced," and "single."

3. 5   Statistical Methods

To facilitate binary logistic regression modelling, I recoded the health behaviour dependent variables as dummy variables with 1 representing the behaviour of interest (being physically active and smoking). For each regression model, I report odds ratios and 95% confidence intervals for them.

For each model, significant values less than 0.05 are considered to be statistically significant. I code gender, sexual orientation, race, income, and education as sets of dummy variables and exclude the referent group from the regression equation. The referents are "men", "heterosexual," "white," "more than $80,000" and "bachelor's degree or higher," respectively. The assigned referent groups facilitate interpretation of odds ratios and allow for a discussion of health behaviours in relation to the dominant, privileged groups in society which are typically endowed with better health outcomes.

In stage two of my analysis, I individually introduce multiplicative variables to the complete additive models for each dependent variable in order to explore interaction effects. I do so in multiple waves assessing each interaction effect independently of others and in comparison to the additive models. As articulated by Jaccard (2001), the odds ratios for a cross-product term is the ratio of the odds ratios of the two variables involved in the interaction. Drawing on Jaccard's (2001) proposed methodology, I calculate odds ratios that comprise a ratio of ratios in order to offer a complete interpretation of results produced by the logistic regression models. I

conduct analyses using the SPSS 15.0 statistical analysis software package except for the predicted probabilities which are calculated using STATA 12.0.

Chapter 4: Results

4.1   Additive Model for Physical Activity

Table 2 presents odds ratios and their p-values and 95% confidence intervals for all five key independent variables regressed on physical activity. Model 1[7] suggests a number of significant outcomes. The odds of physical activity for women is 0.817 as high as the odds of physical activity for men. The odds of physical activity for visible minority respondents are 0.856 as high as the odds of physical activity for their white counterparts. Moreover, the odds of physical activity increase by a factor of 1.358 for individuals with a household income of "$80,000 or more" compared to the odds of physical activity for less wealthy respondents. The odds of physical activity for respondents with a postgraduate degree are 1.388 as high as the odds for those with less education. Furthermore, the odds of physical activity for individuals who identify as bisexual or homosexual are 1.218 as high as the odds for heterosexual respondents.

In summary, results from Table 2 are consistent with previous empirical research on physical activity. The odds of physical activity are significantly higher for respondents who are highly educated compared to their less educated counterparts and also higher for wealthy respondents compared to poorer respondents. Furthermore, the odds of physical activity are higher for men than women and white respondents in comparison to their visible minority counterparts. The additive model presented in Table 2 indicates that the two measures of class have the strongest effects on physical activity. These results also outline that, from an additive

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[7] Logistic Regression Equation: $\text{logit}(\text{physical activity}) = b_0 + b_1\text{Gender}_i + b_2\text{Race}_i + b_3\text{HouseholdIncome}_i + b_4\text{Education}_i + b_5\text{Sexuality}_i + b_6\text{Age}_i + b_7\text{MaritalStatus}_i + b_8\text{ImmigrationStatus}_i$

perspective, white, rich, highly educated, homosexual men are most likely and visible minority, poorer, less educated, heterosexual women are least likely to be physically active.

4.2   Additive Model for Smoking

Table 3[8] describes results from a regression model with gender, race, sexuality, income and education as independent variables and smoking as the dependent variable. For each independent variable, the table presents odds ratios and their p-values and 95% confidence intervals. Table 3 indicates the existence of statistically significant associations between all five of the key independent variables and smoking. The odds of smoking for women are 0.747 as high as the odds of smoking for men. The odds of smoking for visible minorities are 0.756 as high as the odds of smoking for their white counterparts. Furthermore, the odds of smoking for individuals with a household income of "$80,000 or more" are 0.777 as high as the odds of smoking for less wealthy respondents. With regard to education, the odds of smoking for respondents with postgraduate education are 0.385 as high as the odds for smoking for those with less than a bachelor's degree. The odds of smoking for individuals who identify as either bisexual or homosexual are 1.225 as high as the odds for heterosexual respondents.

In summary, consistent with previous empirical research, the odds of smoking are significantly lower for respondents who are highly educated and for wealthy individuals. Moreover, the odds of smoking are higher for men than women and slightly higher for white respondents in comparison to visible minority individuals. The additive model presented in Table

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[8]   Logistic Regression Equation: $\text{logit(smoking)} = b_0 + b_1\text{Gender}_i + b_2\text{Race}_i + b_3\text{HouseholdIncome}_i + b_4\text{Education}_i + b_5\text{Sexuality}_i + b_6\text{Age}_i + b_7\text{MaritalStatus}_i + b_8\text{ImmigrationStatus}_i$

3 indicates that the two measures of class have strong effects on smoking status, with education having the largest effect by far of all independent variables. Table 3 indicates that, from an additive perspective, white, poorer, not highly educated, and non-heterosexual men are most likely to smoke and visible minority, wealthy, highly educated, heterosexual women are least likely to smoke.

4.3   Interaction Model for Physical Activity

I individually add four-, three-, and two-way interaction terms to the additive model of Table 2 and report all statistically significant interactions in Table 4. Although neither four-way interaction was significant, there were two statistically significant three-way interactions: Gender X Race X Income and Gender X Education X Sexuality. To further facilitate interpretation of these interaction effects, Figure 1 depicts predicted probabilities sequentially generated from the additive and interaction effect models.

The *Gender by Race by Income* interaction is statistically significant (Model 2, Table 4). I interpret this to mean that the raced effect of income on physical activity is gendered (or that the gendered effect of income on physical activity is raced). Table 5 outlines the odds ratios for income on physical activity for all four distinct combinations of gender and race. Amongst men, income has a stronger effect on smoking for visible minority individuals than for white respondents. More specifically, the effect of income on physical activity for white men is 1.358 while for visible minority men it is 1.603. Amongst women, income has a moderately strong and positive effect for white women, which is nearly identical to that of their male counterparts, 1.336. However, an effect of income for visible minority women is non-existent.

Plot 1 in Figure 1 outlines predicted probabilities and further explores this three-way interaction effect. The plot shows that wealthy visible minority men are somewhat more likely to

engage in physical activity than predicted in the additive model and that wealthy visible minority women are far less likely than expected to engage in physical activity. Overall, both models predict that poor, visible minority women are the least likely to exercise while wealthy white men are the most likely.

The *Gender X Education X Sexuality* interaction is also statistically significant (Model 3, Table 4). I interpret this to mean that the classed effect of sexuality on physical activity is gendered (or that the gendered effect of sexuality on health is classed). Table 6 outlines the odds ratios for sexuality on physical activity for all four distinct combinations of gender and education. The only statistically significant odds ratio for sexuality is for women with less than a postgraduate education (OR=1.685, $p < 0.00$). Amongst men in general, it appears that sexuality is unrelated to physical activity.

Plot 2 in Figure 1 outlines predicted probabilities for this three-way interaction effect. The plot outlines that well-educated heterosexual men are significantly more likely to engage in physical activity than is predicted in the additive model. This is an example of multiplicative advantage that is in line with intersectionality theorizing whereby those who occupy positions of privilege will be substantially more likely to exercise than their less-privileged counterparts. That being said, amongst well-educated men, sexuality is not associated with physical activity. Plot 2 also tells us that well-educated non-heterosexual women are substantially more likely to exercise than predicted in the additive model and well-educated heterosexual women are also more likely to exercise than expected. Overall, Plot 2 shows a number of discrepancies between the additive and interaction models. In other words, this three-way interaction effect problematizes the additive method of thinking that gender, race, class, and sexuality act as distinct factors with independent effects on physical activity. Rather, by employing an intersectional approach and

assessing interaction effects, it is apparent that these axes of inequalities are interconnected in complicated ways.

4.4   Interaction Model for Smoking

I individually add interaction terms to the additive model of Table 3 and report all statistically significant interactions in Table 7. There were no statistically significant four-way or three-way interactions but there were three statistically significant two-way interactions: Gender X Education, Gender X Race, and Race X Education. To further facilitate interpretation of these interaction effects, Figure 2 depicts predicted probabilities whereby the probabilities labeled "additive" correspond to the additive model shown in Table 3 and the probabilities labeled "multiplicative" correspond to the models that contain the two-way interaction terms of interest.

The *Gender X Race* interaction is statistically significant. From Model 1 of Table 7, we see that the effect of race on smoking for men is 1.123, i.e., visible minority men are a little more likely than white men to smoke. The corresponding odds ratio for women is 0.433, i.e., visible minority women are much less likely than white women to smoke. In short, race has an opposite and much stronger effect on smoking among women than among men.

The gender by race predicted probability plot in Figure 2 further investigates the nature of this interaction effect. Plot 1 shows that when comparing the additive and interaction models, there is a large multiplicative advantage at play for visible minority women. It also shows that visible minority men are far more likely to smoke than expected from an additive perspective. Finally, the plot shows that the gender effect is strong among visible minority respondents but is weak to non-existent among white respondents.

The *Gender X Education* interaction is also statistically significant. From Model 2 of Table 7, we see that the effect of education on smoking for men is 0.420 and, therefore, the

corresponding odds ratio for women is 0.347. Thus education has a slightly stronger negative effect on smoking among women than among men.

The gender by education predicted probability plot in Figure 2 further explores the interaction effect. Plot 2 shows that when comparing the additive and interaction models, there is multiplicative advantage at play, albeit very small, for highly educated women, a kind of multiplicative advantage that is inconsistent with what we could expect from intersectionality theorizing.

Finally, the *Race X Education* interaction is also statistically significant. From Model 3 of Table 7, we see that the effect of education on smoking for white respondents is 0.370. The corresponding odds ratio for visible minority respondents is 0.484; this indicates that education has a stronger negative effect on smoking among white respondents than among visible minority respondents.

The race by education predicted probability plot in Figure 2 further explores the interaction effect. Plot 3 shows that, when comparing the additive and interaction models, there is not much difference in the predicted probabilities of smoking although there is a slight increase in odds of smoking for highly educated visible minority respondents and a minor decrease among less educated visible minority respondents.

Chapter 5: Discussion

5.1 Conclusions and Future Research

This thesis diverges from traditional health inequities research by applying inter-categorical intersectionality to the quantitative study of health behaviours and exploring whether physical activity and smoking are potentially implicated in intersecting relations of power and inequity. Intersectionality theory investigates the ways in which systems of oppression interlock to create unique social locations with implications for social phenomena (Collins, 1993). This theory, which does not offer a formal set of propositions, can be best understood as a complex discourse that encompasses three key assumptions or principles: *simultaneity, multiplicativity,* and *multiple jeopardy.* Simultaneity suggests that axes of inequity must be investigated in tandem to account for the complex identities that arise in social life (Collins, 1993). The principle of multiplicativity indicates that when axes of inequity intersect the result is not simply a sum of the parts; this assumption is distinct from additive approaches to multiple forms of inequality and suggests that intersections of axes inequities compound to produce unique social locations (Hankivsky & Cormier, 2009). The third tenet, multiple jeopardy, is the idea that disadvantaged identities, such as homosexual and non-white, produce inordinately disadvantaged identities when considered simultaneously (Veenstra, 2011). In like manner, advantaged identities ought to lead to inordinately advantaged identities.

McCall (2005) has outlined three methodological approaches to empirically exploring the key tenets of intersectionality: intra-categorical complexity, anti-categorical complexity, and inter-categorical complexity. Though each offers researchers unique advantages, the majority of

quantitative research adopting intersectional principles uses the inter-categorical approach. In this thesis, I investigate whether adopting inter-categorical intersectionality problematizes the ways in which scholars have previously theorized and researched physical activity and smoking. Results from these analyses indicate that applying inter-categorical intersectionality to the study of these health behaviours disrupts previous understandings in the field regarding key determinants of health behaviours. This is highlighted throughout the results and is especially noticeable in the predicted probability plots. In other words, inter-categorical intersectionality problematizes many of the previously held assumptions regarding social inequalities and patterns of physical activity and smoking for people living in Canada.

Two notable insights emerge from this research. The first regards the importance of challenging understandings of health behaviours which have been drawn from additive models of analysis. This is because additive analyses fail to account for the wide range of complexities of the social world. This is especially problematic in the field of public health as research often informs health promotion at the level of government as well as primary health care practitioners. By failing to account for these complexities and, more specifically, the implications of intersecting axes of inequities, additive research generates results that are both ambiguous and limited in scope. For example, using an additive model, I find that non-heterosexual women who are well educated are very unlikely to be physically active. However, upon introducing a three-way interaction term I find that well-educated non-heterosexual women are in fact *more likely* to be physically active than any other unique social identity I investigate in this study. While this thesis does not offer explanations for why this may be so, the fact that the interaction term is statically significant supports the notion that intersectionality problematizes additive analyses in ways that are potentially extremely useful and meaningful.

With regard to smoking, we see a similar, albeit less striking, trend. Through an intersectional analysis, I find that visible minority women are far less likely to smoke than is predicted using an additive model. Again, this is an important result insofar as it calls into question the applicability of previous investigations into health behaviours and inequalities by gender and race and their ability to accurately depict patterns of smoking in Canada. It is important to note that smoking, unlike physical activity which is commonly understood as a health behaviour facilitated by privilege, may have a more complicated relationship with privilege; for example, smoking can be a marker of social capital amongst various communities (Frohlich, Potvin, Chabot, and Corin, 2002). As such, in certain contexts, patterns of smoking can disrupt the idea that privilege ought to always be associated with health-promoting behaviours (Frohlich et al., 2002). Future studies would greatly benefit from a more in-depth exploration into the ways in which intersecting privilege and disadvantage may facilitate or hinder smoking depending on the context.

The second major insight emerging from this thesis is that in the context of physical activity and smoking only two of the three tenets of intersectionality appear to be useful and applicable, namely, *simultaneity* and *multiplicativity.* This thesis provides considerable evidence for the applicability of both simultaneity and multiplicativity in regard to both physical activity and smoking in Canada. These two principles are clearly demonstrated in the many statistically significant two- and three-way interactions in my models. The third principle of intersectionality, *multiple jeopardy*, is not consistently unveiled in the results which raises doubts regarding its applicability to these particular health behaviours.

The lack of support for multiple jeopardy in my analyses may be an indication that social life is so complex that, with particular scenarios and health behaviours, the intersection of

identities leads to unexpected outcomes. For example, a surprising result is that white males who earn $80,000 or more are less likely to be physically active than an additive or multiple jeopardy perspective might predict. Something appears to intervene in the ability of wealthy white men to be physically active which is in direct contradiction to what would be expected from the principle of multiple jeopardy. Another notable result is that when gender and race are considered in tandem, visible minority females are significantly less likely to smoke than the additive approach would predict. While these two examples disrupt the notion of multiple jeopardy, other results support it. For example, when gender, education, and sexuality are considered simultaneously, the likelihood of physical activity among heterosexual, well-educated men is high and even higher than would be predicted from the additive approach. With regards to multiple jeopardy overall, however, the results from this study are inconsistent and do not provide strong support for the application of this theoretical principle of intersectionality theory to physical activity and smoking.

I do believe nonetheless that these results successfully shed light on the importance of considering social contexts while exploring the intersections of axes of inequities and patterns of healthy behaviours. Social contexts are fluid and can change across time, political and economic spheres as well as geographic locations. Thus, while intersectionality theory does not provide routes for analytical explanation in this thesis, it may serve as an important starting point for researchers who wish to explore direct and indirect ways in which axes of inequities interact not only with themselves but also with specific social contexts to generate particular health behaviour outcomes. Future research would benefit from refocusing attention to the embodied presence of individuals, necessarily taking into consideration their unique social position and lived experiences of gender, race, socio-economic status, and sexuality. A combination of rigorous quantitative research and ethnographic qualitative research would allow a researcher to

explore these intricacies. In qualitative research inquiries, the subtler and telling contextually-bound interactions of privilege and oppression could be uncovered and understood. A mixed-methods approach incorporating intersectionality theory, ethnographic research, and quantitative data analysis would perhaps offer health researchers a novel avenue through which to study health behaviours, develop an accurate account of the implications in intersecting relations of power and inequity and, ultimately, contribute towards reducing health inequities.

TABLE 1: Descriptive Statistics of the Study Sample. (unweighted)

	% (n)
Independent Variables (n=149,574)	
Gender	
Male	46.3 (69,253)
Female	53.7 (80,321)
Age	
25-34	22.4 (33,505)
35-44	24.4 (33,505)
45-54	22.9 (34,252)
55-64	16.4 (24,530)
65 or older	13.9 (20,791)
Race	
White	91.6 (137,010)
Visible Minority	8.4 (12,564)
Highest Educational Attainment	
Less Than Secondary School Graduation	18.8 (28,120)
Secondary School Graduation	23.3 (34,851)
Post-Secondary School Diploma or Certificate	37.9 (56,689)
Bachelor's Degree	13.9 (20,791)
Postgraduate Degree	6.0 (8,974)
Household Income	
$19,999 or less	14.3 (21,389)
$20,000-$39,999	22.7 (33,953)
$40,000-$59,999	20.7 (30,962)
$60,000-$79,999	16.4 (24,530)
$80,000 or more	25.9 (38,740)
Sexual Orientation	
Heterosexual	98.3 (147,031)
Bisexual	1.1 (1,645)
Homosexual	0.6 (897)
Dependent Variables	
Smoking Status	
Daily	21.4 (32,009)
Occasionally	4.8 (7,180)
Not Current Smoker	73.8 (110,386)
Physical Activity Level	
Active	23.5 (35,150)
Moderately Active	25.8 (38,590)
Inactive	50.7 (75,834)

TABLE 2: Results for Logistic Regression of Variables on Physical Activity. (Additive Model)

	1 Odds Ratio (95% CI)
Gender - female (Male=referent)	0.817*** (0.786-0.849)
Race – visible minority (White=referent)	0.856*** (0.785-0.933)
Income - $80,000 or more (Less Than $80,000=referent)	1.358*** (1.300-1.418)
Education – Bachelor's degree or higher (Less Than Bachelor's=referent)	1.388*** (1.326-1.453)
Sexuality – homosexual or bisexual (Heterosexual=referent)	1.218** (1.067-1.391)

[†] $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; n=149,574
[1] All Models Control for Age, Immigration Status, and Marital Status;
[2] 95% Confidence Intervals in Parentheses.

TABLE 3: Results for Logistic Regression of Variables on Smoking. (Additive Model)

	1 Odds Ratio (95% CI)
Gender - female (Male=referent)	0.747*** (0.718-0.777)
Race – visible minority (White=referent)	0.756*** (0.687-0.831)
Income - $80,000 or more (Less Than $80,000=referent)	0.777*** (0.741-0.816)
Education – Bachelor's degree or higher (Less Than Bachelor's=referent)	0.385*** (0.363-0.409)
Sexuality – homosexual or bisexual (Heterosexual=referent)	1.225** (1.060-1.417)

[†] $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; n=149,574
[1]All Models Control for Age, Immigration Status, and Marital Status;
[2] 95% Confidence Intervals in Parentheses.

TABLE 4: Results for Logistic Regression of Statistically Significant Interaction Variables on Smoking. (Interaction Effects Model)

	1 Odds Ratio (95% CI)	2 Odds Ratio (95% CI)	3 Odds Ratio (95% CI)
Gender - female (Male=referent)	0.826*** (0.793-0.860)	0.769*** (0.737-0.802)	0.747*** (0.719-0.778)
Race – visible minority (White=referent)	1.123* (1.002-1.259)	0.755*** (0.686-0.829)	0.711*** (0.641-0.789)
Income - $80,000 or more (Less Than $80,000=referent)	0.781*** (0.745-0.820)	0.777*** (0.740-0.815)	0.779*** (0.742-0.817)
Education – Bachelor's degree or higher (Less Than Bachelor's=referent)	0.380*** (0.359-0.403)	0.420*** (0.388-0.455)	0.370*** (0.347-0.394)
Sexuality – homosexual or bisexual (Heterosexual=referent)	1.228** (1.065-1.416)	1.219** (1.054-1.410)	1.230** (1.064-1.423)
Interaction Variables			
Gender X Race	0.386*** (0.332-0.448)		
Gender X Education		0.827** (0.737-0.928)	
Race X Education			1.307** (1.104-1.547)

† p ≤ .10; * p ≤ .05; ** p ≤ .01; *** p ≤ .001; n=149,574
[1]All Models Control for Age, Immigration Status, and Marital Status;
[2] 95% Confidence Intervals in Parentheses. [3]

TABLE 5: Results for Logistic Regression of Statistically Significant Interaction Variables on Physical Activity. (Interaction Effects Models)

	1	3	4
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Gender - female (Male=referent)	0.817*** (0.786-0.849)	0.835*** (0.796-0.875)	0.839*** (0.803-0.878)
Race – visible minority (White=referent)	0.856*** (0.785-0.933)	0.836** (0.733-0.954)	0.855*** (0.784-0.931)
Income - $80,000 or more (Less Than $80,000=referent)	1.358*** (1.300-1.418)	1.387*** (1.308-1.471)	1.358*** (1.230-1.418)
Education – Bachelor's degree or higher (Less Than Bachelor's=referent)	1.388*** (1.326-1.453)	1.388*** (1.327-1.454)	1.469*** (1.378-1.566)
Sexuality – homosexual or bisexual (Heterosexual=referent)	1.218** (1.067-1.391)	1.218** (1.067-1.390)	1.240 (0.993-1.547)

3-Way Interaction Variables

	1	3	4
Race X Income		1.156 (0.942-1.416)	
Gender X Race		1.082 (0.917-1.275)	
Gender X Income		0.963 (0.887-1.046)	
Gender X Race X Income		0.646** (0.474-0.879)	
Gender X Education			0.891* (0.816-0.974)
Gender X Sexuality			1.05 (0.754-1.460)
Education X Sexuality			0.705 (0.502-0.991)
Gender X Education X Sexuality			1.836* (1.069-3.155)

[†] $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; n=149,574
[1]All Models Control for Age, Immigration Status, and Marital Status;
[2] 95% Confidence Intervals in Parentheses.

TABLE 6: Results for Logistic Regression of 3-Way Interaction of Gender X Race X Household Income on Physical Activity.

| For:	1 Odds Ratio (95% CI)
white men, OR income =	1.387*** (1.307-1.471)
visible minority men, OR income =	1.603*** (1.317-1.951)
white women, OR income =	1.336*** (1.254-1.432)
visible minority women, OR income =	0.997 (0.793-1.252)

[†] $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; n=149,574
[1] All Models Control for Age, Immigration Status, and Marital Status;
[2] 95% Confidence Intervals in Parentheses.

TABLE 7: Results for Logistic Regression of 3-Way Interaction of Gender X Education X Sexuality on Physical Activity.

For:	1 Odds Ratio (95% CI)
men with postgraduate education, OR sexuality =	1.240 (0.993-1.547)
men with less than postgraduate education, OR sexuality =	0.874 (0.674-1.135)
women with postgraduate education, OR sexuality =	1.301 (1.016-1.665)
women with less than postgraduate education, OR sexuality =	1.685** (1.197-2.372)

† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; n=149,574
[1] All Models Control for Age, Immigration Status, and Marital Status;
[2] 95% Confidence Intervals in Parentheses.

Figure 1: Predicted Probability Plots for Physical Activity

A. Gender by Race by Household Income
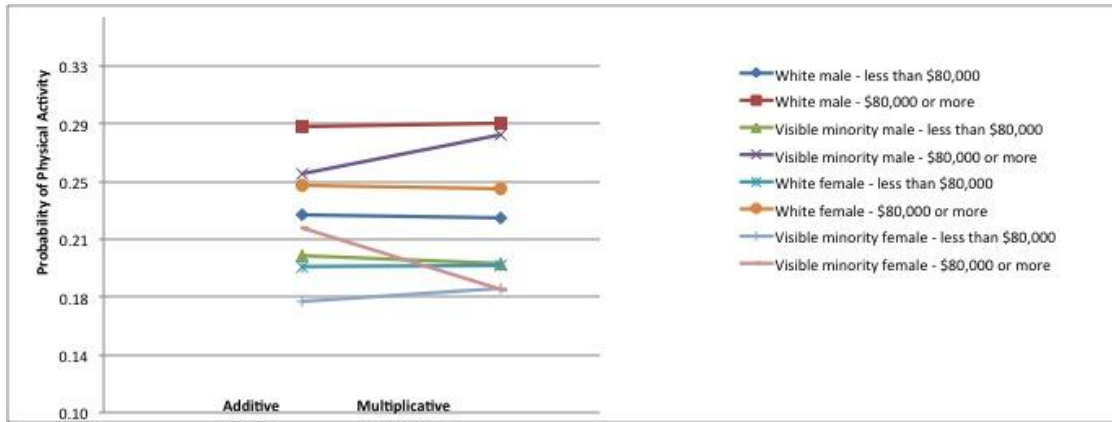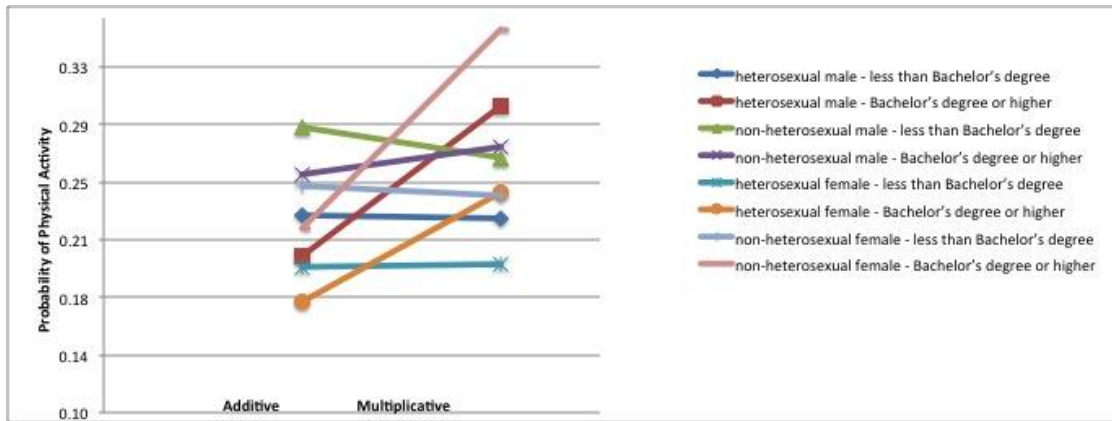

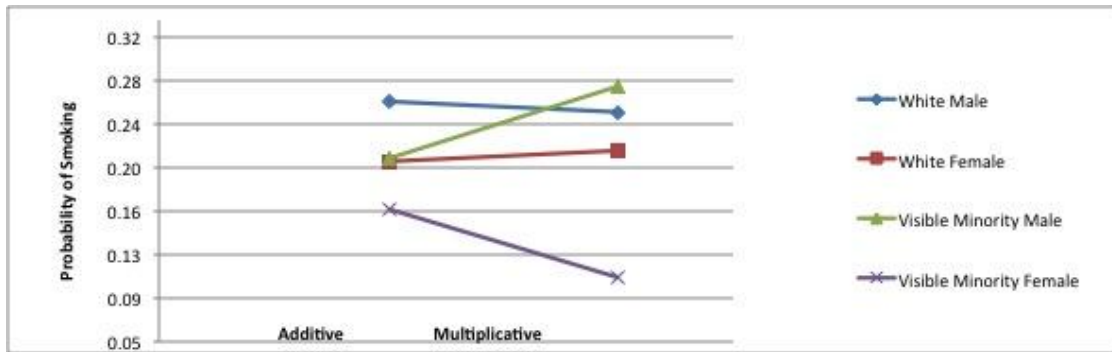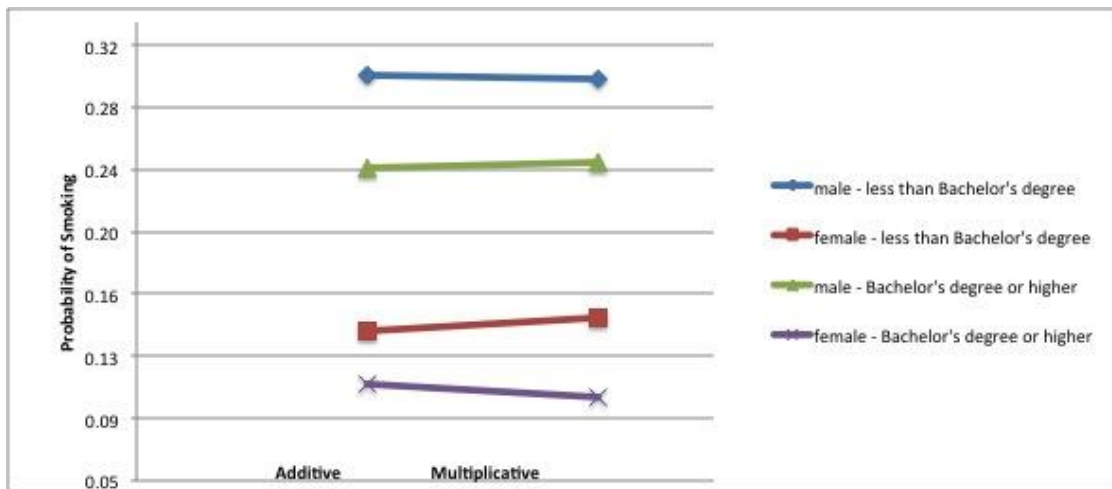B. Gender by Education by Sexuality

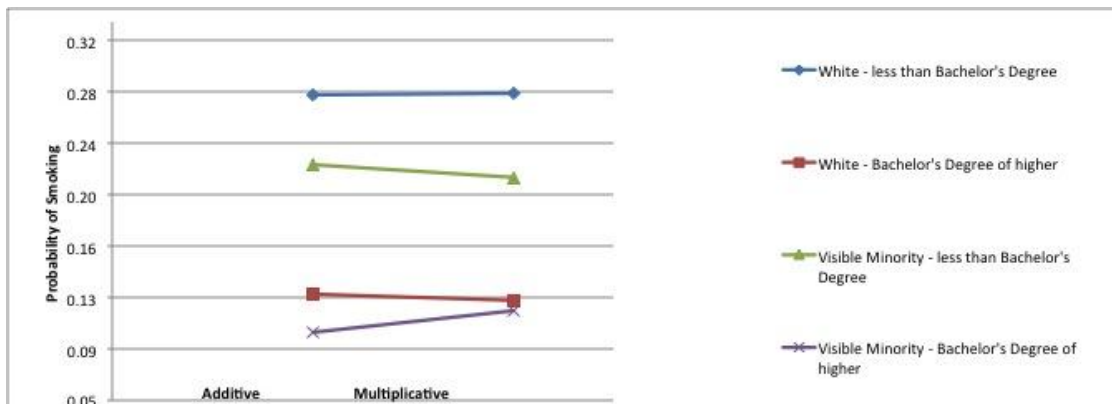**Figure 2: Predicted Probability Plots for Smoking**

A. Gender X Race

B. Gender X Education

C. Race X Education

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