Strengthening Associations to Pictures vs. Words:

The Case for Messages Promoting Fruit and Vegetable Consumption to Men

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Arts

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Abstract

It is well known that fruit and vegetable (FV) consumption is a protective factor against chronic health conditions; however, men tend to eat fewer fruit and vegetables than women. Since FV consumption helps prevent chronic diseases and many men do not eat enough, ways to improve the behaviour are needed. It may be that men's implicit (i.e., automatic) and explicit associations towards healthy foods are different from women's. Investigating methods of changing men's associations to healthy foods will inform health campaigns on the content they should use. This study compared the effects of associative learning using picture stimuli (Picture-AL) or word stimuli (Word-AL) on automatic associations between apples and snackbars and healthy and unhealthy attributes in 120 men recruited at the University of Alberta campus. Automatic associations were measured by two versions of the Implicit Association Test (IAT). One version used picture-stimuli (Picture-IAT) and the other used word stimuli (Word-IAT). The stimuli used in the Picture-AL and Word-AL matched the stimuli in the Picture-IAT and Word-IAT respectively. The target and attribute categories were 'apple+healthy' and 'snackbar+unhealthy'. The moderating effects of healthy-eating schema, changes in explicit associations and the relationship between the associations and actual snack choice between apples and snackbars were also examined. Results showed AL using picture or word stimuli had no differential effects on automatic associations to pictures or words; however, the strength of associations between pictures were moderated by self-schema. Findings were inconclusive on whether the associations to pictures or words are more predictive of food choice behaviour. The implications are discussed in terms of the Reflective- Impulsive Model and the meaning for health campaigns targeting FV consumption in men.

Preface

This is an original work by Sarah Evans. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Strengthening Associations to Pictures vs. Words: The Case for Promoting Fruit and Vegetable Intake To Men", No. Pro00068085, October 3, 2016.

Acknowledgements

I would like to express my gratitude to my supervisor Prof. Tanya Berry for her continuous support of my Masters study and this research. I am very grateful for her knowledge, patience and being so easy to talk to. You made writing this thesis a truly enjoyable experience. I would like to thank the rest of my thesis committee: Prof. John Spence and Prof. Craig Chapman for their insight and valuable comments on this thesis. Thanks to my lab mates Kim Curtin, Maxine Myre, Lira Yun, and Elaine Ori for the great discussions and company and always making the lab a great place to come to. Thank you to my friends Chelsea and Christina for your unwavering support in every aspect of my life- from school to work to home. Lastly, thank you to my family: to my Mom, Dad, brother and grandparents, you made this all possible and I could never have done it without you- and to my dog Beau, thanks for getting me outside and always waiting patiently for me to play with you on those long study days. To all of you I am very grateful!

Table of Contents

Introduction

According to the Public Health Agency of Canada (2011), 4 out of 5 Canadians aged 20 years or older are at risk for developing a chronic disease. Since fruit and vegetable (FV) consumption helps prevent chronic diseases and many people do not eat enough, ways to improve the behaviour is needed. FV consumption is protective against cancer, cardiovascular disease, diabetes and stroke (He, Nowson & MacGregor, 2006). Diets high in fruit and vegetables also help maintain a healthy weight, reducing risks with obesity (Rolls, Ello-Martin & Tohill, 2004). The health benefits are well documented in research and medical communities; however, research on national surveys, intervention studies and public health campaigns report average FV consumption is well below the daily recommendation and in some cases even declining (Kimmons, Seymour & Serdula, 2008; Bowman, 2004; Dixon, Cronin & Kreb-Smith, 2001; McMartin, Jacka & Coleman, 2013). Improving FV consumption is needed to help maintain our populations health.

Daily FV consumption is relatively low regardless of demographic group (i.e., age, education, ethnicity); however, when comparing genders, men tend to eat fewer FV than women (Subar, 1995; Baker & Wardle, 2003; Trudeau, Kristal, Li & Patterson, 1998; Rasmussen, 2006). Gender is a significant socio-cultural factor in determining many health-related behaviours including alcohol and drug use, smoking and physical activity (Denton, Prus & Walters, 2004). According to the Canadian Community Health Survey (2003) gender also influences healthy food choices where only 45% of men reported choosing foods based on health concerns compared to 65% of women. Men’s lower FV consumption puts them at higher risks for developing chronic illness or disease deserving the attention of targeted health promotion strategies.

Mass media health campaigns are a relatively cost effective way to raise awareness and initiate health behaviour change in large populations (Wakefield, Loken and Hornick, 2010); however, campaigns promoting FV consumption are found to be only moderately successful and even less so for men. To start, men are less likely to trust and follow the nutritional guidelines set out for them in health promotion campaigns (Craig & Shelton, 2007; Gough & Conner, 2006). A review of 44 studies evaluating interventions and programs concluded that average fruit and vegetable servings per day only increased from 0.4 to 1.4 post-intervention (Pamerleau, et al., 2005). The “Healthy People 2000” campaign, which ran between 1991 and 1997, marked a significant increase in self-reported FV consumption in women but not in men (Stables et al., 2002). Two campaigns specifically targeting men were also unsuccessful at raising awareness or increasing FV consumption. The BBC Fighting Fat, Fighting Fit campaign targeted working middle class men above the age of 45 through several prime-time specials, radio segments and phone calls. When the campaign finished a random sample telephone survey of men and women revealed men were significantly less aware of the campaign and less able to recall the campaign’s healthy eating messages than women (Wardle et al., 2001). The Australian “5 Fruit and 5 Veg. Everyday” campaign spent a phase of their campaign specifically targeting men; however, men were found to be significantly less aware of the campaign, less likely to know the campaign’s recommendations and still ate significantly fewer fruits and vegetables than women (Dixon et al., 1998). Although health campaigns promoting FV consumption show potential in behaviour change they are less effective for men.

Gender and FV Consumption

To undertand why FV promotion strategies are less successful for men gender differences between knowledge, attitudes and beliefs should be considered. Studies show there are significant socio-cultural differences between men and women that contribute to diet quality. "Masculinity" is conveyed as being strong, resislient and autonomous. Studies show these characteristics translate into less concern and less need for self-care practices and considering oneself the exception to common health problems (Gough & Conner, 2006; Sloan, Gough & Conner, 2010). Although food is a physiological necessity, the types of foods chosen carry social and cultural value and decisions are often made in light of the type of message they convey (Finkelstein, 2003). For example, healthier foods such as fruits, salad, fish and yogurt have much stronger feminine associations; whereas, higher-fat foods such as beef, pork and barbequed meat carry stronger masculine assocaiations (Sobal, 2005; Kimura, et al., 2009). Additionally, men and women have different social approval biases and body image perceptions which influence food choices (Hebert, et al., 1997; Miller, et al., 2000). Men may not respond as well to FV promotion strategies because they have key socio-cultural differences changing how they view healthy eating behaviour.

Studies show on average men hold lower levels of knowledge and awareness when it comes to healthy eating habits. A number of studies have found men are less likely to know the correct daily recommended servings of fruits and vegetables compared to women (Subar, 1995; Nayga, 2005; Lee, 2003; Hendrie, Coveney & Cox, 2008; Tepper, Choi & Nayga, 1997; Lee, 2003; Pirouznia, 2001). Another study found men's lack of experience with cooking and poorer cooking skills contributes to their poor diet quality (Hughes, Bennett & Hetherington, 2004). Men are also more likely to make an incorrect judgement on the heath value of certain foods even when they have nutrition labels. Borgmeier & Westenhoefer (2009) and Parmenter, Waller

& Wardle (2000) found men made the wrong choice more often then women when asked to choose the healthier food alternative (i.e., lower salt, sugar, fat or higher fibre). Lastly, men were found to be less likely than women to be aware of the relationships between certain foods, nutrients and diseases. Parmenter, Waller & Wardle (2000), found more men were unaware of the relationship between fat intake and heart disease and FV consumption and cancer. Mens' lower levels of knowledge and awareness around healthy eating and the benefits may also contribute to their relatively poor response to messages promoting FV consumption.

FV promotion strategies may be less effective for men because they hold different attitudes and beliefs around changing to or maintaining a healthy diet. Men were found to be less motivated and less enthusiastic about maintaining a healthy diet after being informed of the benefits (Hughes, Bennett & Hetherington, 2004; Wardle, et al., 2004). This could be because men consider healthy eating important only for maintaining their weight and body-image which is something they are less concerned with compared to women (Mooney & Walbourn, 2001). When it comes to food labels that explicitly state the benefits of the nutritient content in foods (e.g., high fibre lowers risks for diabetes, higher calcium strengthens bones) men perceived the items as less healthy compared to women (Ares & Gámbaro, 2007). FV promotion strategies may be less effective for men because on average men do not consider changing to or maintaining a healthy eating as concerning as women do.

Gender differences in responses to FV consumption promotion also corresponds with findings that suggest men think differently about healthy eating and health in general. For example, when asked to make a self-assessment of their health, men's accounts were based more on serious illness alone, compared to women who made a more holistic judgement of their health (Benyamini, Leventhal & Leventhal, 2000). More specifically to food and diet some studies report men holding different associations and cognitions around fruits and vegetables. Walsh and Kiviniemi (2014) found men had more negative affective associations towards fruits and vegetables and reported fewer perceived benefits of eating them compared to women. Men also recall significantly different free associations when presented with fruits and vegetables than women (Rapport, 1993). For example, women associated food items with places, events and social situations; whereas men associated them with meal times and being alone. In addition, men also perceive information about food differently than women. One study reported men tend to use nutrition labels less and were less responsive to visual elements of food labels (Satia, Galanko & Neuhouser, 2005; Gofman, et al., 2009).

When it comes to deciding whether to eat fruits and vegetables some studies suggest men also consider different elements more important than others. Consumer studies found men are less interested in the health of foods and less likely to compromise on taste for health (Roininen, Lähteenmäki & Tuorila, 1999; Verbeke, 2006). Consequently "taste" and "habit" were more influential factors for men, compared to women who relied more on "freshness", "quality" and "eating healthy" (Lennernäs, et al., 1997). A handful of studies have also found a gender bias when it comes to food selection. Mooney and Lorenz (1997) found participants categorized foods such as cookies, sirloin steak and chips into a masculine profile and bananas, bagels and carrot sticks into a feminine profile. This study was further supported by Kimura, et al. (2009), who found that high-fat foods were typically rated as more masculine and low-fat foods as more feminine. Together this collection of studies suggest that men have different thought processes than women around fruits and vegetables and food in general which can potentially explain their different responses to FV promotion materials.

Literature Review

In addition to gender differences there are a number of sociological factors that influence eating habits such as socioeconomic status (SES), accessibilty and social support. Numerous studies show a positive correlation between SES and eating habits including the number of healthy foods purchased and daily FV intake (Gittelsohn, et al., 2005; De Irala-Estevez, Groth, Johansson & Oltersdorf, 2000; Hulshof, 2003). Research also shows the accessibility of fruits and vegetables is a strong predictor of diet quality. For example, having a local grocer located within 100 m of the home or having access to a car greatly increases the odds of meeting the daily recommended intake of FV (Bodor et al., 2008; Sorensen, et al., 2007). Factors such as community and family involvement and support also correlate with greater FV consumption. For example, participating in a community gardening project or being a member of a large family (compared to a single-head household) are associated with greater FV consumption (Kamphuis, etal., 2006; Sorensen, et al., 2007). In addition to gender differences, sociological factors such as these greatly influence FV consumption.

Sociological factors that are external rather than internal to the individual are more difficult to control. This makes them somewhat ineffective targets when aiming to change FV consumption and healthy eating behaviour. Methods focusing on more individual or psychological factors are easier to address and are an effective way to increase FV consumption. For example, interventions that aim to increase factors such as self-efficacy, perceived benefits and knowledge account for over half of the increase in daily FV consumption (Steptoe, et al., 2004). Changing psychological factors has even been shown to significantly counteract the negative effects of sociological factors. Those with higher self-efficacy and knowledge around healthy eating consumed more FV even as a member of a low-income population (Steptoe, et al., 2003). Methods focused on changing individual behaviours are effective for increasing FV consumption and for counteracting the negative impact of sociological factors. Focusing on these methods and understanding individual behaviour processes is important when aiming to increase FV consumption.

Dual-Processing Models

Dual-processing models are a set of models that address information processing and behaviour change at the individual level, making them useful for understanding changes in FV consumption behaviour. Dual-processing models divide mental processes that drive social judgements, associations and behaviours into automatic and controlled processes. Each model uniquely describes how the two processes function, interact and activate; however, dual-processing models share characteristics. Automatic processes are associations between objects and experiences that are fast, efficient and require little cognitive effort. Behaviour that stems from automatic processing is said to be more impulsive, uncontrollable and emotional. Controlled processes drive the more rational judgements we make and require the intention and ability to think logically. Behaviour that stems from controlled processing is said to be intentional, conscious and reasoned. Dual-processing models attribute associations and behaviours to one or a combination of both processes.

The Reflective-Impulsive Model (RIM)

The Reflective- Impulsive Model is a dual-processing model that is useful for explaining eating behaviour because it explains conflicts in food choice and incorporates schema and physiological state. Like other models it attributes behaviour to information processing from automatic and controlled pathways called the impulsive system (IS) and reflective system (RS).

According to Strack and Deutsch (2006), the IS forms associative links between objects and experiences that are stable and only change gradually over time. As the associations strengthen they connect to other similar associations creating an associative cluster that activate together. For example, having enough bad experiences with one dog can generalize into a negative association to all dogs. These associations facilitate fast and efficient decision-making under conditions of low-cognitive resources or low self-regulation. Processes in the IS are said to determine more impulsive behaviour. The RS forms reasoned judgements and evaluations either from associations in the IS or from obtaining new facts and information. These reasoned judgements can only operate under conditions of sufficient cognitive resources and are said to determine more reflective behaviour. According to the model, the IS and RS function separately but in parallel to each other- each competing for influence over overt behaviour. The conflict between making a healthy vs. unhealthy food choice is viewed as the conflict between the two pathways. For example, accepting a second slice of cake on a whim is the result of positive automatic associations to cake; whereas, ordering a salad instead of a burger at a restaurant is the result of reasoning and control. The RIM is a useful model for understanding eating behaviour because it explains the conflict between impulsive vs. reasoned food choices.

The RIM is also a useful model because it incorporates the role of schema into information processing. In the RIM, activation of behavioural schema is the final step in the process of conducting overt behaviour (Strack and Deutsch, 2006). Behavioural schema are pre-established scenario-behaviour-consequence associations that are activated by the IS, RS or both. For example, if the behaviour is accepting a second piece of birthday cake on a whim, the activating schema could have been attending a birthday party (i.e., scenario), eating the cake (i.e., behaviour) and enjoying the flavor of it and comradery of the party (i.e., consequence).

The activation of a schema depends on the strength of the automatic or controlled association (or both) that correspond to it. If the automatic association is stronger, then its corresponding schema will activate and the overt behaviour will appear impulsive. If the reasoned association is stronger, then it's corresponding schema will activate making the overt behaviour appear controlled and logical. In the case of accepting a second piece of cake, the activating association could be a strong positive automatic association to cake. Behaviour schema are their own associative cluster that activate automatically via environmental input or RS processes.

Since behavioural schema are an internal process that can not be directly observed, a good method of indicating their presence (outside of overt behaviour) is the presence of self-schema. Defined by Markus (1977), self-schemata are cognitive structures formed from generalizations about the self in past experiences. They are domain-specific and deemed important to the individual. For example, an individual classified with healthy-eating self-schema status would be someone who considers eating healthy to be important and considers themselves a healthy-eater based on past experience with making healthy-choices. Self-schema has been shown to predict healthy-eating behaviour and linked to many of the underlying processes expected from the RIM's description of schema (e.g., information processing, attention-bias, intentions) (Kendzierski, 1988).

Lastly, the RIM is a useful model for understanding eating behaviour because it incorporates the role of physiological state into information processing. According to the RIM, physiological state (i.e., hunger, thirst, physical sensation) is responsible for the pre-activation of certain schema, particularly schema that satisfy physiological need. The pre-activated schema results in an attention-bias to things in the environment that would help satisfy the need. For example, someone who is hungry has an eating schema pre-activated which creates an attention bias for food stimuli (i.e., faster and easier to recognize food). So when they come across food in their environment, the eating schema is activated quickly; therefore, driving the person towards the food and satisfying hunger. The RIM is a useful dual-processing model for understanding eating behaviour because it describes how feelings of hunger influence the processing of information around food.

There is also empirical support for the usefulness of the RIM in understanding eating behaviour. Numerous studies have demonstrated the relationships between the model's constructs and food choice (e.g., Hofmann & Friese, 2008; Hofmann, Rauch & Gawronski, 2007; Vohs & Heatherton, 2000; Seibt, Hafner & Deutsch, 2007; Rothman, Sheeran & Wood, 2009). Studies have found those who consider themselves healthy-eating schematics consume more fruits and vegetables, dietary fiber and less fat than non-schematics (Kendzierski and Costello, 2004). In connection with gender differences in eating habits, men are much less likely to hold a healthy-eating schema than women (Mahalik, Lagan & Morrison, 2006; Mahalik, Levi-Minzi & Walker, 2007; Rozin, Bauer & Catanese, 2003). Studies have shown feelings of hunger are correlated to easier recognition of food stimuli, more positive associations to food and faster activation of eating schemas (Strack and Deutsch, 2006; Brendl Markman & Messner, 2003; Seibt, Häfner & Deutsch, 2007). These findings suggest the RIM is a good model to apply in understanding men's FV consumption.

The Role of Implicit Associations

Dual-processing models like the RIM test their application to behaviour by measuring implicit and explicit associations which are thought to reflect processes in the IS and RS that are otherwise unobservable. There is strong empirical support for the important role of implicit associations in eating behaviour. Implicit associations are automatic judgements or reactions to objects that reflect processing in the IS. They are formed through repeated pairings of a stimulus and that certain reaction also known as associative learning (AL). As the association strengthens it determines the behavioural tendency to approach or avoid the stimulus. For example, a dieter who cannot resist the temptation of cake (i.e., strong positive implicit association) will quickly say yes when offered a slice even though this may be against their dieting goals (Hofmann, Friese & Roefs, 2009). Implicit associations have been found to predict the consumption of a variety of foods including fruit, chocolate, chips, candy, yogurt, low and high calorie-content foods and even restaurant choice (Friese, Hofmann & Wänke, 2008; Gibson, 2008; Hofmann & Friese, 2008; Hofmann, Rauch & Gawronski, 2007; Karpinski & Hilton, 2001; Maison, Greenwald & Bruin, 2001, 2004).

Research also shows decisions about food are often made under conditions when implicit associations are most influential (Gawronski & Creighton, 2013). According to the RIM these conditions are time pressure, low self-regulation and low-cognitive resources. Consumer studies report that time-pressure and the need for speed and convenience are perceived as barriers for purchasing fruits and vegetables (Mothersbaugh, Herrmann & Warland, 1993; Ragaert, et al., 2004; Welch, et al., 2009; Pollard, Kirk & Cade; 2002). Under conditions of low self-regulation, unhealthy food choices are more likely (Allom & Mullan, 2012; Kalavana, Maes & De Gucht, 2010; Hofmann, Rauch & Gawronski, 2007). Self-regulation is lowered in a variety of everyday experiences such as having low-blood sugar and even simple exposure to snack-foods (Gailliot, et al., 2007; Baumeister, et al, 2005; Vohs & Heatherton, 2000; Muraven & Baumeister, 2000). Finally, under conditions of low-cognitive resources (i.e., high-cognitive load, low working-memory or impaired memory retrieval) implicit associations are more influential. Research shows cognitive-resources may be depleted in a variety of ways including processing multiple forms of information at once, age and psychosocial stress (Mousavi, Low & Sweller, 1995; Salthouse, 1991; Kuhlmann, Piel & Wolf, 2005). The role of implicit associations in eating behaviour is important because the associations operate under conditions that are often experienced when making food-related decisions.

Strengthening Automatic Associations

According to the RIM, implicit associations are formed and strengthened through both impulsive and reflective processes. The simplest way implicit associations are formed is through the IS. The repeated pairing of a stimulus presented in the environment with another element such as emotion, sensation or cognitive reaction builds the associative link between the two elements. Every time the same stimulus is encountered the corresponding positive or negative element is activated and the association becomes stronger. As it becomes stronger its potential to activate schema and determine behaviour increases. According to the RIM, the resulting behaviour is the tendency to approach or avoid the stimulus (Strack and Deutsch, 2006). In the context of food choice, the tendency to approach or avoid healthy foods may depend how it has tasted in the past or the feelings experienced after its eaten. Although no study is known to examine implicit associations toward healthy vs unhealthy foods and actual food choice behaviour, a number of studies have shown the associations are significantly related to BMI, weight gain and weightloss over a year (Czyzewska & Graham, 2008; Calitri, et al., 2010; Craeynest, et al., 2005; Finlayson, Bryant, Blundell & King, 2009). Implicit associations that are formed in the IS are thought to have no semantic meaning connected to them. That is, their connection is simply a reflection of the two elements co-occuring in the past. Via processing in the IS, this is the simplest way implicit associations are formed and strengthened.

The second way implicit associations can be formed is via processing in the RS. According to the RIM, actively thinking about the relationship between two elements (i.e., propositional evaluation) simultaneously activates the visual or conceptual representations of the corresponding elements in the IS. Every time the same elements are thought of together the implicit association between them is strengthened (Strack and Deutsch, 2006). This is important because it suggests learning new semantic information not only determines controlled behaviour but can also carry over into determining automatic and reactive behaviour. This is supported by previous research reporting the significant effects of explicit learning on implicit associations (e.g., Gregg, Seibt & Banaji, 2006; Rydell. et al., 2007). In addition to impulsive processes, implicit associations can be formed via reflective processes and this suggests the associations formation and strength are not solely dependent on simple affective or sensory experience.

Applying Theory

A strategy to designing more effective health campaigns is to look at the theoretical effectiveness of the message. Messages designed based on theory can be more effective than their counterparts (Mitchie, et al., 2009; Kelley & Abraham, 2004; Tsorbatzoudis, 2005). In addition, applying theory helps identify factors which may not have been considered otherwise (Anderson, Winett & Wojcik, 2007; Povey et al., 2000; Williams, et al., 2004). In the present context, improving FV consumption in men could be achieved by using messages that strengthen positive implicit associations towards FV. In context of the RIM, a health campaign strengthens implicit associations towards healthy foods by repeatedly pairing healthy food stimuli with pictures or words representing positive affect, positive attributes or positive experience. One study measuring changes in implicit associations before and after campaign exposure has supported this. Czyzewska and Ginsburg (2007), demonstrated positive changes in automatic associations after reading anti-marijuana and anti-tobacco print messages. The same effect is replicated in a laboratory setting using associative learning (AL) techniques. AL functions by repeatedly pairing two concepts within close temporal or spatial proximity of each other- usually a picture representation of an object paired with a picture representation of positive or negative affect. AL has been shown to significantly change implicit associations towards alcohol and soft-drinks (Houben, Havermans, Nederkoorn & Jansen, 2012; Houben, Havermans & Wiers, 2010; Gawronski & LeBel, 2008; Gibson, 2008). To strengthen positive implicit associations towards FV, AL would pair a picture of fruit with a picture of a happy person. These studies suggest improving FV consumption could be improved using messages designed to strengthen positive implicit associations.

To change behaviour via change in implicit associations, the associations that best correlate with behaviour are the ones needed to be strengthened. In RIM's context, this would be the association that most likely activates the healthy-eating schema. A good measure to examine associations to specific stimuli is the Implicit Association Test (IAT). It is useful because the object of interest and type of stimuli used (i.e., picture or word stimuli) to represent that object can be modified. It is also a good measure to use because implicit associations related to health behaviours measured by the IAT (e.g., implicit associations towards exercise, alcohol, smoking) have been shown to be good predictors of actual behaviour (Legget, et al., 2015; Lascelles, Field & Davey, 2003; Lebens, et al., 2001; Walsh & Kiviniemi, 2014; Czopp, Monteith, Zimmerman & Lynam, 2004; Banting, Dimmock & Lay, 2009; Houben & Weirs, 2008; De Houwer, Custers & De Clercq, 2006; Ostafin & Palfai, 2006). Developed by Greenwald, McGhee & Schwartz

(1998), the IAT captures implicit associations by comparing the time it takes to categorize target picture or word stimuli and positive concepts in one group with the time it takes to categorize the same target stimuli and negative concepts in another group. For example, categorizing pictures of chocolate bars and positive affective words together faster than categorizing pictures of chocolate bars and negative affective words together indicates a more positive implicit association towards chocolate bars. The IAT is a good measure to use to compare the relationship between different associative links and behaviour- in this case it can help determine whether picture of foods or word-names of foods are most likely to activate the healthy-eating schema.

Picture vs. Word Associations

According to the RIM, associations are activated based on the similarity and contiguity of the environmental input (Strack & Deutsch, 2004). In other words, associations are activated when the stimulus looks like the one previously linked and is in close temporal or spatial proximity to the affect or experience previously linked. Using this logic it can be expected that a picture of a food item is more likely to activate the strongest and most accurate association, compared to word names of foods, because they are the most visually similar to what is encountered in real life. Consequently this also suggests automatic associations connected to pictures of food would be more correlated with overt behaviour. For example, every time we open our fridge we see the food items exactly for what they are. In contrast, it is seemingly more rare to come across the word name of a food, let alone decide whether to eat it or not based just on its name. For example, this would only happen when making choices from a restaurant menu or reading the label on a Tupperware container. Even then it can be argued the decision to eat something is only made once we are presented with the actual food item, such as when the server comes out with the food or we open that container. Therefore, it is expected that IAT's using picture stimuli (Picture-IAT's) measure stronger automatic associations to foods because they are more accurate representations of what is encountered in real life. Comparatively, word stimuli have less visually similar features to food, making IAT's using word stimuli (Word-IAT's) less likely to capture the strongest or most accurate associations to food. The RIM provides theoretical support for the argument that pictures of food activate stronger more accurate associations with that item, than its corresponding word name. Accordingly, Picture-IAT's are expected to be more reflective of actual behaviour than Word-IAT's.

Present Study

Based on a review of the literature, to date no study has directly compared the predictive validity of the Picture-IAT and Word-IAT in any context; however, there are a handful of studies that have used one or the other to examine correlations between implicit associations towards foods and food choice behaviour. The findings from them support the hypothesis that Picture-IAT's measure associations more reflective of food choices than Word-IAT's. Studies using picture stimuli in the IAT have found implicit associations to be predictive of food choice; however, studies using word stimuli did not. For example, implicit associations measured by the Picture-IAT were able to predict the consumption of chocolate, M&M's and fruit (Friese, Hofmann & Wänke, 2008; Hoffman & Friese, 2008; Walsh & Kiviniemi, 2014; Hofmann, Friese & Roefs, 2009). In contrast, implicit associations measured with Word-IAT's were not able to predict the selection of genetically-modified food or fruit and snack foods such as chips and chocolate (Spence & Townsend, 2007; Richetin, Perugini, Prestwich & O'Gorman, 2007). Studies using the Picture-IAT report implicit associations are more predictive of food choice compared to Word-IAT's; however, no study has directly compared them. The purpose of this study is to determine whether pictures of food activate automatic associations more predictive of behaviour than word-names of foods. This will be done by comparing Picture and Word-IAT's correlations with food choice behaviour. This information will help determine whether messages promoting FV consumption to men should use more pictures or words when aiming to improve the behaviour via change in implicit associations.

Purpose

The purpose of the study was to compare the effects of associative learning using picture stimuli with associative learning using word stimuli on implicit associations towards apples vs. snackbars, explicit associations and food choices.

Predictions

H1. Increases in implicit associations towards apples compared to snackbars will be greatest when stimuli in associative learning match the stimuli in the association (e.g., associative learning using pictures (Picture-AL) will increase associations to pictures and associative learning using words (Word-AL) will increase associations to words). The changes will be moderated by healthy-eating schema and hunger.

H2. Associations to pictures of food will best predict food choice behaviour when the choice must be made between pictures or actual food items (i.e., actual choice). Associations to word names of food will best predict food choice behaviour when the choice must be made between word names.

Methods

Participants and Design

The study used a 3-way (Word-AL, Picture-AL, Control-AL) x 2-way (pre and post associations) mixed design to compare the effects of Picture-AL and Word-AL on implicit and explicit associations toward apples versus snackbars and choice behaviour. Implicit associations to pictures and words were measured using a picture version and word version of the IAT. Choice behaviour was measured by asking participants to choose an apple or snack bar as a compensatory item in a picture-format and word-format computer question and an actual apple or snack bar at the end of the study. Based on sample sizes of previous studies comparing EC and IAT effects (Foroni & Bel-Bahar, 2010; Lebens, et al., 2011), 124 male students from the University of Alberta were recruited to participate. An effect size (Cohen's d) of .75 was anticipated following previous research using a repeated-measures design to investigate changes in implicit associations following AL procedures (Houben, Havermans, Nederkoorn & Jansen, 2012). Conventionally, an effect size of .75 is considered large; therefore, assuming equal sample sizes in both treatment and control groups, equal variance and relative stability of the IAT effect over time, a sample of at least 78 (or 26 per condition) was needed to measure the effect of conditioning on implicit Associations (Cohen, 1992). An effect size of .59 was expected when comparing Word-IAT and Picture-IAT effects (Lebens, et al., 2011). To measure this medium to large effect size a sample of 64 participants is needed (or 32 within each group). Based on these estimates, to meet the sample sizes required for both of these analyses a sample size of 120 male participants (40 per condition) was recruited.

Participants were recruited on campus via the University of Alberta's psychology participant pool, posters, word-of-mouth, and table stations set-up around campus. Upon consent, participants were given a hand-out listing all the apple and snackbar picture and word items and asked to take a moment to familiarize themselves with them. Once they indicated they were familiar, they completed a Picture-IAT and Word-IAT on a computer and an apple-explicit and snackbar-explicit measure on a paper. Then they were directed back to the computer to complete their assigned AL task (i.e., Picture-AL, Word-AL or Control-AL) and post-test Picture-IAT and Word-IAT. In the final steps participants completed the post-test explicit measures along with a self-schema measure, hunger measure and demographic questions all on paper. The order of completing the pre-test and post-test picture and word IAT's was counterbalanced (see Table A1). At the end of the session, participants were asked to choose between an apple or snackbar as their compensation in two counterbalanced questions (picture and word version) on a computer screen and then as a real choice from a bowl on the table.

The IAT's and AL tasks used the targets 'apple' and 'snackbar', and 'healthy' and 'unhealthy' as the dichotomous concepts. The AL tasks paired apples with healthy items and snackbars with unhealthy items over a series of 144 trials. The IAT's compatible blocks were apple+ healthy and snackbar+unhealthy and incompatible blocks were apple+unhealthy and snackbar+healthy. Apples and snackbars were chosen because they both have sweet tasting profiles and made the list of top snack foods in Canada (Fernando and Matejovsky, 2011). Snackbars were paired with "unhealthy" attributes because they are often perceived as healthy even though most are not (Mentel, 2012; Beck, 2013).

Measures

IAT

The IAT's were modified versions of the measure developed by Greenwald, McGhee and Schwartz (1998). The test measures the difference in time (milliseconds) it takes to sort target picture/words and attribute stimuli into compatible and incompatible blocks. The target categories were apple and snackbar and the attribute categories were healthy and unhealthy. The compatible blocks were apple+healthy and snackbar+unhealthy and the incompatible blocks were apple+unhealthy and snackbar+healthy. The IAT effect (D score) was calculated using the algorithm developed by Greenwald, Nosek & Banaji (2003) adding a 600 ms penalty for every error. Higher scores (i.e., faster reaction time in compatible versus incompatible blocks) indicated a stronger association between apples and healthy compared to snackbars. The tests were delivered on a computer with Inquisit software.

The stimuli representing the apples in the Word-IAT were names of six types of apples (i.e., gala, granny smith, red delicious, fuji, honeycrisp, and apple). The stimuli representing snackbars were the names of six kinds of snackbars (i.e., Nature Valley, Quaker, Nutri-Grain, Kashi, Cliff and Granola). The Picture-IAT used pictures of the items (Appendix B). To ensure participants were familiar with the items, a sheet showing the apple and snackbar stimuli was given for review before completing the IAT's. The picture and word stimuli representing the healthy and unhealthy categories were chosen based on the results of an online pilot survey completed by 30 men recruited via word of mouth and Facebook. For the Picture-IAT participants were asked to rate a series of 37 pictures related to health and illness on a 5-point Likert scale with 1 being extremely unhealthy and 5 being extremely healthy. The seven highest rated pictures were used to represent "healthy" including pictures of men doing yoga, working out, running and hiking ($M=4.2$). The seven lowest-rated pictures were used to represent "unhealthy" and included pictures of men looking ill, lying in a hospital bed and experiencing chest-pain ($M= 1.55$). For the Word-IAT participants were asked to rate a series of 24 words on how related they thought the words were to the terms" healthy" and "unhealthy" on a 3-point scale where 1 equaled "not related at all" and 3 equaled "very closely related". The top seven words most closely related to "healthy" were happy, able-bodied, athletic, balance, flourish, strong and wellness (*M*= 2.47). The top seven words most closely related to “unhealthy” were sick, pain, run-down, unwell, frail, ailing and disease (*M*= 2.37).

Apple and Snackbar Explicit Associations

The questionnaire measuring explicit associations was identical to the one used by Richetin, Perugini, Prestwich and O'Gorman (2007) except it addressed participant’s associations toward eating apples and snackbars. It used 5-bipolar scales (bad-good, unpleasant-pleasant, enjoyable- unenjoyable, negative-positive, healthy-unhealthy) with the question “For me eating apples is…” or “For me eating snackbars is…”. (See Appendix C).

Associative Learning

The procedures in the AL tasks were similar to the evaluative conditioning tasks used in Lebens et al. (2011) and were delivered on a computer using Inquisit software. In the task, apple stimuli or snackbar stimuli showed in one of four quadrants on the screen. Participants were instructed to indicate whether they appeared on the left or right hand side of the screen by pressing the “e” or “i” keys within 2 seconds of seeing them. Next, the healthy or unhealthy stimuli appeared in the same quadrant for 400ms. Apple stimuli were always paired with healthy stimuli and snackbar stimuli with unhealthy stimuli. The Word-AL used the same stimuli in the Word-IAT and the Picture-AL used the same stimuli in the Picture-IAT. The Control-AL replaced the apple and snackbar items with pictures of t-shirts and pants. There were 144 trials in which the pairs of stimuli appeared. Participants were told the task was investigating their reading ability and visual acuity to reduce contingency awareness.

Health- Eating Self-Schema

Healthy eating schema was measured using the scale developed by Allom and Mullan (2012) and derived from Kendzierski (1988), which asked participants to rate on an 11-point scale how well three statements describe themselves and how important the descriptions were to them The statements were “I am a healthy eater”, “I eat in a nutritious manner” and “I am careful about what I eat”. Scores were calculated using the procedures from Kendzierski and Costello (2004). Those who rated at least two out of three of both the descriptor and importance items an 8 or above were categorized as schematics. All other participants were rated as non-schematics.

Hunger

Hunger level was measured using a 7-point Likert scale asking participants how hungry they were where 0 was “not hungry at all” and 7 was “extremely hungry”. Seven participants were missing hunger scores which were replaced with the mean of the sample (M= 4, SD= 1.6). This appeared to be due to the position of the item at the very top of the paper questionnaire making it difficult to notice.

Picture-Format and Word-Format Choice

Participants were asked to choose an apple or snackbar on the computer in two questions- one asking them to select from word names of the items and one asking them to select from pictures of the items. To elicit spontaneous snack choice and reflect implicit associations (Gibson, 2008) the questions were delivered under conditions of cognitive-load. Participants were asked to memorize an 8-digit number right before each computer question and told they must correctly recall that number after the questions to receive their snack. This method was used following reports of the intended effect in previous studies (Friese, Hofmann & Wänke, 2008; Gibson, 2008; Maison, Greenwald & Bruin, 2004). To administer both versions of the questions without suspicion participants were told they got the number wrong the first time and had to try again. Snack bar selections were assigned a score of 0 and apple selections were assigned a 1.

Actual Choice

As the final behaviour measure, the explicit-choice question openly offered participants to choose an apple or snack bar from a bowl as compensation for participating.

Data Analysis

Changes in Implicit and Explicit Associations (H1)

A 3 (Picture-AL, Word-AL, Control-AL) x 2 (schematic, non-schematic) x 2 (pretest to posttest) mixed analysis of variance was conducted to examine changes in implicit and explicit associations. Cohen's *d* values were used to interpret the findings. From the starting sample (N=123), three participants had more than 10% of latencies below 300ms in one of IAT's, which were replaced with the mean score for that test. One participant had more than 10% of latencies below 300ms in all four IAT's so his data was excluded. Two participants had outlying scores in the pre-test Picture-IAT and two had outlying scores in the pre-test Word-IAT. These were replaced with the mean. One participant had outlying scores in all four of their IAT's so his data was excluded. Two participants were missing post-test Word-IAT scores and three were missing post-test Picture-IAT scores. The missing scores seemed to occur randomly throughout the sample; therefore, it is likely they resulted from a technical error with the Inquisit software. The missing scores were replaced with the mean. Three participants had outlying scores in the pre-test apple-explicit measure which were replaced with the mean. One participant did not complete the post-test explicit associations measures so his data was excluded. The final sample used in the Mixed-ANOVA was 120.

Participants were evenly distributed between AL groups with 42 in Picture-AL, 39 in Word-AL and 39 in Control-AL. A one-way ANOVA was originally used to determine any differences between baseline implicit and explicit associations, hunger and age between groups. Baseline Picture-IAT (p = .01) and apple-explicit scores (p = .025) violated Levene's test of homogeneity of variance so a Welch ANOVA and Games-Howell post-hoc tests were used. The Welch ANOVA revealed no significant differences between AL groups in baseline implicit or explicit associations or age (M= 23, SD= 7); however, there was a significant difference in hunger (p < .001) (See Table A2). Games-Howell post-hoc tests revealed feelings of hunger were significantly higher in the Picture-AL group (3.85 ± .31, p = .003) and Word-AL group (4.1 ± .32, p < .001) compared to the Control-AL group (2.79 ± .31). There was no significant difference in hunger between the Picture-AL and Word-AL groups (p = .69). It was unclear whether the AL tasks influenced feelings of hunger because it wasn't measured at pre-test; however, past research has shown repetitive exposure to food stimuli, like that in the Picture and Word-AL tasks, increases feelings of hunger (Wang, et al., 2004; Fedoroff, Polivy & Herman, 1997; Marcelino, et al., 2001). For this reason, hunger was excluded from the analyses.

Predicting Behavior (H2)

Binary logistic regression analyses were used to compare which IAT best predicted behavior in the choice tests. Separate models were run for computer choice and actual choice. Post-test apple and snackbar explicit associations and schema were added at step 1, and post-test

Picture-IAT and Word-IAT scores were added at Step 2. The interactions between schema and IAT scores were originally included; however, they were removed after the confidence intervals were found to be abnormally large. Schema was dummy-coded such that non-schematics equaled 0 and schematics equaled 1. Following the procedures outlined by Aiken, West and Reno (1991), two dummy codes were created such that the effects of Picture-AL and Word-AL would be compared in reference to Control-AL. Those who chose snackbars were coded 0 and those who chose apples were coded 1.

The samples used for the regression analyses were adjusted from the Mixed-ANOVA sample. In the picture and word-format choice tests, most participants made the same choice so the tests were combined into one outcome variable called computer choice. Participants who made different selections in the picture and word-format questions (n=6) were excluded. The final sample used in the regression analyses for computer choice was 114.

In actual choice (i.e., from the bowl) 11 participants refused a snack. Three were in the Picture-AL, four in the Word-AL and four in the Control-AL. Since number of refusals were evenly distributed across conditions their data was removed. Actual choice remained separate from computer choice because 15 participants chose differently between the them (eg., chose apple in computer choice and snackbar in actual choice). The final sample used in the regression analyses predicting actual choice was 109.

Results

Changes in Implicit and Explicit Scores

In the Mixed-ANCOVA, Box's M test of equality of covariance and Levene's test of equality of covariance was violated, $F(180, 11352) = 1.18$, $p = .048$. This was not a concern because ANOVA is generally robust to this violation and samples sizes were equal (Garnet, Meyers & Guarino, 2008, pp. 57). Means and standard deviations of all pre-test and post-test measures are shown in Tables A3 and A4 and results of ANOVA are in Table A5. The analyses revealed H1 was not supported. The effect of AL group on changes in IAT scores was not significant and explicit associations towards snackbars did significantly change. Multivariate within-subject's tests revealed a significant effect of time. Univariate tests revealed the effect of time was significant for Picture-IAT ($p < .001$) and explicit-snackbar attitude scores ($p < .001$). This was reflected in effect sizes, where all three AL groups had medium to large effects on Picture-IAT scores and small to medium effects on and explicit snackbar attitude scores. Contrary to the hypothesis, schema was not a significant moderator of change in implicit scores. Results of between subject's effects revealed a significant effect of schema on Picture-IAT scores ($p < .006$). The effect of non-schematic on change in Picture-IAT scores was large; whereas as effect of schematic was medium. Collapsed across time and AL group, pairwise comparisons showed non-schematics had significantly lower Picture-IAT scores than healthy-eating schematics (MD= -.14, SE =.05).

Predicting Computer Choice

In the final data set used in the regression model predicting computer choice (n=114), 72 participants chose apples (63%) and 42 chose snackbars. At step 1, the model was significant, $\chi^2(3, N = 114) = 9.58$, $p = 0.022$. It accounted for 11% of the variance (Nagelkerke R^2) and correctly predicted 64% of observed choices. Adding the IAT's in step 2 did not significantly improve the model. Both apple-explicit and snackbar-explicit associations were significant at step 1 and remained significant at Step 2 ($p = 0.035$ and $p = 0.008$ respectively) (See Table A6).

Predicting Actual Choice

In the model predicting actual choice from the bowl (n=109), 64 participants chose apples (59%) and 45 chose granola bars. Shown in Table A7, at step 1 the model was significant, $\chi^2(3, N = 109) = 11.99$, $p = 0.007$. It accounted for 14% of the variance (Nagelkerke R^2) and correctly predicted 66% of observed choices. The model was better at predicting apple choice (78% correct) than snackbar choice (50% correct). Step 2 did not significantly improve the model, but it remained significant, $\chi^2(5, N = 109) = 13.58$, $p = 0.018$. Snackbar explicit associations were significant at step 1 ($p = .003$) and remained significant at step 2 ($p = 0.002$).

Discussion

The first purpose of this study was to determine whether picture or word stimuli used in associative learning changes automatic associations to those stimuli in different magnitudes or directions. The effects of associative learning using pictures (Picture-AL) compared to associative learning using words (Word-AL) on implicit and explicit associations towards apples and snackbars were examined. Hypotheses were made in context of the RIM. H1 predicted that changes in implicit associations would be greatest when the stimuli in associative learning matched the stimuli in the automatic associations. More specifically, predictions were made that changes in associations to pictures of apples and snackbars would be greater in the Picture-AL group, and changes in associations to word-names of apples and snackbars would be greater in the Word-AL group. Both groups were compared to a Control-AL group. H1 also predicted the magnitude of change in associations would be moderated by schema type and hunger.

Effects of Associative Learning

H1 was partially supported. In contrast to the hypothesis, positive associations to pictures increased in all AL groups and associations to words remained unchanged or slightly decreased. Schema was a significant moderator of changes in associations to pictures but hunger could not be evaluated due to significant differences between AL groups. These findings suggest associations to pictures and word names of foods do not change according to the type of stimuli used in associative learning. The RIM provides reasoning for why this may have occurred. The AL tasks and IAT's were designed to examine changes in automatic associations based on semantic value (i.e., knowledge or fact) rather than affective value (i.e., emotion or sensory input). The remaining findings were interpreted based on this concept.

Automatic associations based on semantic value may be more difficult to change using AL. The attribute categories in the IAT's were 'healthy' and 'unhealthy' which are arguably values based on knowledge and reasoning rather than emotion or experience. According to the RIM, associations like this are more likely formed from reflective processes (Strack and Deutsch, 2004). More specifically, the concepts 'apple' and 'healthy' are more likely to co-occur during propositional evaluation as mental representations than in reality. The AL tasks and IAT's were designed to examine automatic associations based on semantic value rather than affective value. This was the fundamental difference between this study and other studies reporting success using AL to change implicit associations toward foods (Houben, Havermans, Nederkoorn & Jansen, 2012; Houben, Havermans & Wiers, 2010; Gawronski & LeBel, 2008; Gibson, 2008). It could be that automatic associations built from propositions are more difficult to change using procedures like associative learning.

The effects of AL may also have been minimal because automatic associations based on semantic value are stronger and therefore harder to change. This can only be inferred from processes outlined in the RIM, findings in other similar studies and the significant effect of schema. The developers of the IAT do not state a cut-off value or range in D scores that represent strong vs. neutral implicit associations (Greenwald, McGhee and Schwartz, 1998) and the average IAT scores in this study can not be compared in strength to scores in other studies because their IAT's measured affective associations (e.g., good+fruit, hate+chocolate) (Friese, Hofmann & Wänke, 2008; Prestwich, Hurling & Baker, 2011). Lastly, the role of baseline strength in changes in automatic associations can only be inferred because to the best of current knowledge no other study has used a repeated-measures design to examine the effects of AL on implicit associations to food items. The following section discusses the possibility the AL tasks aimed to changed implicit associations that were strong and difficult to change from the start. This possibility is considered in terms of the RIM, findings in other similar studies and the significant effect of schema.

Implicit Associations

The RIM supports the limited effects of AL on implicit associations because it describes the process of change as gradually occurring over many learning trials with limited flexibility (Strack and Deutsch, 2004). Regardless of semantic or affective value, it is unlikely for one session of associative learning to change potentially years of associative learning surrounding apples and snackbars. In addition, apples and snackbars are common snack items. Participants were more likely to be familiar with them suggesting they entered the study with previously well-established associations built from their own experience. One session of associative learning is unlikely to change strong implicit associations, regardless of semantic or affective value.

Further support for the theory that baseline implicit associations were strong and resistant to change, comes from research showing a ceiling-effect occuring in changes to implicit associations. Since participant's reported a strong preference for both apples and snackbars at pre-test it can be posited their implicit associations were equally strong in the positive direction. This would reduce the amount of change that could occur in the positive direction. Previous studies have shown this sort of ceiling-effect in changes to implicit associations when explicit associations were strong are pre-test. Haynes, Kemps & Moffitt (2015), found positive implicit associations towards unhealthy foods corresponding to strong positive explicit assocaitions only changed in the negative direction. That is, their target-positive associative learning treatment could not increase positive associations further, but the target-negative treatment could decrease them. Gibson (2008) found the effects of associative learning (i.e., Coke+positive, Pepsi+negative) on automatic associations were only significant in participants with neutral explicit associations at baseline (i.e., no preference at the start). Those who had a strong explicit preference for either Coke or Pepsi were less effected by AL. Similarly, Houben, Havermans and Wiers (2010) found that AL did not strengthen negative associations to smoking that were already negative implicitly and explicitly at baseline.These findings correspond to the present study because most participants had strong positive associations to both apples and snackbars with a slightly stronger positive explicit association towards apples at baseline. Participants maintained their original implicit preference for apples as healthy compared to snackbars as healthy after AL. This suggests a similar ceiling-effect may have occurred and emphasises the role of baseline strength in changes to implicit associations.

In terms of the RIM, these carry-over effects of explicit association strength into implicit association strength makes sense, especially for associations based on semantic value. Every reasoned association that emerges in the RS simultaneously activates the corresponding mental representations in the IS and forms the implicit association. Implicit associations that are based on semantic meaning are thought to be a sort of mental shortcut for making decisions that usually require mort effortful and time consuming systematic processing (Strack and Deutsch, 2004). In this study, it is possible the strong positive explicit associations towards apples and snackbars contributed to the formation of well-established implicit associations. This further supports the idea that the semantic-based associations examined in this study were stronger and resistant to effects of AL.

The significant effect of schema on changes in associations to pictures is also support for the role of baseline strength in implicit attitude change. Collapsing across AL groups, non-schematic's experienced the greatest change in associations to pictures compared to healthy-eating schematics, but most importantly non-schematics started with much lower implicit associations. This effect can not be attributed to AL, but it does support the theory that association strength at baseline may have been a contributing factor in the present findings. According to the RIM, healthy-eating schematics are assumed to have stronger automatic and controlled associations that activate a "healthy eating" schema (i.e., stronger input from the IS and RS) (Strack and Deutsch, 2004). As expected, schematics held stronger implicit associations towards apples compared to snackbars that were more resistant to the effects of AL. It was noted that Word-IAT scores were larger than Picture-IAT scores at baseline; however, they did not increase like Picture-IAT scores. This adds additional support for the role of baseline strength in the effects of AL on automatic associations.

Changes in Picture vs. Word Associations

This study partially supported the hypothesis that automatic associations to pictures change in different magnitudes than associations to words. Associations to pictures of apples and snackbars did significantly increase; whereas, associations to words remained the same. To date this is the first study to directly compare the magnitude of change over time in these two types of associations so plausible explanations can only be inferred. The RIM justifies the original contention of the difference in associative activation between picture and word stimuli representing the same mental concepts. Even so, methodological issues in this study may have been responsible for this effect and deserve consideration. Lastly the differences in changes may be due to the level of semantic and affective value associated with each type of association. The following section discusses what may have caused the difference in changes between picture but not word associations at a theoretical and methodological level.

Collapsing across AL and schema groups, associations to pictures of apples and snackbars significantly increased but associations to their corresponding word names were unchanged. This occurred even though conceptually the pictures and words were assumed to represent the same mental concepts. This finding supports the RIM's emphasis of the importance of similarity and contiguity of the stimulus when activating associations. Pictures and words are fundamentally different in how they appear (i.e., different colours, shapes, size and perception of dimension). This study shows potential for their visual differences being large enough that they hold different associations in numbers and strength and that they may not connect through spreading activation. According to the model, the ability of one associative link to activate other similar associations depends on its strength. It could be expected then that the repeated activation of associations to pictures of apples would spread and simultaneously activate associations to the word name "apple". This is assuming pictures and word-names of apples share the same associative cluster on some level. This did not occur in this study. Associations to pictures of apples and snackbars changed without any evidence of carry-over effects into the associations of their word names. In this context, the difference in changes between the two associative links support the RIM's emphasis of stimulus similarity and contiguity in associative activation.

The difference in changes between associations to pictures but not words could also have been the result of methodological issues. Since participants completed four IATs in one session the role of practice-effects were considered; however, this possibility was rejected for two reasons. First, the IAT is known to be susceptible to practice-effects where previous experience with the IAT is correlated with smaller effects in subsequent IAT's (i.e., negative correlation) (Greenwald, Nosek & Banaji, 2003). With each additional completion of the IAT, participants get slower at completing compatible blocks and faster at completing incompatible blocks. This reduces the difference in average latency between blocks. In this study, Picture-IAT scores increased at post-test meaning the difference in average latency between blocks increased; therefore, practice-effects were unlikely to be the cause. Second, practice-effects were ruled out because Word-IAT scores did not significantly change in either direction. If practice-effects were taking place Word-IAT scores would have decreased as expected. For these reasons, practice-effects were ruled out as the cause of change in Picture-IAT scores.

Another methodological issue was identified following a more recent studt that found the IAT can act as a form of associative learning in and of itself. Ebert, Steffens, Von Stülpnagel and Jelenec (2009) concluded this after finding participants who completed one block of the IAT (i.e., compatible or incompatible block) held implicit associations at post-test corresponding to that block measured by the Go No-Go task. Most importantly, they found this effect after completion of IAT blocks using snack items (i.e., chocolate bars and gummy bears). The same results were also found in a study using an intervention IAT to change implicit attitudes towards healthy vs. unhealthy foods (Haynes, Kemps & Moffitt, 2015). In this study negative implicit attitudes towards unhealthy foods (e.g., pizza, hamburgers) were significantly increased after completing an IAT block pairing unhealthy foods with negative words and healthy foods with positive words. These studies support that each IAT in the current study potentially acted as an additional session of associative learning. This would explain why scores on the Picture-IAT increased in the control group as well. In respect to the RIM, this finding corresponds to the models emphasis of spatio-temporal contiguity when forming associations between concepts. The IAT places the associative elements close in space and time like other associative learning techniques. For this reason, administering four IAT's in one session could be responsible for the increase in Picture-IAT scores in all AL groups and poses a methodological problem in this study.

Semantic Associations

The last possible explanation for the difference in changes between Picture-IAT and Word-IAT scores may be the level of semantic value associated with each type of stimuli. Previous research has demonstrated effect sizes in Picture-IAT 's (i.e., D-score) tend to be much smaller than effect sizes in Word-IAT's (Foroni & Bel-Balhar, 2010; Slabbinck, De Houwer & Van Kenhove, 2011). A similar result was found in this study at pre-test and post-test. Foroni and Bel-Balhar (2010) argue these effects are due to the semantic fan effect. The semantic fan effect is the finding that when people know more about a certain topic it takes them longer to respond to questions about it; whereas when they know less, they can come to a quicker conclusion (Anderson and Reder, 1999). Foroni and Bel-Bahar (2010) suggest words activate much more semantic information than pictures which slows reaction times in IAT's. They argued a word-name of something can refer to more than one exemplar, is more abstract and contains textual features; therefore, activating multiple associations and integrating a fair amount of information. The additional information associated to words translates into a slower response time and larger effect size in Word-IAT's. In contrast, a picture of an object would only activate associations specific to that item, is more concrete and perceptually does not reflect much semantic meaning; therefore, activating fewer associations and incorporating less information. This translates into faster response times (i.e., smaller effect size) in Picture-IAT's.

In the present study this argument serves to explain why Word-IAT scores were less subject to change than Picture-IAT scores. The words used for the target and attribute stimuli (e.g., Granny-Smith, athletic, Granola, disease) activated multiple associations and incorporated more semantic information allowing the Word-IAT's to capture a broader and more comprehensive measure of the strength of associations to apples and snackbars. Associations at this level would require extensive learning, beyond what one session of AL provides. The pictures used in the Picture-IAT (see Appendix B) activated fewer associations that were only related to those items specifically, therefore drawing less semantic meaning.

In addition, the items in the Picture-IAT may have elicited a level of affective value to the semantic associations between apples and healthy and snackbars and unhealthy. The 'healthy' attribute stimuli contained pictures of men smiling while exercising, adding a level of positive affect. The 'unhealthy' attribute stimuli contained pictures of men experiencing pain while gripping their chest and lying in a hospital bed, adding a level of negative affect. Research has shown semantic associations that carry over a level of affect skew the strength of the association reflected in the IAT (Perkins & Forehand, 2006; Schnabel, Asendorpf & Greenwald, 2008, Rudman, et al., 2001; Bluemke & Friese, M, 2006). Arguably the affective features in the picture stimuli may have made the associations to pictures more malleable to AL explaining the significant change in associations to pictures vs. words found in this study.

Explicit Associations

The findings in this study did not support the hypothesis that explicit associations would remain the same before and after AL. Explicit associations towards snackbars significantly decreased in all AL groups. The mechanism of change may have been contingency awareness- a factor often measured in studies using associative learning but not considered in this study. Contingency awareness is the consciousness of the relationship between two events. Reviewed by Fields (2000) contingency awareness in associative learning is simply being aware that one stimulus precedes another. It is usually measured after AL by asking participants to either recall what they were aware of (if anything) or specifically indicate which stimuli were paired with others. In many studies using AL, contingency awareness is required for the effects of AL to be significant.

In another review of studies investigating contingency awareness by Lovibond and Shanks (2002), single-process models were used to explain how contingency awareness translates into explicit association change. Single-process models assume the state of being aware of the pairing between two concepts is propositional in nature. Translating to dual-processing models and the RIM, this makes sense because awareness (by definition) requires the conscious recognition of information (i.e., a reflective process). Perhaps participants in this study became increasingly aware of the apple, snackbar, healthy and unhealthy pairings with each additional completion of the IAT. This suggests the addition of propositional information over the span of the session. This would explain the change in explicit association to snackbars including in the control group.

The fact that explicit associations towards snackbars significantly decreased, but did not significantly increase towards apples also supports the role of ceiling- effects in this study. Just like the lack of positive change in Word-IAT scores, explicit associations to apples may not have increased because they were already very strong and positive. A ceiling-effect may have occurred leaving very little room for any signficicant change in the positive direction to occur. In contrast, baseline explicit attitudes towards snackbars were strong in the positive direction leaving them with plenty of "room" to change in the negative direction. This corresponds to the snackbar+unhealthy associations targeted in the IAT's and AL's. Finding a significant change in explicit associations towards snackbars but not apples, supports the role of ceiling-effects in this study and emphasizes the role of baseline strength in explicit associations when attempting to change both implicit and explicit associations.

Schema

As expected, schema was a significant moderator of change in associations to pictures of apples and snackbars. Collapsing across AL groups, healthy-eating schematics held stronger associations between 'apples' and 'healthy' than they did 'snackbars' and 'healthy' as measured by the Picture-IAT. In comparison, non-schematic's automatic associations between 'apples' and 'healthy' were weaker. This supports the RIM's claim that in some instances the connection between reflective processes and behavior is mediated by impulsive processes. Assuming the association between 'apples' and 'healthy' is based on semantic value it takes form in the reflective system first. With every thoughtful evaluation of the association, the corresponding elements are activated in the impulsive system forming an automatic association. Since healthy-eating schematics had stronger automatic associations of this type, it suggests the association relates to behavior (Kendzierski, 1988). This completes the connection from reflective processes to overt behaviour through the impulsive system. In understanding the development of healthy-eating behavior, this is important because it suggests propositional information about the health value of foods can (over time and repetition) form an automatic association strong enough to activate behavior.

Finding stronger implicit associations in schematics compared to non-schematics is also evidence for the synergistic and antagonistic interaction between implicit and explicit associations and behaviour described in the RIM and other dual-processing models. Schematics and non-schematics held equally strong positive explicit associations towards apples and snackbars; however, only schematic's held stronger implicit associations. This is evidence the combination of holding implicit and explicit associations related to schema type may contribute to meeting self-schema status. That is, those who associate 'apples' and 'healthy' at the implicit and explicit level are more likely to consider themselves healthy-eaters and to consider healthy-eating an important behaviour. In contrast, those with explicit associations only are less likely to consider themselves healthy-eaters. Since schema is predictive of healthy-eating behaviour this is evidence of implicit and explicit associations working in a synergistic fashion predicting behaviour. In contrast, non-schematics who eat less healthy may do so because they experience an antagonist effect between explicit associations and weaker implicit associations. Finding schematics to have stronger implicit associations than non-schematics supports the RIM and other dual-processing models describing the synergistic and antagonistic interactions between implicit and explicit associations predicting behaviour.

Predicting Snack Choice

The second part of the study aimed to determine whether automatic associations to pictures or words were more predictive of actual behaviour. Regression analyses were run using post-test IAT scores, post-test explicit associations and schema. The difference in contributions to the models between each IAT was observed. H2 predicted associations to pictures would be better predictors of snack choice in picture-format questions and actual choice from a bowl and associations to words would be better predictors of behaviour in word-format questions.

H2 was not supported. The picture-format and word-format questions did not elicit different choices depending on the format of the question. Participants made the same choice in both questions - 71 participants chose “apple” and 41 chose “snackbar”. Both questions were converted into one variable called computer choice. This removed the ability to examine the predictive relationship between associations to words and the word-format question making part of H2 void. In reference to Table A6 and A7, scores from the Picture-IAT were more positively related to behaviour than scores on the Word-IAT in both choice tests, but they were not significant. Explicit associations towards snackbars were significant predictors in both the computer questions and actual choice from the bowl. Explicit associations towards apples were significant in the computer choice model only. The relationship between explicit associations towards snackbars and choice behaviour was such that participants were more likely to choose an apple if they reported a more negative association to snackbars. Since explicit attitudes were significant it suggests participants were making controlled and reasoned decisions in both questions to some degree. The following section discusses reasons why the IAT’s did not contribute meaningfully to the models and how explicit associations and schema support this interpretation.

Neither associations to pictures or words significantly contributed meaningfully to the models. There are two reason for this finding. First, since explicit associations were significant predictors it is expected that implicit associations would not be significant. According to the RIM, most behaviours are reflective of only one type of association- that is, the behavioural schema activated depends on which association (i.e., automatic or reasoned) crosses a certain threshold first (Strack & Deutsch, 2004). The model does describe instances where automatic and reasoned associations can activate a different schema simultaneously, but the overt behaviour depends on which association activates the stronger schema. Behaviour in the computer choice and actual choice suggests participant's behavioural schema were reflective of their controlled and reasoned evaluations of the snack choices.

The second reason implicit associations may not have contributed to the choice tests is likely due to a methodological issue. The IAT's measured semantic associations; whereas, behaviour in the choice tests arguably reflected affective associations. As discussed in the first part of the study, scores on the IAT's reflected the strength of associations between 'apples' and 'healthy' and 'snackbars' and 'unhealthy'. These associations were likely built from evaluating the health value of apples and snackbars suggesting they reflected semantic value.

In contrast, the choice tests asked participants to choose a snack based on their affective value. This was evident for a few reasons, the first being the choice tests used the term "like". The computer questions asked participants to choose the snack they would *like* at the end of the study. In the actual choice test the researcher offered apples and snackbars from a bowl using a phrase similar to "you may choose what you like". Asking participants to choose the food item they 'like' is asking them to choose the item with the highest affective value. Affective values of foods are based on sensory experience; for example, determining which snack tastes better, looks better or is more likely to bring a pleasurable eating experience (Letarte, Dube & Troche, 1997). Second, it was evident behaviour in the choice tests were based on affective judgements because behaviour was significantly related to the explicit association measures. Shown in Appendix C, four of the five items in the explicit measure asked participants to evaluate apples and snackbars using affective terms (e.g., pleasant, enjoyable, attractive). Only one item addressed how 'healthy' they considered the item to be. Lastly, behaviour in the choice tests was more likely to reflect affective values because schema type was not a significant predictor of behaviour in the models. If schema was significant this would at least suggest healthy-eating schematics were making selections based on what they thought was more healthy rather than appealing. This is under the assumption healthy-eating schematics make a healthier food choice in most cases (Kendzierski & Costello, 2004).

For the choice tests to elicit behaviour most closely related to the IAT's in this study, participants would need to be asked to choose the snack they thought was the healthiest. Then a more meaningful interpretation of the relationships between automatic associations and behaviour could be made. Even with explicit evaluations acting as the predominant determinants of behaviour, scores on the IAT would be more meaningful because they could indicate whether implicit and explicit associations were acting in a synergistic or antagonistic fashion. The conceptual discrepancy between the IAT's and choice tests was a procedural issue that likely contributed to the IAT's not adding significant meaning to the regression models.

Limitations

The main limitation of this study was not using affective attributes in the AL tasks and IAT's. Administering four IAT's in one session also posed as a procedural issue with possible unintended effects on implicit and explicit association change. There was also an error in the

Word-IAT's where the word 'apple' was used as a target stimulus when it should have only been used as a category. The choice tests did not correctly reflect the automatic associations being examined; therefore, removing conceptual meaning between scores on the IAT's and food choice behaviour.

Conclusion

This study did not give insight into its original purpose because of fundamental differences in the AL tasks and IAT's. It did not determine whether associations to pictures or words change according to the stimuli used in associative learning. It also did not determine which type of association is more predictive of behaviour. It remains unclear whether messages promoting FV consumption to men should use more pictures or words in their content. It did demonstrate the importance of self-schema in determining baseline strength and change in automatic associations based on semantic-value. Mainly health-eating schematics held stronger automatic associations to pictures of stimuli related to their schema compared to non-schematics. Non-schematic's associations were weaker in strength; but demonstrated more potential for change. The findings in this study support the RIM's description of automatic associations linking objects to affective value and not propositional value. It also emphasises the importance of using affective attributes over semantic-based attributes in associative learning when trying to change implicit associations. It is evidence that automatic associations stemming from reflective processes may be harder to change using associative learning. Lastly, this study supports the RIM's description of the ability for impulsive processes to mediate the connection between reflective processes and behavioural schema.

Implications

This study did not give insight into whether messages promoting FV consumption should use more pictures or words when aiming to change implicit associations in men. It does suggest messages simply pairing FV stimuli and attributes based on knowledge may not be effective for association change- at least not without the propositional information to support the association. People who do not consider themselves healthy-eaters may be more responsive to messages designed with associative learning in mind; however, even when they do consider themselves health-eaters and have corresponding stronger associations to healthy foods it does not mean they will make healthier food choices every time.

Future Research

Future research should directly compare the effects of associative learning using affective vs. semantic associations on automatic associations. This would give insight and support to processes in the RIM and build a better understanding of the most effective way to strengthen targeted associations. Further research should also investigate whether the relationship between automatic association strength and corresponding schema exists in other areas such as social or stereotype schemas. This would again provide further support the RIM, and further support the method of changing automatic associations when aiming to change behaviour. Lastly, more research comparing automatic associations to picture vs. word versions of the same concept is needed. This can be extended to other food-related items (e.g., brand vs. brand), other health-related concepts (e.g., smoking, physical activity, alcohol and drug-use) or other more abstract concepts (e.g., ideas of the self, racial-bias). Further understanding the pattern of stronger associations measured by the Word-IAT compared to the Picture-IAT will inform future studies investigating automatic associations on the type of stimuli they should consider using.

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Appendix A: Tables

Table A1. Order of Study Procedures

Step	Procedures
1. Pre-test	Picture-IAT, Word-IAT, Explicit Associations
2. Treatment	Picture-AL, Word-AL, or Control-AL
3. Post-test	Picture-IAT, Word-IAT, Explicit Associations, healthy-eating schema,
4. Behaviour	Picture-Format, Word-Format and Explicit Choice

Table A2. Welch ANOVA of Baseline IAT, Explicit Associations, Age and Hunger

Measure	SS	df	M	F
Picture-IAT	.43	2	.22	1.38
Word-IAT	.36	2	.18	1.32
Apple-Explicit	1.31	2	.66	1.52
Snackbar-Explicit	.06	2	.03	.04
Hunger	37.66	2	18.83	9.53*
Age	25.93	2	12.97	.27

Note: * $p<.001$

Table A3. Means (standard devisations) of Implicit and Explicit Associations By Time and AL

Variable	Control-AL	Word-AL	Picture-AL	Total
Picture-IAT				
Pre	.22(.44)	.24(.44)	.11(.29)	.19(.40)
Post	.59(.37)	.49(.32)	.59(.33)	.56(.34)
ES	.91	.65	1.55	1.00
Word-IAT				
Pre	.51(.34)	.37(.43)	.47(.32)	.45(.37)
Post	.48(.29)	.36(.38)	.46(.32)	.43(.33)
ES	.10	.03	.03	.06
Explicit-Apple				
Pre	5.17(.77)	5.42(.56)	5.22(.62)	5.27(.66)
Post	5.22(.80)	5.22(.80)	5.18(.66)	5.24(.76)
ES	.06	-.29	-.06	.04
Explicit-Snackbar				
Pre	4.35(.94)	4.31(.99)	4.30(.79)	4.32(.90)
Post	4.16(1.07)	4.15(1.20)	3.93(.98)	4.08(1.08)
ES	-.19	-.15	-.42	-.24
N	39	42	39	120

* AL = associative learning; ES = effect size (Cohen's d)

Table A4. Means (standard deviations) of Implicit and Explicit Associations By Time and Schema

Variable	Non-schematic	Schematic	Total
Picture-IAT			
Pre	.11(.35)	.33(.43)	.19(.40)
Post	.54(.35)	.59(.32)	.56(.34)
ES	1.23	0.69	1
Word-IAT			
Pre	.42(.36)	.50(.38)	.45(.37)
Post	.44(.33)	.43(.33)	.43(.33)
ES	0.06	-0.2	0.06
Explicit-Apple			
Pre	5.25(.63)	5.30(.71)	5.27(.66)
Post	5.23(.69)	5.25(.88)	5.24(.76)
ES	0.03	-0.06	0.04
Explicit-Snackbar			
Pre	4.39(.82)	4.20(1.02)	4.32(.90)
Post	4.12(1.07)	4.01(1.11)	4.08(1.08)
ES	-0.28	-0.18	-0.24
N	76	44	120

* AL = associative learning; ES = effect size (Cohen's d)

Table A5. RM-ANOVA of Implicit and Explicit Associations by Time, AL and Schema

Source	Variable	SS	df	MS	F	Sig.
Time	Picture-IAT	6.33	1	6.33	49.12	.000*
	Word-IAT	.03	1	.03	.47	.496
	Apple-Explicit	.10	1	.10	1.53	.219
	Snackbar-Explicit	2.73	1	2.73	14.67	.000*
AL Group	Picture-IAT	.13	2	.07	.50	.607
	Word-IAT	1.00	2	.50	2.92	.058
	Apple-Explicit	.97	2	.48	.52	.597
	Snackbar-Explicit	.70	2	.35	.19	.826
Schema	Picture-IAT	1.02	1	1.02	7.70	.006*
	Word-IAT	.02	1	.02	.14	.711
	Apple-Explicit	.08	1	.08	.09	.767
	Snackbar-Explicit	1.47	1	1.46	.80	.373
Time*AL Group	Picture-IAT	.59	2	.29	2.28	.107
	Word-IAT	.02	2	.01	.12	.892
	Apple-Explicit	.24	2	.12	1.91	.153
	Snackbar-Explicit	.64	2	.32	1.72	.184
Time*Schema Type	Picture-IAT	.45	1	.45	3.50	.064
	Word-IAT	.08	1	.08	1.14	.288
	Apple-Explicit	.04	1	.04	.63	.429
	Snackbar-Explicit	.10	1	.10	.55	.458
Time*AL Group*Schema	Picture-IAT	.02	2	.01	.06	.943
	Word-IAT	.14	2	.07	1.0	.370
	Apple-Explicit	.05	2	.03	.41	.662
	Snackbar-Explicit	.16	2	.08	.44	.648

Table A6. Logistic Regression Predicting Computer Choice adding Post-test IAT's at Step 2

	Step 1				Step 2			
Variable	B	*SE B*	Exp(B)	95% C.I.for EXP(B)	B	*SE B*	Exp(B)	95% C.I.for EXP(B)
Apple-Explicit	.63	.30	1.87*	1.04-3.36	.64	.30	1.89*	1.05-3.42
Snackbar-Explicit	-.62	.23	.54*	.34-.85	-.66	.25	.52*	.32-.85
Schema	.11	.42	1.12	.49-2.53	.12	.42	1.12	.49-2.56
Picture-IAT	-	-	-	-	.13	.67	1.14	.31-4.19
Word-IAT	-	-	-	-	-.41	.69	.67	.17-2.57
Constant	.59	.21	1.81		.60	.21	1.81	

Note. * = $p < 0.05$

Table A7. Logistic Regression Predicting Actual Choice adding Post-test IAT's at step 2

	Step 1				Step 2			
Variable	B	*SE B*	Exp(B)	95% C.I.for EXP(B)	B	*SE B*	Exp(B)	95% C.I.for EXP(B)
Apple-Explicit	.52	.31	1.68	.91-3.09	.56	.32	1.74	.94-3.25
Snackbar-Explicit	-.69	.23	.50*	.32-.79	-.78	.26	.46*	.28-.76
Schema	-.33	.43	.72	.31-1.68	-.33	.43	.72	.31-1.69
Picture-IAT	-	-	-	-	.14	.66	1.15	.31-4.21
Word-IAT	-	-	-	-	-.86	.70	.43	.11-1.66
Constant	.70	1.52	2.02		.88	1.54	2.42	

Note. * = $p < 0.05$

Appendix B: Picture Stimuli

Apples	Snackbars	Healthy	Unhealthy

Appendix C: Questionnaires

Explicit Associations Measure

Instructions: Please answer the following questions by circling the number that most closely corresponds to how you feel.

For me, eating apples is…

1 Bad	2	3	4	5	6 Good
1 Unpleasant	2	3	4	5	6 Pleasant
1 Negative	2	3	4	5	6 Positive
1 Unenjoyable	2	3	4	5	6 Enjoyable
1 Unhealthy	2	3	4	5	6 Healthy
1 Unattractive	2	3	4	5	6 Attractive

For me, eating snackbars is…

1 Bad	2	3	4	5	6 Good
1 Unpleasant	2	3	4	5	6 Pleasant
1 Negative	2	3	4	5	6 Positive
1 Unenjoyable	2	3	4	5	6 Enjoyable
1 Unhealthy	2	3	4	5	6 Healthy
1 Unattractive	2	3	4	5	6 Attractive

Hunger Item

How hungry are you right now?

1 Not hungry at all	2	3	4 Moderately hungry	5	6	7 Extremely hungry

Schema Measure

1. Please rate how **descriptive of yourself** each of the following statements are.

I am a healthy eater.

1 Not at all descriptive	2	3	4	5	6 Neutral	7	8	9	10	11 Very descriptive

I eat in a nutritious manner.

1 Not at all descriptive	2	3	4	5	6 Neutral	7	8	9	10	11 Very descriptive

I am careful about what I eat.

1 Not at all descriptive	2	3	4	5	6 Neutral	7	8	9	10	11 Very descriptive

2. Please rate **how important** you find these descriptions of yourself to be.

I am a healthy eater.

1 Not at all important	2	3	4	5	6 Neutral	7	8	9	10	11 Very important

I eat in a nutritious manner.

1 Not at all important	2	3	4	5	6 Neutral	7	8	9	10	11 Very important

I am careful about what I eat.

1 Not at all important	2	3	4	5	6 Neutral	7	8	9	10	11 Very important

Demographic Questions

On an average day do you adhere to any of the following diets?

☐ Vegetarian
☐ Vegan
☐ Paleo
☐ Atkins
☐ Mediterranean
☐ Raw Food
☐ Other (Please list here): ________________________

Do you have any dietary restrictions due to medical reasons?

☐ Yes (List here): ____
☐ No

What gender do you identify with? Please circle. Male Female Other

What is your age? ______________

What is your highest level of education?

☐ High school
☐ Some college
☐ College or technical school diploma
☐ Bachelor's degree
☐ Post-graduate or professional degree.

What is your ethnicity? _________________________________