# UNDERSTANDING HEALTHY EATING BEHAVIOUR WITHIN THE CONTEXT OF THE MODERN FOOD ENVIRONMENT

by

Tarra L Penney

Submitted in partial fulfilment of the requirements
for the degree of Master of Arts

at

Dalhousie University
Halifax, Nova Scotia
August 2013

## DEDICATION PAGE

This thesis is dedidicated to my wonderful friends and family who have supported me through my many professional detours. Especially to my best friend, partner and husband. Thank you for your love and support, I am excited for our next adventure.

## Table of Contents

**List of Tables**

**List of Figures**

**Abstract**

The prevention of chronic disease requires understanding and intervention related to both individual and environmental level determinants. However, traditional approaches to chronic disease prevention and management have primarily been focused at the individual level, with limited attention toward environmental level influences on health behaviour. This lack of comprehensiveness is partially due to a paucity of complex theoretical frameworks for clarifying the influences of personal cognitive, and broader environmental, variables on a range of health behaviours. Therefore, the purpose of this research was to expand and test a popular health behaviour theory, Social Cognitive Theory (SCT), to include influences of the perceived food environment on healthy eating behaviour. This study involved two phases. Phase 1 expanded SCT to include a perceived food environment construct through review of the food environment literature. Phase 2 conducted a cross-sectional study of 201 adults (age 35 to 69 years) using an online survey to test the expanded SCT informed by phase 1. Data analysis included descriptive statistics and structural equation modeling (SEM) to compare the traditional and expanded SCT model. Results demonstrated no significant model fit, with no improvement in oveall fit with the inclusion of the perceived food environment. However, the expansion of SCT to include perceived food environment attributes altered the pathways of influence within the social cognitive model, suggesting that the presence of perceived environment measures is important for understanding how perceived environments might mediate the effect of personal cognitive influences on eating behaviour. These findings have implications for food environment research, the development of ecological theories, the field of health promotion and the prevention of chronic disease.

**List of Abbreviations Used**

| | |
|---|---|
| APATH | Atlantic Partnership for Tommow's health |
| FV | Fruit and vegetable |
| GS | Goal setting |
| HEI | Healthy eating index |
| OE | Outcome expectations |
| OFE | Objective food environment |
| PFE | Perceived food environment |
| SE | Self-efficacy |
| SEM | Structural equation modeling |
| SES | Socio-economic status |
| SCT | Social Cognitive Theory |
| SS | Social support |

**Acknowledgements**

This thesis could not have been completed without the continued support and encouragement from my primary supervisor, Dr. Sara Kirk and co-supervisor Dr. Michael Vallis. In addition, the time, guidance and support of my thesis committee Dr. Daniel Rainham and Dr. Stefan Kuhle have been critical. I would also like to thank the entire Atlantic PATH research team for their time and assistance in data collection, especially Dr. Trevor Dummer and Dr. Louise Parker. Most importantly, I would like to thank my friends and family for their support and encouragement, especially my husband Shane Hinchey.

## Chapter 1: Introduction

The prevention of a range of chronic diseases requires understanding and intervention related to both individual and environmental level determinants, however traditional approaches to chronic disease prevention and management have primarily been focused at the individual level, with limited attention toward environmental level influences on health behaviour (Brug, van Lenthe, & Kremers, 2006). This limited focus on individual behaviour is partially due to a paucity of complex theoretical frameworks for clarifying the influences of personal cognitive, and broader environmental, variables on a range of health behaviours (Glanz, Rimer, & Viswanath, 2008). The purpose of this research was to expand and test a popular, individual level, health behaviour theory, Social Cognitive Theory (SCT), to include influences of the perceived food environment on healthy eating behaviour. Although SCT is one of many ecological theories of health behaviour that can be used to guide interventions for health behaviour, it was selected for this work due to its prevelance in the literature and potential for understanding personal and environmental influences on behaviour (Sallis et al., 2008). This chapter will provide the context and rationale for conducting research related to developing ecological models of health behaviour, including a review of the evidence linking chronic disease to healthy eating behaviour and the modern food environment, and a rationale for the expansion and testing of a health behaviour theory to include environmental determinants of healthy eating.

### *1.1 Healthy Eating, the Modern Food Environment and Chronic Disease*

Chronic disease prevention is an important health issue with global relevance. The World Health Organization (WHO) has reported that chronic disease is the leading cause

of death worldwide, with increasing prevalence across all regions and socioeconomic status (World Health Orgnization, n.d.). In 2002, the WHO released a report that focused specifically on the global impact of chronic diseases such as heart disease, stroke, cancer, chronic respiratory disease and diabetes. The report stated that by the year 2020, the expected contribution of chronic disease to mortality, morbidity and disability will rise to 73% of all deaths (from 60% in 2002) and 60% of the global burden of disease (from 43% in 2002) (World Health Organization, 2002). The most recent Canadian statistics estimate that approximately 750,000 (2.3%) people have been diagnosed with cancer in the last 10 years (as of 2007), 1.6 million people are living with heart disease or the effects of stroke (as of 2009), 3 million people are coping with respiratory disease (as of 2007), and 2.4 million people (6.8%) are living with diagnosed diabetes (as of 2008) (Government of Canada, 2008a). In Canada, the Public Health Agency of Canada has a mandate to prevent and control chronic disease and promote health (Government of Canada, 2004a). This mandate has given rise to a focus on chronic disease prevention and the creation of the Centre for Chronic Disease Prevention and Control (CCDPC) (Government of Canada, 2004b) which shares reports related to various classifications of chronic disease.

The etiology of the spectrum of chronic disease is complex; however improving overall health of individuals through engagement in healthy behaviours is an important component of prevention and management strategies. Unhealthy diets, physical inactivity and tobacco use are estimated to account for 80% of premature heart disease, stroke and type 2 diabetes, along with 40% of various cancers (Strong, Mathers, Epping-Jordan, & Beaglehole, 2006). Evidence has shown that significant reductions in the risk

of chronic disease can be achieved through promoting healthy eating behaviours in both men and women (Amine et al., 2012). Specifically, dietary patterns and food choices that are consistently associated with lower risk of chronic disease in clinical and epidemiological studies include improved fruit and vegetable, fish, poultry and whole grain intake and reduced alcohol consumption (Hung et al., 2004; McCullough et al., 2002).

To successfully improve healthy lifestyle behaviours, evidence suggests that a focus beyond individual level determinants toward a broader environmental perspective has significant potential. Although improved lifestyle behaviours, including diet, have been the focus of intervention and prevention efforts over the past several decades, sustained health behaviour change has not yet been successful at the population level (Brug, van Lenthe, & Kremers, 2006). In one study of individuals living with chronic disease, while participants reported better nutrition awareness and food label use behaviours compared with those without chronic disease, this did not translate into improved eating behaviours (Lewis et al., 2009). This study suggests that increased awareness, education and even motivation to reduce disease may not lead directly to improved behaviour for individuals with chronic disease. Therefore, the most recent approaches for chronic disease prevention and health promotion call for a focus beyond individual level determinants to the environments that elicit, maintain and distribute risk factors, such as healthy eating, across the population (Choi et al., 2008; Fang, Kmetic, Millar, & Drasic, 2009; Government of Canada, 2008b; Raphael, 2004).

### *1.2 An Ecological Approach to Understanding Healthy Eating Behaviour*

Ecological models are intended to elucidate how people interact with their environments, by working within the assumption that providing individuals with motivation and skills to change behaviour may not be effective, if environments and policies make it difficult or impossible for individuals to engage in these behaviours (Green, Richard, & Potvin, 1996). As such, an ecological approach to health behaviour change suggests we need to create environments and policies that make it convenient, attractive, and economical for people to make healthy choices, and then motivate and educate people about those choices (Sallis, Owen, & Fisher, 2008). The utility of ecological models with respect to healthy behaviour is that they broaden perspectives, however unlike individual level approaches, they do so without identifying specific variables or guidance about how to directly use these broader models to improve our understanding or guide interventions (Glanz, Rimer, & Viswanath, 2008). Thus, a major challenge for those working in areas of health promotion that necessitate the use of an ecological approach (such as the area of chronic disease prevention) is to develop more sophisticated health behaviour models that lead to testable hypotheses and useful guidance for interventions that target both behavioural and environmental determinants (Gaziano, Galea, & Reddy, 2007).

In order to futher our understanding of healthy eating from an ecological perspective, Social Cognitive Theory (SCT) is proposed as the basis for this work. The benefit of using SCT for understanding the role of the food environment for healthy eating is its inclusion of personal and environmental determinants of behaviour (Bandura, 2001), and the strength of evidence that has been accumulated over 30 years of examination

(McAlister, Perry, & Parcel, 2008). Specifically for healthy eating, SCT has been used to describe the relationship between variables related to ones confidence in their ability to eat a healthy diet (i.e. self-efficacy), their expectation that the outcome of eating healthy will be a positive experience (i.e. outcome expectations), the strategies one uses to regulate their desired behaviour (i.e. goal setting) and the attitudes and behaviours of family and close friends (i.e. social support) (discussed in the following section 1.3). Although SCT is described as including environmental determinants of behaviour, its current use is restricted to social environmental influences, excluding physical, community or organizational elements (Sallis et al., 2008).

### *1.3 Background for Social Cognitive Theory and Healthy Eating Behaviour in Adults*

In health psychology, Social Cognitive Theory (SCT) holds great promise for bridging the gap between the need for broad ecological models and the specific social-cognitive mechanisms of behaviour through its inclusion of constructs related to personal, interpersonal and environmental factors. It posits that behaviour is a function of the environment and the person (both personal and behavioural dimensions), all of which are in constant reciprocal interaction (Bandura, 2001, 2004). Figure 1 shows the theoretical 'triadic of reciprocal determinism' that is the foundation of SCT.

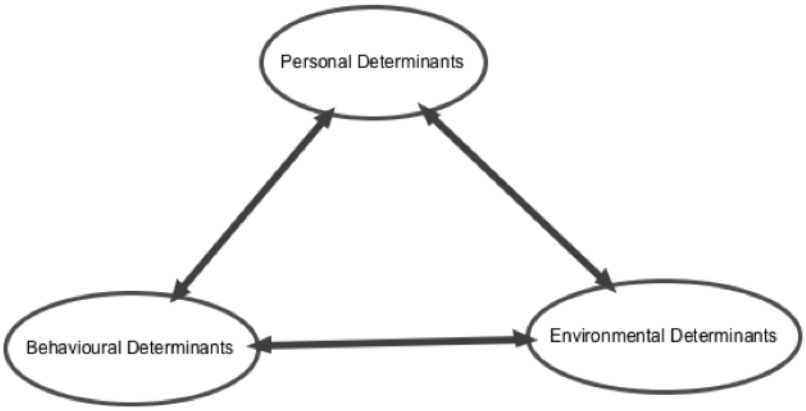


Figure 1 The triadic reciprocal determinism that is the foundation of SCT

These broad concepts have been refined over many years and now most commonly include hypothesized paths of influence in the social-cognitive causal model where beliefs of personal efficacy affect health behavior both directly and by their impact on goals, outcome expectations, and perceived sociostructural facilitators and impediments (Figure 2) (Bandura, 2004).

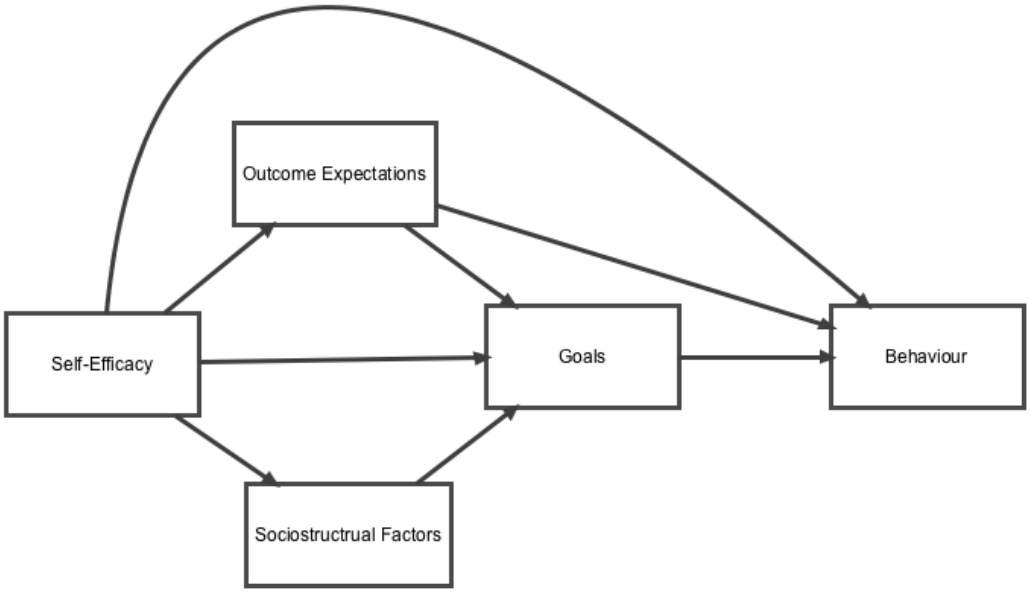


Figure 2 Hypothesized SCT pathways of influence on behaviour

To date however, the use of SCT for healthy eating in adults has focused primarily on the personal attributes (e.g., self-efficacy, outcome expectations and goals), less so on interpersonal attributes of sociostructural factors (e.g. social support) and has completely neglected higher-level aspects of the sociostructural factors related to the food environment; however this exclusion does not seem to be based on existing empirical research. For example, a study that examined the self-efficacy and outcome expectations on food purchases and intake did not include any interpersonal or food environment aspects of SCT (Anderson, Winett, & Wojcik, 2000). In another study, SCT was used to explain the nutrient context of food purchases and constructs beyond personal attributes (i.e. self-efficacy and outcome evaluations) including interpersonal factors (i.e. family social support) (Anderson, Winett, & Wojcik, 2007). In this study, the addition of family support improved the fit of SCT to the nutrition data, suggesting that the inclusion made a significant contribution to understanding the nutritional quality of food purchases. Although there seems to be a trend suggesting that the addition of distal levels of influence might better explain healthy eating behaviour, no studies to date have defined or employed a broader sociostructural construct within SCT in relation to healthy eating behaviour. One study, not explicitly using SCT, did incorporate both self-efficacy and the perceived food environment in a model of dietary fat intake (Hermstad, Swan, Kegler, Barnette, & Glanz, 2010). Although self-efficacy was positively related with the perceived food environment, the direction of influence could be considered counterintuitive (i.e. perceptions influenced by self-efficacy). Also, the authors did not discuss the implications of this relationship as they focused on other findings in the study.

Additionally, the measure of the perceived environment used was narrowly defined and included four items related to the purchase and variety of fruits and vegetables/low fat foods used in previous research (Echeverria, Diez-Roux, & Link, 2004). Although SCT theoretically links the individual with their perceived and actual contextual circumstances through the inclusion of broader socio-structural factors, the full potential of this construct has not yet been comprehensively defined, operationalized or tested, in relation to healthy eating behaviours for adults.

### *1.4 Purpose, Objectives and Method Overview*

The purpose of this research was to expand and test a popular health behaviour theory, SCT, to include influences of the perceived food environment on healthy eating behaviour, with specific objectives to:

1. Expand SCT through defining and operationalizing the perceived food environment for healthy eating behaviour in adults.
2. Test the expanded SCT for improved predictive utility of healthy eating behaviours in adults.

Achievement of objective 1 involved a review of the literature to identify potential measures of the food environment that could be incorporated into the SCT.. Achievement of objective 2 involved a cross-sectional study of adults (age 35 to 69 years) using an online survey to test the expanded SCT informed through objective 1. Data analysis included descriptive statistics and structural equation modeling to investigate and compare the traditional and expanded SCT models in a cohort of individual residents of Nova Scotia.

### *1.5 Chapter Overview*

The following chapters in this thesis will discuss the knowledge gap identified in the preceding literature. Chaper 2 will provide an overview of methods and procedures for achievement of the two objectives outlined above, and chapter 3 will present the results. A full discussion of the results for both objectives is presented in Chapter 4. Chapter 5 then presents conclusions and implications for the field of health promotion and chronic disease prevention.

## Chapter 2: Methods and Procedure

This chapter will provide an overview of methods and procedures used for this study. It begins wih the methods used for expanding Social Cognitive Theory (SCT) through a review of the food environment literature and the development of a perceived food environment measure (objective 1), followed by a description of methods for testing the expanded SCT (objective 2).

### *2.1 Objective 1: Expanding Social Cognitive Theory*

The first objective of this research was to expand SCT to include characteristics of the perceived food environment. This section provides a rationale for a review framework, and methods used to develop a perceived measure of the food environment.

#### *2.1.1 A framework for conceptualizing the perceived food environment*

Research related to conceptualizing how healthy eating might be encouraged through removing barriers, increased availability of nutritious foods, provision of quality nutrition services in various settings, and accessible point-of-purchase information, began several decades ago (Glanz & Mullis, 1988; Glanz et al., 1995). In recent years, there has been a marked surge in food environment literature from a variety of fields including the social sciences, behavioural sciences, public and community health sciences, and environmental sciences. For example, in a review that examined environmental influences on nutrition and physical activity behaviours, the authors found a need for the integration of our existing understanding of personal influences on behaviour with the emerging evidence on the role of the environment (Ball, Timperio, & Crawford, 2006). With respect to dietary behaviour, another review of associations between environmental factors, energy and fat intake among adults, found that no study provided a clear conceptualization of

how environmental factors may influence dietary intakes and called for more theoretical development of the relationship between environmental factors and dietary intakes (Giskes, 2007). In 2008, a narrative review of associations between environmental influences on nutrition behaviour found that, although the number of studies on potential environmental determinants of nutrition behaviours has increased steeply over the last few decades, there remained a paucity of well-designed studies for providing consensus on the environmental determinants of healthy eating behaviours (Brug, Kremers, Lenthe, Ball, & Crawford, 2008). In addition, it has been reported that further work is needed to improve measures of the food environment that incorporate psycho-social variables within all study designs, including cross-sectional self-report (Lytle, 2009; McKinnon, Reedy, Morrissette, Lytle, & Yaroch, 2009).

As the state of the evidence evolves, trends in the research are emerging. Specifically, we know that the food environment consists of a range of potential places where behaviour can occur (i.e. settings including home, school, community), environmental features or elements that provide a cluster of distinctive attributes (i.e. dimensions including social, physical, economic, cultural) and different perspectives describing how individuals and environments interact (Cummins, Curtis, Diez-Roux, & Macintyre, 2007; Glanz, Sallis, Saelens, & Frank, 2005; Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). This research also includes evidence of influences through measures of both the objective food environment (OFE) and the perceived food environment (PFE). The OFE is considered those features that are directly measureable, while the PFE would include characteristics measured indirectly through an individual. However it is not yet clear to what extent the conceptual influences of the OFE map onto

influences of the PFE and vice versa, and the implications for behavioural intervention (Williams, Thornton, Ball, & Crawford, 2012). This suggests that currently, we should not assume that the PFE can be used as a proxy for the OFE across settings (Gustafson et al., 2011), although PFE measures may have the same conceptual dimensions, settings and functions as those for the OFE.

Given the complexity of potential influences captured by the PFE, three key manuscripts were used to develop a framework to guide the conceptualization of the PFE for this study. The first was a review by Glanz et. al., 2005, which described a model of Community Nutrition Environments (Figure 3). The model also follows an ecological specification with policy variables (i.e. government and industry policies) influencing environmental variables (i.e. community and consumer environments across settings) and informational variables (i.e. media and advertising), which then impact upon individual level factors and behaviours. Within this model, the PFE is included as an individual level variable, but is not defined with any specificity. It is also at the same level as other personal psychosocial variables, even though a great deal of complexity likely exists within that ecological level alone.

In addition, Story et. al., 2008 published a review describing an ecological framework for conceptualizing conditions that influence food choices and eating behaviour. This framework illustrates the many complex influences beyond individual level factors (Figure 4), with particular emphasis on physical environments defined as an array of settings where people eat and procure food including their home, workplace and retail outlets like grocery stores, corner stores and restaurants, and social environments defined as networks and interactions with family, friends, peers and others.

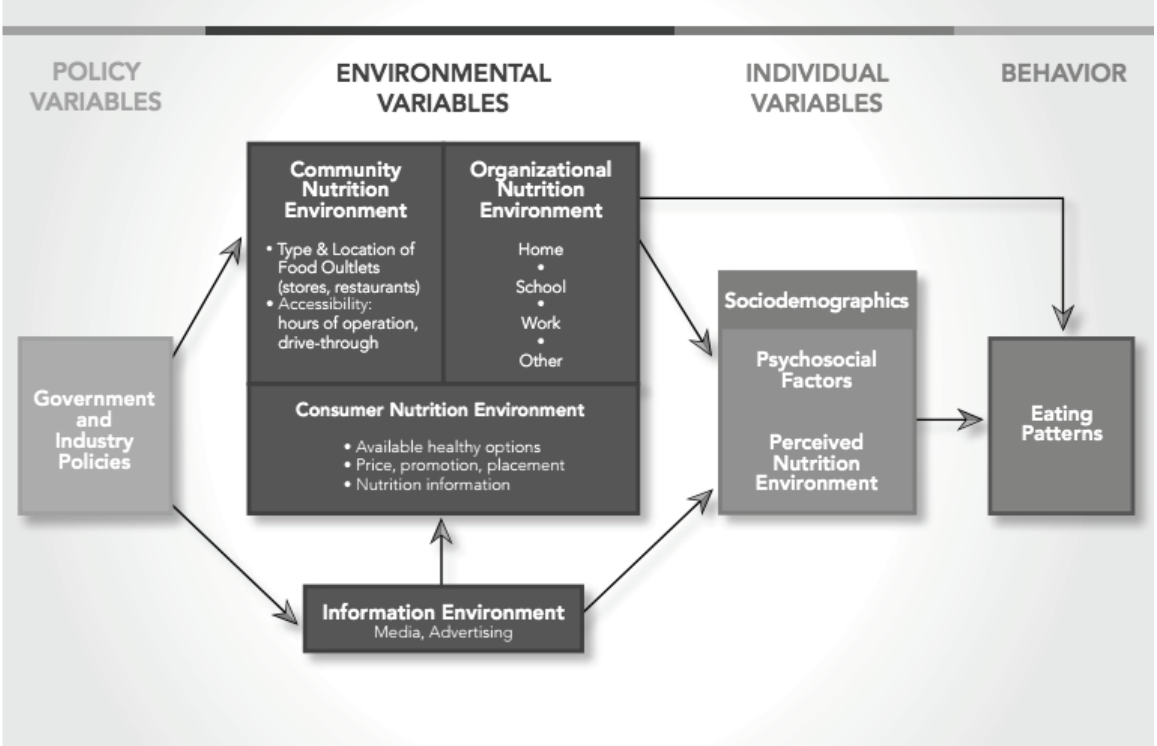


Figure 3 Model of community nutrition environments (Glanz, et. al., 2005)

The framework also provides influences at the macro level that represent sectors and systems, like government political structures and policies and food production and distribution.

The final piece of literature, that was used to shape the conceptualization of the PFE included a critique of the current trend toward viewing the influence of place on health through a dichotomy of individual (i.e. composition) and environment (i.e. context). For example, viewing people as representing a set of individual level risk factors (i.e. low income residents), and place as distance to, or density of, spatially bounded characteristics (i.e. neighbourhood fast food outlets). The authors suggest that this 'false dualism of context and composition' has shaped much of the current research literature, potentially masking important contributions of 'place' in health research (Cummins et al., 2007).

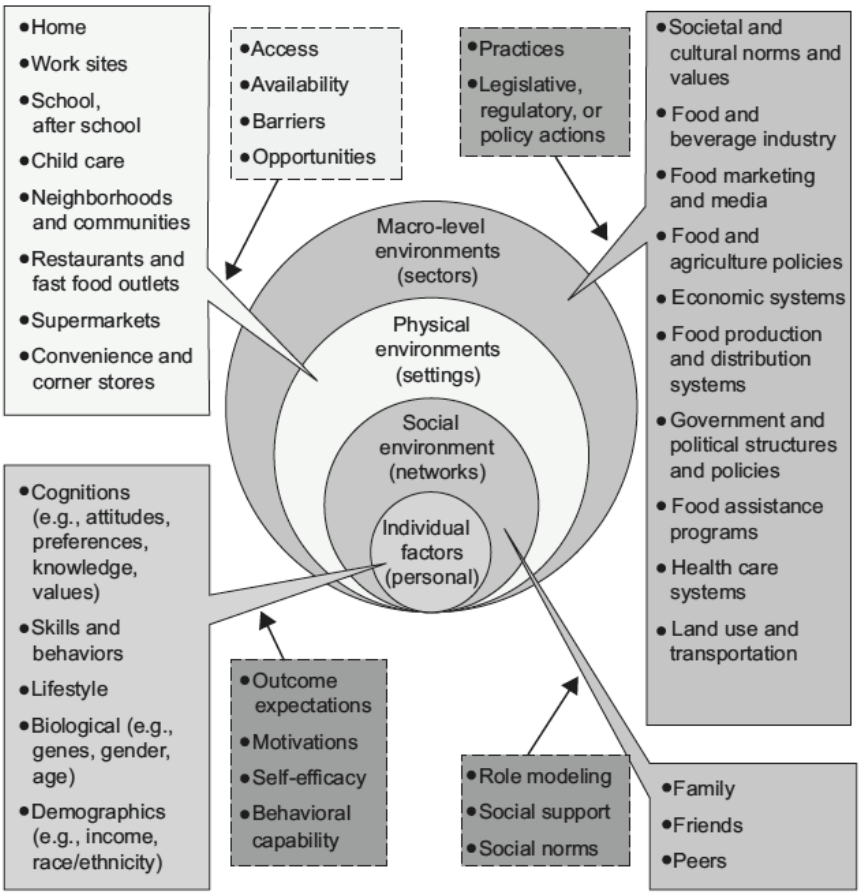


Figure 4 An ecological framework depicting the multiple influences on what people eat (Story, et. al., 2008)

Instead, the authors argue that a relational approach to understanding place in health may better reflect the 'mutually reinforcing and reciprocal relationship between people and health' that considers the role of networks, social rather than physical distance, and mobility (Table 1) (Cummins et al., 2007). Investigating this aspect of the current state of food environment research is of particular importance for SCT, as SCT was originally conceptualized as a description of bidirectional, even recipricol, influences between individuals, environments and behaviour (Bandura, 2001).

Table 1 A comparison of the 'conventional' and 'relational' understandings of 'place' for health (Cummins et. al., 2007)

| **'Conventional' view** | **'Relational' view** |
|---|---|
| Spaces with geographical boundaries drawn at a specific scale | Nodes in networks, multi-scale |
| Separated by physical distance | Separated by socio-relational distance |
| Resident local communities | Populations of individuals who are mobile daily and over their lifecourse |
| Area definitions relatively static and fixed | Area definitions relatively dynamic and fluid |
| Characteristics at fixed time points, e.g. 'deprived' versus 'affluent' | Dynamic characteristics, e.g. 'declining' versus 'advancing' |

*2.1.2 Literature review and perceived food environment measure testing*

A review of the most recent peer-review literature was conducted to identify review studies related to both objective and perceived environmental determinants of healthy eating behaviour. These studies did not include personal or psychosocial determinants of healthy eating, as those characters are captured through current uses of SCT, or macro level determinants, as they are the scope of this study. Databases searched included Pubmed, Web of Science and PsycInfo with key words:

*'food environment', 'environment', 'food', 'diet*', 'healthy eating', 'adult', 'behav*', 'social environment', 'built environment', 'physical environment', 'economic', 'policy', 'ecolog*'*

In order to focus on the most recent, and strongest possible evidence, inclusion criteria were to 1) target review studies published since 1990, 2) target studies for adult (i.e. age > 18 years old) men and women, 3) examine any environment related to a measure of healthy eating (i.e. fruit and vegetable consumption, healthy eating indices, diet quality

indices or specific nutrients and food group patterns), and 4) provide definition and measurement details on the environment examined.

Following the literature search, abstracts were screened against the inclusion criteria and retrieved for review. Papers were then examined and information added to the data extraction framework described below in order to provide evidence to operationalize the modern food environment construct and inform the development of the expanded SCT. Data extraction included collection of the following information using the data extraction table (Table 2), which was informed by the framework presented in the previous section.

Table 2 Data extraction table based on the framework for conceptualizing the perceived food environment

| **Definition** | **Environment characteristics** | | | |
|---|---|---|---|---|
| | **Role** | **Dimension** | **Setting** | **Function** |
| Type of environment | Facilitator or Impediment | Physical, economic, socio-cultural or informational | Home, work or neighbourhood | Conventional or relational |

The populated framework was then used to inform the development of measurement items for the perceived environment construct. Factor analysis was combined with tests of internal consistency (i.e. Cronbach's alpha) and current knowledge of the literature to evaluate the perceived food environment items and develop the final construct indicators.

### *2.2 Objective 2: Testing an Expanded Social Cognitive Theory*

The second objective of this research was to test a traditional and expanded Social Cognitive Theory (SCT) for healthy eating behaviour. This cross-sectional study included participants who were enrolled in a larger research project, the Atlantic

Partnership for Tomorrow's Health (APATH)[1], designed to understand how genetics, the environment, lifestyle and behaviour contribute to the development of cancer. The 30-year study is recruiting 30,000 men and woman aged 18 to 69 years from Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland and Labrador. The study is ongoing with rolling recruitment underway since 2009. Of the 14,500 individuals currently enrolled in the study in Nova Scotia, potential participants were screened for agreement to follow-up and the presence of personal and healthy eating data. Of those who met the inclusion criteria, 500 participants (200 woman and 300 men) were randomly selected for recruitment and examined for a distribution across socio-demographic (i.e. age, gender, income, education and employment status) and geographic characteristics (i.e. rurality and community level socio-economic status[2]). After being selected, all 500 participants received a pre-study notice in the mail to improve response rates (Kaplowitz, Hadlock, & Levine, 2004), followed by a series of email invites to participate in the online survey (Appendix A). The APATH team have an established protocol that is supported by literature for follow-up, which includes two follow-up email reminders each at 2 week intervals following the pre-study notice, with a final reminder 1 week later (Sheehan, 2001). Important aspects of successful web-based survey methods were followed, including reasonable survey length (20-25 minutes to complete survey), pre-notification of study by mail, follow-up web-based contact, and addressing the issue of salience for participants (Sheehan, 2001).

[1] For more details visit the Atlantic PATH website http://atlanticpath.ca/
[2] Community level SES was determined using the Community Counts profiler for communities by employment, household income and eduction http://www.gov.ns.ca/finance/communitycounts/sesview.asp

A secure server used by the APATH team hosted the online survey and participants were provided with a link through their mail card or email notification to participate. Dalhousie University Human Ethics Board provided ethical approval and participants received a chance to be entered into a lottery for 1 of 3 possible prizes which included a tablet ($175.00 value) and two grocery store gift cards ($30.00 value each).

*2.2.1 Measures*

Data for this study were collected from two sources. The APATH study provided demographic and healthy eating data for participants who were involved in data collection that began in 2010. Follow-up with participants in March and April of 2013 occurred through an online survey for the remaining social cognitive and environmental measure needed to test an expanded SCT (see Table 3 for a summary of data sources). Each set of measures is described in the following sections.

Table 3 Summary of measures and data source

| Purpose | Construct | Tool for measurement | Data source |
|---|---|---|---|
| Demographic | n/a | Self-report survey: APATH survey | APATH database |
| Behaviour | Healthy Eating Behaviour | Self-report survey: APATH survey | APATH database |
| SCT Traditional | Self-Efficacy | Self-report survey: Health Belief Survey (Anderson et al., 2000, 2007) | Online survey |
| | Outcome Expectations | | |
| | Goals | | |
| | Social Support | | |
| SCT Expanded | Perceived Food Environment | Perceived food environment scale (objective 1) | Online survey |

Demographic measures

Demographic measures were provided by the APATH study and included ethnicity age, gender, and socio-economic status (SES) derived from level of education, employment status and household income (see Appendix C). There was little ethnic diversity in the sample, so ethnicity was grouped as white and other (i.e. non-white). For socioeconomic status, levels of educational attainment were categorized as high school or lower, college and trades level, and university level or higher. Occupation was grouped as employed, unemployed and retired or volunteer. Household income was classified into three categories according to self-reported household income levels, i.e., ≤ CAD $49,999, CAD $50,000 – 99,999, and ≥ CAD $100,000.

Healthy eating index

The APATH study also provided previously collected data on healthy eating behaviour. These include self-report nutrition information such as the frequency of consumption (weekly or daily) of fruits, vegetables, whole grain products, milk and dairy products and snack foods (see Appendix C). Data from the nutrition survey were used by the APATH study to develop a healthy eating index with scores between 0 and 60, which is defined in Table 4. This final score was provided by APATH for the analysis. In addition to the healthy eating index, a question related to the degree of change in diet was asked during the follow-up survey because of the time difference from initial data collection in 2010 (when nutrition information was collected) and the follow-up in 2013.

Table 4 Components of the healthy eating index

| Component (servings per day) | Score | Criteria for perfect score | Criteria for minimum score |
|---|---|---|---|
| Vegetables and fruit | 0-10 | >= 7 servings, or >8 servings for male under 50 yr | 0 servings |
| Grain products | 0-10 | >= 6 servings for woman, >= 7 servings for men over 50 and >-8 servings men under 50 | 0 servings |
| Milk and dairy products | 0-10 | >= 2 servings under 50 and >= 3 servings under 50 | 0 servings |
| Meat and alternatives | 0-10 | >=2 servings for woman and >= 3 servings for men | 0 servings |
| Snack, dessert and non diet soft drink | 0-10 | <.05 servings | >= 2 servings |
| Other (dark leafy vegetables, salt at table etc.) | 0-10 | Depend on item | Depend on item |

Social cognitive measures

In order to determine the contribution of social cognitive variables on healthy eating behaviours, constructs were measured using the health belief survey from previous research (Anderson et al., 2000, 2007). Permission to use this survey was attained from the author and replicated in this study. The survey included social cognitive variables and subscales for social support, self-efficacy, outcome expectations and goal setting for healthy eating. In addition, PFE subscales described in objective 1 were included (full survey available in Appendix B). All social cognitive measure descriptions and subscale details are summarized in Table 5.

Table 5 Social cognitive measures with scale descriptions

| Social Cognitive Variable | Description | Subscale |
|---|---|---|
| Social support | Perceived support from family for eating healthier | • Lower fat foods<br>• Fibre, fruits and vegetables |
| Self-efficacy | Certainty of performance of behaviors to improve nutrition, across time and situations | • Increase fibre, fruits and vegetable intake<br>• Decrease fat and sugar intake |
| Outcome expectations | Expectations of outcomes to eating healthier | • Positive physical and self-evaluative outcomes<br>• Negative physical, social and self-evaluative outcomes |
| Goal setting | Use of self-regulatory behaviours | • Regulate calories and fat<br>• Regulate fibre, fruit and vegetable intake |

*Social support for healthy eating*

This construct includes questions about what participant's family and friends do and think about eating healthier foods. It uses a scale of 1-5 and asks participants to rate the degree to which they agree with statements including: '*My family says they try to eat lower-fat foods when dining out*'; '*My family does not drink many regular sodas or sugared drinks*'; and '*My family has told me they want to eat more fruits and vegetables*'.

Goals for healthy eating

This construct includes questions on what participants feel they have done in the past 3 months to eat healthier foods. It uses a scale of 1-5 and asks participants to rate the frequency of certain actions including: '*In the past 3 months how often did you eat out?*'; '*In the past 3 months how often did you eat smaller portions?*'; and '*In the past 3 months how often did you plan to eat only a certain number of calories a day?*'.

Self-efficacy for healthy eating

This construct includes questions about how certain participants feel that you can do different things to eat healthier foods. It uses a scale of 0-100 and asks participants to rate how certain they are including: '*How certain are you that you can eat fruit for a snack?*'; '*How certain you are that you can eat half a dessert in a restaurant and take the rest home?*'; and '*How certain you are that you can use low-fat salad dressing?*'.

Outcome expectations for healthy eating

This construct includes questions about what participants expect will happen when they eat healthier foods. It uses a scale of 1-5 and asks participants to rate the degree to which they agree with statements including: '*If I eat healthier food every day, I expect I will feel healthier and happier*'; '*If I eat healthier food every day, I expect I will be hungrier*'; and '*If I eat healthier food every day, I expect I will be doing what I know I should*'.

*2.2.2 Data Analysis*

The analysis included descriptive statistics for all measures, and structural equation modeling (SEM) for testing the fit of the traditional SCT and expanded SCT. SEM is considered a family of statistical techniques that represent a hybrid of factor analysis and path analysis that is ideal for model testing (Weston & Gore, 2006). Specifically, SEM is similar to factor analysis by providing a parsimonious summary of the interrelationships among variables, and is similar to path analysis in providing researchers with the ability to test hypothesized relationships between constructs (Weston & Gore, 2006). Both techniques are an extension of the general linear model, where variables are assumed to have an additive linear relationship, which enables researchers to test a series of

regression equations simultaneously, and allows the testing of direct and indirect effects, or mediating relationships among variables (Kline, 2010). Unlike regression analysis, where the independent variables are assumed to have perfect measurment, SEM assumes that all variables have some measurement error and that any error is accounted for in the explanatory model. In addition, these two statistical techniques represent the two primary components of SEM 1) the measurement model which describes the relationships between observed variables and the construct those variables are hypothesized to meaure (i.e. factors) and 2) the structural model which describes interrelationships among constructs (i.e. paths) (Schumacker & Lomax, 2004; Weston & Gore, 2006).

SEM experts recommend five steps for rigorous model testing which consist of model specification, identification and estimation, followed by model evaluation and modification that is described in the sections below (Kline, 2011; Schumacker & Lomax, 2004).

SCT model specification, identification and estimation

This section outlines the first three steps for model testing, including model specification which specifies the hypothesized relationships among observed and latent variables and unspecified relationships assumed to be equal to zero, model identification that includes ensuring model parameters are appropriate given the model specification and sample size, and model estimation which consists of selecting an appropriate estimation method and approach.

Two causal models were specified according to Bandura's specifications (Bandura, 1997, 2001), and previous research (Anderson et al., 2000, 2007), one for the traditional SCT and one for the expanded SCT. In SEM, equations are typically represented through

a path diagram (Figure 3), however they can also be described mathematically (Appendix D). A path diagram uses a variety of symbols to describe different aspects of SEM. Latent variables (i.e. variables that are not directly observed) are represented using ovals (SS, SE, OE, GS and PFE); indicator or observed variables are represented by rectangles or squares (hei, age, gender and SES). Factor loadings are represented by a unidirectional arrow between a latent construct and an indicator, for example (e.g., social support for fruit and vegetable consumption (ss fv) and social support for reduced fat intake (ss fat)) are indicators of family social support (SS). Direct effects are represented by a unidirectional arrow between two latent variables (e.g., SS -> SE), and correlation or covariance between variables are represented by bidirectional arrows (e.g., age <-> ses).

Within each recursive model (i.e. no reciprocal directed paths or feedback loops), personal variables (age, gender, SES) preceded social cognitive variables, making them the three exogenous (i.e. independent) variables. Within the remaining endogenous (i.e. dependent) social cognitive variables, social support (e.g. modeling of healthy behaviour by family members) was a source of self-efficacy and other SCT variables. Efficacy beliefs influence the outcomes expected from beahviour, and the extent to which individuals engaged in goal setting behaviours. Although SCT does not preclude social support from influencing behaviour directly, or through outcome expectations and self-regulatory behaviours (as modeled here), Bandura suggested that, for some healthy behaviours, social support influences behaviour through self-efficacy rather than directly (Bandura, 1997). However, previous research on dietary behaviour has suggested this direct effect not to be the case (Anderson et al., 2007). It is expected that the PFE acts as

an extension of social support and has potential influences on self-efficacy, goal setting and outcome expectations in addition to behaviour.

To ensure model identification, models for this study have more known than unknown parameters, sample size is greater than 200 participants and data were examined for outliers, normality (skewness between 1 and -1, kurtosis with values close to 0) and missing data (missing data were <10 per item) as recommended (Garver & Mentzer, 1999; Schreiber, Nora, Stage, Barlow, & King, 2006). Control and outcome variables with single indicators were assumed error free and therefore not treated as latent variables.

Model estimation sought to make full use of the available data and was normally distributed. Therefore full information likelihood estimation (FIML) was used by STATA 12. In FIML, the null model is not available; consequently, some measures of model fit such as the standardized root mean square residual (SRMR) (described below) could not be computed when the proposed models were fit to the data (Weston & Gore, 2006).

SCT model evaluation and modification

Once estimated, the model's fit to the data is evaluated. The significance and strength of estimated parameters, and variance accounted for in endogenous observed and latent variables are reported. Due to the latent constructs, model fit is best evaluated through a combination of fit indices, rather than a single measure of fit (Schumacker, 2004; Kline, 2011), with a range of cut-off criteria (Schreiber et al., 2006).

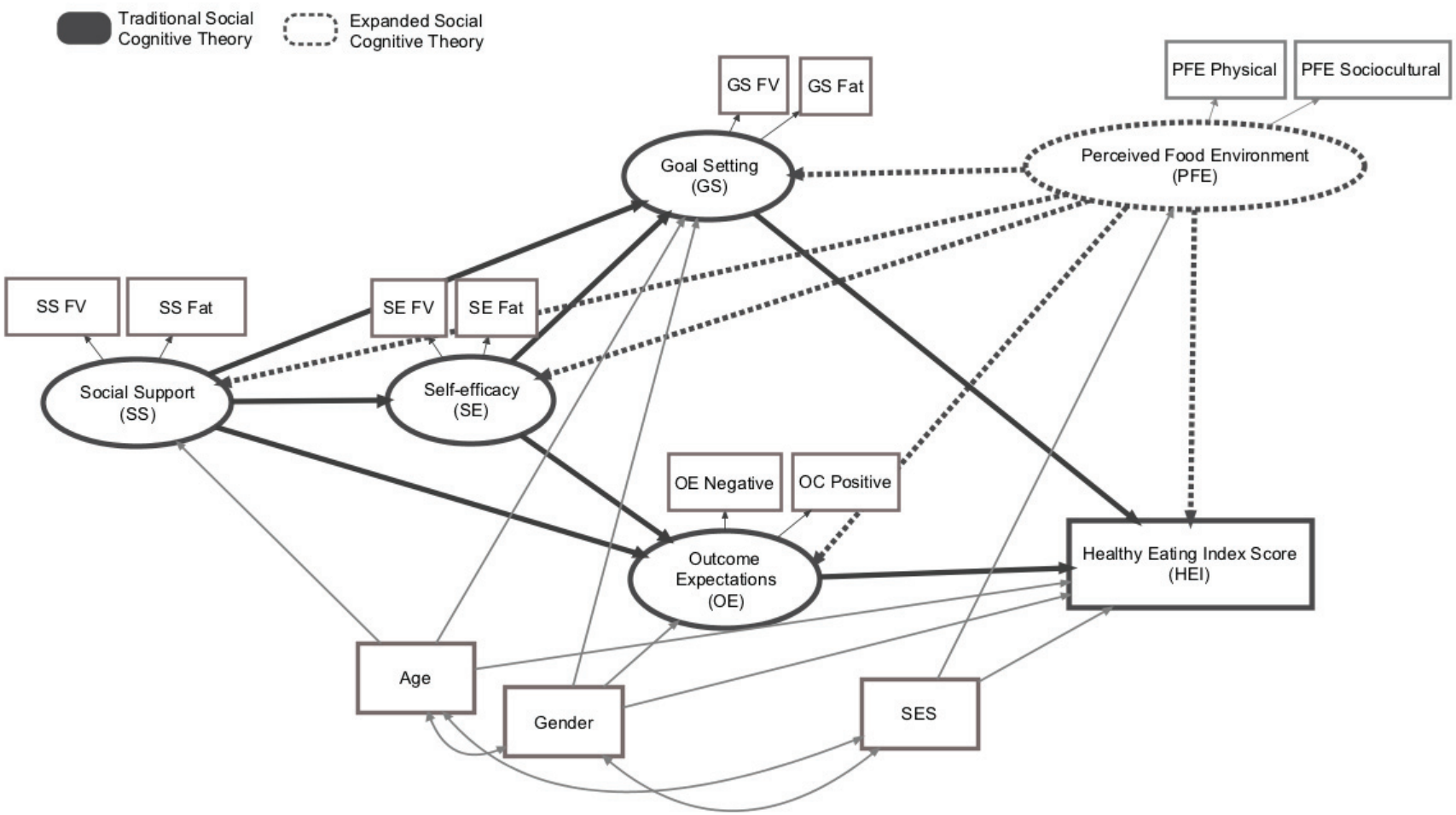


Figure 5 Hypothesized path diagram for traditional and expanded SCT models. Expanded model shows pathways using a dotted line.

Therefore, model fit is reported to include $\chi^2$, which directly assesses *exact* model fit to observed data testing misspecification of the model. This means that significant values suggest that the model does not fit the data. Also, a ratio of $\chi^2$ to df <= 2 is also used to assess model fit. Due to the rigidity of the $\chi^2$ test, other fit indices are recommended during model evaluation. The comparative fit index (CFI), which compares the improvement of the fit of the model over a more restricted model, is reported on a scale from 0-1.0 with values closer to 1.0 suggesting a better fit. The accepted cut-off is >= .95 for acceptance. The root mean square error of approximation (RMSEA) corrects for a model's complexity, meaning that when two models explain the observed data equally well, the simpler model will have the more favorable RMSEA value where 0.00 indicates that a model exactly fits the data, with values between .06 to .08 viewed as acceptable. Lastly, standardized root mean square residual (SRMR) is based on the covariance residuals, with smaller values indicating a better fit. However, this index does not tolerate missing values or use with FIML estimation methods, so it is not reported here.

During the evaluation process, a model is also reviewed for modification. This type of post-hoc modification is a controversial topic within SEM, however is a generally well accepted practice if the model is modified within the limitations of the proposed theory (Weston & Gore, 2006).

## Chapter 3: Results

This chapter presents the results of the online survey including descriptive statistics for demographic measures, change in diet and the general and relational questions, followed by the results of expanding Social Cognitive Theory (SCT) to include a measure of the perceived food environment (objective 1), and the testing of the newly expanded SCT and the traditional SCT models (objective 2).

Of the 500 participants recruited, 201 completed the online survey (40% response rate). This included 97 women and 104 men with an age range of (M=58.48, SD=8.22). Participants were also mainly white (n=189) 94.97%, Employment status: Unemployed = 8 (4%), employed = 138 (69%) and Retired or volunteer 54 (27%) (1 missing). Highest level of education: High school = 24 (11.94%), College or trade = 57 (28.36%) and University 120 (59.70%). Household income: Less than $50,000 = 33 (17.01%), Between $50,000 and $100,000 = 83 (42.78%) and Over $100,000 = 78 (40.21%) (7 missing).

Participants described a change in diet (N=200) with n=24 (12%) reporting exactly the same diet, 55 (27.5%) reporting almost identical diet, 73 (36.5%) reporting mostly the same diet, 40 (20%) reporting a mostly different diet and 8 (4%) reporting a completely different diet.

### *3.1 Objective 1: Expanding Social Cognitive Theory*

The review of observed and perceived food environment literature resulted in a total of 516 abstracts identified and reviewed for eligibility. Inclusion criteria were applied and duplicates removed. Final articles for data extraction included 12 review studies

(1997-2010) covering 216 primary studies[3]. According to the data extraction framework outlined in the previous section, the PFE was captured across different settings and divided into five possible dimensions including the physical environment (what is available, accessible and acceptability of healthy foods), the economic environment (what is the affordability of healthy foods), the socio-cultural environment (what are the norms, networks and capital regarding eating healthy foods), and the informational environment (what is the decision support availability in retail settings). Primary studies were then examined for their environment role, dimension, setting and function showing that the majority of studies are being conducted in the physical (33%, n=82) and informational (27%, n=68), rather than socio-cultural (22%, n=55) or economic (18%, n=45) environments. In addition, the setting for these types of environments being studied is within the neighborhood retail environment (85%, n=213), home (8%, n=20) and workplace (6%, n=17) with no studies reviewed that examine the environmental function as relational (0%). Instead, all took a more traditional composition versus contextual approach (100%) suggesting a gap exists for relational food environment research (Table 7).

[3] Studies were counted twice when examining more than one environment, so the total with repeated counts was 250.

Table 6 Summary data extraction for review of environmental influences on healthy eating behaviour

| Citation | Definition | # Studies | Environment characterization | | | |
|---|---|---|---|---|---|---|
| | | | Role | Dimension | Setting | Function |
| (Harnack, Block, & Lane, 1997) | Social support | 5 | Facilitator | Socio-cultural | Home/Personal[4] | Conventional |
| | Food price | 9 | Facilitator | Economic | Neighbourhood retail | Conventional |
| | Time contraints[5] | 7 | Impediment | Socio-cultural | Home/Personal | Conventional |
| | Conflicting or confusing dietary advise | 4 | Impediment | Information | Neighbourhood retail | Conventional |
| (Odoms-Young, Zenk, & Mason, 2009) | Food outlets | 6 | Facilitator/ Impediment | Physical | Neighbourhood-retail | Conventional |
| | Cultural food | 7 | Facilitator | Socio-cultural | Neighbourhood retail | Conventional |
| | Crime, poverty, racial conflict | 7 | Impediment | Socio-cultural | Neighbourhood retail | Conventional |
| (Glanz & Yaroch, 2004) | Availability, variety, convenience | 3 | Facilitator/ Impediment | Physical | Neighbourhood retail | Conventional |
| | Pricing and coupons | 2 | Facilitator/ Impediment | Economic | Neighbourhood retail | Conventional |
| | Point of purchase information | 15 | Facilitator | Information | Neighbourhood retail | Conventional |
| | Promotion and advertising | 5 | Facilitator | Information | Neighbourhood retail | Conventional |

[4] Personal setting represents a potential perceived food environment influence that does not relate specifically to a particular setting.
[5] Although time contraints was measured as perceived, findings could not show conclusively if those contraints were due to actual life circumstances, or lack of knowledge. Therefore, it is included here as a potential cultural perceived environment influence.

| Citation | Definition | # Studies | Environment characterization | | | |
|---|---|---|---|---|---|---|
| | | | Role | Dimension | Setting | Function |
| (Seymour, Yaroch, Serdula, Blanck, & Khan, 2004) | Point of purchase information | 10 | Facilitator | Information | Workplace | Conventional |
| | Point of purchase information | 19 | Facilitator | Information | Neighbourhood retail | Conventional |
| (Finkelstein, French, Variyam, & Haines, 2004) | Mandated nutrition labeling | 5 | Facilitator | Information | Neighbourhood retail | Conventional |
| (Walker, Keane, & Burke, 2010) | Cost | 6 | Facilitator/ Impediment | Economic | Neighbourhood retail | Conventional |
| | Availability, accessibility, convenience, quality | 16 | Facilitator | Physcial | Neighbourhood retail | Conventional |
| (Caspi, Sorensen, Subramanian, & Kawachi, 2012) | Availability, accessibility, accomodation, acceptability (quality) | 24 | Facilitator | Physcial | Neighbourhood retail | Conventional |
| | Affordability | 1 | Facilitator/ Impediment | Economic | Neighbourhood retail | Conventional |
| (Lallukka, Laaksonen, & Rahkonen, 2009) | Affordability | 6 | Facilitator/ Impediment | Econoomic | Neighbourhood retail | Conventional |
| | Availability | 15 | Facilitator | Physical | Neighbourhood retail | Conventional |

| Citation | Definition | # Studies | Environment characterization | | | |
|---|---|---|---|---|---|---|
| | | | Role | Dimension | Setting | Function |
| (French, Story, & Jeffery, 2001) | Eating outside of the home (convenience, portion sizes, energy and fat content) | 13 | Impediment | Socio-cultural | Neighbourhood retail | Conventional |
| | TV advertising | 8 | Impediment | Information | Home | Conventional |
| | Nutrition labelling | 2 | Facilitator | Information | Neighbourhood retail | Conventional |
| | Food pricing | 7 | Facilitator/ Impediment | Economic | Neighbourhood retail | Conventional |
| (Story et al., 2008) | Accessibility | 7 | Faciltitator | Physical | Workplace | Conventional |
| | Accessibility (availability, variety, convenience, pricing, promotion) | 8 | Facilitator | Physical | Neighbourhood retail | Conventional |
| | Eating outside of the home (convenience, portion sizes, energy and fat content) | 9 | Impediment | Socio-cultural | Neighbourhood retail | Conventional |
| | Food price | 4 | Facilitator/ Impediment | Economic | Neighbourhood retail | Conventional |
| (Popkin, Duffey, & Gordon-Larsen, 2005) | Accessibility | 3 | Facilitator/ Impediment | Physical | Neighbourhood retail | Conventional |
| | Eating outside the home | 7 | Impediment | Socio-cultrual | Neighbourhood retail | Conventional |
| | Food prices | 10 | Facilitator/ Impediment | Economic | Neighbourhood retail | Conventional |

*3.1.1 Synthesis of review literature*

As expected, the literature reviewed was both varied and diverse, representing evidence from a wide array of disciplines and contexts. This synthesis looks briefly at literature identified according to the type of food environment.

Food accessibility, availability, affordability, acceptability and advertising

One review of local food environments and diet examined the concept of food access, identifying five dimensions including availability, accessibility, affordability, accommodation and acceptability (Caspi et al., 2012). These dimensions were discussed with recommendations by the authors to broaden the definition of the food environment to include other aspects beyond food access itself and to develop measures for studies like collecting utilization data for food stores by area residents, and to continue to review and reassess the definition of food access. The authors reiterated that the five dimensions stated may not fully explain food access, and that conceptual evidence is still under development (Caspi et al., 2012). Specifically affordability has been examined in relation to food pricing, food stamp programs and promotional pricing (Finkelstein et al., 2004; Lallukka et al., 2009). Another set of reviews examined various strategies for increasing fruit and vegetable purchasing in grocery stores, finding evidence for four key types of grocery interventions: point-of-purchase information, reduced prices and coupons, increased availability, variety, convenience and advertising (Glanz & Yaroch, 2004; Seymour et al., 2004). The inclusion of promotional information and advertising can occur through television advertising, national campaigns or nutrition labeling which can both clarify, or obfuscate, dietary advice for the public (French et al., 2001; Harnack et al., 1997). In a review of disparities in access to healthy food in the US, the authors

provided evidence from an array of the literature on food deserts, or geographic areas in which access to healthy foods are lacking. At the heart of food desert research is the issue of accessibility to healthy food, and the authors discussed research related to access to supermarkets and retail outlets (Walker et al., 2010).

Social and cultural aspect of food

It has been suggested that our time pressured culture may contribute to challenges in changing dietary behaviour, specifically the effect of perceived time constraints for adopting a healthy diet, although results are currently mixed (Harnack et al., 1997). In a review of measuring food availability and access in African-American communities, it was found that much of the neighbourhood food environment literature does not take into consideration the role of cultural, or ethnic diversity (Odoms-Young et al., 2009). Additionally, the authors suggest a move from a focus on food availability and access alone, to consider the social aspects of neighbourhoods (Odoms-Young et al., 2009). This includes aspects of attending social events or being connected to activities that value healthy eating.

Settings: home, workplaces, retail food stores and restaurants

A review of healthy eating environments examined the various conditions that influence food choices, including the home, workplace and retail food stores and retaurants (Story et al., 2008). Those factors discussed above, i.e., issues of food availability, affordability, acceptability and social influences, were relevant for different settings (see Table 5 for full descriptions of influences by settings).

Measuring the food environment

Typically, environment measures are divided into two primary types: objective and percieved measures (McKinnon et al., 2009). The majority of studies are investigating the role of the environment using objective measures. These include the use of a variety of measures for access, availability and accessibility of food in retail settings. Typically tools used include geographic information systems, observational audit tools, and data related to the physical environment and accessibility (e.g. street connectivity, density of fast food restuarants, and affordablility of foods through receipt or cost analysis). Much less examined are perceived measures of the food environment with respect to healthy eating behaviour. These measures include aspect of the physical (perceived accessibility, availability and quality) and economic (perceived affordability) influences, predominately driven by geographic literature, followed by measures of social support (friend and family) from the psychological and social literature (McKinnon et al., 2009). Most often tools used are restricted to survey questionairres.

This collection of evidence helps to shape possible dimensions, settings and functions important for the development of a food environment meaure for expanding SCT discussed in the following section.

*3.1.2 Development of a measure of the perceived food environment*

The purpose of this review was to examine the current state of the review literature to inform the development of a comprehensive measure of the perceived food environment for adults. The literature was divided into various dimensions to assist in conceptualizing, defining and operationalizing a PFE construct. Measures of the PFE are sparce in the literature. When they are defined, they are often defined narrowly, mainly

capturing perceived accessibility to healthy food within ones neighbourhood retail environment (Echeverria et al., 2004; Hermstad et al., 2010; Moore, Diez Roux, Nettleton, & Jacobs, 2008).

Based on the results discussed in the previous section, items were selected that represent the different environmental dimensions, settings and functions that were found. Four subscales were developed related to the physical, economic, socio-cultural and informational environments (Table 8). In addition to these four dimensions, **general and relational items** were asked, however these items did not have a clear basis in the literature and therefore are not included in the perceived food environment measure but used to provide some contextual details. **Physical environment items** asked participants if they have a large selection of healthy foods in various neighbourhood retail outlets, workplaces and homes (i.e. availability), if neighbourhood retail outlets are within walking distance of their home (i.e. accessibility) and have high quality foods (i.e. acceptability). **Economic environment items** asked participants if foods in various retail settings, healthy foods were too expensive to purchase (i.e. affordability). **Sociocultural environment items** asked participants if healthy foods were present at social events like weddings or birthday parties or if their lives were too hecktic to eat healthy (i.e. cultural influences), if they are involved with activities or groups that value healthy eating (i.e. social networks) and if they can draw on neighbours and coworkers to help them eat healthier (i.e. social capital). While **informational environment items** asked participants if they were exposed to advertising at point-of-purchase, or during the day, for healthy eating (i.e. advertising). In addition, contextual items were included that might reflect more relational aspects of the food environment, although these were not directly taken

from the literature, as no studies reviewed were relational in nature. These items asked participants if they purchase foods while travelling between destinations like home and work, and if they purchase their groceries outside of their local neighbouhood.

Table 7 Definition, items and scale for percieved food environment measure

| Dimension | Definition | No. of Items | Items | Scaling |
|---|---|---|---|---|
| Physical | Availability, accessibility, acceptability of healthy foods for three settings. These setting include the home, neighbouhood and work place setting. | 14 | • I have a large selection of places to purchase healthy food within walking distance of my home.<br>• My neighbourhood grocery store has a large selection of fruits and vegetables to purchase.<br>• My neighbourhood corner store has a large selection of fruits and vegetables to purchase.<br>• My neighbourhood grocery store has a large selection of low fat foods to purchase.<br>• My neighbourhood corner store has a large selection of low fat foods to purchase.<br>• The fresh fruits and vegetables in my neighbourhood grocery store are of high quality.<br>• The fresh fruits and vegetables in my neighbourhood corner store are of high quality.<br>• My neighbourhood fast food restaurants have a large selection of healthy foods.<br>• My neighbourhood sit down restaurants have a large selection of healthy foods.<br>• Community centres that I visit for recreation (i.e. sport, social gatherings etc.) have a large selection of healthy foods.<br>• There are often lots of fruits and vegetables to eat in my home.<br>• There are often lots of low fat foods to eat in my home.<br>• My work place has a large selection of fruits and vegetables to purchase.<br>• My work place has a large selection of low fat foods to purchase. | Likert Agreement:<br>(1) strongly disagree<br>(2) disagree<br>(3) neither agree or disagree<br>(4) agree<br>(5) strongly agree |

| Dimension | Definition | No. of Items | Items | Scaling |
|---|---|---|---|---|
| Economic | Affordability of healthy foods available in certain settings (i.e. neighbourhood, workplace and other facilities). | 5 | • The healthy foods in my neighbourhood grocery store are too expensive.<br>• The healthy foods in my neighbourhood corner store are too expensive.<br>• The healthy fast food options in my neighbourhood are too expensive.<br>• The healthy options at sit down restaurants in my neighbourhood are too expensive.<br>• The healthy options at my work place are too expensive. | Likert Agreement:<br>(1) strongly disagree<br>(2) disagree<br>(3) neither agree or disagree<br>(4) agree<br>(5) strongly agree |
| Socio-cultural | Social networks, capital and cultural values related to healthy eating. | 7 | • Events like weddings, parties and social gatherings often have lots of fruits and vegetables to eat.<br>• Events like weddings, parties and social gatherings often have lots of low fat foods to eat.<br>• My life is too hectic to find, prepare and eat healthy foods.<br>• Growing up I didn't eat many healthy foods.<br>• My close relationships with people other than my friends or family (i.e. neighbours and coworkers) helps me to eat healthy food.<br>• I am often involved with people and activities that encourage me to eat healthier foods.<br>• Most of the people I know other than my friends or family (i.e. neighbours and coworkers) care about eating healthy food. | Likert Agreement: same as above |
| Information | Information available in retail settings | 2 | • Advertising on food packaging helps me decide what foods are healthy.<br>• I see many advertisements for healthy foods during my day. | Likert Agreement: same as above |

| Dimension | Definition | No. of Items | Items | Scaling |
|---|---|---|---|---|
| General | General and relational information for the perceived food environment | 4 | • I purchase most of my food when travelling between my home and other places (i.e. work, recreation etc.).<br>• I own a vehicle that I use to get groceries and food from outside of my neighbourhood.<br>• It is very easy to eat healthy food during my day.<br>• I feel I am in full control of my decisions to eat a healthy diet. | Likert Agreement:<br>(1) strongly disagree<br>(2) disagree<br>(3) neither agree or disagree<br>(4) agree<br>(5) strongly agree |

*3.1.3 Results of perceived food environment measure evaluation*

General and relational questions were summarized (Table 6) showing 178 (88.56%) strongly agree or agree they are in full control of their ability to eat a healthy diet. 35 (17.59%) participants reported that they agree, or strongly agree that they purchase their food while traveling between locations and 160 (80%) of participants reported they agree or strongly agree that they own a vehicle, which they use to purchase groceries outside of their neighbourhood. Other PFE measurement items were not summarized as they formed the basis of the PFE constructs for the expanded SCT.

Table 8 Summary statistics (frequency and percentages) for contextual questions

| | **Likert scale [frequency (percent)]** | | | | |
|---|---|---|---|---|---|
| **Question** | **Completely disagree** | **Disagree** | **Neutral** | **Agree** | **Completely agree** |
| I feel I am in full control of my ability to eat a healthy diet (N=201) | 5 (2.9%) | 9 (4.48%) | 9 (4.48%) | 88 (43.78%) | 90 (44.78%) |
| I frequently eat outside of the home (N=200) | 34 (17%) | 83 (41.5%) | 36 (18%) | 38 (19%) | 9 (4.5%) |
| I purchase most of my food when travelling between my home an other places (i.e. work, recreation etc.) (N=199) | 72 (36.18%) | 65 (32.66%) | 27 (13.57%) | 25 (12.56%) | 10 (5.03%) |
| I own a vehicle that I use to get groceries and food outside of my neighbourhood (N=200) | 17 (8.5%) | 8 (4%) | 15 (7.5%) | 72 (36%) | 88 (44%) |

In order to develop the PFE construct, the remaining PFE items were evaluated. First a test of internal consistency to estimate the reliability of the four environment

dimensions outlined in the literature was done. Results of the Cronbach's alpha[6] showed $\alpha = 0.70$ for the physical environment (15 items), $\alpha = 0.76$ for the economic environment (5 items), $\alpha = 0.58$ for the sociocultural environment (7 items) and $\alpha = 0.35$ for the informational environment (2 items). The physical and economic environments dimension showed good reliability, the sociocultural environment dimension showed poor reliability, while the informational environment dimension showed unacceptable reliability. Therefore, the information environment was dropped from the measure. However, this statistic is sensitive to the number of items in a scale, and therefore the internal consistency may be underestimated for the smaller scales so the sociostructural environment remained included.

Additionally, an exploratory factor analysis, based on polychoric correlation estimation (for ordinal variables) with pairwise deletion was done on all items. There were 7 eigenvalues >=1.0 suggesting 7 relevant factors. The expected number of potential factors (i.e. factors with an eigenvalue >=1.0) was four, one each for the physical, economic, sociocultural and informational environments. However the larger number of potential factors (7) is possibly due to the challenge of conceptualizing the PFE given the multiple ways one could organize the different environmental characteristcs. In addition, most of the evidence that served as the basis for this conceptualization was provided by our understanding of OFE, rather than PFE which may have contributed to the lower factor loadings and challenge in finding clear themes for the items.

[6] Cronbach's alpha cutoffs specify an alpha 0.8-0.9 is good, 0.7-0.8 is acceptable, 0.6-0.7 is questionable, 0.5-0.6 is poor and less than 0.5 is unacceptable.

Factor loadings across the 7 factors were low to moderate, with the highest loadings occurring on a selection of the physical and socio-cultural items (see Table 9). Although the physical environment subscale appears to span a range of potential factors, when items were examined for a clear theme among the indicators, items did not seem to cluster according to the literature. For example, while the item# 3,5, 7, 17 and 18 are related to availability through neighbourhood corner stores and affordability at restaurants, item# 6,8 and 9 included one item related to availability through grocery stores, one for restaurants and none for affordability. With a lack of clear clustering it was difficult to assess the validity of this measure, beyond face validity.

When the results of the reliability testing and factor analysis were considered together, it was decided to remove the informational and economic environments from the measure.

Table 9 Factor loadings for PFE subscales, loadings > 0.5 are in bold

| **Subscale** | **I#** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **Uniq.** |
|---|---|---|---|---|---|---|---|---|---|
| Physcial | 1 | 0.3322 | 0.2665 | 0.1142 | -0.1269 | -0.221 | -0.0219 | -0.0952 | 0.7311 |
| | 2 | 0.4846 | -0.1791 | 0.2898 | -0.283 | -0.318 | -0.2908 | 0.0789 | 0.3772 |
| | 3 | 0.4118 | **0.5978** | -0.1126 | 0.0639 | -0.1662 | 0.3346 | 0.2567 | 0.2509 |
| | 4 | 0.497 | -0.2032 | 0.2259 | -0.2781 | -0.3701 | -0.3097 | 0.0962 | 0.3412 |
| | 5 | 0.3829 | **0.5917** | -0.1614 | 0.0322 | -0.2137 | 0.2478 | 0.3154 | 0.2696 |
| | 6 | **0.507** | -0.116 | 0.1339 | -0.3337 | -0.3711 | -0.2289 | 0.0156 | 0.4099 |
| | 7 | 0.3038 | **0.6271** | -0.1537 | 0.0467 | -0.0926 | 0.1438 | 0.2789 | 0.3816 |
| | 8 | **0.5213** | 0.2341 | -0.1554 | -0.2861 | 0.1884 | 0.0837 | -0.2207 | 0.4763 |
| | 9 | **0.6511** | 0.1037 | -0.0284 | -0.2869 | 0.0966 | -0.1283 | -0.3464 | 0.3364 |
| | 10 | 0.3984 | 0.3102 | -0.1059 | -0.0082 | 0.1839 | -0.0608 | -0.2661 | 0.6255 |
| | 11 | 0.275 | -0.3182 | 0.354 | 0.3957 | -0.0865 | 0.0057 | 0.237 | 0.4776 |
| | 12 | 0.1874 | -0.2253 | 0.3966 | 0.3141 | -0.0235 | 0.198 | 0.0884 | 0.6106 |
| | 13 | 0.2368 | 0.2456 | -0.1198 | **0.6782** | -0.0386 | -0.417 | -0.2034 | 0.1924 |
| | 14 | 0.2261 | 0.31 | -0.0645 | **0.6867** | -0.0103 | -0.4404 | -0.1848 | 0.1488 |
| Economic | 15 | 0.4611 | -0.3889 | -0.2862 | 0.2544 | -0.1173 | 0.1359 | 0.073 | 0.452 |
| | 16 | 0.3295 | -0.1985 | -0.3792 | 0.0211 | 0.1628 | 0.1627 | 0.1109 | 0.6425 |
| | 17 | 0.4061 | **-0.5285** | -0.4826 | 0.0018 | 0.0673 | 0.06 | 0.0675 | 0.3102 |
| | 18 | 0.4827 | **-0.5113** | **-0.5133** | 0.0372 | 0.1 | 0.0179 | 0.0824 | 0.2235 |
| | 19 | 0.2365 | -0.2124 | -0.4669 | 0.1218 | 0.1395 | 0.091 | -0.1773 | 0.607 |
| Socio-cultural | 20 | 0.296 | 0.022 | 0.3677 | -0.1439 | **0.6808** | -0.2173 | 0.292 | 0.16 |
| | 21 | 0.288 | 0.1319 | 0.212 | 0.013 | **0.7109** | -0.1836 | 0.3253 | 0.2097 |
| | 22 | 0.258 | -0.2697 | 0.3109 | 0.2971 | -0.0368 | 0.1114 | 0.2568 | 0.596 |
| | 23 | 0.1293 | -0.1205 | 0.1704 | 0.2095 | -0.1961 | 0.0997 | 0.1433 | 0.8269 |
| | 24 | 0.3534 | 0.0006 | 0.3635 | 0.1506 | 0.0332 | 0.2031 | -0.3083 | 0.5829 |
| | 25 | 0.2935 | -0.0259 | 0.3638 | 0.0401 | -0.0313 | 0.2685 | -0.2757 | 0.6302 |
| | 26 | 0.2079 | -0.1211 | 0.3784 | 0.0402 | 0.1786 | 0.2496 | -0.2229 | 0.6534 |
| Information | 27 | 0.0023 | 0.0969 | -0.2159 | -0.1714 | 0.0569 | -0.3551 | 0.2141 | 0.7394 |
| | 28 | 0.2548 | 0.0492 | 0.137 | -0.0787 | 0.2507 | 0.2697 | -0.1702 | 0.7431 |

In summary, the literature review provided evidence for the development of four potential dimensions of the food environment to include in this work. The availability, accessibility and acceptability of healthy foods (i.e. physical environment), the affordability of healthy foods (i.e. economic environment), the social and cultural influences for eating healthy foods (i.e. sociocultural environment) and advertising related to healthy foods (i.e. informational environment) were measured. Analysis of the measure showed a moderate degree of internal consistency, and low to moderate factor loadings leading to the final selection of the physical and sociocultural environments for inclusion in the testing of an expanded SCT (described in the following section).

### *3.2 Objective 2: Testing an Expanded Social Cognitive Theory*

Once the perceived food environment measure was complete, all sub-scales were examined and showed a moderate to high degree of internal consistency, with the exception of the socio-cultural scale for the PFE. Variable means, standard deviations and internal consistency statistics are summarized in Table 10.

#### *3.2.1 Structural model fit comparison and direct effects*

Structural equation analysis of the models indicated moderate model fit for both traditional and expanded models. The traditional model: $\chi^2$ (40, N=201) = 99.75, p <0.0001, $\chi^2$ /df ratio = 2.50, RMSEA = 0.086, 90% CI [0.065, 0.108], CFI = 0.887, the expanded model: $\chi^2$ (57, N=201) = 151.87, p < .0001, $\chi^2$ /df ratio = 2.66, RMSEA = 0.091, 90% CI [0.74, 0.109], CFI = 0.842. Model modifications were examined, but none altered the model fit significantly within parameters that could be justified by theory.

Table 10 Means and standard deviations for measured variables

| Latent and indicators variables * | Range | N | Mean | SD | No. of items | Cronbach's alpha $\alpha$ |
|---|---|---|---|---|---|---|
| *Social support (SS)* | | | | | | |
| Increase fibre and FV (ss fv) | 1-5 | 198 | 3.47 | .70 | 10 | .87 |
| Reduce fat (ss fat) | 1-5 | 198 | 3.45 | .71 | 7 | .84 |
| *Self-efficacy (SE)* | | | | | | |
| Increase fibre and FV (se fv) | 1-100 | 201 | 66.87 | 18.25 | 11 | .78 |
| Reduce fat and sugar (se fat) | 1-100 | 200 | 71.31 | 17.62 | 17 | .83 |
| *Outcome expectations (OE)* | | | | | | |
| Positive expectations (oe positive) | 1-5 | 200 | 4.11 | .52 | 10 | .85 |
| Negative expectations (oe negative) | 1-5 | 200 | 2.37 | .72 | 12 | .90 |
| *Goal setting (GS)* | | | | | | |
| Increase fibre and FV (gs fv) | 1-5 | 201 | 4.10 | .68 | 4 | .82 |
| Decrease fat and calories (gs fat) | 1-5 | 201 | 3.49 | .67 | 14 | .84 |
| *Perceived Food Environment (PFE)* | | | | | | |
| Physical (pfe physical) | 1-5 | 201 | 2.94 | .47 | 14 | .70 |
| Socio-cultural (pfe sociocultural) | 1-5 | 201 | 3.13 | .53 | 7 | .58 |
| Healthy eating index score (hei) | 0-60 | 201 | 40.53 | 8.24 | 1 | n/a |

*FV=fruit and vegetables; SD = standard deviation

The completely standardized[7] structural model parameter coefficients associated with direct, indirect, and total effects of the latent variables in the models are reported in Table 11. The two models differed with respect to estimates, which are reflected by providing the expanded model coefficients before the slash, and the traditional model coefficients after the slash. The focus of this work was examing model fit and the structural direct

[7] Standard errors are not included in the results as they only apply to the unstandardized solution. Unstandardized coefficient results were used to determine significance.

effects, with significant direct effects ($p < 0.05$ and $p < 0.10$) illustrated in Figure 6. Direct effects are the portion of a variable's total effect that is independent of other variables in the model; a variable's indirect effect is the portion of its total effect that is dependant on other variables in the model.

For the traditional model there were significant relationships between social support and self-efficacy ($\beta[direct] = 0.20$), self-efficacy and outcome expectations ($\beta[direct] = 0.89$) with age and gender influencing social support ($\beta\ [direct] = 0.26$) and healthy eating behaviour ($\beta[direct] = 0.16$) respectively. With the addition of the PFE for the expanded model, paths shifted to show significant relationships between the PFE and social support ($\beta[direct] = 0.51$) as well as self-efficacy ($\beta[direct] = 0.39$), self-efficacy and goal setting ($\beta[direct] = 0.55$), with age and gender influencing the PFE ($\beta[direct] = 0.21$) and goal setting ($\beta[direct] = 0.20$) respectively.

Table 11 Standardized direct, indirect and total effects (expanded model/traditional model)

| | | Sex | SES | Age | SS | SE | OE | GS | HEI |
|---|---|---|---|---|---|---|---|---|---|
| SS | Direct | -0.14**/-0.04 | - | 0.15*/0.26** | | | | | |
| | Indirect | - | 0.04/- | 0.12/- | | | | | |
| | Total | -0.14**/-0.04 | 0.04/- | 0.25**/0.26** | | | | | |
| SE | Direct | - | - | - | 0.01/0.20* | | | | |
| | Indirect | 0.01/-0.01 | 0.03/- | 0.08*/0.05* | - | | | | |
| | Total | 0.01/-0.01 | 0.03/- | 0.08*/0.05* | -0.01/0.20** | | | | |
| OE | Direct | -0.01/0.02 | - | - | 0.10/0.12 | 0.92/0.89* | | | |
| | Indirect | -0.01/-0.01 | 0.02/- | 0.10/0.08* | 0.01/0.18** | - | | | |
| | Total | -0.01/0.01 | 0.03/- | 0.10/0.08* | 0.09/0.30** | 0.92/0.89** | | | |
| GS | Direct | 0.23**/0.27 | - | 0.10/0.13 | 0.07/0.18 | 0.55**/0.59 | - | | |
| | Indirect | -0.01/-0.01 | 0.03/- | 0.11/0.08 | -0.01/0.12** | - | | | |
| | Total | 0.22*/0.26 | 0.03/- | 0.21*/0.21 | 0.07/0.30** | 0.55**/0.59 | | | |
| HEI | Direct | 0.015*/0.16* | 0.12/.11 | -0.08/-0.07 | - | 0.31**/- | 0.22/0.22 | 0.23/0.22 | |
| | Indirect | 0.05/0.06 | 0.02/- | 0.08**/0.06 | 0.21/0.13** | - | - | - | |
| | Total | 0.20*/0.22** | 0.12*/.11 | -0.01/-0.01 | 0.21/0.13** | 0.31**/0.33** | 0.22/0.22 | 0.23/0.22 | |
| PFE | Direct | - | 0.07 | 0.21* | 0.51** | 0.39* | 0.01 | 0.21 | 0.03 |
| | Indirect | - | - | - | - | -0.01** | 0.40* | 0.25* | 0.19* |
| | Total | - | 0.07 | 0.21* | 0.51** | 0.38* | 0.40* | 0.46 | 0.22 |

Note: Coefficients are included for both the traditional and explanded SCT models. Social support=SS; Self-efficacy=SE; Outcome expectations=OE; Goal setting=GS; Perceived food environment=PFE; Healthy eating index=HEI. '-' = no path or constrained * $p < .10$, ** $p < .05$. Coefficients were rounded to two decimal places, some total effects may not add up exactly.

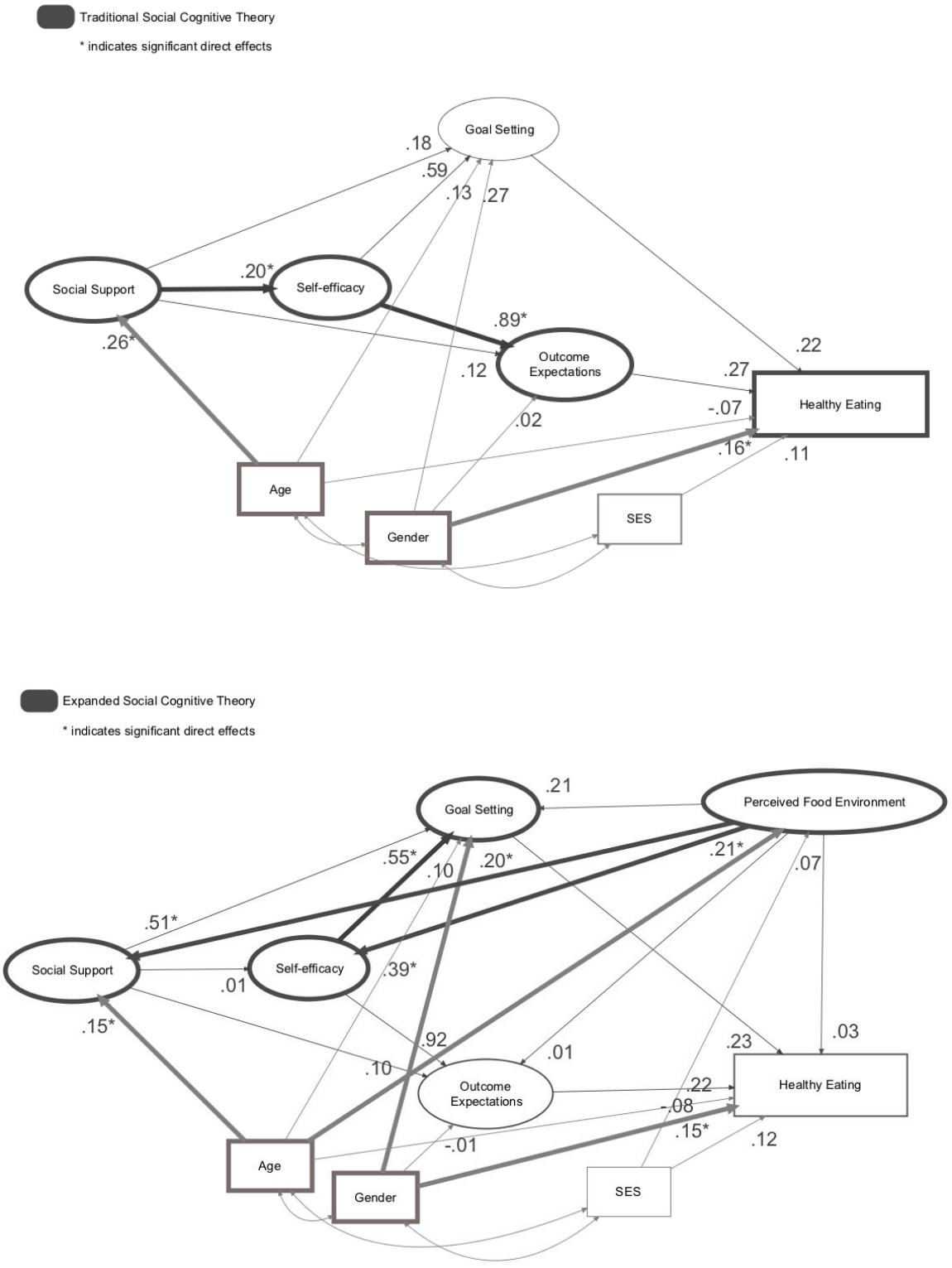


Figure 6 Depicts significant direct effects for traditional and expanded models. Bold paths represent significant direct effects, while thin paths represent hypothesized paths that were found not to be significant.

## Chapter 4: Discussion

The purpose of this research was to contribute to the evidence base for ecological theories related to healthy eating behaviour in adults. It sought to use Social Cognitive Theory (SCT) as the basis for examining the utility of combining measures of cognitive, social and perceived environmental relationships with respect to healthy eating. To accomplish this, SCT was expanded to include perceived influences beyond an individual or their immediate access to family social support. This step was necessary due to the paucity of clear definitions, conceptualization or measures of the PFE for adults. Although there is not yet a clear understanding of the OFE and PFE, or how best to measure them, a number of researchers are working on filling this gap. In particular, there has been work on a reliable and valid objective nutrition environment measure for stores and restaurants (Glanz, Sallis, Saelens, & Frank, 2007; Saelens, Glanz, Sallis, & Frank, 2007), and even the use of these measures in understanding the influence of the retail environment, the PFE and psychosocial variables on healthy eating (Hermstad et al., 2010). However this work to date has used a narrowly defined measure of the PFE that only incudes accessibility to, and acceptability of, fruits and vegetables (Echeverria et al., 2004). Therefore, work to date has not explored the PFE in a comprehensive way, expanding beyond issues of accessibility and cost, to those of culture and the inherent mobility with which people navigate their daily lives.

After a measure of the PFE was developed from the existing literature, it was used to test the contribution of the additional PFE contruct to a traditional model of SCT. The final two sections of this thesis will discuss the implications of this research for our understanding of social-cognitive-ecological influences on healthy eating behaviour,

moving toward the development of an ecological theory of healthy eating behaviour for the field of health promotion and chronic disease prevention.

### *4.1 The Perceived Food Environment and Social-Cognitive Influences on Healthy Eating Behaviour*

The traditional SCT and expanded SCT comparison did not show a significant model fit, or improvement in model fit, although the inclusion of measures of the PFE did alter the direct effects of pathways in the expanded model. This suggests that the inclusion of measures of the PFE may alter the traditional role of other cognitive variables. In turn, this suggests that it is as important to understand *what* PFE mechanisms might influence behaviour, as it is to understand *how* those influences directly, or indirectly, affect preceeding cognitive variables themselves. For example, in the traditional SCT model, social support was directly related to self-efficacy, suggesting that the more family and friends support your desire to increase your fruit and vegetable consumption and decrease your fat intake, the more confidence you have in your ability to eat fruits and vegetables while consuming less fatty foods, a relationship discussed and established in previous studies for healthy eating behaviour (Anderson et al., 2000, 2007; Bandura, 2004). However, with the inclusion of the PFE, this direct relationship was replaced by a direct effect of the PFE on both social support and self-efficacy. This may indicate that, when other physical and social dimensions of the PFE are included such as perceived accessibility to healthy foods in grocery stores, corner stores and restuarants and at social events, family social support is no longer the only significant predictor of one's confidence in selecting healthy foods.

In addition to altering paths of social support and self-efficacy, the inclusion of PFE measures also modified the relationship between self-efficacy and outcome expectations (in the traditional model) to a relationship between self-efficacy and goal setting. In the traditional model, although a person's confidence in their ability to eat a healthy diet may influence whether they feel the outcome will be positive (e.g. you feel better) or negative (e.g. you feel deprived of foods you love), when the PFE was incorporated into the model, the role of confidence switched to relating to one's strategies to set goals for improving their diet, making the role of goal setting even more important for behaviours susceptible to perceived environmental inflences. This is an interesting finding given the frequent use of S.M.A.R.T[8] goals in a variety of self-management interventions and their potential to facilitate behaviour change within a variety of contexts (DeWalt et al., 2009; Lawn & Schoo, 2010; Strecher et al., 1995). Goal setting has been shown to be an effective strategy in dietary behaviour change, often improving the frequency of desirable dietary behaviour (Cullen, Baranowski, & Smith, 2001; Nothwehr & Yang, 2007; Shilts, Horowitz, & Townsend, 2004). Therefore, if we accept that these constructs may have an influence on healthy eating behaviours established in previous research, as outlined in Chapter 3, the incorporation of the PFE may assist our understanding of cognitive pathways of influence, even though this study was unable to demonstrate such a link conclusively.

### *4.2 The Future of Perceived Food Environment Research*

An important finding of this research has been the challenge inherent in defining, operationalizing and measuring the PFE for healthy eating behaviour. This challenge is

[8] Specific. Measurable. Attainable. Realistic. Timely.

partially due to a paucity of studies that produce evidence appropriate for defining perceived facilitators or barriers to healthy eating behaviour that may not reflect the objective environment. This may be expected as there is little consensus as to the most appropriate approaches for defining environments or the selection of environmental exposures that might be important for nutrition and physical activity behaviours (Ball et al., 2006). In fact, previous reviews have stated that much of the current literature has been opportunistic, focusing on measures of facility availability alone rather than issues of social, economic or political importance (Ball et al., 2006). Although the literature has evolved from a focus on availability to include issues of affordability, quality and decision support, there still remains a lack of understanding of other dimensions, such as culture, or research that spans several dimensions of the environment simultaneously. In addition, studies that use both individual level, PFE and OFE factors for healthy eating behaviour could help to support a better conceptualization of the PFE. In preparation for this study, only a handful of papers were found that met these criteria (Anderson et al., 2000, 2007; Hermstad et al., 2010). While important steps have been taken to improve our understanding of individual and environmental factors through an increase in multi-levelled studies for healthy eating, these studies do not tend to include measures of the PFE or cognitive variables (Giskes, Turrell, van Lenthe, Brug, & Mackenbach, 2007; Pickett & Pearl, 2001).

As stated, the vast majority of evidence being generated for the food environment was derived from objective measures. However, as illustrated in the model for community nutrition environment by Glanz et al., the PFE might best be viewed as a potential mediator between the OFE and behaviour (Glanz et al., 2005). Additionally, a recent

report developed by Health Canada reviewed the extent of the literature for measures of the food environment in Canada and found few studies using perceived measures of the food environment, and also provided evidence to support the need for increased research into this important construct (Health Canada, 2013).

Additionally, the aforementioned conceptual challenges may also be due to a lack of existing research that takes a relational view of people and place as it relates to health (Cummins et al., 2007). This conceptualization acknowledges the bidirectional interactions between people and their circumstances, and is especially relevant for any theoretical approach that postulates a reciprocal relationship between personal and environmental determinants, like SCT (Bandura, 2001). However, the review of the evidence used in this work did not find any studies that would meet the criteria for a relational study defined by Cummins et.al, 2007. With the majority of studies focused on static, bounded definitions of neighbourhood where the food environment includes physical distance to food stores within a pre-defined geographic area (i.e. access to neighbourhood grocery store), rather than a dynamic, un-bounded definition where the food environment consists of exposure to a range of food outlets while en route between different destinations (i.e. exposure to advertising while driving home from work) (Cummins et al., 2007). This is an emerging area of study, where health geographers and epidemiologists are debating the definition of neighbourhood in urban or rural settings (Clapp & Wang, 2006; Weiss, Ompad, Galea, & Vlahov, 2007). The heavy use of neighbourhood retail environments in the reviewed literature, especially grocery stores as a setting, may need to be expanded for an improved understanding of eating behaviour. For this study, nearly half of participants agreed they frequently eat outside of the home,

with less than a fifth agreeing they purchase their food while travelling between other destinations and 85% of participants agreeing they own a vehicle that they use to purchase groceries outside of their neighbourhood. These results suggest that although neighbourhood retail environment is an important setting, people frequently eat outside of the home, drive to purchase groceries outside their neighbourhood and that these trips may be planned with intention, rather than opportunistic. From the perspective of the perceived food environment this could have implications for environmental exposures individuals encounter while driving, including a greater influence of advertising, convience, and space for parking a vehicle, while reducing some potential social influences that reflect broader social norms, in favor of other social influences like food preferences of those one might purchase food with (i.e. spouse), or for (i.e. children).

These gaps related to the conceptualization of the perceived food environment, the abundance of measures for the objective environment, and a lack of relational research methods may be related to the multiple disciplines contributing to the evidence base. For example, traditionally the field of psychology has been interested in individual behaviour, with very few investigations into more distal influences, while environmental sciences and fields utilizing methodologies from epidemiology traditionally include factors beyond the individual without the inclusion of cognitive measures. The disciplines of public health and health promotion now have an opportunity to bridge the gap between the foundations of these multiple disciplines to better understand food environments, both perceived and objective. The field can also advocate for accepting the uncertainty inherent in using a mixture of methods and innovative approaches for measuring individuals within their environments in real time. These could include resident reports,

systematic observation and objective measures on the location and spatial accessibility of resources (Cummins et al., 2007). A particularly promising method is ecological momentary assessment (EMA). EMA involves sampling an individual's experiences and perceptions through prompts over the course of the day to provide insights into behaviour in real time (Shiffman, Stone, & Hufford, 2008). The future of perceived, and even objective, environment research needs to work at addressing some of the complexities of these relationships, which might require the use new methods and tools. Therefore, we need not only to bring various fields together to generate evidence; we need to ensure that the evidence is filling existing gaps in our theoretical understanding.

### *3.5.1 Study limitations*

As with any study, there are several limitations to consider. The review used to inform the development of the PFE measure did not include some of the most recent primary studies, and therefore may not represent an exhaustive review of the literature, but instead a review of evidence that has been previously screened for inclusion in review studies. While this may help ensure some of the more rigourous studies were included, it also may have led to the exclusion of primary studies that did not meet stringent inclusion criteria set out by previous authors. This includes studies with more non-traditional methodologies, qualitative studies or grey literature. The development of the PFE measure was also limited by the length of the health belief survey. In order to minimize participant burden, a survey of 20 minutes maximum was developed. The full survey included a variety of measures, totaling 83 items. This meant the PFE measure was limited by the number of items that could be included, and therefore items may not have reflected all possible perceived environment dimensions. Also, as the majority of the

research literature originates through objective measurement of the food environment, the resulting PFE measure may not fully represent those aspects of the food environment most relevant for facilitating or inhibiting healthy eating from the point of view of the individual. Additionally, the PFE measure has not had significant reliability or validity testing, and many of the factors in the measure loaded low or moderately on possible indicators. This could indicate that using a conceptualization of the PFE mostly based on evidence from the OFE may not be adequate. Also, the data for this work were collected three years apart, with demographic and healthy eating data being collected in 2010 and social cognitive variables collected in 2013, potentially misrepresenting SEM relationships between demographic and healthy eating factors, with SCT or PFE factors. Although both the traditional and expanded SCT models include significant paths of influence, none of those paths provided significant relationships with healthy eating behaviour itself. Given previous research that has found strong, significant influences of a variety of psychosocial variables on healthy eating (Anderson et al., 2007; Luszczynska, Tryburcy, & Schwarzer, 2007; Povey, Conner, Sparks, James, & Shepherd, 2000), it is likely that the lack of association in this study is due to the healthy eating index measure, the moderate sample size or the delay in data collection for nutrition data (2010) and the social cognitive data (2013). Only 12% of participants reported having 'exactly the same diet' as 2010, with 64% reporting almost or mostly the same diet and 24% reporting a mostly, or completely, different diet at the time of the survey. In addition, the healthy eating index did not provide a component that included a measure of fat outside of high calorie snacks, given the restrictions on the data available to the APATH team.

The sample used for this work was also part of a larger cancer cohort study and included a sub-set of participants with an age range of 35-69 years, a smaller range of the adult population of Nova Scotia. In addition, the sample included in this study was highly educated, mainly employed or retired with middle to high income. This may have had implications for the results of model testing and direct effect due to a more homogeneous sample than the Nova Scotia population.

## Chapter 5: Conclusions

The field of health promotion seeks not only to educate and advocate for the health of individuals, it endeavours to help create the conditions that support the healthy behaviours necessary to live a long, healthy life. As such, it has the potential to bring together the various disciplines of health psychology, environmental science and epidemiology to generate the evidence needed to push food environment research forward. In addition to improving our knowledge, the results of this research have suggested that this field of study could benefit from additional research that bring together social-cognitive and environmental factors, especially through the use of innovative mixed methods.

The famous quote by Kurt Kewin reads 'There is nothing so practical as a good theory'. However, the state of food environment literature and research suggests that conceptual development is currently lagging behind progress in analysis methods (Ball et al., 2006). The findings of this work further reinforce the importance of ecological approaches to health promotion that recognise individuals as operating within a broader social and environmental context. Thus without the inclusion of the PFE, our focus on particular cognitive factors (e.g., goal setting) may become more important to consider than others (e.g., outcome expectations) that were previously identified without providing environmental context. This could potentially change the focus of behaviours intervention from supporting people to think positively about how they will feel about eating healthier, to encouraging the setting of specific goals to improve eating behaviour within a broader environmental context. Alternatively, it may also suggest that changes to environmental features may not have the anticipated effect on behaviour, if a clear

understanding of *how* that environmental characteristic interacts with an individuals (Ball et al., 2006; Brug et al., 2008; Glanz, 2009), their environmental perceptions, and their cognitive makeup.

Consequently, before successful interventions can be developed that have the potential to improve long term healthy eating and prevent the development of chronic disease, we must acknowledge that the theoretical basis for understanding healthy eating behaviour within the context of our modern food environment is only in the formative stages. New research is emerging to fill these gaps, and this study has helped to outline some of the challenges and opportunities to move the evidence forward.

While there is still work to be done, a trend towards better understanding the complexity inherent in ecological theories is emerging. Specifically, food environment research would benefit from a convergence of the multiple disciplines that are investigating this important field of research. This includes a greater diversity in conceptual approaches to understanding person-environment interactions beyond the traditional psychological, geographic and epidemiological methods used. It is not yet known what developments in measurement and analysis will allow researchers to begin to unravel some of the intricate dynamics that are part of the social world, but we do know that in order to truly improve healthy eating behaviour at the population level, we need to embrace the complexity of the topic in future research and practice. The work included in this thesis represents a first step on this journey towards a greater understanding of how we can better measure the complex interactions between an individual and the food environment.

**References**


Amine, E., Baba, N., Belhadj, M., Deurenbery-Yap, M., Djazayery, A., Forrester, T., … Yoshiike, N. (2012). Diet, nutrition and the prevention of chronic diseases : report of a Joint WHO/FAO Expert Consultation. Retrieved from http://dro.deakin.edu.au/view/DU:30010488

Anderson, E. S., Winett, R. A., & Wojcik, J. R. (2000). Social-cognitive determinants of nutrition behavior among supermarket food shoppers: A structural equation analysis. *Health Psychology*, *19*(5), 479–486. doi:10.1037/0278-6133.19.5.479

Anderson, E. S., Winett, R. A., & Wojcik, J. R. (2007). Self-regulation, self-efficacy, outcome expectations, and social support: Social cognitive theory and nutrition behavior. *Annals of Behavioral Medicine*, *34*, 304–312. doi:10.1007/BF02874555

Ball, K., Timperio, A. F., & Crawford, D. A. (2006). Understanding environmental influences on nutrition and physical activity behaviors: where should we look and what should we count? *International Journal of Behavioral Nutrition and Physical Activity*, *3*(1), 33. doi:10.1186/1479-5868-3-33

Bandura, A. (1997). *Self-efficacy: the exercise of control*. W.H. Freeman.

Bandura, A. (2001). Social Cognitive Theory: An Agentic Perspective. *Annual Review of Psychology*, *52*, 1–26. doi:10.1146/annurev.psych.52.1.1

Bandura, A. (2004). Health Promotion by Social Cognitive Means. *Health Education & Behavior*, *31*(2), 143 –164. doi:10.1177/1090198104263660

Brug, J., Kremers, S. P., Lenthe, F. van, Ball, K., & Crawford, D. (2008). Environmental determinants of healthy eating: in need of theory and evidence. *Proceedings of the Nutrition Society*, *67*(03), 307–316. doi:10.1017/S0029665108008616

Brug, J., van Lenthe, F. J., & Kremers, S. P. J. (2006). Revisiting Kurt Lewin: How to Gain Insight into Environmental Correlates of Obesogenic Behaviors. *American Journal of Preventive Medicine*, *31*(6), 525–529. doi:10.1016/j.amepre.2006.08.016

Caspi, C. E., Sorensen, G., Subramanian, S. V., & Kawachi, I. (2012). The local food environment and diet: A systematic review. *Health & Place*, *18*(5), 1172–1187. doi:10.1016/j.healthplace.2012.05.006

Choi, B. C. K., McQueen, D. V., Puska, P., Douglas, K. A., Ackland, M., Campostrini, S., … Torres, R. E. (2008). Enhancing global capacity in the surveillance, prevention, and control of chronic diseases: seven themes to consider and build upon. *Journal of Epidemiology and Community Health*, *62*(5), 391–397. doi:10.1136/jech.2007.060368

Clapp, J. M., & Wang, Y. (2006). Defining neighborhood boundaries: Are census tracts obsolete? *Journal of Urban Economics*, *59*(2), 259–284. doi:10.1016/j.jue.2005.10.003

Cullen, K. W., Baranowski, T., & Smith, S. P. (2001). Using goal setting as a strategy for dietary behavior change. *Journal of the American Dietetic Association*, *101*(5), 562–566. doi:10.1016/S0002-8223(01)00140-7

Cummins, S., Curtis, S., Diez-Roux, A. V., & Macintyre, S. (2007). Understanding and representing "place" in health research: A relational approach. *Social Science & Medicine*, *65*(9), 1825–1838. doi:10.1016/j.socscimed.2007.05.036

DeWalt, D. A., Davis, T. C., Wallace, A. S., Seligman, H. K., Bryant-Shilliday, B., Arnold, C. L., … Schillinger, D. (2009). Goal setting in diabetes self-management: Taking the baby steps to success. *Patient Education and Counseling*, *77*(2), 218–223. doi:10.1016/j.pec.2009.03.012

Echeverria, S. E., Diez-Roux, A. V., & Link, B. G. (2004). Reliability of self-reported neighborhood characteristics. *Journal of Urban Health : Bulletin of the New York Academy of Medicine*, *81*(4), 682–701. doi:10.1093/jurban/jth151

Fang, R., Kmetic, A., Millar, J., & Drasic, L. (2009). Disparities in Chronic Disease Among Canada's Low-Income Populations. *Preventing Chronic Disease*, *6*(4).

Finkelstein, E., French, S., Variyam, J. N., & Haines, P. S. (2004). Pros and cons of proposed interventions to promote healthy eating. *American Journal of Preventive Medicine*, *27*(3), 163–171. doi:10.1016/j.amepre.2004.06.017

French, S. A., Story, M., & Jeffery, R. W. (2001). Environmental Influences on Eating and Physical Activity. *Annual Review of Public Health*, *22*(1), 309–335. doi:10.1146/annurev.publhealth.22.1.309

Garver, M. S., & Mentzer, J. T. (1999). Logistics Research Methods: Employing Structural Equation Modeling to Test for Construct Validity. *Journal of Business Logistics*, *20*(1), 33–57 25 pages.

Gaziano, T. A., Galea, G., & Reddy, K. S. (2007). Scaling up interventions for chronic disease prevention: the evidence. *Lancet*, *370*(9603), 1939–1946. doi:10.1016/S0140-6736(07)61697-3

Giskes, K., Turrell, G., van Lenthe, F. J., Brug, J., & Mackenbach, J. P. (2007). A multilevel study of socio-economic inequalities in food choice behaviour and dietary intake among the Dutch population: the GLOBE study. *Public Health Nutrition*, *9*(01). doi:10.1079/PHN2005758

Glanz, K. (2009). Measuring food environments: a historical perspective. *American journal of preventive medicine*, *36*(4 Suppl), S93–98. doi:10.1016/j.amepre.2009.01.010

Glanz, K., Lankenau, B., Foerster, S., Temple, S., Mullis, R., & Schmid, T. (1995). Environmental and Policy Approaches to Cardiovascular Disease Prevention Through Nutrition: Opportunities for State and Local Action. *Health Education & Behavior*, *22*(4), 512–527. doi:10.1177/109019819502200408

Glanz, K., & Mullis, R. M. (1988). Environmental Interventions to Promote Healthy Eating: A Review of Models, Programs, and Evidence. *Health Education & Behavior*, *15*(4), 395–415. doi:10.1177/109019818801500403

Glanz, K., Rimer, B. K., & Viswanath, K. (2008). *Health behavior and health education: theory, research, and practice*. John Wiley & Sons.

Glanz, K., Sallis, J. F., Saelens, B. E., & Frank, L. D. (2005). Healthy nutrition environments: concepts and measures. *American journal of health promotion: AJHP*, *19*(5), 330–333, ii.

Glanz, K., Sallis, J. F., Saelens, B. E., & Frank, L. D. (2007). Nutrition Environment Measures Survey in Stores (NEMS-S): Development and Evaluation. *American Journal of Preventive Medicine*, *32*(4), 282–289. doi:10.1016/j.amepre.2006.12.019

Glanz, K., & Yaroch, A. L. (2004). Strategies for increasing fruit and vegetable intake in grocery stores and communities: policy, pricing, and environmental change. *Preventive medicine*, *39 Suppl 2*, S75–80. doi:10.1016/j.ypmed.2004.01.004

Government of Canada. (2004a, July 23). Public Health Agency of Canada. Retrieved September 27, 2012, from http://www.phac-aspc.gc.ca/about_apropos/index-eng.php

Government of Canada. (2004b, July 23). Centre for Chronic Disease Prevention and Control (CCDPC). Retrieved September 27, 2012, from http://www.phac-aspc.gc.ca/ccdpc-cpcmc/index-eng.php

Government of Canada. (2008a, July 10). Chronic Disease Facts and Figures - Public Health Agency Canada. Retrieved September 30, 2012, from http://www.phac-aspc.gc.ca/cd-mc/facts_figures-faits_chiffres-eng.php

Government of Canada, P. H. A. of C. (2008b, July 10). Chronic Disease Risk Factors - Public Health Agency Canada. Retrieved September 25, 2012, from http://www.phac-aspc.gc.ca/cd-mc/risk_factors-facteurs_risque-eng.php

Green, L. W., Richard, L., & Potvin, L. (1996). Ecological Foundations of Health Promotion. *American Journal of Health Promotion*, *10*(4), 270–281. doi:10.4278/0890-1171-10.4.270

Gustafson, A. A., Sharkey, J., Samuel-Hodge, C. D., Jones-Smith, J., Folds, M. C., Cai, J., & Ammerman, A. S. (2011). Perceived and objective measures of the food store environment and the association with weight and diet among low-income women in North Carolina. *Public health nutrition*, *14*(6), 1032–1038. doi:10.1017/S1368980011000115

Harnack, L., Block, G., & Lane, S. (1997). Influence of Selected Environmental and Personal Factors on Dietary Behavior for Chronic Disease Prevention: A Review of the Literature. *Journal of Nutrition Education*, *29*(6), 306–312. doi:10.1016/S0022-3182(97)70244-9

Health Canada. (2013). *Measuring the food environment in Canada* (No. 978-1-100-2097-6). Ottawa, ON. Retrieved from http://www.foodsecuritynews.com/resource-documents/MeasureFoodEnvironm_EN.pdf

Hermstad, A. K., Swan, D. W., Kegler, M. C., Barnette, J. K., & Glanz, K. (2010). Individual and environmental correlates of dietary fat intake in rural communities: A structural equation model analysis. *Social Science & Medicine*, *71*(1), 93–101. doi:10.1016/j.socscimed.2010.03.028

Hung, H.-C., Joshipura, K. J., Jiang, R., Hu, F. B., Hunter, D., Smith-Warner, S. A., … Willett, W. C. (2004). Fruit and Vegetable Intake and Risk of Major Chronic Disease. *Journal of the National Cancer Institute*, *96*(21), 1577–1584. doi:10.1093/jnci/djh296

Kaplowitz, M. D., Hadlock, T. D., & Levine, R. (2004). A Comparison of Web and Mail Survey Response Rates. *Public Opinion Quarterly*, *68*(1), 94 –101. doi:10.1093/poq/nfh006

Kline, R. B. (2010). *Principles and Practice of Structural Equation Modeling, Third Edition*. Guilford Press.

Kline, R. B. (2011). *Principles and Practice of Structural Equation Modeling, Third Edition*. Guilford Press.

Lallukka, T., Laaksonen, M., & Rahkonen, O. (2009). Healthy eating: what is the role of the economic situation. *Bioactive foods in promoting health: fruits and vegetables. 1st edn. Elsevier, USA*, 99–110.

Lawn, S., & Schoo, A. (2010). Supporting self-management of chronic health conditions: Common approaches. *Patient Education and Counseling*, *80*(2), 205–211. doi:10.1016/j.pec.2009.10.006

Lewis, J. E., Arheart, K. L., LeBlanc, W. G., Fleming, L. E., Lee, D. J., Davila, E. P., … Clark, J. D. (2009). Food label use and awareness of nutritional information and recommendations among persons with chronic disease. *The American Journal of Clinical Nutrition*, *90*(5), 1351–1357. doi:10.3945/ajcn.2009.27684

Luszczynska, A., Tryburcy, M., & Schwarzer, R. (2007). Improving fruit and vegetable consumption: a self-efficacy intervention compared with a combined self-efficacy and planning intervention. *Health Education Research*, *22*(5), 630–638. doi:10.1093/her/cyl133

Lytle, L. A. (2009). Measuring the food environment: state of the science. *American journal of preventive medicine*, *36*(4 Suppl), S134–144. doi:10.1016/j.amepre.2009.01.018

McAlister, A. L., Perry, C. L., & Parcel, G. S. (2008). How individuals, environments, and health behaviors interact. *HEALTH BEHAVIOR*, 169.

McCullough, M. L., Feskanich, D., Stampfer, M. J., Giovannucci, E. L., Rimm, E. B., Hu, F. B., … Willett, W. C. (2002). Diet quality and major chronic disease risk in men and women: moving toward improved dietary guidance. *The American Journal of Clinical Nutrition*, *76*(6), 1261–1271.

McKinnon, R. A., Reedy, J., Morrissette, M. A., Lytle, L. A., & Yaroch, A. L. (2009). Measures of the food environment: a compilation of the literature, 1990-2007. *American journal of preventive medicine*, *36*(4 Suppl), S124–133. doi:10.1016/j.amepre.2009.01.012

Moore, L. V., Diez Roux, A. V., Nettleton, J. A., & Jacobs, D. R. (2008). Associations of the Local Food Environment with Diet Quality—A Comparison of Assessments based on Surveys and Geographic Information Systems. *American Journal of Epidemiology*, *167*(8), 917 –924. doi:10.1093/aje/kwm394

Nothwehr, F., & Yang, J. (2007). Goal setting frequency and the use of behavioral strategies related to diet and physical activity. *Health Education Research*, *22*(4), 532–538. doi:10.1093/her/cyl117

Odoms-Young, A. M., Zenk, S., & Mason, M. (2009). Measuring Food Availability and Access in African-American Communities: Implications for Intervention and Policy. *American Journal of Preventive Medicine*, *36*(4, Supplement), S145–S150. doi:10.1016/j.amepre.2009.01.001

Pickett, K. E., & Pearl, M. (2001). Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology and Community Health*, *55*(2), 111–122. doi:10.1136/jech.55.2.111

Popkin, B. M., Duffey, K., & Gordon-Larsen, P. (2005). Environmental influences on food choice, physical activity and energy balance. *Physiology & Behavior*, *86*(5), 603–613. doi:10.1016/j.physbeh.2005.08.051

Povey, R., Conner, M., Sparks, P., James, R., & Shepherd, R. (2000). Application of the Theory of Planned Behaviour to two dietary behaviours: Roles of perceived control and self-efficacy. *British Journal of Health Psychology*, *5*(2), 121–139. doi:10.1348/135910700168810

Raphael, D. (2004). *Social Determinants Of Health: Canadian Perspectives*. Canadian Scholars' Press.

Saelens, B. E., Glanz, K., Sallis, J. F., & Frank, L. D. (2007). Nutrition Environment Measures Study in Restaurants (NEMS-R): Development and Evaluation. *American Journal of Preventive Medicine*, *32*(4), 273–281. doi:10.1016/j.amepre.2006.12.022

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological models of health behavior. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice (4th ed.)* (pp. 465–485). San Francisco, CA, US: Jossey-Bass.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review. *Journal of Educational Research*, *99*(6), 323–337.

Schumacker, R. E., & Lomax, R. G. (2004). *A Beginner's Guide to Structural Equation Modeling*. Psychology Press.

Seymour, J. D., Yaroch, A. L., Serdula, M., Blanck, H. M., & Khan, L. K. (2004). Impact of nutrition environmental interventions on point-of-purchase behavior in adults: a review. *Preventive medicine*, *39 Suppl 2*, S108–136. doi:10.1016/j.ypmed.2004.04.002

Sheehan, K. B. (2001). E□mail Survey Response Rates: A Review. *Journal of Computer□Mediated Communication*, *6*(2), 0–0. doi:10.1111/j.1083-6101.2001.tb00117.x

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological Momentary Assessment. *Annual Review of Clinical Psychology*, *4*(1), 1–32. doi:10.1146/annurev.clinpsy.3.022806.091415

Shilts, M. K., Horowitz, M., & Townsend, M. S. (2004). Goal Setting as a Strategy for Dietary and Physical Activity Behavior Change: A Review of the Literature. *American Journal of Health Promotion*, *19*(2), 81–93. doi:10.4278/0890-1171-19.2.81

Story, M., Kaphingst, K. M., Robinson-O'Brien, R., & Glanz, K. (2008). Creating Healthy Food and Eating Environments: Policy and Environmental Approaches. *Annual Review of Public Health*, *29*(1), 253–272. doi:10.1146/annurev.publhealth.29.020907.090926

Strecher, V. J., Seijts, G. H., Kok, G. J., Latham, G. P., Glasgow, R., DeVellis, B., … Bulger, D. W. (1995). Goal Setting as a Strategy for Health Behavior Change. *Health Education & Behavior*, *22*(2), 190–200. doi:10.1177/109019819502200207

Strong, K., Mathers, C., Epping-Jordan, J., & Beaglehole, R. (2006). Preventing chronic disease: a priority for global health. *International Journal of Epidemiology*, *35*(2), 492–494. doi:10.1093/ije/dyi315

Walker, R. E., Keane, C. R., & Burke, J. G. (2010). Disparities and access to healthy food in the United States: A review of food deserts literature. *Health & place*, *16*(5), 876–884. doi:10.1016/j.healthplace.2010.04.013

Weiss, L., Ompad, D., Galea, S., & Vlahov, D. (2007). Defining Neighborhood Boundaries for Urban Health Research. *American Journal of Preventive Medicine*, *32*(6, Supplement), S154–S159. doi:10.1016/j.amepre.2007.02.034

Weston, R., & Gore, P. A. (2006). A Brief Guide to Structural Equation Modeling. *The Counseling Psychologist*, *34*(5), 719–751. doi:10.1177/0011000006286345

Williams, L. K., Thornton, L., Ball, K., & Crawford, D. (2012). Is the objective food environment associated with perceptions of the food environment? *Public health nutrition*, *15*(2), 291–298. doi:10.1017/S1368980011001947

World Health Organization. (2002). *Reducing Risks, Promoting Healthy Life*. Retrieved from http://www.who.int/whr/2002/en/

World Health Orgnization. (n.d.). Integrated chronic disease prevention and control. *Chronic disease and health promotion*. Retrieved September 27, 2012, from http://www.who.int/chp/about/integrated_cd/en/

**APPENDIX A Recruitment card and email notification**

CARD
Dear [participant name]:

You are receiving this notice because of your participation in the Atlantic PATH study. When you completed the Atlantic PATH study, you consented to be recontacted by the study team. We are contacting you to inform you of an upcoming opportunity to be involved in some research being conducted by Tarra Penney who is a graduate student at Dalhousie University, as part of her Master of Arts program. This study seeks to better understand the role of the environment in the health of the residents of Nova Scotia.

The research has been reviewed by the Health Sciences Research Ethics Board at Dalhousie University and includes a brief online survey that should take 15-20 minutes of your time. We will be contacting you through email in the next few weeks with details of the survey. As a token of appreciation for your time, we are also holding a lottery for participants with a chance to win a prize to be announced when you begin your survey. Please find attached a more detailed description of the study.

If you would like to participate, but prefer to have a hard copy of the survey mailed to you, please contact Tarra Penney at info@atlanticpath.ca or 1-877-285-7284.

Thank you for your time and we look forward to your valuable contribution to better understand the health of Nova Scotians.

Best wishes,
Dr Louise Parker, Scientific Director
Atlantic PATH Project

Tarra Penney, MA (candidate)
School of Health and Human Performance
Dalhousie University

EMAIL

Dear [participant name]:

The Atlantic PATH project invites you to take part in a research study being done by Tarra Penney who is a graduate student at Dalhousie University, as part of her Master of Arts program. You are being invited to take part in this study because you are a participant in Atlantic PATH and have consented to Atlantic PATH re-contacting you for other research. The study is described below and looks at the many influences that can help or get in the way of eating a healthy diet and improving our health. This description tells you about the risks, inconvenience, or discomfort that you might experience. Participating in the study might not benefit you, but we might learn things that will benefit all of us by understating of the many things that effect being able to eat healthy every day.

Your participation in this study is voluntary and you may withdraw from the study at any time by closing the survey window. If you choose to withdraw from the survey after you start, your information will not be used in the final results and it will be destroyed after the prize draw at the conclusion of the project. **If you agree to voluntary participation please click on the link below to begin the online survey, however if you do not wish to participate, simply delete this email.**

Thank you for your time and we look forward to your valuable contribution to better understand healthy eating for Nova Scotians.

Sincerely,
Dr Louise Parker, Scientific Director
Atlantic PATH study

Tarra Penney, MA (candidate)
School of Health and Human Performance
Dalhousie University

## Study Information

**Title:**
Understanding healthy eating behaviour within the context of the modern food environment

**Purpose of the Study:**
The prevention of chronic disease requires understanding of both the individual, and environmental causes of healthy eating. However, traditional approaches to chronic disease prevention and management have focused on the role of individual behavior in improving healthy eating, and less attention has been paid to other influences outside this. This study is exploring the many influences that can help or hinder your ability to eat a healthy diet. By participating in this study you can help us to better support people in making changes to their eating habits by contributing to our understating of the personal, social and environmental impacts on healthy eating that you experience every day.

**Study Design:**
This study will include the completion of one anonymous survey either online or through the mail. The survey will complement some of the information that you have already provided to Atlantic PATH including details on your age, gender, employment, education, marital status and healthy eating. For this study we are looking to collect additional information to help us get a full picture of what helps or gets in the way of people looking to eat a healthier diet.

**Who can participate?**
People who participated in the Atlantic PATH study, understand English and have access to a computer or are able to complete a survey sent through the mail are eligible to participate.

**What you will be asked to do?**
You will be asked to participate in an online survey lasting approximately 15-20 minutes. Alternatively, you can request that a paper-based survey be sent to you, filled out and returned by mail, postage will be included in your package.

**Possible risks:**
None expected.

**Possible benefits:**
By participating in this study you can help us to better support people in making changes to their eating by contributing to our understating of many things that influence your ability to eat healthy every day.

**Compensation:**
Participants in this study will be eligible to put their name in for a draw for a prize to be announced when you begin your survey.

**Confidentiality and Anonymity:**
Steps will be taken to protect your privacy. Anonymity will be maintained by assigning a code to your survey so that your name will not be connected to your survey information. This will be done, after your name is entered into a list for the draw the prize. This list will not be connected to your survey answers and will be destroyed after the prize is awarded. Your confidentiality will be maintained by making sure no identifying information will be used in any written, verbal or presented information. Electronic data will be password protected and kept in a secure location.

**How you will get the results:**
Results of this study will be announced through the Atlantic PATH study through social media, email or other communication.

**Who is doing the research?**
This study is being conducted by Ms. Tarra Penney, who is a student in the School of Health and Human Performance at Dalhousie University, with support from the Atlantic PATH Project. If you have any questions please contact Ms. Tarra Penney at tpenney@dal.ca or 1-877-285-7284. In addition, you can contact Dr Louise Parker, the Scientific Director of Atlantic PATH at louise.parker@dal.ca or Ms. Penney's supervisor Dr. Sara Kirk at sara.kirk@dal.ca.

**If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, you may contact Catherine Connors, Director, Research Ethics, Dalhousie University for assistance at (902) 494-1462, ethics@dal.ca.**

**APPENDIX B Health belief survey and perceived food environment scale**

# Survey Questions

Name:

Address:

Would you like to be entered into the lottery at the conclusion of the study?

___ Yes, please enter me into the lottery to win a prize
___ No, do not enter me into the lottery to win a prize

Has your diet changed in the past three years?

This survey will ask you a series of questions about information related to the foods you eat. In order to help us, we would like to know if your diet has changed a lot over the past three years.

On a scale of 1-5, rate how much your diet has changed in the past three years?

| **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|
| **I have the exact same diet** | | | | **I have a completely different diet** |

# The Conditions for Healthy Eating – Page 1 of 3

These questions ask about **what things help or get in the way of you eating healthier foods every day**. We just want your opinion even if you are not sure or they don't apply to your situation.

Use this scale to tell us if you agree with the following statement:

**1 2 3 4 5**

**strongly disagree strongly agree**

| Thinking about healthy eating every day around my neighbouhood, at work or at home (1-5) | Do you agree? |
|---|---|
| 1. I feel I am in full control of my decisions to eat a healthy diet. | |
| 2. I frequently eat outside of the home. | |
| 3. I purchase most of my food when travelling between my home and other places (i.e. work, recreation etc.). | |
| 4. I own a vehicle that I use to get groceries and food outside from my neighbourhood. | |
| 5. I have a large selection of places to purchase healthy food within walking distance of my home. | |
| 6. My neighbourhood grocery store has a large selection of fruits and vegetables to purchase. | |
| 7. My neighbourhood corner store has a large selection of fruits and vegetables to purchase. | |
| 8. My neighbourhood grocery store has a large selection of low fat foods to purchase. | |
| 9. My neighbourhood corner store has a large selection of low fat foods to purchase. | |
| 10. The fresh fruits and vegetables in my neighbourhood grocery store are of high quality. | |
| 11. The fresh fruits and vegetables in my neighbourhood corner store are of high quality. | |
| 12. My neighbourhood fast food restaurants have a large selection of healthy foods. | |
| 13. My neighbourhood sit down restaurants have a large selection of healthy foods. | |
| 14. Community centres that I visit for recreation (i.e. sport, social gatherings etc.) have a large selection of healthy foods. | |
| 15. There are often lots of fruits and vegetables to eat in my home. | |
| 16. There are often lots of low fat foods to eat in my home. | |
| 17. My work place has a large selection of fruits and vegetables to purchase. | |
| 18. My work place has a large selection of low fat foods to purchase. | |

# The Conditions for Healthy Eating – Page 2 of 3

These questions ask about **what things help or get in the way of you eating healthier foods every day**. We just want your opinion even if you are not sure or they don't apply to your situation.

Use this scale to tell us if you agree with the following statement:

**1 2 3 4 5**

**strongly disagree strongly agree**

Thinking about the cost of healthy eating every day Do you agree? (1-5)

19. The healthy foods in my neighbourhood grocery store are too expensive.
20. The healthy foods in my neighbourhood corner store are too expensive.
21. The healthy fast food options in my neighbourhood are too expensive.
22. The healthy options at sit down restaurants in my neighbourhood are too expensive.
23. The healthy options at my work place are too expensive.

# The Conditions for Healthy Eating – Page 3 of 3

These questions ask about **what things help or get in the way of you eating healthier foods every day**. We just want your opinion even if you are not sure or they don't apply to your situation.

Use this scale to tell us if you agree with the following statement:

**1 2 3 4 5**

**strongly disagree strongly agree**

Thinking about the experience of healthy eating every day Do you agree? (1-5)

24. Events like weddings, parties and social gatherings often have lots of fruits and vegetables to eat.
25. Events like weddings, parties and social gatherings often have lots of low fat foods to eat.
26. My life is too hectic to find, prepare and eat healthy foods.
27. Growing up I didn't eat many healthy foods.
28. My close relationships with people other than my friends or family (i.e. neighbours and coworkers) helps me to eat healthy food.
29. Most of the people I know other than my friends or family (i.e. neighbours and coworkers) care about eating healthy food.
30. I am often involved with people and activities that encourage me to eat healthier foods.
31. Advertising on food packaging helps me decide what foods are healthy.
32. I see many advertisements for healthy foods during my day.

# Social Support for Healthy Eating

These questions ask about **what you do and think about eating healthier foods**. It also asks about what the members of **your family and your friends do and think about eating healthy foods**. We just want your opinion even if you are not sure.

Use this scale to tell us if you agree with the following statement:

**1 2 3 4 5**

**strongly disagree strongly agree**

| My family, … | Level of Agreement (1-5) Family |
|---|---|
| 1. say they try to eat lower-fat foods when dining out. | |
| 2. believe it's important to eat enough fiber. | |
| 3. have told me they want to eat less fat. | |
| 4. have told me they want to cut down on high-fat dairy foods. | |
| 5. seat high-fiber cereal every day. | |
| 6. don't drink many regular sodas or sugared drinks. | |
| 7. eat 5 servings of fruits and vegetables every day. | |
| 8. avoid high-fat snacks like chips and snack crackers. | |
| 9. try to eat low-fat dairy foods. | |
| 10. don't eat large portions of beef. | |
| 11. eat higher-fiber bread every day. | |
| 12. have told me they want to eat more fruits and vegetables. | |
| 13. have told me they want to eat cereal with fiber. | |
| 14. have told me they want to cut down on sweets. | |
| 15. cook with very little fat. | |
| 16. eat lower-fat foods at fast-food restaurants. | |
| 17. have told me they want to eat higher-fiber bread. | |

# Goals for Healthy Eating

These questions ask about what you **have done in the past 3 months** to eat healthier foods.

Use this scale to tell us if you agree with the following statement:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| **never** | **seldom** | **occasionally** | **often** | **repeatedly** |

In the past 3 months how often did you: How Often (1-5)

1. Remind yourself that high-fat foods have more calories than low-fat foods.
2. Tell yourself that every calorie counts.
3. Remind yourself that “fat-free” does not mean “calorie-free”.
4. Eat out less often.
5. Avoid going to restaurants where you eat too much.
6. Avoid fast-food restaurants.
7. Eat high-fiber foods.
8. Eat more vegetables.
9. Eat more fruit.
10. Pay closer attention to serving sizes.
11. Eat smaller portions.
12. Avoid ice cream and other high-fat dairy foods.
13. Avoid high-fat beef.
14. Eat low-fat toppings for potatoes and other vegetables.
15. Eat low-fat salad dressing.
16. Choose low-fat foods in fast-food and other restaurants.
17. Eat 3 meals a day.
18. Eat no more than 3 snacks a day.

# Confidence for Healthy Eating

These questions ask **how certain you are that you can do different things** to eat healthier foods. You will be asked to decide how certain or how sure you are that you can do these things on most days and in lots of different situations. Think about times when it will be easy to do these things and when it will be harder.

Use any number from 0 to 100 on the following scale to tell how certain you are that you can – all or most of the time:

| **0** | **50** | **100** |
|---|---|---|
| **Certain I CAN NOT** | **Somewhat certain I can** | **Certain I CAN** |

| How certain are you that you can: | How Certain (0-100) |
|---|---|
| 1. bring fruit to work or school for a snack every day? | |
| 2. eat at least 5 servings of fruits and vegetables every day? | |
| 3. eat vegetables (like carrot or celery sticks) for a snack? | |
| 4. eat fruit for a snack? | |
| 5. have a side salad instead of French fries when dining out? | |
| 6. drink fruit or vegetable juice at meals? | |
| 7. drink 1%, ½% or fat-free (skim) milk? | |
| 8. switch to low-fat or fat-free ice cream or frozen yogurt? | |
| 9. eat low-fat cheese? | |
| 10. eat higher-fiber bread for lunch? | |
| 11. bring higher fiber cereal to work or school for a snack? | |
| 12. bring a slice of higher-fiber bread to work or school for a snack? | |
| 13. eat at least 6 servings of higher-fiber breads and cereals a day? | |
| 14. avoid eating cookies or snack cakes for snacks? | |
| 15. share a dessert in a restaurant? | |
| 16. avoid eating sweets for dessert? | |
| 17. eat fruit for dessert instead of sweets? | |
| 18. eat half a dessert in a restaurant and take the rest home? | |
| 19. cut back on the size of sodas and sugared drinks? | |
| 20. eat pretzels or low-fat popcorn for snacks? | |
| 21. stick to eating no more than ONE high-fat salty snack everyday? | |
| 22. use low-fat spreads on bread? | |
| 23. use low-fat toppings for potatoes and other vegetables? | |
| 24. use low-fat or diet salad dressing? | |
| 25. switch to low-fat types of beef (90% fat free)? | |
| 26. avoid eating more than 3 ounces of cooked beef in one serving? | |
| 27. avoid eating more than 1 serving of beef a day? | |
| 27. switch to lower fat alternatives of beef? | |

# Expectations for Healthy Eating

Now, tell us **what you expect will happen** when you eat healthier foods.

Use this scale to tell us if you agree with the following statement:

**1 2 3 4 5**

**strongly disagree strongly agree**

If I eat healthier foods every day, I expect to: Do you agree? (1-5)

1. I will have more energy.
2. I will lose weight.
3. I will feel healthier and happier.
4. I will live longer
5. I will feel better in my clothes
6. I will be hungrier.
7. I will be unhappy and irritable.
8. My health will improve.
9. I will miss eating the foods I love.
10. I will have healthier skin, hair or teeth.
11. I will be less likely to get cancer or heart disease.
12. Shopping for healthy foods will be a lot of trouble.
13. I will be board with what I have to eat.
14. I will have to change a lot of my favorite foods.
15. I wont' be able to eat the same foods as the rest of my family.
16. I will have to spend too much time keeping track of what I eat.
17. The food I eat will not taste good.
18. It will take too long to prepare meals and snacks.
19. I will have to plan my meals to far in advance.
20. I will be more attractive.
21. I will be doing what I know I should.
22. I won't be able to stick with it – I'll just go back to my old habits.

Thank you for participating in this survey!

# Follow-up Request

We may want to contact you again in the future to invite you to take in an interview of community focus group related to this study on healthy eating. Your future involvement is completely optional, even if you agree to being contacted.

Please click below to indicate if we can, or cannot, contact you again about this study on healthy eating.

___ Yes, you may contact me again about this study
___ No, please do not contact me about this study

**APPENDIX C: Atlantic PATH questions for healthy eating index and demographic data provided**

The Atlantic PATH study has collected data relevant to this study including demographic data and nutrition data.

## Demographic Data

- Current age (years)
- Sex (male, female)
- Level of education
- Employment status
- Household income

## Nutrition Data

- In a typical week, how many days do you eat 5 or more servings of fruits and vegetables (0-7)
- In a typical day, how many total servings of vegetables do you eat?
- In a typical day, how many total servings of fruit (not including fruit juice) do you eat?
- In a typical day, how many servings of 100% fruit or vegetable juice do you drink?
- In a typical day, how many servings of dark green vegetables do you eat?
- In a typical day, how many servings of whole grain products do you eat?
- In a typical day, how many servings refined/milled grains do you eat?
- In a typical day, how many servings of milk and dairy products do you eat?
- In a typical day, how many servings of dark green vegetables do you eat?
- In a typical week, how many eggs do you eat?
- In a typical day, how many servings of meat/poultry do you eat?
- In a typical day, how many servings of fish do you eat?
- In a typical day, how many servings of tofu or bean curd do you eat?
- In a typical day, how many servings beans or other legumes do you eat?
- In a typical day, how many servings of nuts or seeds do you eat?
- How many times per week do you eat snack food? (never – 7 per week)
- How many times per week do you eat desserts or sweet snacks? (never – 7 per week)
- How often do you typically purchase food at a fast food restaurant? (never – 2 or more/day)

**APPENDIX D Structural equation models expressed mathematically**

$$\eta = B\eta + \Gamma\xi + \zeta, \text{ where:}$$

$\eta = endogenous\ concept\ in\ column\ vector$
$\xi = exogenous\ concepts\ in\ column\ vector$
m = number of endogenous concepts
n = number of exogenous concepts
$B = represented\ by\ \beta\ beta$ (structural coefficients)
$\Gamma = represented\ by\ \gamma\ gamma$ (structural coefficients)

Traditional SCT

Therefore, substituting the structural elements gives the following set of equations representing the traditional SCT:

$$\begin{bmatrix}\eta_1\\ \eta_2\\ \eta_3\\ \eta_4\\ \eta_5\end{bmatrix} = \begin{bmatrix}0 & \beta_{12} & \beta_{13} & 0 & 0\\ 0 & 0 & 0 & 0 & \beta_{25}\\ 0 & 0 & 0 & 0 & \beta_{35}\\ \beta_{41} & \beta_{42} & \beta_{43} & 0 & 0\\ 0 & 0 & 0 & 0 & 0\end{bmatrix}\begin{bmatrix}\eta_1\\ \eta_2\\ \eta_3\\ \eta_4\\ \eta_5\end{bmatrix} + \begin{bmatrix}0 & \gamma_{12} & 0\\ \gamma_{21} & \gamma_{22} & \gamma_{23}\\ 0 & \gamma_{32} & 0\\ \gamma_{41} & 0 & 0\\ \gamma_{51} & \gamma_{52} & \gamma_{53}\end{bmatrix}\begin{vmatrix}\xi_1\\ \xi_2\\ \xi_3\end{vmatrix} + \begin{bmatrix}\zeta_1\\ \zeta_2\\ \zeta_3\\ \zeta_4\\ \zeta_5\end{bmatrix}$$

Expanded SCT

Then, substituting the structural elements gives the following set of equations representing the expanded SCT:

$$\begin{bmatrix}\eta_1\\ \eta_2\\ \eta_3\\ \eta_4\\ \eta_5\end{bmatrix} = \begin{bmatrix}0 & \beta_{12} & \beta_{13} & 0 & 0\\ 0 & 0 & 0 & 0 & \beta_{25}\\ 0 & 0 & 0 & 0 & \beta_{35}\\ \beta_{41} & \beta_{42} & \beta_{43} & 0 & \beta_{45}\\ 0 & 0 & 0 & 0 & 0\end{bmatrix}\begin{bmatrix}\eta_1\\ \eta_2\\ \eta_3\\ \eta_4\\ \eta_5\end{bmatrix} + \begin{bmatrix}0 & \gamma_{12} & 0\\ \gamma_{21} & \gamma_{22} & \gamma_{23}\\ 0 & \gamma_{32} & 0\\ 0 & 0 & \gamma_{43}\\ \gamma_{51} & \gamma_{52} & \gamma_{53}\end{bmatrix}\begin{vmatrix}\xi_1\\ \xi_2\\ \xi_3\end{vmatrix} + \begin{bmatrix}\zeta_1\\ \zeta_2\\ \zeta_3\\ \zeta_4\\ \zeta_5\end{bmatrix}$$

With correlation matrix equation:

$$\Phi = \begin{vmatrix}\phi_{11} & 0 & 0\\ \phi_{21} & \phi_{22} & 0\\ \phi_{31} & \phi_{32} & \phi_{33}\end{vmatrix}$$

Where m = 5; n = 3

Vectors for endogenous concepts

$\eta_1$ = self-efficacy
$\eta_2$ = goal setting
$\eta_3$ = outcome expectations
$\eta_4$ = social support / food environment
$\eta_5$ = healthy eating index

Vectors for exogenous concepts

$\xi_1$ = age
$\xi_2$ = sex
$\xi_3$ = ses

Matrices of structural coefficient

Endogenous

$\beta_{11,21,31,41,51,61}$ = self-efficacy
$\beta_{12,22,32,42,52,62}$ = goal setting
$\beta_{13,23,33,43,53,63}$ = outcome expectations
$\beta_{14,24,34,44,54,64}$ = social support / food environment
$\beta_{15,25,35,45,55,65}$ = healthy eating index

Exogenous

$\gamma_{11,21,31,41,51,61}$ = age
$\gamma_{12,22,32,42,52,62}$ = gender
$\gamma_{13,23,33,43,53,63}$ = ses

Correlation between exogenous variables

$\Phi_{11,21,31}$ = age * age, age * gender, age * ses
$\Phi_{22,32}$ = gender * gender, gender * ses
$\Phi_{33}$ = ses * ses