2015

EXPLORING DAILY DIETARY BEHAVIOUR THROUGH EXAMINATION OF THE FOOD CHOICE PROCESS

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DISSERTATION

Submitted to the Department of Geography and Environmental Studies

in partial fulfillment of the requirements for

Degree in Doctor of Philosophy in Geography

Wilfrid Laurier University

ABSTRACT

As obesity rates continue to rise, the negative health impacts associated with unhealthy food choice behaviour remain an issue of concern. Observing the connection between food consumption and weight gain alone is likely not sufficient to understanding people's construction of food choices. More detailed examination of a novel concept, the overall *food choice process* (FCP), including *food thoughts*, *plans*, *purchases*, and *preparation*, leading up to *food intake/consumption* may contribute to an improved understanding of food choice behaviour.

This thesis explored the wider FCP that gives rise to observed food consumption by testing passive video recording technologies, an innovative data collection method that yielded maximum detail and minimal recall bias and misreporting as possible. This thesis also examined the patterns of FCP decisions, and its potential relationships with sociodemographic and social interaction related variables using exploratory multivariate statistical techniques, as well as the possible effects of social influence on FCP decisions, based on real-world observations and an in-depth follow-up interview.

Data were obtained from 20 participants (aged 30 to 50), who wore a *hidden body video camera* over a 4-day period to capture their actual daily food-related activities. FCP events were coded with relative certainty about 66.1% of the time, according to a subjective, yet systematic ranking by the researcher.

Findings from the empirical analysis revealed that food purchases tended to occur in social settings and food preparations occurred alone at home; social interaction variables tended to correlate most with the FCP variables and body mass index unexpectedly had no significant correlation at all; overweight subjects' FCP decisions that were affected by social influence when they conformed to others' dietary patterns were possibly due to social stigma.

This experimental study demonstrated the potential for an automated tracking system to capture fine-leveled information as part of the overall FCP beyond just food consumption in real-world environments. The empirical results potentially supported several elaborations to the *food choice process model*—expansion of the *personal food systems stage* to possibly include FCP decisions, sociodemographic and social interaction variables, and ordered sequence strings of FCP decisions, as well as the *influences stage* to potentially include sociodemographic characteristics and social factors influencing FCP decisions. Adding these observable and interconnected elements missing from the mechanical part of the model may contribute to an improved understanding of daily food choice behaviour, however further research on a larger scale is warranted.

ACKNOWLEDGEMENTS

I would like to thank my PhD dissertation supervisor, Dr. Sean T. Doherty for his continued support and guidance through every step of my PhD studies at Wilfrid Laurier University. His extensive knowledge, skills, and years of experience in Geography research contributed to the development of a novel data collection technique that has advanced the observation of dietary behaviour. His positive attitude, enthusiasm, and dedication contributed to my achievements during my graduate studies, including successful conference presentations.

I would like to thank members of my PhD dissertation committee, Drs. Hanning, Scott, and Sharpe, for their support and contributions to my dissertation. Also, thank you to all support staff at Laurier Graduate and Postdoctoral Studies and Geography and Environmental Studies for all of their hard work.

Lastly, I would also like to thank my family and friends, including especially Khon Toun, Jennifer Dam, and Celina Hoang, for lending their moral support throughout this journey. My graduate experience would not have been the same without them.

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CHAPTER 1 Introduction

1.1 Introduction

Food is a major part of our lives. In most developed societies, people are confronted with a vast array of affordable food ingredients, preparation methods and gadgets, convenient purchasing opportunities, and efficient food storage techniques. This widespread food accessibility has led to nutritional benefits, as well as weight management issues.

The prevalence of high obesity rates is contributing to numerous serious health conditions, such as hypertension, type 2 diabetes, cardiovascular disease, osteoarthritis and various cancers. In addition, the risk of developing psychological disorders, such as low self-esteem and depression, are increased with obesity. This is especially dangerous given that impairments to mental health may ultimately affect individuals' motivation to participate in and/or successfully complete weight management programs. This health epidemic is expected to continue to grow.

The alarming obesity rates and the associated negative health impacts have subsequently sparked research interest. Food consumption is undoubtedly a strong contributing factor of weight gain and is the focus of a myriad research and diet programs. Previous studies have attempted to understand that connection by observing food consumption through traditional and high-technology techniques and have examined various determinants influencing food intake, yet obesity is still an on-going struggle for many individuals. Nonetheless, focusing on observing food consumption and its associated impacts alone are likely not sufficient to understanding people's construction of food choices. More detailed examination of a novel concept, the overall *food choice process* (FCP), including *food thoughts*, *plans*, *purchases* (made at grocery stores, restaurants, etc.), and *preparation* (including cooking), leading up to *food intake/consumption*, may contribute to an improved understanding of food choice behaviour.

This thesis attempted to address this need by utilizing an automated activity monitory system for observing the wider elements of the underlying FCP that lead to observed food choices in real-world environments, as well as for exploring potential patterns of and factors associated with FCP decisions and possible effects of social influence on FCP decisions. The innovative experimental technique was conducted on a relatively small and non-random sample as an initial step in the discovery of a potentially effective method for observing FCP with maximum detail and minimal recall bias and misreporting.

The observed elements and patterns associated with FCP from the thesis were intended to make theoretical contributions to the current food choice process model as shown in Figure 1 (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996). As one of the most comprehensive theoretical frameworks for explaining food choice behaviour, this model consists of an extensive framework of potential attributes impacting food choice decisions explained through three major interconnecting components: the life course, influences and personal food systems.

The life course involves transformations in one's past and current food selection experiences over different periods of one's life, as well as expectations for future possibilities. While, the personal food systems are dynamic sets of mental processes that dominate one's dietary choices, which include categorizing food related events, prioritizing conflicting values, balancing priorities, and building strategies for food choice and eating in different situations. Food choices are also subjected to five major types of influences: ideals, personal factors, resources, social factors, and contexts, which interact with each other as they fluctuate over the life course and operationalize in the personal food systems during food related events.

The diagram in Figure 1 narrows down from long-term elements at the top (life course) towards short-term entities at the bottom (food choice). Although the model contains a broad range of significant elements to explain food choice behaviour, it could be more comprehensive with elaborations to the personal food systems and influences stages by adding practical, observable and interconnected elements, which represent a mechanical part of the process that is missing in the model.

Experimental results from each of the *three papers* were intended to make specific theoretical contributions to the current food choice process model. For instance, the *first paper* proposed the expansion of the personal food systems stage to include the five FCP decisions. The *second paper* offered another elaboration to the same stage to include FCP decisions, sociodemographic and social interaction variables, and ordered sequence strings of FCP decisions. The *third paper* suggested a change to the influences stage to include sociodemographic characteristics and social factors influencing FCP decisions. Overall, these proposed modifications might add another dimension to the current food choice model making it more comprehensive, as well as make an original contribution to knowledge.

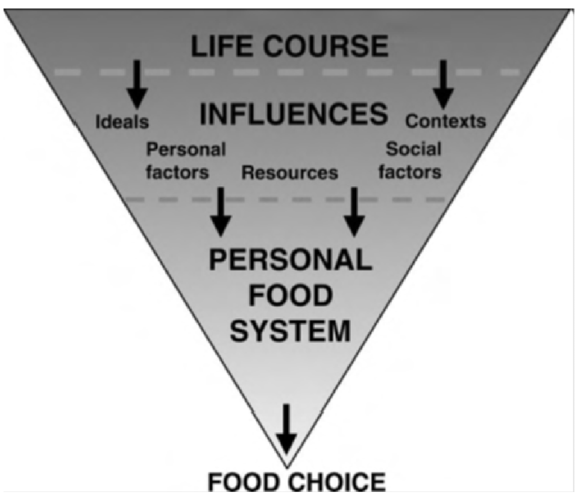

Figure 1: The food choice process model explains people's construction of food choices (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996).

1.2 Overview of objectives and chapters

The goal of this exploratory thesis was to expand on the understanding of daily dietary behaviour by examining the actual FCP leading to food intake in real-world situations, as well as exploring patterns of and factors associated with FCP decisions and social influencing behaviours. To achieve this goal, this thesis was designed with *three specific research objectives*. The *first objective* was to test a novel data collection method developed for exploring the wider FCP that gives rise to observed food consumption using passive video recording technologies. The *second objective* was to possibly expand the last stage of the food choice process model (see Figure 17 in chapter 3) by including potential relationships and patterns of FCP decisions based on exploratory results. The *third objective* was to perhaps elaborate on another part of the food choice process model—the influences section (see Figure 23 in chapter 4), by incorporating the possible effects of social influence on FCP decisions, based on real-world observation of FCP decisions and an in-depth follow-up interview. Each of these objectives is addressed in a separate paper, forming a chapter in this thesis (see chapters two to four). Two additional chapters were added to round out the thesis, including an *introduction* and *conclusions*, to pull it all together.

The *first paper* included a description of the intensive and experimental multi-stage data collection process and video data coding procedure, as well as descriptive analysis of the results. To build upon the exploration of FCP decisions, the *second paper* examined the potential impact of sociodemographic and social interaction related variables on FCP decisions, which included descriptive and exploratory multivariate analysis of results. To advance the understanding of dietary behaviour, the *third paper* investigated the possible effects of social influence on FCP decisions, which consisted of content analysis of social factors and descriptive analysis of social factors related to FCP events. The potential implications of the findings for the food choice process model are discussed in the individual papers. The fifth and last chapter reviews the main outcomes, likely key contributions, and recommendations for future studies.

All three papers will be prepared for journal publication starting in April 2015. The first paper is planned for submission to the *Journal of The American Dietetic Association*. In July 2015, the second paper is planned for submission to *BMC Public Health*. In August 2015, the third paper is planned for submission to *Appetite*.

1.3 References

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Falk, L.W., Bisogni, C.A., and Sobal, J. (1996). Food Choice Processes of Older Adults: A Qualitative Investigation. Journal of Nutrition Education *28*, 257–265.

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CHAPTER 2 Tracking the daily food choice process through an automated activity monitoring system

2.1 Introduction

As obesity rates continue to rise, the negative health impacts associated with unhealthy food choice behaviour remain an issue of concern. Food consumption is undoubtedly a strong determinant of weight gain and is the focus of a myriad research and diet programs. Traditional and high-technology data collection techniques have garnered data on food intake behaviour in real-world and simulated environments, some of which are subject to recall bias and misreporting. However, observing food consumption alone is likely not sufficient to understanding people's construction of food choices. More detailed examination of a novel and broader concept, the overall *food choice process* (FCP), including *food thoughts*, *plans*, *purchases*, and *preparation*, leading up to *food intake/consumption* may contribute to an improved understanding of food choice behaviour.

This chapter attempted to address this need by presenting an automated activity monitoring system for observing the wider aspects of the underlying FCP that ultimately give rise to observed food choices. The intensive and experimental multi-stage data collection process is outlined in the methods section followed by the data coding and descriptive analysis of the results. The possible implications of these findings for the food choice model are also discussed.

2.2 Background

Since food consumption is a strong contributor to unhealthy weight gain, many researchers have focused on observing food intake activities through traditional and high-technology techniques. Table 1 provides a review of the most common techniques, including potential challenges faced, environment data is collected in, examples of usages, and potential to observe underlying food choice processes. Traditional techniques include mostly self or researcher reported food records or questionnaires reported in-person or during telephone interviews (Burke et al., 2005; Obarzanek and Levitsky, 1985; Simen-Kapeu et al., 2010; Bonke, 1992; Posner et al., 1982; Tran et al., 2000; Conway et al., 2004; Moshfegh et al., 2008; Hise et al., 2002). The traditional methods, except the observer-recorded food records and recall method, require the subjects to recall and report the information to the researcher, which is subject to recall bias and misreporting.

Researchers have also attempted to study dietary behaviour with high-technology methods, such as electronic food diaries using hand-held computers (Burke et al., 2005; Holubar and Harvey-Banchik, 2007; Welch et al., 2010), on-body and oral sensors (Amft et al., 2005a; Amft et al., 2005b; Amft and Tröster, 2008), dining table sensors (Chang et al., 2006; Westerterp-Plantenga, 2000), smart cards (Ngo et al., 2009), digital photography (Boushey et al., 2009; Lassen et al., 2010; Martin et al., 2009; Ngo et al., 2009; Small et al., 2009), barcode scanning & voice recording (Siek et al., 2009, 2006). Most of the techniques collect data digitally in real-time under real-world conditions, in order to reduce the chances of recall bias and misreporting. For smart cards and digital video cameras in particular, recall bias and misreporting were not issues since they do not require subjects to report at all, as smart cards logged data when meals were paid for and digital video cameras continuously recorded data when device was turned on. Three of the high-technology methods (on-body and oral sensors, dining table sensors, and researcher-administered digital photography), were utilized in simulated environments to collect data; thus their ability to observe food choice behaviour in the real-world remains uncertain. Both the traditional and high-technology techniques have garnered rich data on food intake behaviour in real-world and simulated environments. Going beyond just food intake to observe other aspects of the food choice process requires more creative methods and an alternative theoretical basis.

Table 1: Traditional and high-technology techniques used for collection of food choice behaviour data.

Technique	Procedure	Data collection environment	Potential challenges	Food choice behaviour observed by studies	Potential to *observe food choice process* (e.g., food thoughts, plans, purchases, preparation, and consumption)
Traditional					
Food record	-Administered over multiple days -Manual self-report food intake diary	-	-Subject to recall bias and misreporting if not reported immediately	Burke et al., 2005 Obarzanek and Levitsky, 1985	Yes
Food frequency questionnaire	-Self-report or interview format -Length of questionnaire can vary -Preset questions -May require participants to recall information 6-12 months prior to questionnaire	-	-Preset questions; restricts amount and type of info collected -Chance of recall bias and misreporting	Bonke, 1992 Simen-Kapeu et al., 2010	Yes
24-hour recall	-Interview via in person or phone to garner info about subject's food intake over the preceding 24 hours	-	-Preset questions; restricts amount and type of info collected -Collected within last 24 hour of dietary intake -Chance of recall bias and misreporting	Posner et al., 1982	Yes
Multiple-pass 24-hour recall	-Interview via in person or phone -Interviewer uses 5 passes to garner info about subject's food intake over the preceding 24 hours	-	-Preset questions; restricts amount and type of info collected -Chance of recall bias and misreporting	Conway et al., 2004 Moshfegh et al., 2008 Tran et al., 2000	Yes
Observer-recorded food record and recall method	-Researcher observes and records subject's meal intake at a cafeteria -Food eaten & wasted weighed for 2 week -Interview (recall method) to garner info about subject's snack intake over the preceding 24 hours	Real-world	-Limited data collection environment -Limited type of information can be collected	Hise et al., 2002	No
High-technology					
Electronic food diaries	-Subject inputs food intake data into a hand-held computer (e.g., smartphone) over multiple days	Real-world (partially real-time)	-Subject to recall bias and misreporting if not reported immediately	Burke et al., 2005 Holubar and Harvey-Banchik, 2007 Welch et al., 2010	Yes
On-body and oral sensors	-Arm movements, biting, chewing, and swallowing monitored using on-body and oral sensors in laboratory facility	Simulated	-Unknown usefulness in real-world environments	Amft et al., 2005a Amft et al., 2005b Amft and Tröster, 2008	No
Dining table sensors	-Dining table is augmented with 2 layers of weighing and RFID sensor surfaces to track food intake in laboratory facility -Live dining scenarios with co-eaters	Simulated	-Unknown usefulness in real-world environments	Chang et al., 2006 Westerterp-Plantenga, 2000	No
Smart cards	-Data stored when subject uses smart card to pay for meal in eating facility with smart card capability -Administered over multiple days	Real-world	-Limited data collection environment -Subject could buy foods for other people and/or use different payment methods other than smart card	Ngo et al., 2009	No
Digital photography (self-administered)	-Subject takes photo of food eaten with camera -Types, quantity, and frequency of photos taken can vary	Real-world	-Subject to recall bias and misreporting if not reported immediately -Need to specify types, quantity, and frequency of photos taken to gather the appropriate data for analysis	Boushey et al., 2009 Lassen et al., 2010 Martin et al., 2009 Small et al., 2009	No
Digital photography (researcher-administered)	-Researcher takes photo of food eaten with camera in dining facilities with subjects' identities kept anonymous	Simulated	-Limited data collection environment -Need to photograph same set of subjects at a regular interval throughout the day over multiple days	Ngo et al., 2009	No
Digital video camera	-Subject records video footages with video camera over multiple days	Real-world	-Potential technical issues with equipment -Privacy issues with capturing other people who did not provide consent to be recorded		Yes
Barcode scanning & voice recording	-Subjects scan the barcodes of or voice records food items when consumed	Real-world	-Subject to recall bias and misreporting if not reported immediately	Siek et al., 2009 Siek et al., 2006	No

A few key studies have attempted to capture other aspects beyond food consumption events to understand the complexities of FCP through qualitative in-depth interviews. Furst et al. (1996) went beyond observing food consumption behaviour by examining how people's life course experiences affected major influences on their food choices. Results from interviews at a grocery store on how individuals made food decisions while grocery shopping and what influenced their choices showed that past experiences impacted influences on food choice such as ideals, personal factors, social contexts, resources, and food context, as well as informed the development of the conceptual model of the food choice process. A study by Devine et al. (1998) also went beyond just observing food intake by developing a deeper understanding of how people's life-course influences their food choices, with a focus on fruit and vegetable intake through semi-structured in-depth interviews. Results revealed that past events strongly shaped their current food choices and consideration of a person's past experiences provided a more comprehensive understanding of the food choice process as compared to typical studies that focused on contemporary characteristics and conditions to study food choices. Falk et al. (1996) attempted to understand the complexity of food choices made by individuals aged 65+ using a multiple-perspective model of the food choice process. Results from the in-depth interviews illustrated that food preferences were shaped by life course experiences and were strongly influenced by personal belief regarding appropriate food behaviour, which were derived from childhood. Connors et al. (2001) aimed to understand how people managed values in making food choices in various contexts through in-depth interviews. They learned that all participants based their food choices on their personal food systems, which are the mental processes driving people's dietary choices. Unlike other studies, Palojoki and Tuomi-Gröhn (2001) investigated the construction of daily food choices at the household level by employing a 4-day qualitative food diary and a semi-structured interview based on the diary. The study concluded that household choices are influenced not only by stimulus, cognition or societal structures, but are also impacted by daily situations and the activities of other people. All of the above studies went beyond observing food intake by studying how people formulated their food choices using in-depth interviews. Overall, these studies gained new insights into the food choice process by taking a more holistic approach; most of which used the food choice process approach as the theoretical framework to understand how people constructed their food choices. However, this type of qualitative data may be subjected to recall bias and reporting errors. Alternative data collection methods capable of observing food choice process attributes more accurately may be needed.

To conceptualize how people construct their food choices, existing models, frameworks and theories developed in the fields of social psychology, health behaviour, economics, and social sciences have been applied to study food choice behaviour (Axelson and Brinberg, 1989; Baranowski et al., 1999; Conner and Armitage, 2002; Lancaster, 1998, 1991). Specifically, theoretical frameworks, such as life-course perspective Devine et al. (1998), food choice process model (Falk et al., 1996; Furst et al., 1996), and personal food systems (Connors et al., 2001) have been utilized in food choice behavior studies and have contributed to the development of the food choice process model (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996) (see Figure 2). This model, is perhaps one of the most comprehensive theoretical frameworks and was developed based on in-depth qualitative interviews with American adults regarding their food choice behaviour (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996) (see Figure 2). This food choice process model includes three major interconnecting components: the life course, influences and personal food systems, which provides a broad framework of potential factors involved in making food selections. The life course considers an individual's past and current food related experiences as it changes over different periods of one's life and influences include ideals, personal factors, resources, social factors and contexts. While, personal food systems are dynamic sets of mental processes constructed to enact food choices which include categorizing food related events, prioritizing conflicting values, balancing priorities, and building strategies for food choice and eating in different situations. The diagram narrows down from long-term effects at the top (life course) towards short-term or daily entities at the bottom (food choice). The model contains many of the most significant components of the food choice process. However, the model could be more comprehensive with an elaboration on the 'personal food system' stage, which could be broken down into observable everyday components that lead up to food consumption, such as food thoughts, plans, purchases, and preparations. The addition of the observable components to the model would bring about more depth to the model.

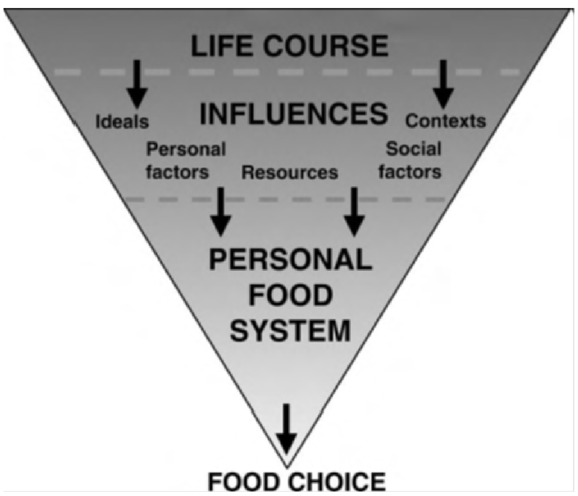

Figure 2: The food choice process model explains people's construction of food choices (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996).

2.3 Objectives

This exploratory thesis aimed to develop and test a new data collection method that may allow exploration of the wider FCP that gives rise to observed food consumption, with as much detail, and as little recall bias and misreporting as possible, using passive video recording technologies. Based on pilot results, the intent was to then expand on the last stage of the food choice process model (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996) by exploring personal food systems in more depth, including especially food thoughts, plans, purchases, and preparations leading up to food intake/consumption.

2.4 Methods

The novel data collection process was multi-staged, including a preparatory meeting with participants, a four-day data observation period and follow-up interview. Each of these stages is described in detail below. Given the exploratory nature of the thesis, a small sample of 20 participants were instructed to wear two complementary tracking devices: a *hidden body video camera* worn at chest level pointed outward and a GPS location tracking device. They wore the devices for 10-12 hours each day for four consecutive days. The intent was to observe participants' daily food-related events without requiring participants to manually recall them. This entire data collection process for each participant spanned over 7-8 days. Given the intensive nature of the data collection, only one participant at a time was observed over 20 weeks.

2.4.1 Stage 1: Preparatory meeting

The first stage began the day before the 4-day data collection period when the researcher met with the participant for approximately an hour. The intent was to provide details on the data collection process, set up end-of-day checkup meetings, exchange contact information, and train subjects to use the video camera and GPS receiver (more details on the tracking devices in the section below). Subjects were informed that all of their daily activities and trips were going to be monitored (which essentially includes food-related activities) rather than telling them about the focus on food-related activities. This was done to help minimize the likelihood that participants would alter their usual food habits knowing they were the focus.

The video camera worn by participants consisted of a mock button that replaced the actual button of their shirt to make the presence of the camera discreet (see Figure 3). The Digital Video Recorder (DVR, PV-500 Pocket), weighed 91 grams, was capable of recording at 720 x 480 resolution with 28 frames per second, and was time and date stamped on screen. With the extended battery clipped onto the back of the camera base, the camera nearly doubled in size and weight and recorded continuously for 5 to 6 hours. Participants had to position the camera lens in the zone between the chest level parallel to the ground and 30 degrees down from the chest level to minimize recording people's faces and thus protecting their privacy (see Figure 4). Participants were instructed to disable the camera at any time they needed privacy (e.g., washrooms, confidential meetings, and places with young children) by turning it off, covering camera lens with hands or object, flipping the camera lens around, or leaving the camera behind.

Figure 3: Example of a person wearing the video camera lens as a replacement button in a button-up shirt. Source of images: http://www.ecvv.com/product/2426227.html and http://www.cctvcamerassystem.com/.

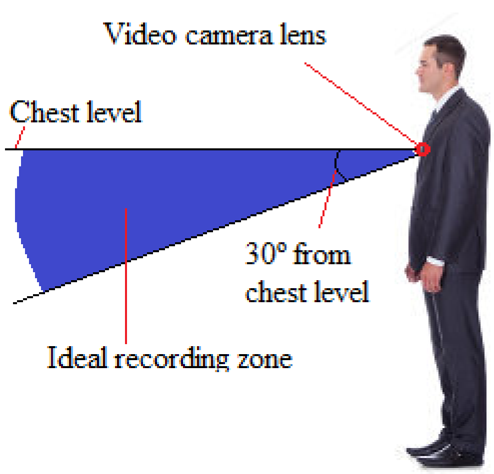

Figure 4: Example of a person wearing the video camera with the camera lens placed at the optimal recording zone represented by the shaded area in the diagram. The camera lens should be positioned between the chest level parallel to the ground and 30 degrees down from the chest level to avoid recording people's faces. Source of image: www.shutterstock.com.

Participants carried the GPS tracking device in their pocket or a zip-up pouch strapped around their hips to ensure that the device was with them as much as possible during the day. The GPS device, called the Genie GT-31, was small enough to fit in the palm of a hand, and could run for up to 46 hours in power saving mode approximately 2 days logging at 1-second intervals with the built-in lithium-ion polymer rechargeable battery. The device was customized to passively log GPS co-ordinates at 1-second intervals and was accurate to approximately 5 meters, which provided valuable data on user geo-locations. Participants could disable the GPS device at any time they felt uncomfortable with their location being recorded. The device was disabled by turning it off or leaving it behind. At the end of each day, subjects recharged both the video camera and GPS navigation device overnight and prepared to wear the devices again the next day.

2.4.2 Stage 2: Four-day observation period

The second stage began with the participants wearing the video camera and GPS receiver for all waking hours (~10-12 hours per day) over 4 consecutive days—2 weekdays and 2 weekend days. Each day, the subjects spent several minutes in the morning setting up the devices before wearing them for the day. From days 1 to 3, they recharged the devices in preparation for use the next day, and met with the researcher at the end of each day allowing the researcher to assess the quality of the video data and instruct participants on how to adjust the devices to improve the recording quality (if necessary). The daily meetings also allowed the researcher to retrieve the data recorded that day and begin preliminary video data coding after the meeting. The researcher was able to conduct preliminary coding on at least 2 days of video data per participant before each interview (see section 2.4.7 for more detail on the coding procedure). On the fourth and last day of the data collection period, the researcher visited the subject to pick up all devices and schedule the one-hour interview, which took place within 3 days of the observation period to minimize the participants' memories from fading.

2.4.3 Stage 3: Follow-up interview

The final stage involved a one-hour one-on-one in-person interview to reveal the special study focus, verify the accuracy of FCP events coded from video in the second stage, explore the effects of social influence during FCP events, and collect body mass index (BMI) related information. Interviews were audio recorded. After the special study focus on food-related activities and the reason for concealing it were revealed, subjects had the choice to withdraw from the study or continue with the interview. Afterwards, subjects were prepped for the discussion pertaining to FCP and social influence, key terms and concepts were defined and explained. Next, the researcher selected 4 to 6 coded FCP events for the discussion that needed clarity. Initially, the participant was asked about the food related activity and/or accompanying persons present in the event and then they were asked about the social influence experienced during the events with accompanying persons present. Both directions of social influence were discussed: influence on participant from accompanying persons present and vice versa. The question formats were generally based on Table 2, which is an interview guide developed in an attempt to be systematic and consistent throughout all interviews. At the end of the interview, the participant's height and weight information were gathered and compensation of $100 provided for their time commitment involved. Refer to the methods section in CHAPTER 4 for a full description of the interview process.

Table 2: Interview question format regarding social influence at FCP events with accompanying persons present.

Social influence on participant from accompanying persons present

During the [**A**] with your [**C**] present, was your [**B**] [**A**] influenced by your [**C**]?
If so, how?

Example:
During the [food preparation] with your [sister] present, was your [speed of] [food preparation] influenced by [sister]?
If so, how?

Social influence *from participant* on accompanying persons present

During the [**A**] with your [**C**] present, was your [**C**]'s [**B**] [**A**] influenced by you?
If so, how?

Example:
During the [food preparation] with your [sister] present, was your [sister]'s [speed of] [food preparation] influenced by you?
If so, how?

Options to fill in [X] in the question formats.

A	B	C
FCP	**Characteristics of FCP**	**Accompanying person type**
Food thoughts	Method *of*	Friend
Food plans	Quantity *of*	Parent
Food purchases	Location *of*	Child
Food preparation	Date *of*	Sibling
Food consumption	Time *of (in hours)*	Extended family member
	Duration *of*	Significant other/spouse
	Speed *of*	Household member
	Frequency *of*	Person of interest (romantic)
	Food /ingredient type *for your*	Household member (roommates)
	Food quality (e.g., production method, brand, cost, etc.) *for your*	Organization member
	Feeling(s) *about your*	
	Opinion(s) *on your*	

2.4.4 Study area

The data for this thesis were collected from individuals who resided in Hamilton and Kitchener, Ontario, Canada. Hamilton is the 10th largest city in Canada with a population of 519,949 and Kitchener is ranked 22nd with a population of 219,153. Both have a minimum population density of 400 persons per square kilometer, and are located in the most populous Canadian province with a population of 12,851,821 (Statistics Canada, 2012).

2.4.5 Participants

Eighty males and females, aged 30 to 50 years, were invited to participate in this study. Such people are typically considered 'Generation X' (generation born after the Western post-World War II baby boom), and were considered ideal participants because they were likely to have one or more child, consume meals alone and/or with others (friends, family or colleagues), and be familiar with the use of technology. Another goal was to obtain a sample in which half the participants were overweight or obese and the other half were of normal weight, as defined by BMI. People who were abnormally tall (greater than 6'6") were not recruited due to the increased probability of recording people's faces on the video camera. Individuals who worked or spent time in sensitive environments such as daycare centers and police officers were also excluded due to extreme privacy concerns.

Invitations were delivered by email, phone calls, and face-to-face meeting to eighty individuals identified by the researcher based on convenience sampling approach. Of these, twenty people agreed to participate. Twenty was the target number due to the time commitment required for one researcher to collect the multi-day data from twenty participants in a short time span, the invasive nature of the video recording device, desire to minimize risk as a condition of ethics approval, but primarily the experimental nature of the study has not been done before; better to conduct a smaller sample.

2.4.6 Special procedures for ethics approval

Approval of this thesis was made by Wilfrid Laurier University's Research Ethics Board. Careful procedures were put in place to maintain the anonymity of subjects, and to minimize the risk of capturing sensitive information. For instance, participants' names and home addresses were not recorded to maintain the anonymity of subjects. To protect the video data from being viewed by others, all data in transit and on the computer server had strong password protection. The digital video data were scanned immediately upon receipt to check for video footages that contained confidential information of the participant or other people (e.g., bank information, phone numbers, or license plates). If any identifying information was found, it was immediately deleted. The video data were also recorded at a low resolution to minimize the possibility of capturing textual documents that may have contained identifying information. The data on memory storage devices were securely erased immediately upon retrieval from subjects and uploaded to a secure and encrypted computer. The data were only viewed by the researcher and would be permanently deleted from the secure computer immediately after coding. The interview speeches were recorded on a digital audio recorder, which was transcribed and stored on the secure and encrypted computer along with the video and GPS data. The GPS and interview data would be retained until successful defense of this thesis. Despite these measures, much information from people other than participants was captured on video without their consent, even if only stored temporarily. This ethical breach was deemed worth the risk in light of the benefits of collecting the data for research purposes.

2.4.7 Data coding and analysis procedures

The preliminary video data coding, which was completed during stage two of the data collection process by one researcher, included observation of FCP event type (food thoughts, plans, purchases, preparations, consumption) and their attributes including date, time, location, accompanying persons present at FCP, and indication of social influence from participant to accompanying persons and vice versa. Other attributes coded were video data length and size, working status of microphone for video data, FCP location if identified by GPS data, qualitative description of FCP events, and researcher's perceived reasons for assigning low coding confidence levels.

Since multiple researchers were not employed to independently code the same video data, the level of inter-rater/coder reliability could not be assessed and in turn, the robustness of the coded data may have been compromised (Neuendorf, 2008). However, given the exploratory nature of the thesis, one coder was likely sufficient. To strengthen the reliability and validity of the coding, a systematic coding scheme was developed through multiple revisions and rigorously testing during the pilot test period. The coding scheme consisted of long and detailed lists of observable situations that precisely defined and categorized each FCP type and their attributes. The scheme was utilized throughout the actual coding process to ensure that all coded events adhered to the same standards and maintained the highest degree of consistency as possible.

Additionally, coding confidence levels/scores were assigned to all FCP attributes on 0 to 100% scale, representing a subjective, yet systematic ranking by the researcher to provide insight as to what the researcher observed on the video data. Percentage for confidence scoring is a common practice in coding qualitative data (Neuendorf, 2008; Ryan, 1999). In this study, confidence levels were defined as: 70% or lower was low confidence; 71 to 80% was moderate confidence; 81 to 90% was high confidence; 91 to 100% was very high confidence. This ranking system was also applied to all coded events to maintain the highest degree of reliability as possible for an exploratory study.

After all the video data coding was completed, an experimental dataset was compiled consisting of a listing of all FCP events by the participants and their attributes. To explore the characteristics of FCP events, descriptive statistical analyses were conducted appropriate to each variable type. Such variables included data collection days, working status of microphone, FCP type, and reason for low coding confidence level per coded FCP. The minimum, maximum, mean, and standard deviation were computed for all continuous variables, such as number of hours of video data, number of coded FCP events, number of words used to code food choice sequences events. Next, to illustrate the five types of FCP captured on video and how they appeared from the researcher's point of view, screen shots were taken for each FCP from the corresponding video clips. All events observed from the video data were then described with as much detail as possible by the researcher using text. To quantify the textual descriptions, word counts were computed on all descriptions of events. The number of words used to code events were placed into four categories (less than 6 words, 6-9 words, 10-20 words, and greater than 20 words), which were then cross-tabulated with the total number of events, percentage, level of detail coded, type of detail coded, example from dataset.

A similar descriptive analysis was conducted for social interaction related and location variables. The categorical variables included accompanying person type at FCP, reason for low coding confidence level for accompanying person present at FCP, and FCP locations. The continuous variables consisted of number of accompanying person(s), number of *different* accompanying person(s) *types*, and coding confidence level for accompanying person(s) at events per coded FCP event. Lastly, to learn which FCP locations were most challenging to identify during the coding process, the FCP locations were cross-tabulated with FCP location coding confidence levels.

To explore the potential relationships between the FCP and the sociodemographic characteristics, video data related variables, and social interaction related variables, an extensive set of cross-tabulated analyses and analysis of means were generated. Analysis was computed for the mean number of each FCP *per participant per day* by categorical variables, such as sex, age, body mass index, marital status, family characteristics, and occupation type, data collection day, and accompanying person types at events. In addition, continuous variables, such as coding confidence levels per coded event, accompanying persons at events, and *different* accompanying person *types* at events (mean number *per participant per day*) were cross-tabulated with each FCP for the analysis of means. Although the data was not randomly selected, t-tests were still used as a guide to assess statistically significant differences at $p < .05$ in two-sided tests of equality for column means.

2.5 Results

2.5.1 Sample characteristics

The sample consisted of 20 participants, 17 of whom resided in Hamilton, Ontario and 3 resided in Kitchener, Ontario. There was an almost equal divide between the number of female (11) and male adults (9) in the sample (see Table 3a), which was similar to the national census profile of female (52%) and male adults (48%) (Statistics Canada, 2012). In terms of marital status, the sample was overrepresented by married individuals (65% of sample) when compared to the statistics in Canada (46% married; 54% not married). On average, individuals had one child at home, which was close to the national average number of children at home per census family (1.1). The BMI ranged from 19.3 (normal weight) to 33.2 (obese) (see Table 3b). Forty-five percent of sample was overweight or obese, which was slightly lower than the proportion reported from the 2012 Canadian Socio-Economic Information Management System for overweight or obese adults in Canada (52.5%) (Statistics Canada, 2012).

Table 3: Sociodemographic characteristics of the sample (n = 20):
a) Sex, marital status, family unit type and occupation

		Number of participants	%
Sex	Male	9	45%
	Female	11	55%
Marital status	Married	13	65%
	Not married	7	35%
Family characteristics	Married with children at home	8	40%
	Married without children at home	5	25%
	Not married with children at home	2	10%
	Not married without children at home	5	25%
Occupation	Health	3	15%
	Education	11	55%
	Trades	2	10%
	Manufacturing	1	5%
	Government services	2	10%
	Domestic work	1	5%

b) Age, weight, body mass index, household size, and number of children in household

	Minimum	Maximum	Mean	Standard Deviation
Age	30.0	50.0	35.8	6.7
Weight (pounds)	112.4	205.0	155.0	31.1
Body mass index	19.3	33.2	24.5	4.0
Household size	1.0	6.0	3.8	1.6
Number of children in household	0.0	3.0	1.0	1.1

2.5.2 Descriptive analysis of video data

Three participants ended up providing only 3 out of 4 days of video data during the data collection process due to personal reasons. Thus, the total number of data collection days for all 20 participants was 77, rather than the full 80 expected. There was almost an equal divide of data collection days on weekdays (51.9%) and on weekend days (48.1%), which was expected given instructions to users to this extent. On average, 8.5 hours of video data were gathered per day, which was as expected given instructions to users and the battery capabilities of the device. The average number of FCP events per day was 10.6 with a standard deviation of 6.8, suggesting considerable variability in the process across participants. Unfortunately, there was a malfunction with the microphone on the video camera early on in the data collection process; thus, audio data was only present in a third of the video data.

To illustrate the five types of FCP events captured on video and how they appeared from the researcher's point of view, a series of screen shots taken from short video clips are shown in Figure 5 through Figure 9, coming from participants who gave full permission to release them publicly. For each screen shot and video clip, the number in the top left corner represents the video recording frame number, the bottom left number is the calendar date, and the time is found in the bottom right corner. The full video clips can be accessed through the web-based hyperlinks provided in the figure captions.

A considerable amount of behavioural detail was evident through examination of the screen shots and video clips. For instance, Figure 5 shows the individual opening a refrigerator door and then standing in front of the refrigerator while touching several food containers. The participant appeared to be having food related thoughts based on the length of time spent standing with the fridge door opened and the types of items touched and/or taken out from the fridge. In Figure 6, the participant is looking at weekly flyers sent from local food retailers, which indicated an interest in purchasing food in the upcoming week. The specific food types, brands, prices, and food retailer were evident from the video and images. A food shopping event is shown in Figure 7 with a wide variety of detail captured such as the specific food prices, food items, food storage containers, etc. Also, the video shows the individual touching/selecting the food, using the scale to weigh selective foods, walking around the grocery store up and down aisles, standing in front of food stands, opening store refrigerator doors, etc. Figure 8 features a participant preparing a meal, which includes cooking utensils, cooking method and technique, food items, food ingredients, location (kitchen), cooking appliance (stovetop), etc. More detail may have been captured in this example as the meal was not completed before the video clip ended. The last example is of the participant consuming a bowl of soup with a spoon while sitting at a table in a well lit room (Figure 9). The food colour, size, quantity, texture were evident in the screen shots. The video illustrated the eating speed, amount of food placed in mouth per bite, participant's choice of hand (right or left) for holding eating utensil, etc.

Figure 5: Screen shots from video clip of a participant's food thoughts. Full video clip: http://www.youtube.com/watch?v=i6fduk10uLw.

Figure 6: Screen shots from video clip of a participant's food plans. Full video clip: http://www.youtube.com/watch?v=OBNU1kaQ8_8.

Figure 7: Screen shots from video clip of a participant's food purchases. Full video clip: https://www.youtube.com/watch?v=D7CnLa-d_bE&feature=youtu.be.

Figure 8: Screen shots from video clip of a participant's food preparation. Full video clip: http://www.youtube.com/watch?v=e9o0I9Nv6G8.

Figure 9: Screen shots from video clip of a participant's food consumption activity. Full video clip: http://www.youtube.com/watch?v=rkV-R8g6XZ8.

A total of 813 FCP events were observed in the video data, including mostly food consumption events (47%), food preparations (24.1%), and food thoughts (14.8%), as shown in Table 4. Of these, 276 events (33.9%) had a low coding confidence level (defined as 70% or less) resulting most often because an activity/object in video was not identifiable with adequate view of video data (60.9%), poor recording angle (18.1%), or technical issues with video camera (15.2%). Some of the technical issues included dark lighting captured in video data (1.8%), video footage cut off (9.1%), video camera screen blacked out (2.2%), and other issues (e.g., inaccurate time, subject fixing camera) (2.2%).

Table 4: Descriptive statistics of FCP types.

FCP type	Total number of FCP events	Mean number of FCP events *per participant per day*	%
Thoughts	120	1.6	14.8%
Planning decisions	27	0.4	3.3%
Purchases	88	1.1	10.8%
Preparations	196	2.5	24.1%
Consumption events	382	5.0	47.0%
Total	813	10.6	100.0%

During the data coding process, the researcher attempted to describe the FCP observed from the video data with as much detail as possible using text. Examples and a word count of these are shown in Table 5. The number of words used to code FCP events ranged widely from a minimum of 3 to maximum of 95 words, with an average of 28.9. More than half of the events (50.6%) were coded with 20 words or more used for the description. The types of details coded included action and food items, eating utensils, locations, activity besides FCP, and activity of accompanying persons.

Table 5: Frequency, level of detail coded, and type of detail coded for number of words used to code FCP event per coded FCP events (n = 813).

Number of words used to code FCP events	Total number of FCP events	%	Level of detail coded	Type of detail coded	Example from dataset
<6 words	32	3.9%	Low	Action to conduct FCP; food item(s)	Drinks beverage from mug
6-9 words	102	12.5%	Moderate	Action and food item(s); eating and drinking utensil(s); location(s)	Eats chips/crackers with fingers while watching TV
10-20 words	268	33.0%	High	Action and food item(s); eating utensil(s); location(s); activity besides FCP; activity of company	Subject eats at dining table while reading; Subject eats a Boston Cream donut with hands
>20 words	411	50.6%	High	Same types of details observed as above category (10-20 words) *except longer event duration*	Subject sits at dining table and eats breakfast with fork and knife; subject dips toast into syrup to eat; subject drinks her ….

2.5.3 Descriptive analysis of social interaction related variables

Approximately half of the participants' FCP events had accompanying person(s) present, the types and numbers of which are shown in Table 6. The mean number of accompanying persons per event was 0.9, the most common of which was participant's significant other/spouse/partner. If present, participants were accompanied by 1 to 4 different types of people per event. Of the 813 events, 61 events (7.5% of the time) had low coding confidence level for accompanying person(s) at FCP events (defined as 70% or less) and the most common reason was due to lack of information to identify company type in video data.

Table 6: Descriptive statistics of social interaction related variables: accompanying person(s) types at FCP event.

Accompanying person(s) types at events	Total number of FCP events	Mean number of FCP events with accompanying persons present *per participant per day*	%
Significant other/spouse/partner	146	1.9	18.0%
Child(ren)	83	1.1	10.2%
Parent(s) and/or sibling(s)	95	1.2	11.7%
Friend(s), extended family member(s) & in-law(s)	102	1.3	12.5%
Non-personal/professional associate(s)	106	1.4	13.0%
None (accompanying person(s) absent)	414	5.4	50.9%
Total	813[1]	105.6	100.0%

[1] Total does not sum to 813 because more than one type of accompanying person can be present at a given FCP event.

2.5.4 Descriptive analysis of location

Through observation of video, it was possible to determine the name and/or type of physical locations of FCP events (but not exact map location) as shown through screen shots taken from short video clips (see Figure 10 and Figure 11). To do so, the researcher used visual clues from the video footages, such as retailer's company sign and the types of products sold at the venue. Figure 10 presents an example of when the location was easy to identify due to the presence of the store sign (i.e. "Food Basics") in the video frame. This particular grocery store had a relatively large parking lot in front of the store. Therefore, the extended time and distance the participant took to approach the entrance of the store gave the researcher increased opportunity to identify the food venue type and company name in the video. A more challenging location to pinpoint would be a building that was unmarked/unlabeled and/or had no signage. For instance, the screen shots in Figure 11 revealed a building within the premise of an academic institution. The building would be very difficult to detect without prior knowledge and/or physical visit to that location.

Figure 10: Screen shots from video clip of a participant's FCP location that was easy to identify. Full video clip: http://www.youtube.com/watch?v=wseRqNKjC8I.

Figure 11: Screen shots from video clip of a participant's FCP location that was difficult to identify. Full video clip: <u>http://www.youtube.com/watch?v=xaK-nX6JV6Q.</u>

The majority of FCP events took place at the participants' home (63.2%), food retailers (7.9%), and workplace/school (5.9%), as shown in Table 7. Nearly all of these locations were coded by the researcher with high confidence levels (98.8% of the time). For the very few remaining locations that were coded with low confidence (only 10), these tended to be at food focused retailers, such as cafés and restaurants. In these few cases, locations were easily verified by GPS data.

Table 7: Descriptive statistics of FCP event location and FCP event location coding confidence level (n = 813).

		Total number of FCP events	Mean number of FCP events *per participant per day*	%
FCP event location	Home (participant's)[1]	514	6.7	63.2%
	Food retailer (e.g., grocery store)	64	0.8	7.9%
	Academic and/or paid workplace (participant's)[1]	48	0.6	5.9%
	Vehicle	42	0.5	5.2%
	Other's home	38	0.5	4.7%
	Non-food retailer (e.g., clothing store)	38	0.5	4.7%
	Restaurant	33	0.4	4.1%
	Beverage focused retailer (e.g., café)	17	0.2	2.1%
	Food court	5	0.1	0.6%
	Other (e.g., public transit facility, urban open space, greenspace, entertainment, hospital, etc.)	14	0.2	1.7%
FCP event location coding confidence level (%)[2]	80-100 (high)	803	10.4	98.8%
	0-79 (low)	10	0.1	1.2%

1 Researcher had knowledge regarding participants' home and academic and/or paid workplace locations prior to coding the location data, which resulted in higher coding confidence levels.
2 FCP event locations with low coding confidence level were verified by GPS data; locations with high coding confidence level were left as is.

2.5.5 Factors related to food choice processes

An extensive set of cross-tabulated tables and analysis of means were conducted to further explore the relationships between the FCP and sociodemographic characteristics, video data related variables, and social interaction related variables. Analysis of the mean number of each FCP *per participant per day* by the sociodemographic characteristics (e.g., sex, age, body mass index, marital status, family characteristics, and occupation type) and data collection day, as well as the mean coding confidence levels *per participant per day* by each FCP, yielded no statistically significant differences when tested using t-tests (p<0.05 in all cases).

The analysis of the mean number of each FCP *per participant per day* by accompanying person types at events, as well as the analysis of the mean number of accompanying persons and *different* accompanying person *types* at events *per participant per day* by each FCP yielded statistically significant differences when tested using t-tests (p<0.05 in all cases) as shown Table 8. In particular, food purchases had the highest mean number of accompanying persons and different accompanying person types at events *per participant per day* (1.69 and 1.26, respectively) as shown in Table 8a. An average of 2.8 food purchases were accompanied by non-personal/professional associate(s) as displayed in Table 8b. While food preparations had the lowest mean number of accompanying persons and *different* accompanying person *types* at events *per participant per day* (0.54 and 1.11, respectively) as shown in Table 8a. Lastly, an average of 6.6 food preparation events were conducted alone (see Table 8b).

Table 8: Descriptive statistics of FCP types by video data related variable and social interaction related variables:

a) Coding confidence level per coded FCP event, number of accompanying person(s) at FCP event, number of different accompanying person types at FCP event *per participant per day.*

Variable	FCP type	Mean
Coding confidence level per coded event (%)	Thoughts	76.67
	Planning decisions	77.04
	Purchases	70.17
	Preparations	69.78
	Consumption events	74.41
	Total	73.25
Number of accompanying person(s) at event	Thoughts	1.07*
	Planning decisions	1.19*
	Purchases	1.69*
	Preparations	0.54*
	Consumption events	0.76*
	Total	0.87
Number of *different* accompanying person *types* at event	Thoughts	1.21*
	Planning decisions	1.26*
	Purchases	1.43*
	Preparations	1.11*
	Consumption events	1.14*
	Total	1.18

*. Mean is significantly different at p< .05 in the two-sided test of equality for row means. Tests assume equal variances.

b) Accompanying person types at FCP event *per participant per day*

FCP type	Accompanying person types at FCP event	Mean	Total
Thoughts	Spouse/partner	1.35	27
	Immediate family member(s)	1.35	27
	Friend(s), extended family member(s) & in-law(s)	1.35	27
	Non-personal/professional associate(s)	0.6	12
	None (accompanying person(s) absent)	2.4	47
Planning decisions	Spouse/partner	0.4	8
	Immediate family member(s)	0.2	4
	Friend(s), extended family member(s) & in-law(s)	0.4	8
	Non-personal/professional associate(s)	0.2	4
	None (accompanying person(s) absent)	0.5	10
Purchases	Spouse/partner	0.8*	16
	Immediate family member(s)	1.0*	20
	Friend(s), extended family member(s) & in-law(s)	1.1*	21
	Non-personal/professional associate(s)	2.8*	56
	None (accompanying person(s) absent)	0.6*	11
Preparations	Spouse/partner	1.3*	25
	Immediate family member(s)	2.0*	40
	Friend(s), extended family member(s) & in-law(s)	0.5*	10
	Non-personal/professional associate(s)	0.3*	5
	None (accompanying person(s) absent)	6.6*	132
Consumption events	Spouse/partner	3.5*	70
	Immediate family member(s)	3.9*	78
	Friend(s), extended family member(s) & in-law(s)	3.9*	36
	Non-personal/professional associate(s)	1.5*	29
	None (accompanying person(s) absent)	10.7*	214

*. Mean is significantly different at p< .05 in the two-sided test of equality for row means. Tests assume equal variances.

2.5.6 Challenges and data accuracy

The video recording technology garnered a rich experimental dataset, yet there were challenges with respect to participant recruitment, 4-day data observation period, equipment functionality, and data coding. Participant recruitment was challenging due the invasive nature of the video recorder, which explains the 25% response rate for participant recruitment. The data collection procedure also involved multiple stages, thus the procedure appeared complicated and invasive to the potential participants. The researcher had to explain the procedure carefully to individuals, as well as conduct a live demonstration. Overall, participant recruitment was more challenging than anticipated. Four days—two weekdays and two weekend days, was the appropriate number of days for the data collection period. For most individuals, it took about a day to get familiar and comfortable with the tracking devices. After that initial period, the process seemed to move along quickly. The weekend days were more challenging for setting up end-of-day checkup meetings since participants were busier with social outings and had a less structured and predictable schedule. After setting up the participants with the video recording equipment, collecting 10 to 12 hours of video data as instructed was challenging for some participants who had to turn off the camera during sensitive moments, such as personal and/or work meetings. In addition, some people were not aware of the total number of hours of video data they had recorded with all the recording breaks they took throughout the day. The end-of-day checkup meetings were beneficial; the researcher checked subject's video data and informed subjects when they did not record enough video data.

Malfunction of the microphone on the video camera occurred early on in the data collection process. Most participants asked about the microphone and when they learned about the microphone malfunction, they appeared to be comfortable with participating in the study knowing that their conversations would not be recorded. In addition, the video data coding process was faster with no audio data since it took more time to listen the audio data on top of watching the video data. However, without the audio data, the researcher may have missed food thoughts and planning events that were communicated verbally. The data analysis revealed that food purchases were not one of the top three types of FCP events observed in the video data, which included food consumption events, food preparations, and food thoughts. Perhaps, some participants' partner did the grocery shopping for the household, which resulted in fewer food purchases observed in video data.

Given the experimental nature of the thesis, the coding confidence levels allocated to coded events was a subjective yet systematic method of rating events. This rating method was necessary as it provided insight as to what the researcher observed on the video data. Some of the reasons for low coding confidence of FCP events were dependent on the participants' actions, whiles others were unavoidable. Not being able to identify the activity/object when the view of the activity/object in the video data was adequate was the reason that occurred most often. This reason was unavoidable since subjects did not physically hold each food related item up to the camera lens as subjects were not instructed to since they were not aware of the food related focus part of the study until after the video recordings were over. Participants admitted that they would have definitely behaved differently if they knew that the researcher was going to observe their FCP in the video data. Thus, this strategy helped prevent participants from altering their usual food habits, which led to more representative observations of their actual dietary patterns.

Low coding confidence due to poor video recording angle was an issue that would have occurred more often if the researcher did not conduct quality checks at the end-of-day checkup meetings. The researcher invested a great deal of time and effort in helping subjects to modify the position of camera lens in their button up shirts to obtain optimal recording angle. When the camera lens was worn as a button in a button up shirt, the lens tended to droop with the shirt and record the ceiling or ground. Thus, it was a flawed design that needed manual modification for optional recording angle. Dealing with the video recording angle was one of the most challenging aspects for both the researcher and the participants. Minor technical issues that led to low coding confidence were known to the researcher during the pilot test period, thus, participants were alerted and trained to deal with the issues. However, video footage cutting off before a FCP event ended was a situation that was unavoidable since subjects were instructed to continuously record all possible events as well as take breaks from recordings as needed.

Very few FCP events with accompanying persons present had a low coding confidence level (7.5% of the time). The researcher was usually able to identify the accompanying person type in the video data based on the way they interacted with the subject. If the same accompanying person appeared in multiple FCP events, then it was easier to identify the accompanying person type. Nearly all FCP event locations were coded with high confidence levels; most of which occurred at the participants' home, food retailers, and workplace/school. This is due in part to participants being at their home/work locations repetitively over the 3-4 data collection days, addresses of which the researcher had prior knowledge on, making them easier to identify. Even without the prior knowledge of any addresses, the visual clues from the video footages, such as the subject's activity type, building type, and interior and exterior design made it easy to determine the name and/or type of any physical locations of FCP events. FCP event locations with low coding confidence level (below 80%) were verified by GPS data; locations with high coding confidence level were left as is. Beverage focused retailers, such as cafés, were one of the few locations that were coded with low confidence. They were harder to code since the company signs were usually not visible in the video data. Some subjects also went to small chain cafés that did not have distinct exterior and/or interior design that were recognizable to the researcher. Thus, these locations required verification by GPS data and resulted in lower coding confidence levels.

2.6 Discussion and conclusions

This thesis may have broadened the understanding of dietary behaviour through a unique data collection technique. Despite the challenges and data quality issues, the automatic tracking system captured novel information on the FCP event types and their attributes. With regards to the experimental data collection process, this thesis tested a passive video recording, which resulted in a dataset virtually free of participant recall bias and misreporting since participants did not need to manually recall their food-related events. Although the data is not necessarily 100% accurate due to potential data coding mistakes, the researcher conducted data quality checks to minimize data coding mistakes. As for data quality issues, training participants to correctly use the video recorder and positioning the video camera lens was a crucial part in collecting optimal video data. It took a tremendous amount of time and effort to ensure the data collection process went smoothly as possible. Video data quality checks conducted by the researcher throughout the process was the vital step in obtaining the highest quality dataset as possible.

With respect to the experimental results, the analysis of means yielded only a few statistically significant patterns. In particular, food purchases had the highest mean number of accompanying persons and different accompanying person types at events per participant per day. The food purchases were likely made at restaurants since eating out to socialize and to celebrate special occasions with friends, family, and/or partner were top reasons for a paid meal at a commercial establishment (Warde and Martens, 2000). There was a relatively high mean number of food purchases accompanied by non-personal/professional associate(s) that may have also occurred at commercial establishments since meal partners tend to be co-workers at lunch (Sobal and Nelson, 2003). For food preparations, it is not surprising that people tended to prepare food with few or no accompany persons present given that preparing food is primarily considered as a household chore rather than a social event (Daniels et al., 2012). Overall, the results demonstrated that food purchases tended to occur in social settings and food preparations occurred alone at home. Although the analyses led to some interesting results, the results may not be generalized to any population and are best reserved for exploratory purposes only since the study utilized an experimental technique that was conducted on a relatively small and non-random sample. Conclusions from the analysis can be used a guide for future studies.

Past studies have attempted to understand people's construction of food choices by focusing only on observing food intake behaviour with traditional and high-technology data collection techniques. This thesis aimed to observe the actual food choice process leading to food intake, including participants' food thoughts, plans, purchases, and preparations, in real-world environments. Many of these decisions and behaviours go a long way towards explaining how and what people eventually end up consuming. Finding methods to observing them is only the first step. Larger studies will allow further elaboration on how such steps in the food choice process could become a target for remediation in the battle to curb obesity.

Theoretically, these results allow for a possible elaboration of the personal food systems stage of the food choice process models shown in Figure 2 (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996). The experimental results demonstrated that the FCP (food thought, plans, purchases, preparation, and consumption) may be practical and observable elements that represent a mechanical part of the process that is missing in the current food choice process model. Thus, it might add another necessary dimension to the current personal food systems stage, which could lead to a more comprehensive food choice process model. This may be a step toward an improved understanding of food choice behaviour. The results confirmed the need for further investigation through similar studies on a larger scale.

Moving forward, modifications to the methodology could help improve the quality of the data collected. Future studies should consider using a digital video recorder with a working microphone to record both video and audio data. More food thoughts and planning events communicated verbally may be observed. This thesis purposely utilized a small sample and one video data coder due the exploratory nature of the data collection technique. Future studies could use larger and random sample, which may lead to results that can be generalized to a population. Also, future studies could employ multiple researchers to independently code the same video data and use the same confidence scoring to establish a reasonable level of inter-rater reliability and robustness. Furthermore, more advanced and higher quality video recording is needed to deal with the technical issues that may arise, such as dark lighting in video recording, video camera screen randomly blacking out, short battery life, device heating up after extensive use, oversized battery pack, etc. A completely different video recorder should also be considered since not all participants appreciated the video camera lens that had to be worn with a button up shirt. If the camera lens could be worn with a headwear, eyewear, or necklace, then carrying the camera may be more convenient and comfortable for participants. Google Glass, a wearable computer with an optical head-mounted display, is an example of an eyewear with a built-in camera. However, it is capable of approximately 45 minutes of continuous video recording, which is not long enough. Finding video recorders with long battery life that can last up to 8-10 hours is very challenging.

The video recording technology has the potential to garner detailed information on other attributes of interest, such as food item/ingredients involved, eating utensils used, duration and frequency of meals as observed in this study. This could perhaps assist nutritionists with helping patients with dietary modifications to improve health. Fitness instructors and/or weight loss program doctors may be able to build custom dietary and fitness plans for clients after analyzing their day-to-day activities from video data. Health care workers and/or family members could possibly watch over individuals in need of extra care at a distance with video recorders while making occasional in-person check-up visits. The potential of the video recording technology may be beyond observing FCP events, but would require careful attention to ethical and privacy concerns, time consuming data collection processes, data quality checks, and storing and processing large data.

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CHAPTER 3 Exploring patterns of the daily food choice process through an automated activity monitoring system

3.1 Introduction

Obesity is a modern day epidemic affecting 18.4% of Canadians aged 18 and older who were classified as obese based on the body mass index (BMI) (Statistics Canada, 2012). Obese individuals are more susceptible to developing chronic diseases, such as hypertension, type 2 diabetes, cardiovascular disease, osteoarthritis and various cancers, which can impact overall quality of life. Weight gain is strongly linked to food consumption and has been the focus of numerous researches. Examining factors motivating food consumption alone has likely not been sufficient to fully understanding individuals' daily dietary behavior. Focusing on a novel concept, the underlying *food choice process* (FCP), including *food thoughts*, *plans*, *purchases*, and *preparation*, leading up to the final *food intake/consumption* may improve our understanding. This paper attempted to tackle this need by testing an automated activity monitory system for observing the broader elements of the underlying FCP that lead to observed food choices and subsequently exploring potential patterns of and factors associated with FCP decisions. The experimental multi-stage data collection process is outlined in the methods section followed by the data coding, descriptive and exploratory multivariate statistical analyses of the results. The potential implications of these findings for the existing food choice process model are also discussed.

3.2 Background

Since food intake is strongly tied to weight gain, many previous studies have attempted to understand the potential factors affecting dietary patterns by exploring selective forces behind food habits. Early studies focused on cost, taste, health, and social status, as likely contributing attributes in individual food selection (Lewin, 1951, 1943). Subsequent studies also considered those factors, but also expanded attention on cognitive and motivational determinants impacting food intake decisions (Bell et al., 1981; Betts, 1985; Cosper and Wakefield, 1975; Krondl and Lau, 1982; Lau et al., 1984; Michela and Contento, 1986; Rappoport et al., 1993). Social influences on food selection have also been investigated, such as societal normal and personal relationships (Schutz, 1988; Worsley et al., 1983). A study by Lennernäs (1997) revealed that household food choices were dominated by quality or freshness, price, taste, trying to eat healthy, and family preferences. Another study that explored the significance of taste, nutrition, cost, convenience, and weight control on individual food selections learned that taste followed by cost were the most important factors influencing food choices (Glanz et al., 1998). Overall, there has been an abundance of research on potential determinants influencing food intake decisions, yet obesity is still an on-going struggle for many individuals.

Alternatively, a few key studies that were informed by theoretical approaches have shifted the focus from factors impacting food consumption to the wider food choice process, in order to gain a deeper understanding of the construction of dietary patterns. For instance, Connors et al. (2001) learned through in-depth interviews that individuals' food selection was based on personal values from their personal food systems, which are the mental processes driving people's dietary choices. Several studies sought to understand how a person's life-course influences their food choices. For example, results from interviews conducted during grocery shopping events revealed that past experiences strongly impacted several elements of people's food selection, such as personal factors, ideals, social contexts, food context, and resources (Furst et al., 1996). Falk et al. (1996) explored the complexity of food choices made by individuals aged 65 and up through in-depth interviews and also concluded that food preferences were molded by life course experiences that were derived from childhood. Additionally, semi-structured in-depth interviews on participants' fruit and vegetable intake illustrated that past events from people's life-course strongly affected their current food choices (Devine et al., 1998). Unlike other studies, Palojoki and Tuomi-Gröhn (2001) investigated daily household food choices through 4-day qualitative food diaries and semi-structured interviews and discovered that household food selections were impacted not only by cognition, stimulus, or societal structures, but were also influenced by day-to-day situations and the actions of people they socialize with.

To identify a smaller number of factors that may explain most of the variance within the set of observed FCP decisions, the Principal component analysis (PCA), a well-established and standard statistical procedure, was applied on the experimental dietary data. PCA is typically used to reduce the dimensionality of a large dataset with interrelated variables into a smaller set of variables, with minimum loss of information and variation from original dataset (Jolliffe, 2002). It is generally accepted that PCA was first described by Pearson (1901) and Hotelling (1933). Since then, the interest in PCA has expanded and is widely used. For instance, the Web of Science, a citation indexing service, reported that over 2000 articles were published within two years (1999 to 2000) in the context of PCA as identified in the titles, abstracts, and/or keywords (Jolliffe, 2002). PCA has been used in numerous research fields, such as, agriculture, biology, climatology, demography, economics, geology, meteorology, oceanography, psychology and quality control, as well as food research. Some recent examples of dietary related studies include comparison of dietary patterns (Smith et al., 2011), examination of food intake profiles of children (Gatica et al., 2012), evaluation of methodologies for assessing the overall diet (Ocké, 2013), investigation of diet–disease relationships (Bakolis et al., 2014), and assessment of nutrition and mood of vegan diet (Olabi et al., 2015).

The application of unidimensional sequence alignment analysis on dietary behaviour was explored in this paper as a novel approach to gain insight into the potential sequential patterns of FCP events. The origin of this approach stems back to Watson and Crick's (1953) introduction of deoxyribonucleic acid (DNA), which sparked research interest in finding techniques to examine this type of sequential structure. In the 1980s, biochemists created analytical methods, which were altered to fit various research fields, such as economics (game theory, marketing strategies), psychology (sequence of item recall, stimuli, and anchoring), archeology (ordering of artifacts), and linguistics (formulation of textual images) (Abbott, 1995). Perhaps, the most widely recognized application of sequence analysis is in the field of molecular biology for DNA matching in paternity tests and criminal investigations. This approach has been relatively understudied in the context of human behaviour, with the exception of a few travel behaviour pattern studies, such as daily activity pattern analysis (Wilson, 1998), vacation behaviour (Bargeman et al., 2002), activity pattern similarity (Joh et al., 2002), human activity analysis in space and time (Shoval and Isaacson, 2007), as well as urban space interpretation (Huynh et al., 2008).

In terms of conceptualizing how individuals formulate their daily food choice decisions, theoretical frameworks and conceptual models derived from disciplines, such as social psychology, health behaviour, economics, and social sciences, have been used in food choice behavior studies (Axelson and Brinberg, 1989; Baranowski et al., 1999; Conner and Armitage, 2002; Lancaster, 1998, 1991). In particular, theoretical frameworks, such as the life-course perspective (Devine et al., 1998), early food choice process models (Falk et al., 1996; Furst et al., 1996), and personal food systems (Connors et al., 2001) have been widely used in dietary behavior studies.

Perhaps one of the most comprehensive theoretical frameworks for explaining food choice behaviour is the food choice process model shown in Figure 12 (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996). This model is based on interviews with American adults' concerning their food choice behavior. This model offers an extensive framework of potential attributes impacting food choice decisions, comprised of three major interconnecting components: the life course, influences and personal food systems. The life course includes the changes in a person's past and current food choice experiences over multiple points in one's life and incorporates various influences, such as personal factors, ideals, resources, and social factors. In addition, the personal food systems, which are the mental processes that shape people's food choices, represent the different methods that individual boundaries, options, and trade-offs are formed during different food choice decisions. Not only are the systems dynamic and evolving as new life course events and food choice influences are encountered, they also consist of the processes of constructing food choice values, categorizing foods and situations based on food choice values, negotiating and balancing values, and creating strategies for different food selection situations. Figure 12 illustrates the transition from long- to short-term elements (top to bottom) starting with life course to food choice. The food choice process model has a broad range of significant elements to explain individual food choice behaviour.

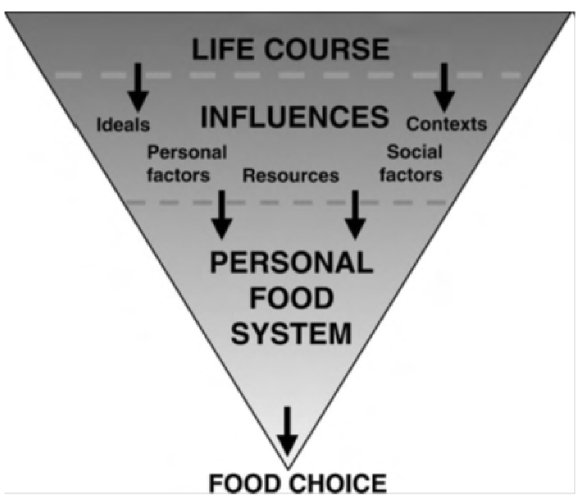


Figure 12: The food choice process model explains people's construction of food choices (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996).

3.3 Objectives

The main goal of this exploratory paper was to expand on the last stage of the food choice process model (see Figure 12) by exploring personal food systems in more depth, including potential relationships and patterns of food thoughts, plans, purchases, and preparations leading up to food intake based on exploratory results. Included was exploration of possible patterns and relationships of FCP decisions, including impact of sociodemographic and social interaction related variables, using descriptive and exploratory multivariate statistical techniques.

3.4 Methodology

3.4.1 Data collection

The novel data collection process was multi-staged including a preparatory meeting with participants, a 4-day data observation period and a follow-up interview. Participants wore a *hidden body video camera* worn at chest level pointed outward and a GPS location tracking device for 10 to 12 hours each day for four consecutive days. The goal of the tracking devices was to observe subject's daily food-related activities without requiring participants to manually recall them. Afterwards, subjects participated in one-hour interview exploring several aspects of their choices in more depth. This paper focuses on the 4-day observation data. Refer to CHAPTER 2 for more details on the 4-day observation period and CHAPTER 4 for a full description of the follow-up interview.

Eighty individuals were invited by email, phone calls, and face-to-face meetings to participate in the study. Of these, twenty individuals agreed to participate, or a 25% response rate. The sample size was kept purposely small due the time commitment required, the invasive nature of the video recording device, the desire to minimize risk as a condition of ethics approval, but primarily the experimental nature of the study. The twenty participants resided in Hamilton and Kitchener, Ontario, Canada, both of which have a minimum population density of 400 persons per square kilometer. Individuals aged 30 to 50 years were ideal candidates as they are considered "Generation X" (generation born after the Western post-World War II baby boom) and are likely to have one or more children, consume meals alone and/or with others (friends, family or colleagues), and be familiar with the use of technology. The goal was also to obtain a sample in which half the participants were overweight as defined by BMI.

This thesis was approved by Wilfrid Laurier University's Research Ethics Board. Special procedures implemented to protect subjects' privacy included immediate securing of video data with strong password protection and promptly removing personal confidential information if captured in video footages. Despite these strategic measures, some information belonging to people other than participants was captured on video without their consent, but only stored temporarily. This ethical breach was deemed worth the risk in light of the benefits of collecting the data for research purposes.

3.4.2 Data analysis procedures

The first step in analysis was to closely review the video and code the FCP events observed in a quantitative fashion suitable for analysis. This included coding of food thoughts, plans, purchases, preparations, and consumption events along with their attributes: date, time, location, accompanying persons, and any indication of social influence amongst participants. Other attributes coded were video data length and size, working status of microphone for video data, FCP location if identified by GPS data, and qualitative description of FCP events.

Given the exploratory nature of the thesis, one researcher was deemed sufficient for the video data coding. The main limitation of not having multiple researchers to independently code the same video data was the inability to evaluate the level of inter-rater reliability. To maximize the reliability of the coding, clear and concise guidelines for coding FCP attributes and a systematic confidence scoring were applied throughout the process to ensure that all coded events adhered to the same standards and maintained the highest degree of consistency as possible for an exploratory study (see the methods section in CHAPTER 2 for further details).

An experimental database of observations for each of the twenty participants was created, including sociodemographic variables and number of FCP measured on a per day basis for ease of interpretation. Further variables used in the analyses are defined in Table 9 in the next section. To explore the potential relationships between the food choice process, sociodemographic, and social interaction related variables, several types of analyses were conducted including Pearson correlations, Principal component analysis (PCA), and unidimensional sequence alignment analysis. Only the Pearson correlations incorporated all three types of continuous variables chosen based on potential relevance in association with the FCP. Next, the PCA was conducted on the number of food choice processes variables and sociodemographic variables to identify a smaller number of factors that may account for most of the variance within the set of observed variables. This method of data extraction searches for a linear combination of variables, grouped as a component. Components are subsequently formed to account for as much of the outstanding variation as possible and are uncorrelated with other components. They will continue to form until there are as many components as the initial set of variables. Besides the unrotated matrix produced by default, Varimax rotation, an optional orthogonal rotation method, was applied to reduce the number of variable that have high loadings on each component and to simplify the interpretation of the components. Since factor loading coefficients range from -1 to +1, only the variables with loading coefficient above 0.4 in absolute value were considered large and displayed in the output table for interpretation purposes. Rejecting variables with the smallest absolute coefficient values is considered choosing a subset of variables to generate a truncated version of the principal component (Jolliffe, 2002). Although, Stevens (2012) has just recently suggested taking the sample size into account to conduct a significant test for each loading to determine the loading coefficient cutoff value, it is still common practice and more widely accepted to use an arbitrary cutoff value, usually ranging from 0.3 to 0.4 (Jolliffe, 2002; IBM Corp, 2013).

Lastly, the sequence analysis was employed on “strings” of FCP events to explore the potential sequential patterns of events. To prepare the input file, letters A, B, C, D, and E were assigned to represent food thoughts, food planning decisions, food purchases, food preparations, and food consumption events, respectively. Each person’s day could then be represented as a string of events; one for weekday and another for weekend. Since there were two days for weekdays and weekends, the days with the highest average coding confidence levels were selected to represent the weekday or weekend sequence string.

The Clustal Omega software (http://www.clustal.org/omega/) was used to align sequences of FCP decisions. The analysis produced phylogenetic trees (phylogram), matching sequence alignment point diagrams, and percent identity matrices. Initially, Clustal Omega attempted to formulate the best hierarchal tree by grouping two sequences that are as identical as possible. Additional sequences were added to trees in the same manner to build a larger tree plot. These trees illustrated sequence relatedness through concordance scores and tree branch organizational system. For each branch, the numeric values next to the word, ‘participant’, represented each participant’s identification number, followed by the concordance score. The smaller the concordance score, the more related a participant was to other participants in the same group and to all other participants in the sample. For example, if two sequences were identical, their concordance score would be zero. Sequences that match closely were located in close proximity on the phylogenetic trees. Thus, participants can be visually segregated into a few distinct groups based on proximity of branches on the tree and their distance from the root of the tree.

The matching sequence alignment point diagrams also demonstrated sequence relatedness in a form of a chart that separated potential sequence element groupings based on concordance scores. The repetitive clustering of sequence elements in the diagrams indicated sections where the sequence alignments matched.

Clustal Omega also produced a percent identity matrix containing the percentage of matches between each pair of sequence strings, which was used to calculate the average matching percentage for each selected group. The average matching value was used to check the degree of similarity between the groups and functioned as the confidence level for sequence string matches. There is no established guideline or statistical limit for determining significantly acceptable percentages for Clustal Omega results. In the field of biology, the matching value tends to be high (over 99%), especially for DNA matching in paternity tests and criminal cases. Due to the exploratory nature of this research, fifty percent was considered an acceptable sequence matching level, especially given the unique nature of the untested FCP elements in the sequence strings.

A table was created to illustrate the cross-analysis incorporating both the selected groups based on phylogenetic trees and the matching sequence alignment point diagrams. The FCP descriptions, which represented the commonly matched segments of FCP strings per group, was formed by identifying all participants belonging to a group and looking up their corresponding information in the matching sequence alignment point diagrams, and subsequently determining the commonly matched segments amongst the entire group.

3.5 Results

3.5.1 Descriptive analysis of the FCP event type and their attributes

The sample consisted of 20 adults; 17 were residents of Hamilton, Ontario and 3 were residents of Waterloo, Ontario. Table 9 displays descriptive statistics of all the variables measured on a per participant per day basis used in subsequent correlations, PCA and sequence analysis. The average age was 35.8, which is in the lower end of the chosen age range, 30 to 50. There was almost an equal number of males (45%) and females (55%) in the sample (see Table 9), which corresponded with the national census profile for males (48%) and females (52%) (Statistics Canada, 2012). More than half of the participants in the sample were married (65%), which was higher than the national reporting of 46% married individuals. On average, Canadian families had 1.1 children at home, which was close to the average of one child in household in the sample. The BMI ranged from 19.3 (normal weight) to 33.2 (obese) with 45% of sample being overweight or obese, which was lower than the proportion of overweight or obese adults in Canada (52.5%) (Statistics Canada, 2012).

There were a total 813 FCP events observed from the video footages, the distribution of which is shown in Table 9. Food consumption events were the most frequent (19.1), followed by food preparations (9.8) and food thoughts (6.0). The video data also revealed that approximately half of the participants' FCP events had accompanying person(s) present, with an average of 0.9 accompanying person per event, the most common of which was participant's immediate family members. If present, participants were accompanied by 1 to 1.6 different types of people per event.

Table 9: All variables used in the empirical analysis, including sociodemographic, FCP, and social interaction related characteristics measured on a per participants per day basis (n = 20).

Variable	Definition	Number of participants (%)		Mean	Standard Deviation
Sociodemographic characteristics					
Sex	1 if person is female; 0 if person is male				
Male		9	(45%)	-	-
Female		11	(55%)	-	-
Marital status	1 if person is married; 0 if person is single				
Single		7	(35%)	-	-
Married		13	(65%)	-	-
Age (years)	Age in years	-	-	35.8	6.7
Weight (pounds)	Weight in pounds	-	-	155.0	31.1
Body mass index	Underweight if < 18.5; normal weight if 18.5–24.9; overweight if 25–29.9; obesity if =/<30	-	-	24.5	4.0
Number of children in household	Number of children in household	-	-	1.0	
Food choice process characteristics					
Number of food thoughts	Number of food thoughts	-	-	6.0	11.1
Number of food planning decisions	Number of food planning decisions	-	-	1.4	2.9
Number of food purchases	Number of food purchases	-	-	4.4	3.0
Number of food preparations	Number of food preparations	-	-	9.8	6.7
Number of food consumption events	Number of food consumption events	-	-	19.1	8.5
Social interaction related characteristics					
Presence of significant other/spouse/partner	Number of food choice process events with significant other/spouse/partner present	-	-	7.3	9.9
Presence of immediate family member(s)	Number of food choice process events with immediate family member(s) present	-	-	8.5	7.7
Presence of friend(s), extended family member(s) & in-law(s)	Number of food choice process events with friend(s), extended family member(s) & in-law(s) present	-	-	5.1	8.1
Presence of non-personal/professional associate(s)	Number of food choice process events with non-personal/professional associate(s) present	-	-	5.3	5.6
Presence of events with accompanying person(s) *absent*	Number of events with accompanying person(s) *absent*	-	-	20.7	12.3

3.5.2 Pearson correlations

The Pearson correlation analysis conducted on 169 pairs of continuous variables resulted in 34 pairs of correlations significant at the 0.01 and 0.05 level (2-tailed), as shown in Table 10. Both number of food thoughts and food plans were highly correlated with presence of significant other, as well as friends and extended family. Also, both number of food preparations and food consumption events were associated with no accompanying persons present. The last trend was both age and presence of children were moderately correlated with presence of immediate family members. Overall, social interaction variables tended to correlate most with the FCP variables, whilst the sociodemographic variables had minimal correlations, and BMI had no significant correlation at all.

Table 10: Pearson correlation coefficients of number of each FCP events, sociodemographic, and social interaction related variables measured on a per participants per day basis (n = 20).

	Number of food thoughts	Number of food planning decisions	Number of food purchases	Number of food preparations	Number of food consumption events	Age	Body mass index	Number of children in household	Number of FCP events with presence of significant other/spouse/partner	Number of FCP events with presence of immediate family member(s)	Number of FCP events with presence of friend(s), extended family member(s) & in-law(s)	Number of FCP events with presence of non-personal/professional associate(s)	Number of FCP events with no presence of accompanying person(s)
Number of food thoughts		.938**							.753**		.887**		
Number of food planning decisions	.938**								.724**		.913**		
Number of food purchases											.459*	.498*	
Number of food preparations					.680**					.713**			.770**
Number of food consumption events				.680**		.464*							.853**
Age					.464*			.705**		.537*			
Body mass index													
Number of children in household						.705**				.527*		.500*	
Number of FCP events with presence of significant other/spouse/partner	.753**	.724**									.614**		
Number of FCP events with presence of immediate family member(s)				.713**		.537*		.527*					
Number of FCP events with presence of friend(s), extended family member(s) & in-law(s)	.887**	.913**	.459*						.614**				
Number of FCP events with presence of non-personal/professional associate(s)			.498*					.500*					
Number of FCP events with no presence of accompanying person(s)				.770**	.853**								

. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

3.5.3 Principal component analysis

The Principal component analysis factor loadings are shown in Table 11 (unrotated) and Table 12 (rotated). Both types of matrices were included in the analysis for exploratory purposes and they provided distinct results. The matrices were based on the ten variables with highest extraction values, all of which resulted in the four extracted components. Both matrices illustrated different patterns of correlations and explained nearly 82% of variability in original ten variables with only 18% loss of information.

For the unrotated matrix, the first component was characterized by heavier males, with more food thoughts and food planning decisions, yet had less food preparation and food intake events (see Table 11). The second component was characterized as older married individuals with more children in household, who had more food thoughts, planning decisions, preparations, and consumption events. The third component was characterized by unmarried females, who had more food thoughts, plans, and purchases. The last component was characterized by individuals with fewer children, more food preparations and consumption events, but had less food purchases.

In terms of trends in the unrotated matrix, the combination of number of food thoughts and food plans appeared in the first three components and the grouping of number of food preparations and food intake was evident in the first, second, and fourth components. The second component had the most similarities with the other components. For instance, the grouping of number of food thoughts, food plans, and marital status was found in the second and third components. Similar results with the fourth component; number of food preparations, food consumption events, and children in household was apparent in both. The first and second components shared the most similarities as both contained the same combination of four traits—number of food thoughts, plans, preparations, and consumption events. As the only outlier, age loaded in only one component while the rest of the variables appeared in at least two components.

Overall, FCP characteristics mainly appeared in components in pairs, including especially food thoughts and plans, as well as food preparations and consumption events. While food purchases was usually grouped in a set of three variables—food purchase with food thoughts and plans, as well as with food preparations and consumption events. The sociodemographic traits always loaded in a component with another trait, except for the presence of children in the fourth component.

As for the rotated matrix (see Table 12), the first component was characterized by heavier individuals, with more food thoughts, plans, and purchases. While the second component was characterized by lighter unmarried females, with more food purchases. The third component was characterized by older married individuals with more children in the household. The last component was characterized by individuals with more food preparation and food consumption events.

Compared to the unrotated matrix, there were fewer patterns amongst the components as they contained fewer traits—two to four per component, most likely due to the Varimax rotation, which tends to spread the explained variation more evenly amongst components. The combination of weight and number of food purchases was in the first and second components. All variables loaded in the components once except for number of food purchases, marital status and weight, all of which loaded in the second component for the second time.

Overall, the loading of FCP traits in the components were divided in two groups—food thoughts, plans, and purchases in one group and food preparations and consumptions events in another. Whenever present, the sociodemographic variables always loaded in a component with another trait, except for weight in the first component.

There are differences between the two matrices; the rotated matrix had fewer, yet higher factor loading coefficients resulting in fewer component characteristics to describe the components. The unrotated matrix generated a greater number of factor loading coefficients above 0.4 (22) than the rotated matrix (13). However, the rotated matrix had a higher average factor loading coefficients (0.8) than the unrotated matrix (0.6).

Table 11: *Unrotated* Principal component analysis factor loading results for FCP and sociodemographic variables measured on a per participant per day basis (n = 20).

	Component			
	1	2	3	4
Number of food thoughts	.612	.533	.488	
Number of food planning decisions	.596	.533	.530	
Number of food purchases			.725	-.437
Number of food preparations	-.463	.517		.604
Number of food consumption events	-.439	.570		.521
Sex	-.728		.476	
Age		.782		
Marital status		.418	-.669	
Number of children in household		.683		-.509
Weight (pounds)	.823			

Only values larger than 0.4 are shown in table.

Table 12: *Varimax rotated* Principal component analysis factor loading results for FCP and sociodemographic variables measured on a per participant per day basis (n = 20).

	Component			
	1	2	3	4
Number of food thoughts	.942			
Number of food planning decisions	.956			
Number of food purchases	.442	.730		
Number of food preparations				.921
Number of food consumption events				.873
Sex		.826		
Age			.868	
Marital status		-.668	.538	
Number of children in household			.907	
Weight (pounds)	.515	-.598		

Only values larger than 0.4 are shown in table.

3.5.4 Sequence analysis

The sequence analysis of the weekday and weekend strings of FCP events produced phylogenetic trees with visually selected groups (Figure 13 and Figure 14), matching sequence alignment point diagrams (Figure 15 and Figure 16), and percent identity matrices. The results from the cross-analysis of the phylogenetic trees and the matching sequence alignment point diagrams revealed similar patterns in the ordering of FCP elements amongst the groups for both weekdays and weekends, so they are explored separately below.

The weekday sequence alignments diagrams revealed matching at two different alignment points as indicated by the arrows in Figure 15. The first alignment on the left was dominated by food purchases and food consumption events (C and E). The second alignment had repetitive groupings of food preparations and food consumption events (D and E). Regarding patterns, the ordering of food purchase followed by food consumption was evident in two of the three groups as displayed in Table 13. The ordering of food preparation followed by food consumption was apparent for all groups. The repetition of two food consumption events appeared in just one group. For short sequences of two to three elements, the arrangement of the elements always followed the ordering of CDE. For example, E always came after C or D. The longer sequence strings, such as EEDEDE, was unique to one group and the elements followed a sequential repetition of D and E. There was moderate confidence in the matched strings and degree of similarity between the groups as the average matching value was 56.7%.

Regarding the weekend results, the strings matched at three different alignment points, also shown by arrows in Figure 16. The first alignment on the left contained a predominant cluster of food purchases and food consumption events (C and E). The next alignment point possessed a clustered mix of food purchases, food preparations, and food consumption events (C, D, and E). The last alignment point was dominated by food preparations and food consumption events (D and E). As for trends, the ordering of food purchase followed by food consumption was noticeable in a small portion of the matched sequence for one group as displayed in Table 13. The succession of food preparation followed by food consumption was apparent in two groups. The repetition of two consecutive food consumption events appeared in two groups as did two food purchases in another group. For short segments of two to three elements, the arrangement of the elements always followed the ordering of DE. The longer sequence strings, such as DEDEDE and CEDEDE, was unique to one group, contained six elements, and C always preceded D and E. There was moderate confidence in the matched strings and degree of similarity between the groups as the average matching value was 60.0%.

Nonetheless, for both weekdays and weekends, food thoughts and plans rarely appeared in any matched sequences while food consumption was apparent in all groups. The beginning of strings varied amongst C, D, or E, while they all ended with food consumption.

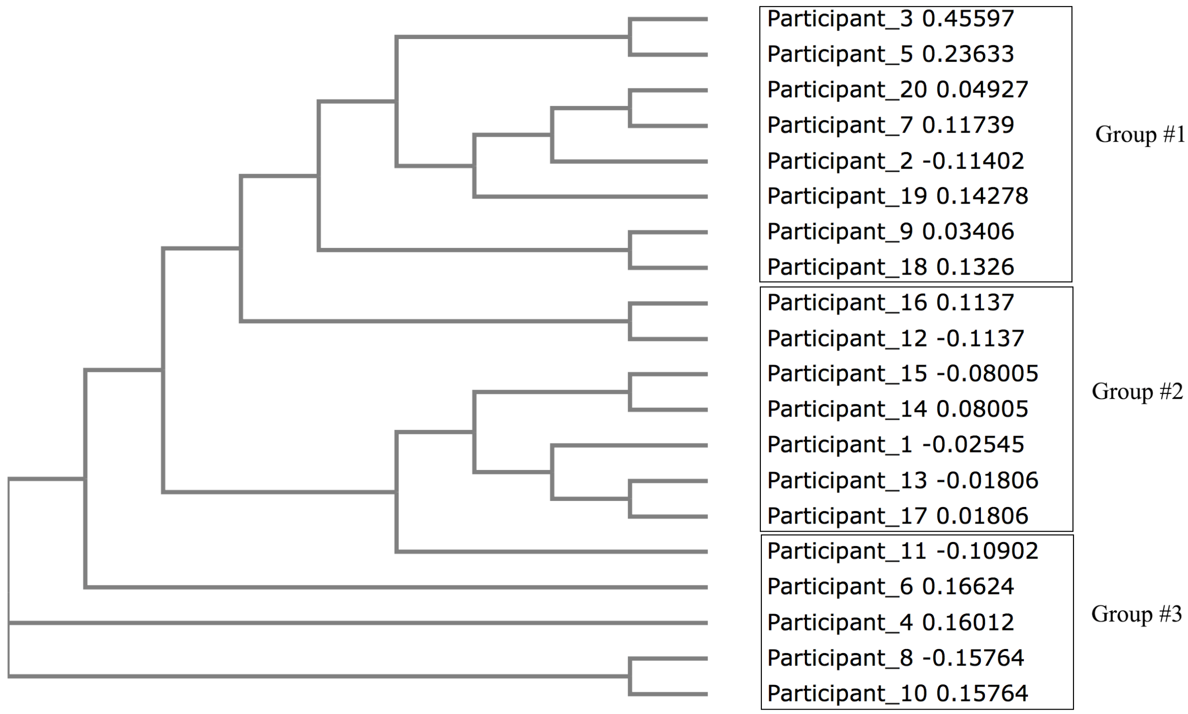


Figure 13: ***Weekday*** **phylogenetic tree showing selection of three groups from the clustering of twenty strings of FCP events (n = 20).**

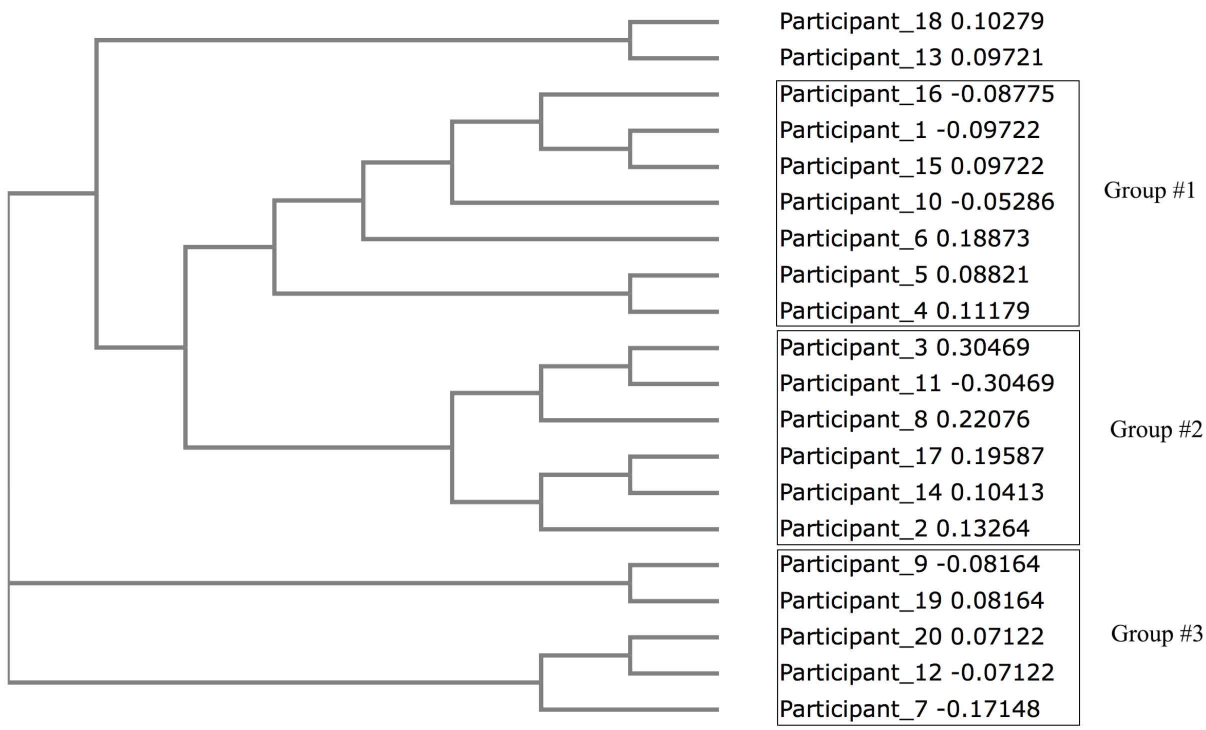


Figure 14: *Weekend* phylogenetic tree showing selection of three groups from the clustering of twenty strings of FCP events (n = 20).

Matching of sequence strings at different alignment points

```
Participant_3       --DEBACEACAAACEABBBEADBEA---
Participant_5       --------ACEDEEABBEEEE-------
Participant_16      -------CECEADE--------------
Participant_15      --DDEDEEECCE----------------
Participant_1       ------ECECCE----------------
Participant_9       ------ECECEEEE--------------
Participant_18      --------DCEEEEEDED----------
Participant_20      ----------EDEEEDE-----------
Participant_7       -----------DEAEDE-----------
Participant_19      ------CCECEDEAADEEADEEE-----
Participant_2       ----EDDBECEDE---------------
Participant_12      ---------------EEDEEEEDEEDE-
Participant_6       DDBEDEAEECAEECAEEDEDEEEE----
Participant_4       -------E--EEBCDEEDEDEDDE----
Participant_11      ---------------EEDEDEEDEDDED
Participant_8       ---------------EEDEDEEDE----
Participant_10      ----DEAD--EAAADEEDEDEEDEDEEB
Participant_14      ------------ADDEEEADEEAEADEA
Participant_13      -------------DDEED----------
Participant_17      -------------DDEEDEEDEDE----
```

Figure 15: ***Weekday*** **multiple sequence alignment showing matching of twenty strings of FCP events at two alignment points (n = 20).**

Matching of sequence strings at different alignment points

```
Participant_18     ------------------------------------ECCEECEE-----------
Participant_16     ---------------------------------CECECC----------------
Participant_1      -------------------------------------CC----------------
Participant_15     -------------------------------------CCEDBA------------
Participant_9      ------------------------------------------EEEEEE-------
Participant_3      DEABAABBAACAEAAAAEAABCAAAAABAAAABCADEAAAACBEA----------
Participant_17     ----------------------------------------DDEDEEAE--DEE--
Participant_14     ----------------------------------DEEEEADEEDEDEE--DE---
Participant_8      -------------------------------------EEADCDEDDEE--DE---
Participant_2      ----------------------------------DEEDEADDEDDDEE--DDE--
Participant_11     ---------------------------------------------DEE-------
Participant_6      ------------------------------------EDEEDBEDEDEDEEADEDE
Participant_10     -------------------------------------------DEDEDE------
Participant_20     -----------------------------------------CEBBEDEEAADE--
Participant_19     -------------------------------------DEDECEE-----------
Participant_13     ---------------------------------------EDCEED----------
Participant_12     -----------------------------------EAEEAECE------------
Participant_5      -------------------------------------EDEECEDEDEDEEDDE--
Participant_4      ---------------------------DEDEEDDDEEADDECEDEDE--------
Participant_7      -----------------------------------------CE------------
```

Figure 16: *Weekend* multiple sequence alignment showing matching of twenty strings of FCP events at three alignment points (n = 20).

Table 13: Cross-analysis of the phylogenetic trees and matching sequence alignment point diagrams based on twenty strings of FCP events on weekdays and weekends (n = 20).

Type of day	Group[1]	Number of participants per group	FCP description[2]	Average matching value[3]
Weekday	1	8	CE → DE Start of sequence is dominated by food purchase and followed by food consumption Later dominated by food preparation and food consumption	55
Weekday	2	7	CE & DEE Start of sequence is dominated by food purchase and followed by food consumption events Other parts are dominated by food preparation and the rest of sequences include groups of food consumption events	32
Weekday	3	5	EEDEDE Dominated by food consumption events at the start. The rest of sequences include food preparation and consumption interspersed throughout.	83
Weekend	1	7	CC & DEDEDE & CEDEDE Dominated by food purchases in some parts of sequence Dominated by food preparation followed by food consumption in other parts of sequence Dominated by food purchases then food preparation and food consumption in other parts of sequence	43
Weekend	2	6	DEE → DE Start of sequence is dominated by food preparation and followed by food consumption events Later dominated by food preparation and food consumption	49
Weekend	3	5	EE Dominated by food consumption events.	88

1 Selection of groups was based on phylogenetic trees.
2 FCP descriptions represent the commonly matched segments of FCP strings per group
3 Calculation of the average matching value per group was based on percentage of sequence matching between pairs of sequence strings obtained from the percent identity matrix generated in Clustal Omega.

3.6 Discussion and conclusions

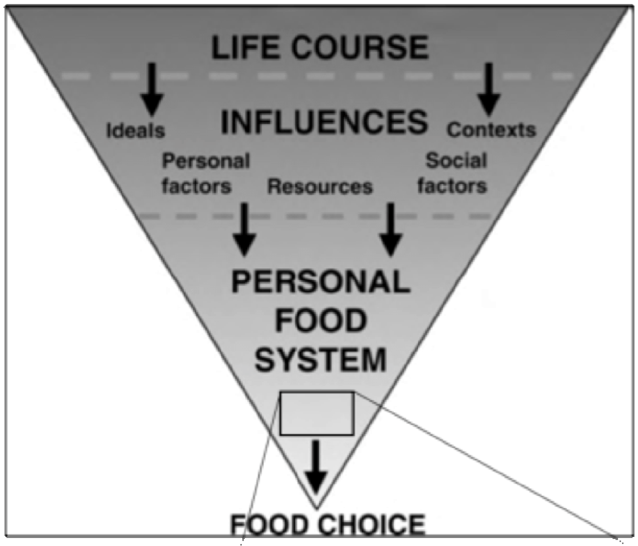
This thesis presented analysis of a novel dataset that tracked real-world FCP-related events beyond just the act of food consumption, including possible patterns of FCP decisions, and potential relationships with sociodemographic and social interaction related variables, through basic descriptive and exploratory multivariate statistical techniques. The Pearson correlation analyses yielded a number of statistically significant correlation pairs (34). Both number of food planning decisions and food thoughts were highly correlated with presence of significant other, friend(s), extended family, and/or in-law(s), which was likely logical as individuals need to express opinions to one another concerning their thoughts in an effort to reach group consensus when negotiating joint food plans (Bove et al., 2003; Sobal and Nelson, 2003). Number of food preparations was highly correlated with presence of immediate family member(s) and no accompanying persons present. This outcome was expected given that preparing food is primarily considered as a household chore rather than a social event (Daniels et al., 2012). The other finding showing that number of food consumption events was also highly correlated with no accompanying persons present was supported by studies reporting that most people ate alone, especially breakfast and lunch (Sobal and Nelson, 2003) and on weekdays (Rodrigues & Almeida, 1996).

Surprisingly, the sociodemographic variables yielded few significant connections with the FCP variables, and BMI not at all. This was unanticipated considering that weight gain is strongly associated with food consumption. Instead, there were correlations between social interaction variables and the FCP variables, which may imply an important connection between these types of variables that may be worth further exploration in future obesity related research.

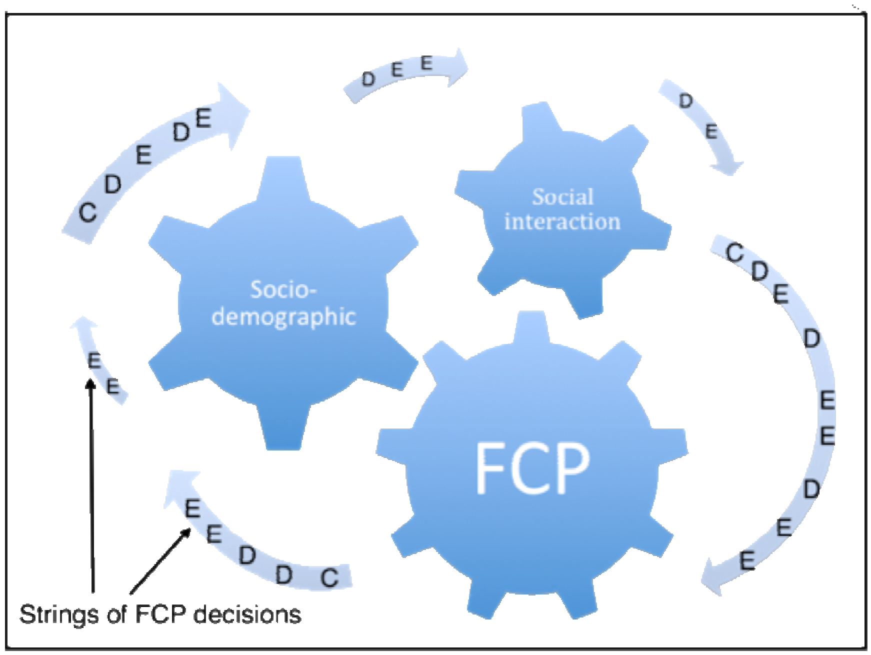
The sequence analysis provided a different perspective on FCP patterns as compared to the PCA results. The grouping of food preparations and consumption events typically appeared in both analysis, which was expected since food preparation at home usually goes hand in hand with immediate food intake and no participant had a domestic worker to prepare meals for them. However, the pairing of food thoughts and plans only appeared in the PCA components, which may be logical as the process of thinking along with organizing activities is usually necessary to achieve the end goal of food consumption as with any type of planning. Absence from the sequence alignments also made sense due to the malfunction with the audio recorder and the general difficulty with observation of that type of FCP decision. Unique results to the PCA included the common loading of both weight and number of food purchases in the unrotated components, which was not surprising given that eating out is associated with an increased risk of becoming overweight or obese as a result of weight gain (Nago et al., 2014). New trends generated from the sequence analysis included the sole presence of food consumption at the end of all matched FCP strings, which likely made sense since food intake is generally the typical goal of nearly all food choice decisions. Also, the arrangement of elements in matched segments tended to follow a specific order (e.g., food purchase, preparation, and then consumption), which may suggest that FCP decisions likely occur in a consistent logical order that is not random. The sequence analysis also showed that both weekdays and weekends yielded moderate confidence in the matched strings and degree of similarity between the groups, which may suggest that the overall sequential patterning of FCP events was not dependent on the day type. This outcome does not concur with dietary related studies reporting that adults consume a diet that is higher in calories and lower in nutrition on weekends as compared to weekdays (Ledet et al., 2014; Yang et al., 2014).

Overall, the experimental results demonstrated that there may be distinct patterns of FCP decisions that could be linked to social interaction related characteristics. Although the sample is small and non-random sample, making generalization is difficult, it represents a promising start and guide for future studies. Studying these relevant patterns and behaviours of FCP decisions may help further the understanding of how and what foods individuals ultimately end up eating. However, whether they have an eventual impact on BMI is still to be determined. Acquiring effective methods to observing FCP decisions is a vital step towards this exploration.

Based on the empirical results presented in this paper, an elaboration of the ‘personal food systems’ stage of the food choice process model might be possible, as shown in Figure 17. The exploratory results suggest that FCP decisions, sociodemographic and social interaction variables, and ordered sequence strings of FCP decisions, may be key observable interrelated components missing from the current food choice process model that signify a practical and ‘mechanical’ part of the process, as implied by the three interconnected gears. Daily FCP decisions might also be organized by varying lengths and patterns of sequence strings that follow a particular ordering of elements. The results supported the need for further research and testing of the experimental technique on a larger scale.



The food choice process model (Source: Falk et al., 1996; Furst et al., 1996; Connors et al., 2001).



Close up of added component to the Food choice process model.

Figure 17: Modified food choice process model with the addition of FCP, sociodemographic and social interaction variables, and ordered sequence strings of FCP decisions based on study results.

Experimental results from the sequence analysis could also potentially inform food retail marketing researchers on consumers' patterns and behavior, including order and timing of FCP decisions, to possibly help them better understand consumers' needs to figure out which foods to sell, what messages to use in advertisements, and when, where, and how to target advertisements to consumers. Furthermore, the video recording technology may be capable of observing other specific food related characteristics, such as food ingredients involved in food preparation, eating utensils used, and quantity of food eaten, as well as non food related attributes, such as one's time spent on daily activities as observed in this study. Analysis involving additional variables could contribute to the discovery of more patterns of and factors associated with FCP decisions, which may eventually assist nutritionists and professional fitness coaches with customizing plans to help people achieve dietary and fitness goals. More importantly, the additional variables may also be more correlated with BMI, and provide a possible link to obesity not necessarily found in the current thesis. Future studies interested in using the video recording technology need to be mindful of the time and labour involved in the data collection process and the privacy concerns regarding the potential of recording individuals outside of the study and/or sensitive information without permission and secure storage of the video data.

This thesis purposely utilized a small sample and one video data coder due the exploratory nature of the study. Future studies could use larger and random sample, which may lead to results that could be generalized to a population. Also, future studies could utilize multiple researchers to independently code the same video data and use the same confidence scoring to establish a reasonable level of inter-rater reliability and robustness.

Moving forward, to explore other potential types of factors connected to the FCP that have not been studied, future studies could investigate various physical locations of FCP events, including public and/or private transportation, restaurant dine-in seat position, and seating in front of television, computer and/or at dining table. Different eating environments may have different amounts of time available to complete a meal or may have different spectators and/or social accompanying persons present that can highly affect FCP decisions. In addition, upcoming studies could examine the FCP and its association with proximity of food retailers to the home and workplace, knowledge of food nutrition, and daily time use on weekdays and weekends, including number of hours spent on paid and unpaid work, physical and sedentary activities, and commute to and from work. Building a more comprehensive profile of individuals could possibly provide more insights into factors associated with FCP decisions, which may potentially enhance the understanding of how people construct their daily food habits.

3.7 References

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CHAPTER 4 Investigating the impact of social influence on the daily food choice process

4.1 Introduction

Obesity, defined by a body mass index (BMI) of 30 or higher, is a growing health concern for many Canadians. Obesity rates for Canadian adults have tripled in less than thirty years (from 1985 to 2011) and are projected to increase by approximately 21 per cent by 2019 (Twells et al., 2014). Weight related issues has been strongly linked to food consumption and has been the focus of numerous studies. Studying food consumption alone is likely not sufficient to understanding overall daily dietary patterns. Special focus on a novel concept, the overall *food choice process* (FCP), including *food thoughts*, *plans*, *purchases*, and *preparation*, leading up to *food intake/consumption* may contribute to an improved understanding of food choice behaviour, as FCP may have significant connections with weight gain that could potentially help combat obesity. To address this need, this paper utilized an automated activity monitoring system for capturing the fundamental elements underlying FCP that lead to observed food choices and specifically explored potential effects of social influence on FCP decisions. The multi-stage data collection process, including in-depth interviews, is summarized in the methods section followed by the data coding and descriptive analyses of the results. The possible implications of these findings for the existing food choice process model are also discussed.

4.2 Background

Since food consumption is a strong contributor of weight gain, previous studies have attempted to understand the potential factors affecting dietary patterns by exploring the effects of social influence on eating in commensal groups during physical social interactions. The typology of these effects are summarized in Table 14a, which includes several types of social situations involving the presence of other people that impacted one to two key food intake features. These impacts are supported by research findings and explained by potential mechanisms, which are further defined in Table 14b. All of these studies observed adult participants' dietary behaviour in both simulated and real-world environments, but mainly the latter. In terms of social impacts, these studies focused on increases and decreases in quantity, quality and duration of food intake. Regarding quantified patterns, food intake quantity and duration were power functions of the number of people present (Clendenen et al., 1994a; De Castro and Brewer, 1991; Mathey, 2000) and the percentage of food intake was proportionally higher with the presence of other people (De Castro and De Castro, 1989b; Redd and de Castro, 1992). The most common mechanisms for explaining the impacts included social facilitation, social conformity, impression and acceptance, and time extension. The food consumed was usually referred to as just 'food' and sometimes as 'meal' or 'snack', but never a specific food type, group, or ingredient. Overall, these empirical findings highlighted in Table 14 provided a unique contribution to the growing body of work on social factors impacting food consumption decisions. However, the previous studies have not considered social influences on the wider FCP leading up to food intake, a major gap in the literature, which may expand the understanding of the construction of food selection.

Table 14: a) Typology of social factors impacting food intake characteristic during food intake events.

Social factor impacting food intake	Food intake characteristic	Examples of how food intake characteristic was impacted by social factor	Potential mechanism(s) explaining the impact*
Presence of accompanying persons	General food consumption patterns	-Preschoolers' food choices, preferences, and consumption patterns were strongly influenced by those of other children (Birch, 1980) -Several weeks after exposure to their peers' food choices, they still showed increased preference for foods they initially did not prefer (Birch, 1980)	Social facilitation Social conformity (matching, imitating, modeling) Impression and acceptance
	Quantity	-Individuals chose larger meals when with others than when alone (De Castro, 1991) -Individuals occasionally limited their food consumption when eating with others (Mori et al., 1987; Pliner and Chaiken, 1990) -The amount of food eaten in a meal by normal humans was larger by 44% when the meal was eaten with other people present than when alone (De Castro and De Castro, 1989b) -Food intake was 60% higher when the subjects ate with others present than when they ate alone (Redd and de Castro, 1992) -Individuals ate less with another person who ate minimally than with someone who ate a large amount of food (Conger et al., 1980a, Goldman et al., 1991, Herman et al., 2003, Nisbett and Storms, 1974, Roth et al., 2001)	
	Duration	-Presence of other people would appear to extend the duration of eating and increase intake (De Castro, 1990)	
Number of accompanying persons	Quantity	-The influence of the number of other people present on the amount spontaneously ingested in a meal was a robust phenomenon that was described by a power function (De Castro and Brewer, 1991) -28% , 41%, 53%, 53%, 71%, and 76% increases were associated with 1, 2, 3, 4, 5, and 6 or more persons present, respectively (De Castro and Brewer, 1991)	Social facilitation Social conformity (matching, imitating, modeling) Impression and acceptance Time extension
	Duration	-When number of eaters was controlled for and duration of meal was observed, meal duration was a positive function of group size (Clendenen et al., 1994a; Mathey, 2000)	
Group size of accompanying persons	Quantity	-Eating in groups led to increased food intake (Clendenen et al., 1994b; De Castro, 1990; Edelman et al., 1986; Hirsch and Kramer, 1993; Klesges et al., 1984; Krantz, 1979)	Social opportunity Time extension
Presence of familiar accompanying persons (e.g., friends, family, significant other, etc.)	Quantity	-Eating with familiar people led to increased food intake (De Castro, 1990) -Males ate significantly more when with friends than alone, while males and females did not consume more food when eating with strangers (Shide and Rolls, 1991) -Both males and females in the couple situation ate more than others in all other conditions (Salvy et al., 2007b)	Social effect of familiar people Peer pressure Time extension Permission giver
	Quality	-Dining with familiar persons led to consumption of higher-fat foods (McIntosh, 1996) -People ate less dessert when dining with strangers than with friends, whereas there was no difference in amount of entrée eaten when with friends or strangers (Clendenen et al., 1994a)	
Presence of unfamiliar accompanying persons	Quantity	-Females ate less in the presence of a desirable male than when with an undesirable male, whereas males ate less in the presence of females regardless of desirability (Mori et al., 1987) -Both male and female ate less when paired with a desirable companion of the opposite sex than with a less desirable companion (Mori et al., 1987)	Impression and acceptance
Body size of accompanying persons (e.g., obese or normal-weight individuals)	Quantity	-Non-obese individuals ate more in the presence of others, whereas obese subjects reduced food intake (Krantz, 1979) -Obese college students ate significantly less in the presence of a lean person, yet ate more when dining with another obese person (De Luca and Spigelman, 1979) -Overweight children displayed the same eating behaviour as adults by eating more when alone than when with a group of peers and vice versa for normal-weight children (Salvy et al., 2007a)	Social stigma
	Quality	-When eating in a cafeteria, overweight individuals chose higher-caloric meals when alone than with others (Krantz, 1979)	
Types of environments during social events	Duration	-There was a positive correlation between group size and meal duration; this effect was studied in one snack setting and one meal setting (Sommer and Steele, 1997) -There was a positive correlation between number of persons and meal duration in three different types of lunch room settings: a worksite cafeteria, a fast food restaurant, and a moderately priced restaurant (Bell and Pliner, 2003) -Meal durations were longest in the moderately priced restaurant and shortest in the fast food restaurant (Bell and Pliner, 2003)	Time and environment

* Explanations for each type of mechanism explaining food intake characteristics impacted by social factors are provided in table below.

b) Description of the potential mechanisms explaining social impacts on food intake.

Mechanism explaining social impact on food intake	Description of mechanism
Social facilitation	-Tendency for people to do better on simple tasks when in the presence of other people -People are more responsive to social factors affecting dietary choices and conform to a model when they are indifferent (neither hungry nor sated) (Goldman et al., 1991)
Social conformity (matching, imitating, modeling)	-Individuals conform their food intake to match their other's food consumption (Nisbett and Storms, 1974; Roth et al., 2001) -Imitation, a model which proposes that individuals in the presence of a high intake "model" could increase food intake while with a low intake "model" (Tolman, 1968), food intake could decrease (Conger et al., 1980; Nisbett and Storms, 1974; Polivy et al., 1979) even after 24-h food deprivation (Goldman et al., 1991)
Impression and acceptance	-Individuals conform their dietary intake to behave like others and ingratiate themselves to others in hopes of getting others to like and accept them (Sunnafrank, 1991; Sunnafrank et al., 2004) -Impression management, self-presentation, and eating conformity to create a specific image for an audience in order to make a good impression (Bock and Kanarek, 1995; Mori et al., 1987; Pliner and Chaiken, 1990) -Social facilitation of eating behaviour could be due to the fact that for men, behaving in a socially desirable manner was an important motive, while being socially desirable and appearing feminine were important for women (Pliner and Chaiken, 1990) -Women who eat minimally are viewed more positively than are women who eat a lot (Bock and Kanarek, 1995; Chaiken and Pliner, 1987) -The presence of unfamiliar persons may increase the salience of making a good impression by suppressing food intake (Vartanian et al., 2007)
Time extension	-The more people present; the longer the meal takes; the greater the intake (Bell and Pliner, 2003; De Castro, 1990; De Castro and Brewer, 1991) -People eat because they are in the presence of palatable food; therefore longer duration of exposure to such cues increases the amount eaten (Nisbett, 1968; Schachter and Rodin, 1974) -The more familiar the person is, the longer the conversation will be and thus the greater the food intake (De Castro, 1994) -The disinhibition notion suggests that the more familiar the person is, the greater the relaxation and thus the greater the food intake (De Castro, 1994)
Social opportunity	-The meal was a social opportunity (Krantz, 1979)
Social effect of familiar people	-Familiar people, such as friends and family exert a social effect on food ingestion beyond that of other companions, possibly due to a release of inhibitory restraints on intake (De Castro, 1994) -The effect of familiarity on food consumption is consistent with findings indicating that social facilitation of eating may be stronger among friends and relatives than among strangers and stronger among men than among women (De Castro, 1994)
Peer pressure	-Familiar persons could provide peer pressure for eating higher-fat foods (McIntosh, 1996)
Permission giver	-Friends can act as a "permission giver" and push the boundaries of acceptable eating behaviours, which could result in increased consumption Herman et al., 2003)
Social stigma	-Reduced food intake is a result of the social stigma associated with being overweight and obesity (overweight individuals eat excessively) (De Luca and Spigelman, 1979; Krantz, 1979; Vartanian et al., 2008, 2007) -The normative framework of the effects of others on food intake postulates that the presence of persons helps to regulate food intake by indicating when to stop eating (Herman et al., 2003), thus, the individual can avoid the stigma of excessive eating (Maykovich, 1978) and achieve the goal of getting others to like and accept them (normative conformity) (Deutsch and Gerard, 1955) -Obese individuals eat less in the company of normal-weight individuals due to self-consciousness and/or wanting to making a good impression (Salvy et al., 2007a) and ate more with other overweight participants due to solidarity (De Luca and Spigelman, 1979)
Time and environment	-Different eating environments were perceived as having different amounts of time available to complete a meal (based on the degree to which the subject felt rushed) (Marshall and Bell, 1996)

Theoretical and conceptual frameworks derived from disciplines, such as social psychology, health behaviour, economics, and social sciences, were a part of early food intake behavior studies (Axelson and Brinberg, 1989; Baranowski et al., 1999; Conner and Armitage, 2002; Lancaster, 1998, 1991). Specific theories, such as the personal food systems (Connors et al., 2001), life-course perspective (Devine et al., 1998), and initial food choice process model (Falk et al., 1996; Furst et al., 1996), have been the driving force behind substantial dietary behavior research. More importantly, they have contributed to the advent of the current food choice process model (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996), which is perhaps one of the most comprehensive and logical theoretical frameworks for explaining food choice behaviour.

This model was built upon on interviews with American adults' regarding their food choice decisions and consists of an extensive set of potential determinants motivating food choice decisions categorized within the three major components: the life course, influences and personal food systems (Figure 18). The life course involves transformations in one's past and current food selection experiences over a lifetime, as well as expectations for future possibilities. As these dynamic food choices evolve over a person's life course, food choices are also subjected to five major types of influences, such as ideals, personal factors, resources, social factors, and contexts.

In particular, social factors represent individuals' eating relationships constructed in broad social units, such as families, social groups and networks, communities, organizations, etc. When making joint food selections with others, decisions regarding where, when, how, and what food is eaten are usually negotiated. Social factors along with the other influences interact with each other as they fluctuate over the life course and operationalize in the personal food systems during food related activities.

The personal food systems, consist of mental processes that dominate one's dietary choices, which represent the different methods in which boundaries, options, and trade-offs are formed during different food related situations. The personal food systems also consider the processes of constructing food choice values, categorizing events based on these values, negotiating and balancing values, and creating strategies for different situations. Figure 18 demonstrates the start of the model with long-term elements at the top, such as the life course and ends with short-term aspects at the bottom, such as food choice. The current food choice process model has an extensive range of relevant components, including general social aspects, to explain individual food choice patterns.

Overall, previous studies have indicated that social influence on food intake is more than just a result of negotiation, but also of indirect and/or direct influences from other people, including the quantity, familiarity, and body size of the individuals. However, further details regarding the nature of the social influences have not been assessed; whether the subject's food choice behavior was influenced by and/or influenced other people (directions of social influences) and whether the influence was direct or indirect based on the nature of the conversation between individuals. For instance, direct influence may occur when a person's mother tells him/her to "eat that apple" and indirect influence may occur when a person orders dessert at the restaurant after following his/her friends.

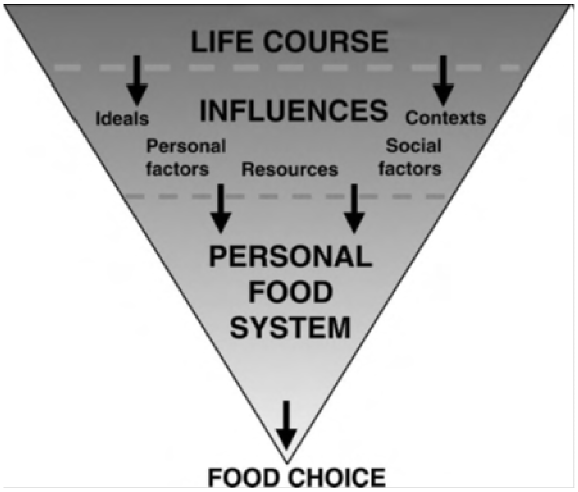


Figure 18: The food choice process model explains people's construction of food choices (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996).

4.3 Objectives

The main goal of this exploratory paper was to expand on the influences section of the food choice process model (Figure 18) by exploring social factors in more depth, including the potential effects of social influence on food thoughts, plans, purchases, and preparations leading up to food intake/consumption, based on real-world observation of FCP decisions and an in-depth follow-up interview.

4.4 Methodology

4.4.1 Data collection

The data collection process was experimental and multi-staged, including a preparatory meeting with participants, a 4-day data observation period, and an in-depth follow-up interview. This entire data collection process for each participant spanned over 7 to 8 days. During the 4-day observation period, participants wore a *hidden body video camera* worn at chest level pointed outward and a GPS location tracking device for 10 to 12 hours each day for four consecutive days. The goal of the tracking devices was to observe subjects' daily food-related activities without requiring participants to manually recall them. Refer to CHAPTER 2 for more details on the 4-day observation period.

Immediately after retrieving the video data, the researcher coded at least two days of video data per participant to provide real-world social situations for further discussion in the one-hour interview. The other two days were coded after the data collection period was completed. FCP events were reviewed and coded to include any of the five FCP types (food thoughts, plans, purchases, preparations, and consumption events), twelve FCP characteristics (method, quantity, location, date, time, duration, speed, frequency, food/ingredient, food quality, feeling, and opinion), and/or nature of social influencing behaviours (number and type of persons involved and direction of influence—to and from others). Refer to section 4.4.2 for more details on the coding procedure.

The interview was scheduled as soon as possible after the video data collection period so as not to unduly hamper participants' recall of events captured on video. The individual semi-structured interviews were conducted in the participant's homes and the questions were tested during the pilot test period, resulting in the development of two interview guides (described below). This interview format has been used by other dietary related studies that also used interview guides, probes to help participants recall and/or reveal information, an audio recorder to capture the conversation, and a small number of participants (e.g., Berge et al., 2012; Bos et al., 2013; Letona et al., 2014; Thomas et al., 2014). There are differences amongst these studies. For instance, the interview process in the study by Bos et al. (2013) was divided into five parts and a 5-minute break was provided. While, the study by Thomas et al. (2014) intended to make a methodological contribution in eating disorder assessments by proposing the first structured interview to assess the specific psychopathology associated with eating disorders. The study by Letona et al. (2014) conducted interviews with different types of local community members (e.g., school principals, school food kiosk vendors, religious leaders, authority representatives), which required multiple interview guides to suit each type of participant. Lastly, this study employed a unique interview method: the inclusion of some interview discussions that would be based on in-situ real-world events from the video data, which would require the interviewer to interactively modify questions to better suit the nature of the events being discussed.

At the start of the interview for this study, the special focus of the study on food-related activities was revealed to the subject. Participants were given the option to withdraw from the study at that point if they were not comfortable with this concealment; although none did. To prepare subjects for the interview questions, key terms and concepts were described, including the FCP diagram shown in Figure 19, as well as the FCP characteristics and direction of social influence shown in Figure 20.

The interview questions proceeded in two stages: first inquiring on specific real-world occurrences of social influence observed from the video data, then asking them to summarize the same social influencing behaviours, but based on their recall of routine situations in their daily lives. The intent was to be thorough, since observed situations (whilst likely to capture actual behaviour in snap shot views) may not have captured all aspects of social influences experienced by subjects, nor provided a complete overview of the nature of social influence experienced on a weekly basis. The responses from the second stage were thus intended to fill in the gaps from the first stage, and were combined together for content analysis (described in the next section) to potentially obtain a more holistic and accurate representation of social influencing behaviours.

In preparation for the first stage of questioning, the researcher reviewed the video data beforehand and selected 4 to 6 coded FCP events that involved other people and had low coding confidence levels. The subject first examined the screenshots of the chosen events and identified the activity and the other people present to help confirm the researcher's coding accuracy (see Figure 21 and Figure 22 for examples of food purchase and consumption events affected by social influence). In addition, the participant was asked to describe any influences that individuals had on each other regarding the observation period to help verify the coded situations. The questioning format as shown in Table 15 was used as a guide in an attempt to be systematic and consistent throughout all interviews.

In the second stage of questioning, to assist participants in summarizing all aspects of their social influencing behaviours, all twelve FCP characteristics were presented in a table as shown in Table 16. This table was also used as a guide in an attempt to be systemic and consistent with all participants. For each FCP characteristic, subjects were asked about the presence of social influence on and from others. For instance, for both weekdays and weekends, participants were asked, "*Are there any social influences on the 'locations of your food purchases' from other people*?" Participants were asked the same question with the direction of influence reversed: "*Do you exert any social influence on other people's 'locations of food purchases'*?" Participants were only required to provide a 'yes' or 'no' response. After generalizing weekly FCP decisions, participants were asked to pinpoint exactly who was involved in these decisions on weekdays and weekends with this question, "*Who has the most influence on your FCP decisions*?" A reverse question was also asked, "*Who do you have the most influence on regarding FCP decisions*? They were also encouraged to explain how they influenced and were influenced by that person. Lastly, to compare the extent of social influence on weekdays versus weekends, subjects were asked: "*Is there more social influence on FCP decisions during the weekdays or weekend and why?*"

At the end of the interview, the participant's height and weight information were collected for calculating their BMI and participants were given $100 compensation for their time committed to the data collection.

Figure 19: The diagram used in the interview process to explain each food choice process type.

Figure 20: The diagram used in the interview process to explain the FCP characteristics and both directions of social influence (on and from other people).

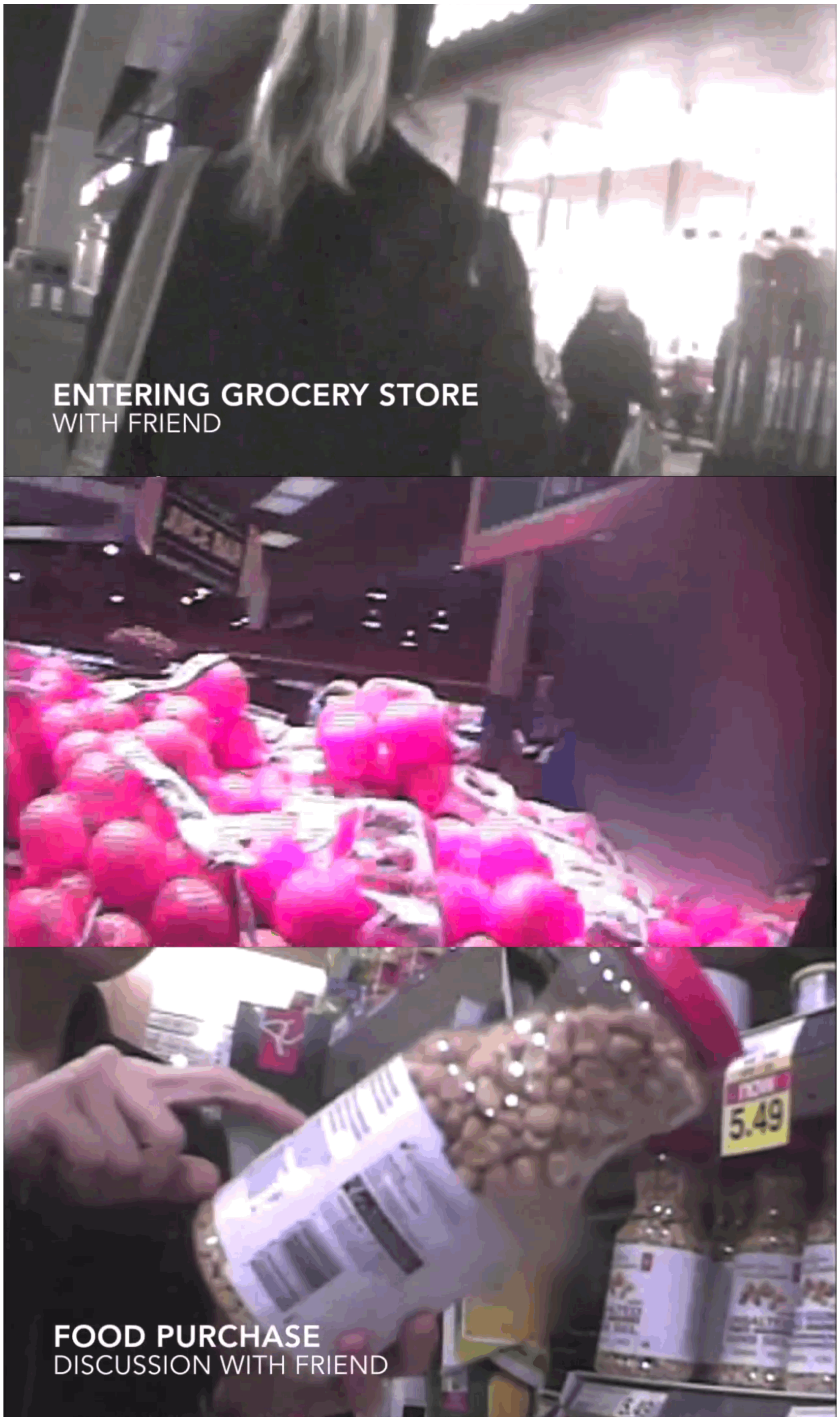


Figure 21: Screen shots from video clip of a participant's food purchase activity affected by social influence while grocery shopping with a friend. Full video clip: https://www.youtube.com/watch?v=ACgl2Htl-BU.

Figure 22: Screen shots from video clip of a participant's food purchase and consumption activities affected by social influence while eating at a dine-in restaurant with friends. Full video clip: https://www.youtube.com/watch?v=-klHoVMU0ek.

Table 15: Questioning format used in the first stage of the interview questions focused on *specific* social influence on FCP decisions based on the video data.

Social influence on participant from accompanying persons present
During the [**A**] with your [**C**] present, was your [**B**] [**A**] influenced by your [**C**]?
If so, how?

Example:
During the [food preparation] with your [sister] present, was your [speed of] [food preparation] influenced by [sister]?
If so, how?

Social influence *from participant* on accompanying persons present
During the [**A**] with your [**C**] present, was your [**C**]'s [**B**] [**A**] influenced by you?
If so, how?

Example:
During the [food preparation] with your [sister] present, was your [sister]'s [speed of] [food preparation] influenced by you?
If so, how?

Options to fill in [X] in the question formats.

A	B	C
FCP	**Characteristics of FCP**	**Accompanying person type**
Food thoughts	Method *of*	Friend
Food plans	Quantity *of*	Parent
Food purchases	Location *of*	Child
Food preparation	Date *of*	Sibling
Food consumption	Time *of (in hours)*	Extended family member
	Duration *of*	Significant other/spouse
	Speed *of*	Household member
	Frequency *of*	Person of interest (romantic)
	Food /ingredient type *for your*	Household member (roommates)
	Food quality (e.g., production method, brand, cost, etc.) *for your*	Organization member
	Feeling(s) *about your*	
	Opinion(s) *on your*	

Table 16: Chart used in the second stage of the interview questions to guide participants in summarizing their social influencing behaviours based on their recall of routine situations.

FCP Characteristics	Weekdays										Weekends									
	Food choice processes										Food choice processes									
	Food thoughts		Food planning		Food shopping		Food prep &/cooking		Food intake		Food thoughts		Food planning		Food shopping		Food prep &/cooking		Food intake	
Location																				
When: Date																				
When: Time																				
How-Method																				
Duration																				
Speed																				
Frequency																				
Quantity																				
Food quality (production method, brand, cost, etc.)																				
Food type /ingredient																				
Feeling(s)																				
Opinion(s)																				

Notes:
Grey boxes = Social influence on participant from others
White boxes = Social influence from participant on others

Eighty individuals were invited by email, phone calls, and face-to-face meetings to participate in the study. Of these, twenty individuals agreed to participate, or a 25% response rate. The sample size was kept purposely small due the time commitment required, the invasive nature of the video recording device, the desire to minimize risk as a condition of ethics approval, but primarily the experimental nature of the study. The participants resided in Hamilton and Kitchener, Ontario, Canada, both of which have a minimum population density of 400 persons per square kilometer. Individuals aged 30 to 50 years were ideal candidates as they are considered 'Generation X' (generation born after the Western post-World War II baby boom) and are likely to have one or more children, consume meals alone and/or with others (friends, family or colleagues), and be familiar with the use of technology. The goal was also to obtain a sample in which half the participants were overweight as defined by BMI.

This thesis was approved by Wilfrid Laurier University's Research Ethics Board. Special procedures implemented to protect subjects' privacy included immediate securing of video data with strong password protection and promptly removing personal confidential information if captured in video data. Despite these strategic measures, some sensitive information was captured on video without the consent of people other than participants, but were only stored temporarily. This ethical breach was deemed worth the risk in light of the benefits of collecting the data for research purposes.

4.4.2 Data coding and analysis procedures

The first step in analysis was to closely review the video and code the FCP events observed in a quantitative manner suitable for analysis. This task was conducted by one coder before each interview and again after all video data were retrieved. Given the exploratory nature of the thesis, one researcher was deemed sufficient for the video data coding. The main limitation of not having multiple researchers to independently code the same video data was the inability to assess the level of inter-rater reliability. To increase the reliability of the coding process, clear and concise guidelines for coding FCP events and a systematic confidence scoring developed during the pilot phase were implemented in attempt to maintain the highest degree of consistency as possible (see the methods section in CHAPTER 2 for further details).

A content analysis was then conducted on the interview data to identify potential *social factors* influencing FCP behaviours (as described in the previous section). The transcribed interview data was reviewed multiple times to pinpoint common themes voiced by the participants. For each *social factor*, the total number of subjects who voiced it was logged and examples of quotes were extracted from the interview to aid in clarification and understanding of the factor. Given that participants could have voiced more than one factor, the social factors were coded as a multiple response variable.

An experimental database of observations for each of the twenty participants was created, including sociodemographic variables, number of FCP decisions, and the *social factors*, measured on a per participant per day basis for ease of interpretation. To begin exploratory analysis of the potential correlates of the *social factors*, descriptive statistical analyses, appropriate to each variable type, was conducted on sociodemographic, FCP, and social interaction related characteristics as shown in Table 17 in the next section. Subsequently, a set of tests of independence and cross-tabulated tables were conducted to explore the potential relationships between the six *social factors* and eight sociodemographic characteristics, including sex, age, weight, body mass index, number of person(s) in household, marital status, number of children in household, and if they were a household cook. Although the data do not constitute a random selection from the population, the various statistical tests (e.g. Pearson chi-square test) were still used as a guide to interpretation of the most significant results, and to avoid over-generalization.

4.5 Results

4.5.1 Sample characteristics

The sample consisted of 20 adults; 17 were residents of Hamilton, Ontario and 3 were residents of Waterloo, Ontario. Table 17 displays descriptive statistics of the variables measured on a per participant per day basis used in subsequent tests of independence and cross-tabulated tables. The sample consisted of 45% males and 55% females (see Table 17), which was close to the national census profile for males (48%) and females (52%) (Statistics Canada, 2012). More than half of the participants in the sample were married (65%), which was higher than the national statistics of 46% married individuals. Canadian families had an average of 1.1 children per home, which was similar to the average of one child per household in the sample. The average BMI was 24.5, which was in the normal weight range and 45% of sample was overweight or obese, which was lower than the proportion of overweight or obese adults in Canada (52.5%) (Statistics Canada, 2012).

A total 813 FCP events was observed from the video footages, the distribution of which is shown in Table 17. Food consumption events were the most frequent (19.1), followed by food preparations (9.8) and food thoughts (6.0). The video footages also revealed that approximately half of the participants' FCP events had accompanying person(s) present with an average of 0.9 accompanying person per event, the most common of which was participant's immediate family members. If present, participants were accompanied by 1 to 1.6 different types of people per event.

Table 17: Variables used in the empirical analysis, including sociodemographic, food choice process, and social interaction related characteristics measured on a per participants per day basis (n = 20).

Variable	Definition	Number of participants (%)		Mean	Standard Deviation
Sociodemographic characteristics					
Sex	1 if person is female; 0 if person is male				
Male		9	(45%)	-	-
Female		11	(55%)	-	-
Marital status	1 if person is married; 0 if person is single				
Single		7	(35%)	-	-
Married		13	(65%)	-	-
Age (years)	Age in years	-	-	35.8	6.7
Weight (pounds)	Weight in pounds	-	-	155.0	31.1
Body mass index	Underweight if < 18.5; normal weight if 18.5–24.9; overweight if 25–29.9; obesity if =/<30	-	-	24.5	4.0
Number of children in household	Number of children in household	-	-	1.0	
Food choice process characteristics					
Number of food thoughts	Number of food thoughts	-	-	6.0	11.1
Number of food planning decisions	Number of food planning decisions	-	-	1.4	2.9
Number of food purchases	Number of food purchases	-	-	4.40	2.98
Number of food preparations	Number of food preparations	-	-	9.8	6.7
Number of food consumption events	Number of food consumption events	-	-	19.1	8.5
Social interaction related characteristics					
Presence of significant other/spouse/partner	Number of food choice process events with significant other/spouse/partner present	-	-	7.3	9.9
Presence of immediate family member(s)	Number of food choice process events with immediate family member(s) present	-	-	8.5	7.7
Presence of friend(s), extended family member(s) & in-law(s)	Number of food choice process events with friend(s), extended family member(s) & in-law(s) present	-	-	5.1	8.1
Presence of non-personal/professional associate(s)	Number of food choice process events with non-personal/professional associate(s) present	-	-	5.3	5.6
Presence of events with accompanying person(s) *absent*	Number of events with accompanying person(s) *absent*	-	-	20.7	12.3

4.5.2 Content analysis of social factors

Content analysis of the interview data revealed six potential *social factors* influencing FCP: *conforming*, *routine*, *common health concerns*, *common cravings*, *indifference*, and *economic concerns*, as shown in Table 18, and explained in more detail below.

FCP decisions were likely impacted by participants' desire to *conform* to others' behaviour to possibly comply with societal norms, which included their attempt to be polite, be obedient, and impress and/or avoid judgment by mimicking others' behaviours. *Conforming* was a commonly sited *social factor* voiced by 14 of 19 subjects. For example, on weekdays, some participants isolated themselves by having lunch in a secluded area to avoid disturbing others with their strong odorous foods and/or to draw unwanted attention to their uncommon ethnic foods. They revealed that they wanted to comply with social norms to fit in and receive acceptance from peers. On the other hand, some participants were proud to show off their ethic foods and teach others how to prepare it. Sometimes they were inspired to make others' cultural dishes, which showed their attempt to diversify their food palette and/or strengthen their cross-cultural friendships.

Routine was another commonly sited *social factor* that was voiced by more than half of the participants (56%). For instance, these subjects had weekday events that were heavily influenced by household members and work colleagues. Weekend events varied slightly, but were mainly influenced by close friends and family outside of household. Thus, they experienced repetitive social influence in a structured manner varying only by the day type (weekdays versus weekends).

Slightly less prominent *social factors* included *common health concerns*, *common craving*, and *indifference*. Dietary choices were possibly affected by social influence when participants had *health concerns* and declined tasty and low nutritional foods due to desire to get fit and/or prevent illnesses or diseases. For example, ten out of nineteen subjects chose 'healthier' foods when persuaded by friends and family who were also trying to get fit and/or live healthier. Food preferences were also likely motivated by social influence when participants had *common cravings* with their friends and family and chose tasty and low nutritional foods. Nine out of nineteen subjects used social gatherings to satisfy cravings of tasty foods low in nutrition that were not normally consumed alone. In addition, social aspects potentially influenced FCP choices when individuals had *indifference*, which was claimed by nearly half of sample, who tried to avoid conflicts by giving up control on joint food choices with 'picky eaters' and/or main household cooks with strong opinions.

Lastly, food selection was perhaps impacted by *social factors* when subjects had *economic concerns* when trying to save time and money by making the same meal for all household members; meal was chosen by the pickiest eaters. *Economic concerns* was the factor voiced by nearly a third of sample who were the main household cooks and always communicated with the 'picky eaters' in order to figure out which ingredients to purchase for household meal preparations. Sometimes they helped to eat an unfinished food item left behind by the 'picky eater' to avoid wasting food.

Table 18: ***Social factors*** **affecting FCP and examples of quotes based on content analysis (n = 19).**

Social factor **affecting FCP**	**Number of participants that voiced the factor**		**Examples of quotes**
Conforming to others' behaviour	14	(74%)	"[My husband and I] usually don't eat our lunch in the lunch room because our Asian food smells and we don't want to bother other people." "If I eat out with someone familiar I would eat all of my food. When I eat with someone who I'm not familiar with, I might mimic their eating speed and quantity. ... I find that when I eat alone I over eat really fast, where as when I go out with other people I eat slower and stop around the same time. If the person is eating slow then I will mimic them."
Following a routine	11	(58%)	"Much more influence from my girlfriend who I see on the weekends. During the weekdays I do my own things." "On weekends usually [my wife and I] get together with our friends so they influence every aspects; location, time, how to prep. … Nobody decide on their own on the weekend."
Having common health concerns	10	(53%)	"[My friend and I] discuss food choices together because we go to the gym together." We influence each other eat healthier and discourage each other to choose bad options." "[My friend and I] are very conscious about our weight. My friend is particular with the dishes she uses for certain food." For example, the ice-cream bowl is a certain size which helps keep the portion control to a point, but that doesn't stop us from getting seconds."
Having common cravings	9	(47%)	"My sister and I decided to have ice-cream cones because I was craving it."" "We had a craving for onions, so we ended up getting them at Fortinos even though it costs more there."
Having indifference	9	(47%)	"Usually my son picks the dinner because he's very picky. I'm not picky. My family is more picky so they choose; I can eat anything." "I'm not picky; I would eat anything, even if I didn't like eating it. I'm use to eating things that I don't like. I'm use to not having a choice."
Having economic concerns	5	(32%)	"My sister usually can't finish her food. Even if it's something I don't like I would help eat it." "My daughter said she wanted yogurt and then she didn't want it anymore so I helped her finish it."

4.5.3 Social factors related to FCP events

A cross-tabulated table was conducted to further explore the potential relationships between the *social factors* and the sociodemographic characteristics as shown in Table 19. In the tests of independence, statistically significant differences were found in *social factors* by four out of the eight sociodemographic variabes: BMI (χ^2=12.9, p=0.044), number of persons in household (χ^2=13.0, p=0.043), number of children in household (χ^2=19.0, p=0.004), and if they were a household cook (χ^2=13.5, p=0.036). In particular, more overweight individuals' FCP were possibly influenced when they were *conforming* to others' behaviour to fit in and/or avoid judgment. More individuals with normal weight had food choices that were likely affected by social influence when they had *common health concerns* while socializing with their friends and family. Only individuals living with four to six people had dietary choices potentially affected by social influence when they had *economic concerns* while trying to save time and money. Majority of subjects with no children in the household also likely experienced social influence on their food selection when they were *conforming* to others' behaviour and having *common health concerns*.

Table 19: Descriptive statistics of *social factors* by sociodemographic characteristics (n = 20):

a) Body mass index and household cook status *per participant per day*.

	Body mass index						Household cook status					
	18.5-24.9 (normal weight)		=/>25 (overweight or obese)		Total		No		Yes		Total	
Number of participants that voiced the *social factor*												
Conforming	6	(54.5%)	8	(88.9%)	14	(70.0%)	6	(75.0%)	8	(66.7%)	14	(70.0%)
Routine	7	(63.6%)	4	(44.4%)	11	(55.0%)	4	(50.0%)	7	(58.3%)	11	(55.0%)
Health concerns	7	(63.6%)	3	(33.3%)	10	(50.0%)	2	(25.0%)	8	(66.7%)	10	(50.0%)
Common cravings	5	(45.5%)	4	(44.4%)	9	(45.0%)	6	(75.0%)	3	(25.0%)	9	(45.0%)
Indifference	2	(18.2%)	7	(77.8%)	9	(45.0%)	6	(75.0%)	3	(25.0%)	9	(45.0%)
Economic concerns	4	(36.4%)	2	(22.2%)	6	(30.0%)	2	(25.0%)	4	(33.3%)	6	(30.0%)
Total	11	(100.0%)	9	(100.0%)	20	(100.0%)	8	(100.0%)	12	(100.0%)	20	(100.0%)

b) Number of persons in household and number of children in household *per participant per day*.

	Number of person(s) in household						Number of children in household					
	1-3		4-6		Total		0		1-3		Total	
Number of participants that voiced the *social factor*												
Conforming	8	(100.0%)	6	(50.0%)	14	(70.0%)	9	(90.0%)	5	(50.0%)	14	(70.0%)
Routine	5	(62.5%)	6	(50.0%)	11	(55.0%)	7	(70.0%)	4	(40.0%)	11	(55.0%)
Health concerns	5	(62.5%)	5	(41.7%)	10	(50.0%)	8	(80.0%)	2	(20.0%)	10	(50.0%)
Common cravings	4	(50.0%)	5	(41.7%)	9	(45.0%)	4	(40.0%)	5	(50.0%)	9	(45.0%)
Indifference	3	(37.5%)	6	(50.0%)	9	(45.0%)	2	(20.0%)	7	(70.0%)	9	(45.0%)
Economic concerns	0	(0.0%)	6	(50.0%)	6	(30.0%)	2	(20.0%)	4	(40.0%)	6	(30.0%)
Total	8	(100.0%)	12	(100.0%)	20	(100.0%)	10	(100.0%)	10	(100.0%)	20	(100.0%)

4.6 Discussion and conclusion

The results presented here are meant to expand our understanding of social influences on dietary behaviour through analysis of a novel dataset that captured real-world observations of daily social influencing behaviours on FCP decisions, as well as exploration of potential relationships between social factors and sociodemographic characteristics using basic descriptive and exploratory multivariate statistical techniques. With regards to the data collection process, scheduling the interview three days after the tracking devices were carried permitted time to prepare for the in-depth interview and allowed the participant to recall events. Screenshots of the chosen video clips shown at the interview also helped some subjects remember exact details of the events. In addition, concealing the special focus on food-related activities during the video recording period resulted in participants behaving as normally as possible as confirmed by nearly all participants. Some participants admitted that they would have made different food related decisions if they knew the study focus. Furthermore, information from participants helped to verify most observations of social influence in video data. Without audio data, the nature of the social influences present during FCP events was not always evident. Thus, the interview questions provided insights into the specific directions and sources of social influences.

Since some of the interview discussions were based on in-situ real-world events, it was difficult to be systematic and use the same set of questions for every participant. Thus, the interviewer had to interactively modify questions to better suit the nature of the events being discussed. At the beginning of some interviews, some participants were not forthcoming with information about social influence in their events because they may not have wanted to disclose information and/or they were not able to report information (due to not being aware of and/or able to recall). Some participants had to be probed with multiple questions (3-5 per event) to get them to reveal information. By the end of the interviews, subjects were more comfortable and/or able to disclose information that appeared to be genuine and truthful with less probing. Participants also appeared to gain some self-awareness with regards to the social influence on FCP in their lives. The interview may have helped them uncover the type and amount of social influence on FCP present in their lives.

The analysis led to some interesting findings, however, they may not be generalized to any population. They are recommended for exploratory purposes only since the sample was relatively small and non-random due to the experimental nature of the data collection technique. Nonetheless, the results may be used as a guide for future studies with larger and random samples that can be generalizable to a given population. In addition, due to the exploratory nature of the study, the experimental findings were based on a dataset that was coded by one researcher. In the future, expanded studies could employ multiple video data coders, who could follow the same confidence scoring to establish a reasonable level of inter-rater reliability and robustness.

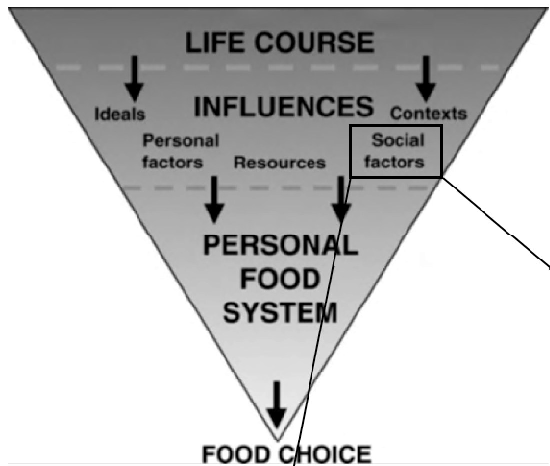
Based on the content analysis, the potential *social factors* affecting FCP voiced by the participants varied from 32 to 74% in proportions. *Health concerns*, one of the possible *social factors* mentioned by approximately half of the subjects, was perhaps linked to weight related concerns based on interview discussions. Additionally, the exploratory analysis revealed a likely connection between BMI and *social factors*. Given that nearly half of the participants were overweight and/or obese and the commonly sited relationship between weight issues and food consumption, the weight related findings with respect to social factors might be reasonable. The outcomes were supported by a study reporting that improved weight management was associated with positive social influence on eating from friends and coworkers, while social undermining from family was associated with unhealthy weight gain (Wang et al., 2014). However, the findings conflicted with a systematic review of empirical research, which revealed that there was no conclusive evidence that social influence from friends affects one's weight and that majority of previous studies focused on adolescents, with limited information on other ages (Cunningham et al., 2012). On the other hand, the *social factor*, *conforming,* was expressed by three quarters of the sample, which may be logical as most people generally want to comply with societal norms to fit in. Given that most social influencing behaviours occurred amongst friends and family, social conformity may have occurred with these familiar people who they socialized with regularly.

Furthermore, the cross-tabulations revealed that BMI, household cook status, number of household members and children, were the sociodemographic variables that had statistically significant connections with the possible *social factors*. The analysis indicated that a greater number of overweight subjects' FCP decisions may be affected by social influence when they conformed to others' dietary patterns. The finding concurred with previous studies that discovered that obese subjects tended to mimic their co-eaters' food intake quantity due to social stigma (De Luca and Spigelman, 1979; Krantz, 1979; Salvy et al., 2007a).

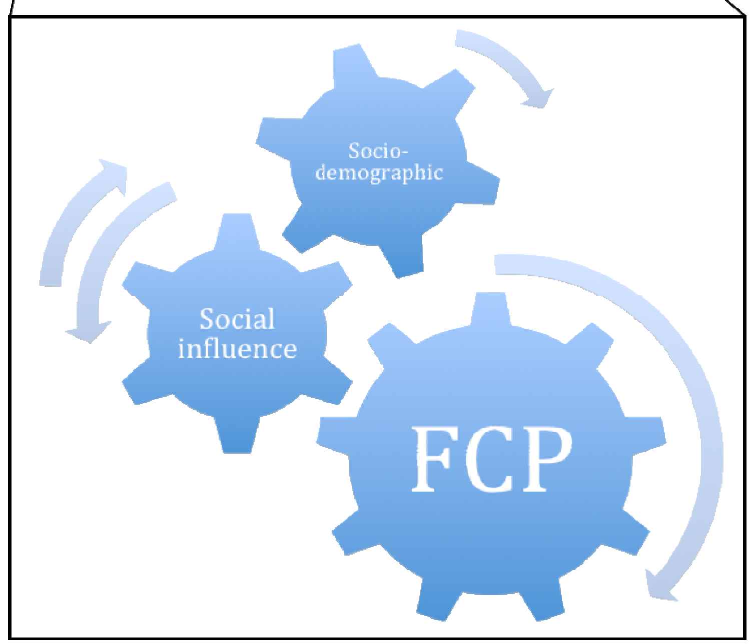
The exploratory results also showed that a greater number of normal weight individuals' food selections were possibly impacted by *social factors* when they had *common health concerns*, which may be logical as weight is directly associated with food consumption. Furthermore, a greater number of subjects with no children reported that their FCP decisions were likely influenced by *social factors* when they *conformed* to others' behaviour and had *common health concerns*. These outcomes are likely reasonable considering that people with no children may have different priorities and perhaps have more time and energy to focus on their wellbeing and social life. Overall, the experimental results demonstrated that there are potential connections between social factors and sociodemographic characteristics that are worth further investigation.

Past studies have attempted to understand one's construction of dietary choices by examining the effects of social influence solely on eating in commensal groups. This exploratory paper observed people's actual FCP leading to food intake in everyday situations, as well as examined the potential impacts of social influence on a wider variety of FCP decisions. Developing effective techniques to capture them is a crucial first step. Larger studies may permit further advancement on how the elements within the FCP could perhaps broaden the understanding of social influences on dietary behaviour.

The experimental results allowed for potential contribution to theory through a possible expansion of the broad and large-scale social factors motivating food intake, one of the main influences listed in the food choice process model (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996), as shown in Figure 23. Results from this thesis suggested that sociodemographic characteristics and social factors influencing food thoughts, plans, purchases, and preparations leading up to food intake, might be key, fine-level, and interconnected elements not present in the current food choice process model. They may represent a useful, observable, and mechanical part of the process. The close up of the added components in Figure 23 are meant to reflect this by the interconnected gears. This possible elaboration on the model could add another vital feature to the existing set of influences on the final food choice resulting in a potentially deeper and more complete food choice process model. The exploratory results confirmed the need for further research to replicate and extend the current findings to deepen the understanding of how people construct their daily food choices.



The food choice process model (Source: Falk et al., 1996; Furst et al., 1996; Connors et al., 2001).



Close up of added component to the Food choice process model.

Figure 23: Modified food choice process model with the addition of social factors influencing FCP decisions and sociodemographic characteristics based on study results.

Health professionals could potentially formulate strategies based on real-world observations of social influencing behaviours, similar to the data collected in this paper, to possibly assist adults who are struggling to make healthy FCP decisions while socializing with others. This common everyday interaction may potentially lead to undesirable and/or regrettable food choices potentially caused by social conformity, impression and acceptance, peer pressure, social stigma, etc. For example, one could be advised to continuously sip on water throughout the meal to consume food at a more controlled pace and quantity, which may help avoid matching or imitating the accompany person's eating behavior. In addition, people grocery shopping with other people could prepare a shopping list to avoid making impulse or unplanned purchases.

Moving forward, since participants in this study mainly socialized with close family and friends, future studies could inquire on social influence on the FCP from unfamiliar accompanying persons, such as desirable companions in romantic or dating situations, as well as associates from workplaces, places of worship, and neighborhood. This new study focus may potentially show that social facilitation occurs during FCP decisions in the presence of unfamiliar people. Additionally, previous studies have explored the potential relationships between virtual communications and health related benefits. For instance, the use of online social support groups provided a means of dietary control in diabetes self-management (McKay et al., 2002). Also, text messages sent to participants helped promote physical activity and healthy eating (Gerber et al., 2009). Since social influence on FCP decisions stemming from virtual social interactions has never been studied, future studies could investigate this possible link, including both real time (e.g., voice or video calls, instant messaging, social media apps, etc.) and non-real-time communications services (e.g., social media websites, text messaging, e-mail, etc.). Overall, further studies on various types and sources of social influences affecting FCP decisions could perhaps help further the understanding of how people construct their daily food choices, which could potentially aid in obesity remediation.

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CHAPTER 5 Conclusions

5.1 Overview of chapters

The goal of this PhD dissertation was to explore the food choice process to possibly broaden the understanding of individuals' daily dietary behavior. The key motivating issue was the need for more focus on examining the overall FCP instead of just food consumption to understand people's construction of food choices to potentially help curb the growing obesity epidemic. Hence, this exploratory thesis addressed the issue by observing the actual FCP leading to food intake/consumption, including participants' food thoughts, plans, purchases, and preparations, in real-world environments, as well as explored potential patterns of and factors associated with FCP decisions and possible effects of social influence on FCP decisions.

Chapter one introduced some of the key issues related to obesity, as well as identified the thesis significance, research objectives, and the layout of the chapters. The second chapter (*first paper*) focused on methodological contributions of the thesis, especially the novelty and utility of using a hidden body video camera to capture the wider aspects of the underlying FCP, and the strategic use of a follow-up in-depth interview. This unique data collection technique yielded maximum detail and minimal recall bias and misreporting as possible; data was coded with relative certainty about 66.1% of the time. This paper also provided some basic empirical analysis of the FCP. For instance, food purchases tended to occur in social settings and food preparations occurred alone at home. This chapter provided an overall sense of the data being analyzed through the descriptive analysis, as well as a guide for further analysis in subsequent chapters.

Chapter three (*second paper*) carried the descriptive analysis from the second chapter to the next level through exploratory multivariate analysis of the patterns of FCP decisions, and potential relationships with sociodemographic and social interaction related variables. Results from the Pearson correlation analyses revealed that social interaction variables tended to correlate most with the FCP variables, whilst the sociodemographic variables had minimal correlations, and BMI unexpectedly had no significant correlation at all. The sequence analysis employed on "strings" of FCP events to explore the ordering of events was a novel methodological contribution of the thesis. Results from the analysis indicated that the sequential patterning of FCP events was likely not dependent on the day type as both weekdays and weekends yielded moderate confidence in the matched strings and degree of similarity between the groups.

The fourth chapter (*third paper*) may have expanded on the understanding of social influences on dietary behaviour, including its potential relationship with sociodemographic characteristics, based on the follow-up in-depth interview, using the real-world observations as context, which built upon the previous papers that relied on the video data alone. Content analysis revealed that *conforming to others' behaviour* was the most commonly sited potential *social factor* affecting FCP decisions, likely occurred amongst familiar people, such as friends and family. Also, outcomes from the cross-tabulations illustrated that overweight subjects' FCP decisions that were potentially affected by social influence when they *conformed* to others' dietary patterns were possibly due to social stigma.

Although BMI had no significant correlations with FCP decisions in the *second paper*, overweight individuals were potentially associated with the possible *social factor* influencing

FCP, *conforming to others' behaviour*, in the *third paper*. This warrants further investigation. Overall, the results from the thesis demonstrated the potential for an automated tracking system to capture fine-leveled information, such as daily FCP decisions, relationships and patterns of those decisions, and social influencing behaviours.

5.2 Contributions

Although this thesis utilized an experimental technique that was conducted on a relatively small and non-random sample, exploratory analysis of such data is a key first step in the discovery process of emerging concepts, such as FCP, for which little is known. The key empirical contribution of this thesis is observing the FCP beyond just food consumption in real-world environments using a novel data collection technique.

Experimental results from each of the *three papers* also possibly allowed for several theoretical expansions to the current food choice process model—personal food systems and influences stages (Connors et al., 2001; Falk et al., 1996; Furst et al., 1996), by potentially adding practical, observable and interconnected elements, which represented a mechanical part of the process that was missing in the model. Exploratory results from the *first paper* may have permitted the expansion of the personal food systems stage to potentially include the five FCP decisions. The empirical results from the *second paper* may have suggested another elaboration to the same stage to possibly include FCP decisions, sociodemographic and social interaction variables, and ordered sequence strings of FCP decisions. The findings from the *third paper* may have allowed for modification to the influences stage to perhaps include sociodemographic characteristics and social factors influencing FCP decisions. Overall, these suggested changes could likely add another dimension to the current food choice model making it deeper and more comprehensive.

Some of the results and/or data collection techniques from this thesis may eventually aid health professionals trying to help individuals improve their health and/or combat obesity by designing dietary plans based on observed information from video data. Dietary plans may include strategies customized per individual stemmed from observed patterns of and factors associated with FCP decisions. These observations may also possibly inform marketing researchers on consumers' food shopping behaviour, which could help determine what food products to sell, what packaging to use, and where to sell the products.

5.3 Future considerations

Many of these decisions and patterns could go a long way towards explaining how and what people eventually end up consuming on a daily basis. Finding effective ways to observe and analyze them is only the first step. This thesis was a step toward a potentially improved understanding of the construction of food choice behaviour, thus future research is needed through similar studies to deal with growing obesity rates.

Moving forward, modifications to the automated activity monitoring system, such as adding an audio recorder to the video camera and using a higher quality device, may improve quality of data collected and garner information beyond FCP events. Future studies could examine physical locations of FCP events, proximity of food retailers to the home and workplace, knowledge of food nutrition, participation in physical activities, and time spent on daily activities. Other research could also focus on the potential link between social influence on

FCP and virtual social interactions (e.g., social media websites, text messaging, e-mail, etc.). Furthermore, future studies interested in utilizing the video recording technology should implement necessary ethical procedures to respect participants' privacy, as well as other people and information potentially captured in video data without consent. Overall, implementing any of these suggestions for future studies could possibly help broaden and deepen the understanding of how people construct their daily food choices, which could eventually aid in obesity remediation.

5.4 References

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