IRIS VERSLUIS

Prevention of the Portion Size Effect

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Voorkomen van het portiegrootte effect

Thesis

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Iris Versluis
Sliedrecht, January 2016

Table of content

Abbreviations used

M	Mean
SD	Standard deviation
SE	Standard error

Notes

All statistical analyses were carried out with SPSS (release 20.0.0, 2011).
An α-level of 0.05 was used for all statistical tests.
Partial eta squared (η_p^2) was used as an indicator of effect size, with respectively 0.01, 0.06, and 0.14 denoting a small, medium and large effect size (Cohen, 1988).

Citations are formatted according to the guidelines of the American Psychological Association (APA).

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Chapter 1

Introduction

1.1 External influences on consumption[1]

The increasing prevalence of obesity and diet-related diseases has become a major concern in not only the US and Western European countries but in less developed countries as well (Popkin, 2006). The OECD (2013) reports that in 20 of the 34 OECD-countries more than half of the population is either overweight or obese. In the US, it is estimated that the direct medical costs per year of those with overweight and obesity are, respectively, 266 dollars and 1723 dollars higher than the equivalent figures for people of normal weight (Tsai, Williamson, & Glick, 2011). When also taking into account the indirect costs associated with obesity, such as loss in productivity and transportation costs, Hammond and Levine (2010) estimate that the total annual costs associated with obesity in the US amount to 215 billion dollar.

The serious health and economic consequences of the current obesity epidemic have led to a large body of scientific work that has tried to provide insight into people's eating behaviour. It has become clear that the external food environment has a considerable impact on what and how much we eat (Cohen & Farely, 2008; Hill & Peters, 1998; Wansink, 2010). People do not solely eat in response to hunger cues, but also in response to external cues such as the smell of tasty food (Fedoroff, Polivy, & Herman, 1997), a candy bowl being nearby (Wansink, Painter, & Lee, 2006), or the variety of foods present (Rolls et al., 1981). In this thesis, I will focus on the consumption quantity decision, in other words, the decision about *how much* to eat.

Various external influences have been identified that all have an impact on the amount consumed, including the size of the plate or cutlery (Geier, Rozin, & Doros, 2006; Wansink, Van Ittersum, & Painter, 2006), the description of the food (Wansink & Chandon, 2006; Provencher, Polivy, & Herman, 2009; Cavanagh & Forestell, 2013), and the amount others eat (Conger, Conger, Costanzo, Wright, & Matter, 1980; McFerran, Dahl, Fitzsimons, & Morales, 2010; for reviews, see Cruwys, Bevelander, & Hermans, 2015; Vartanian, Spanos, Herman, & Polivy, 2015). One particularly robust and persistent influence on consumption is that of the portion and pack size. Studies in various settings, with different types of food, and with various types of people, have all consistently shown that energy intake increases

[1] Part of this introduction has been previously published in: Versluis, I., Papies. E.K., Marchiori, D. (2015). Preventing the pack size effect: Exploring the effectiveness of pictorial and non-pictorial serving size recommendations, *Appetite, 87*, 116-126.

as portion size increases (see for example Holland et al., 2015; Marchiori, Keesman, & Papies, 2015; Zlatevska, Dubelaar & Holden, 2014 for reviews). This effect is usually referred to as the portion size effect. For example, in an experimental study, Rolls et al. (2002) provided participants with portions of 500, 625, 750 and 1000 grams of macaroni and cheese. As the portion size increased, so did consumption, with consumption being 30% higher when the portion size was doubled. The effect of portion size on consumption also persists over longer periods of time (Jeffery et al., 2007, Kelly et al., 2009; Rolls et al., 2006a, 2006b; Rolls, Roe & Meengs, 2007) and can lead to weight gain (French et al., 2014).

This effect of portion size on consumption is particularly worrisome, because portion and pack sizes have increased in recent years (Nielsen & Popkin, 2003; Wansink & Wansink, 2010; Young & Nestle, 2003). Young and Nestle (2012) showed that in the US, the current size of fast food, such as hamburgers, sodas and French fries, is often 2 to 5 times larger compared to when the food was first introduced. The increase in portion sizes is seen as an important contributor to the increase in the prevalence of obesity (Chandon, 2013; Matthiessen, Fagt, Biltoft-Jensen, Beck, & Ovesen, 2003; Rozin, Kabnick, Pete, Fischler, & Shields, 2003).

In this thesis, I therefore focus on the effect of portion and pack sizes on consumption and examine how this effect can be weakened. It has been estimated that lowering people's energy balance by 100 kcal per day is sufficient to prevent weight gain in the population (Hill, Wyatt, Reed, & Peters, 2003). Hence, eating just a few bites less each day could already be sufficient to maintain a healthy weight. Furthermore, often people do not even realise that their energy intake is influenced by the size of the portion (Wansink & Sobal, 2007). In many instances people report similar satiety and hunger ratings when eating from medium or large portions of food, despite their markedly higher intake (Rolls et al., 2002; Rolls et al., 2006b). Hence, if the portion size effect could be prevented, people would still be able to eat until satiated, but they would not eat those extra bites that lead to weight gain. To date, research that specifically focusses on how to prevent the portion size effect is scarce. Instead, most research has focused on finding general ways to reduce the consumption of unhealthy foods, for example by partitioning foods (Cheema & Soman, 2008; Geier, Wansink & Rozin, 2012) or by activating a health goal (Papies & Hamstra, 2010; Van Koningsbruggen, Stroebe, Papies & Aarts, 2011).

1.2 Outline

To determine how the portion size effect can be prevented, it is important to first understand when the effect occurs and what causes it. In Chapter 2, I therefore provide a short review of the portion size effect, including a discussion of several moderators and possible causes of the effect. I build on the view that people find it difficult to determine how much they should eat and therefore simplify this decision by relying on external

reference points, such as the portion size. Based on this discussion, I suggest that efforts to prevent the portion size effect can either focus on encouraging people to rely less on external reference points when deciding their consumption quantity, or on encouraging the use of different reference points, such as a serving size recommendation.

Although various explanations have been provided for the portion size effect, formal tests of these explanations are limited, and as a result much is still unclear about why the portion size effect occurs in different situations. In Chapter 3, we[2] therefore tested one of the most prevalent explanations for the effect, namely that the portion size acts as a social norm and as such communicates how much is the maximum amount that is appropriate to eat. Results confirmed that social norms indeed play a role in the portion size effect, but that other mechanisms might be relevant as well.

Then, in Chapters 4 and 5, we moved on to testing two interventions that could be effective in reducing the portion size effect. In Chapter 4, we encouraged restrained eaters to rely less on the portion size in their consumption quantity decision, by reminding them of their dieting goal. Provision of such a reminder in the form of a diet magazine or diet commercials, indeed removed the portion size effect in restrained eaters. In Chapter 5, we placed a serving size recommendation on packages of unhealthy snacks and tested whether such a recommendation can prevent people from relying on the pack size when determining how much to eat. A pictorial serving size recommendation, which presents the recommended amount visually, indeed weakened the portion size effect.

Taken together, these results suggest that it is difficult, but not impossible, to encourage people to rely less on the portion and pack size when making consumption quantity decisions, and hence, to weaken the portion size effect.

1.3 Terminology

In this thesis both the terms portion size effect and pack size effect are used. While the meaning of the term portion size effect is generally agreed upon in the literature as being an increase in energy intake caused by an increase in the portion size of the food, the term pack size effect is more ambiguous. A number of authors have investigated the effect of an increase in pack size without an accompanying increase in the amount of food in the pack (Marchiori, Corneille, & Klein, 2012; Wansink, 1996). Although this is a very interesting exercise theoretically, in practice, the amount of food in the pack tends to increase simultaneously with the pack size. Hence, when referring to the pack size effect, we refer to an increase in energy intake caused by an increase in the size of the pack that is accompanied by an increase in the amount of food in the pack. Using this definition, the portion size effect

[2] As Chapters 3, 4, and 5 are joint work, "we" instead of "I" is used in the description of the research done in these chapters.

and pack size effect are conceptually similar, as both refer to an increase in intake caused by an increase in the amount of food available.

1.4 Declaration of contribution

I wrote this thesis together with my promotor (Prof.dr. Ph.H.B.F. Franses) and copromotor (Dr. E.K. Papies). Below I outline their and my own contribution to each chapter of this thesis, and also specify if any other people were involved.

I wrote Chapter 2 myself and improved it based on several feedback rounds of my copromotor and promotor.

I wrote Chapter 3 and 4 together with my copromotor. For each chapter, I was responsible for the literature research, creation of the research design, data collection, analyses, and writing of the manuscript. Throughout all the stages of the research, my copromotor provided guidance and gave detailed suggestions for improvements and additions. Her feedback was incorporated in the research design, data analyses and manuscript. Feedback of my promotor was incorporated in the manuscript and in the research design of Chapter 3.

I wrote Chapter 5 together with my copromotor and Dr. D. Marchiori. My own role and the role of my copromotor were the same as for Chapters 3 and 4. In addition, Dr. Marchiori provided feedback throughout the research process, which was incorporated in the research design, data analyses and manuscript. Feedback of my promotor was incorporated in the manuscript.

Chapter 2

The portion size effect: causes and prevention

People have been shown to increase their energy intake when served larger portions. This so-called portion size effect has been shown to occur in a variety of settings for a variety of foods, to persist over a longer period of time and to affect people of different ages, genders, and weights. In this chapter I discuss moderators of the portion size effect, the various explanations that have been provided for why it occurs, and what might be done to prevent it.

The general view on the portion size effect is that people find it difficult to determine how much they should eat and therefore rely on the portion size to determine their consumption amount. The portion size can be incorporated in the consumption quantity decision in various ways, leading to different explanations for the portion size effect: the tendency to clean the plate, unit bias, anchoring, and portion sizes as social norms. The tendency to clean the plate and unit bias refer to the tendency to eat all the food provided or to eat the complete unit of a food. According to the anchoring view, the portion size effect is conceptually similar to the anchoring phenomenon in which judgments under uncertainty are influenced by an initially presented value, such as the portion provided. Finally, from the social norms point of view, the portion size acts as an indicator of how much can appropriately be consumed without coming across as an excessive eater. The social norms explanation is tested in Chapter 3, and the results show that social norms indeed play a role in the portion size effect, but that the other mechanisms might be relevant as well. As all these mechanisms leave certain questions about the occurrence of the portion size effect unanswered, further research is needed in this area.

The discussed mechanisms have in common that the portion size is taken as a reference point in the consumption decision. I therefore posit that in order to weaken the portion size effect, it might be effective to either encourage people to rely less on external reference points (e.g. by goal priming as in Chapter 4), or to provide people with an alternative reference point (e.g. by providing a serving size recommendation as in Chapter 5).

2.1 Introduction[3]

People eat more when they are presented with a large portion of food than when they are presented with a small portion of food (see Chandon & Wansink, 2011; Holland et al., 2015; Marchiori, Keesman, & Papies, 2015; Steenhuis & Vermeer, 2009; Wansink, 2004; Zlatevska, Dubelaar & Holden, 2014 for reviews). The increase in consumption brought about by an increase in the portion size is known as the portion size effect. One of the most striking examples of the portion size effect is given by Wansink and Kim (2005), who provided movie-goers with either a small or large portion of popcorn. As well as manipulating the amount of popcorn provided, they also manipulated the palatability by providing either fresh or stale (14-day-old) popcorn. Even when the popcorn was stale, and hence highly disliked, movie-goers consumed 33% more popcorn when provided with a large instead of a small portion. Also over longer periods of time, people consistently eat more when bigger portions are provided. Rolls, Roe, and Meengs (2007) provided participants with all their meals and snacks for two 11-day periods. The size of the servings varied between the two periods and was either standard or 50% larger than standard. This 50% increase in portion size led to an in an increase in calorie intake of 4,600 calories over the 11-day period. In summary, portion sizes can have a considerable and robust influence on energy intake.

The portion size effect has been shown to occur for many different foods, including pasta (Burger, Fisher & Johnson, 2011; Diliberti, Bordi, Conklin, Roe & Rolls, 2004), sandwiches (Rolls, Roe, Meengs & Wall, 2004), snacks (Raynor & Wing, 2007; Rolls, Roe, Kral, Meeng & Wall, 2004; Stroebele, Ogden & Hill, 2009) and vegetables (Van Kleef, Bruggers, & De Vet, 2015; Mathias et al., 2012; Rolls, Roe & Meengs, 2010), in both the lab (see for example Rolls, Morris, & Roe, 2002) and real life (Diliberti et al., 2004). On average, a doubling of the portion size leads to an increase in consumption of about 35% (Marchiori et al., 2015; Zlatevska et al., 2014). Although the existence of the portion size effect is well established, there is still relatively little known about why it occurs. As a result, knowledge about how to prevent the portion size effect is also limited.

This chapter provides a short review of the portion size effect and its moderators, which is followed by a discussion of the effect's possible causes. Based on the view that people find it difficult to determine how much they should eat, and rely on the portion size to determine the consumption amount, I then provide interventions that might be successful in diminishing the portion size effect, which is the key topic of this thesis.

[3] Part of this introduction has been previously published in: Versluis, I., Papies. E.K., Marchiori, D. (2015). Preventing the pack size effect: Exploring the effectiveness of pictorial and non-pictorial serving size recommendations, *Appetite, 87*, 116-126.

2.2 Characteristics and moderators of the portion size effect

Since Nisbett showed in 1968 that overweight subjects ate more sandwiches when they were provided with three sandwiches instead of one (Nisbett, 1968), most portion size research has focussed on examining the existence of the effect for various foods and in various settings. Only recently, attention has started to shift from describing the effect to understanding the effect with various meta-analyses (Hollands et al., 2015; Marchiori et al., 2015; Zlatevska et al., 2014) and reviews about the potential causes of the effect (English, Lasschuijt, & Keller, 2015; Fisher, Goran, Rowe, & Hetherington, 2015; Herman, Polivy, Pliner, & Vartanian, 2015; Steenhuis & Vermeer, 2009; Wansink & Van Ittersum, 2007). In this section, I will describe several characteristics and moderators of the portion size effect and discuss what kind of implications these have for the understanding and prevention of the effect.

Effect size

All meta-analyses conducted to date agree that the average increase in consumption when the portion size doubles is about 35% (Hollands et al., 2015; Marchiori et al., 2015; Zlatevska et al., 2014). However, as is shown by Zlatevska et al. (2014), the portion size effect is not linear. As the portion size increases, the increase in consumption levels off and might even disappear completely with extremely large portions (Rolls et al., 2002). Feelings of satiation and the physical limits to what can be eaten are most likely responsible for the diminishing increase in the amount consumed as the portion size increases. However, although this is an interesting and important finding, it provides little information as to why the portion size effect occurs.

Food types

There is some evidence that the portion size effect is larger for foods that are liked than for foods that are disliked (Kral, Kabay, Roe & Rolls, 2010; Mathias et al., 2012). In an 11-day study by Rolls et al. (2007), all meals and snacks were provided by the researchers. In this study, the portion size effect was present for all foods except vegetables and two disliked desserts. Marchiori et al. (2015) and Hollands et al. (2015) showed in their meta-analysis that the portion size effect was stronger for foods high in energy density than for foods low in energy density and that it was stronger for unhealthy foods than for healthy foods. Marchiori et al. (2015) interpreted this finding as evidence that the magnitude of the portion size effect increases as the attractiveness of the food increases. Indeed, the unhealthy and high-energy-dense foods used in portion size studies can generally be regarded as highly attractive, while the low-energy-dense foods, such as vegetables, tend to be regarded as less attractive. Furthermore, unhealthy and high-energy-dense foods tend to cause a greater motivation to eat than healthy and low-energy-dense foods (Papies, 2012; Veling, Aarts & Stroebe, 2012). This could mean that because people find it difficult to control consumption

of such attractive, energy-dense foods, consumption of such foods might be more strongly influenced by the portion size than consumption of less attractive, low-energy-dense foods. Furthermore, the motivation to eat more form larger portions can also be expected to be greater for attractive foods than for unattractive foods.

Nonetheless, it is important to keep in mind that although the portion size effect might be stronger for attractive foods, it is also present for less attractive foods. This is illustrated by Wansink and Kim (2005) and Wansink and Park (2001), who showed that the portion size effect was present in a cinema setting regardless of whether the popcorn in their study was liked or disliked. Hence, the portion size effect seems to not be solely caused by the difficulties people experience when trying to control their consumption of attractive foods.

Consumption setting

Not only the type of food but also the setting in which the food is consumed, can potentially influence the strength of the portion size effect. Marchiori et al. (2015) found in their meta-analysis that the portion size effect was significant in both lab and real-life settings, but that it was somewhat stronger in the lab. In a real-life setting, influences for which controls are generally implemented in the lab, such as hunger and the presence of eating companions, may possibly attenuate the influence of the portion size on consumption. Nonetheless, studies conducted in a restaurant (Diliberti et al., 2004; Scheibehenne, Todd & Wansink, 2010), at a cinema (Wansink & Kim, 2005; Wansink & Park, 2001), at home (Raynor & Wing, 2007), or at work (Jeffery et al., 2007; French et al., 2014), all found a considerable portion size effect. For example, Diliberti et al. (2004) found that energy intake in a restaurant increased by 43% when the portion size of the entrée was increased by 50%. It is also interesting to note a recent study by Robinson, Te Raa and Hardman (2015), who showed that the portion size effect was also present when participants were asked to indicate their intended consumption in an anonymous online questionnaire. Hence, although the controlled setting of a lab might inflate the portion size effect somewhat, there is no doubt that it is present and considerable in real life situations as well.

Marchiori et al. (2015) also examined whether a distracting environment lowered the portion size effect, which it indeed did. Similar results were found by Zlatevska et al. (2014), who reported a larger effect size when participants were told that the study was about food. In other words, when participants were focussed on eating, either because they knew the study was about food or because they were not distracted, the portion size effect was smaller. This could mean that the tendency to eat more when more food is available, is strongest when people are not paying attention to the act of eating.

Individual characteristics as moderators

Age has received a lot of attention as a potential moderator of the portion size effect. Rolls, Engell and Birch (2000) found that the portion size effect was absent in 2-3 year old children but later research found that the portion size effect was also present for this age

group (Fisher, 2007; Looney & Raynor, 2011; Spill, Birch, Roe, & Rolls, 2010, 2011). Zlatevska et al. (2014) and Hollands et al. (2015) showed in their meta-analysis that the portion size effect was present for both children and adults, but that the strength of the effect increased with age. In the meta-analysis by Marchiori et al. (2015), age did not significantly moderate the portion size effect when included as a continuous variable. However, when comparing the strength of the effect for children and adults, they did find a marginally significant difference, with the portion size effect being stronger for adults. These different outcomes across the three meta-analyses might be caused by their different focus. While Marchiori et al. (2015) focussed exclusively on portion size studies in which actual consumption was measured, Zlavetska et al. (2014) also included studies with intended consumption, and Hollands et al. (2015) also looked at studies in which container, tableware or unit size were manipulated. It thus seems that when purely focussing on the effect of portion size on actual consumption, there is at most only a small difference in the portion size effect between adults and children. Furthermore, in all meta-analyses, the portion size effect was significant for both children and adults. These findings suggest that the portion size influences consumption at all stages in life, but this influence might become somewhat stronger later in life. This could mean that eating more when more food is provided, is partly an innate response, as it already occurs in young children, but as this response also strengthens during life, it is thus learned as well.

A second potential moderator often included in portion size studies is gender. There is evidence that the magnitude of the portion size effect is greater for men than for women (Robinson, Te Raa, & Hardman, 2015; Rolls et al., 2006a; Rolls, Roe, Kral, et al., 2004; Rolls, Roe, Meengs, et al., 2004; Kelly et al., 2009), although there are also studies that did not find a moderating effect of gender on the portion size effect (Burger et al., 2011; Diliberti et al., 2004; Marchiori & Papies, 2014). Two meta-analyses (Marchiori et al., 2015; Zlatevska et al., 2014), found that the portion size effect was weaker for women than for men, but Hollands et al. (2015) did not find this difference. As described above, these meta-analyses had a somewhat different focus, which could have produced different results. Women tend to be more concerned about dieting and health than men (e.g. Divine & Lepisto, 2005), and it is therefore possible that women exert better control over their consumption and hence are less influenced by external cues such as the portion size. On the other hand, it is also possible that the portion size effect on average is weaker in women than men because women have lower energy needs than men and thus reach satiation sooner. Hence, the increase in consumption in response to an increase in portion size might level off sooner for women than for men, leading on average to a lower portion size effect for women. Hence, as little is known about why women are less susceptible to the portion size effect and under which conditions this is the case, more research is needed before any definitive conclusions can be drawn.

Finally, weight status and dieting behaviour might also influence to what extent people are influenced by external cues such as the portion size. In the study by Nisbett (1968), only overweight participants, and not normal-weight participants, ate more when provided with 3 sandwiches instead of 1 sandwich. These findings were however not replicated in many other portion size studies (Kral, Roe & Rolls, 2004; Rolls et al., 2002; Rolls, Roe, Kral, et al., 2004; Rolls, Roe, Meengs, et al., 2004; Rolls et al., 2006a; Rolls et al., 2006b). Zlatevska et al. (2014) even found in their meta-analysis that the portion size effect was smaller for those with a BMI > 25 than for those with a BMI of 25 or less. In the meta-analyses of Marchiori et al. (2015) and Hollands et al. (2015), BMI did not moderate the portion size effect. Related to BMI are concepts such as dietary restraint, disinhibited eating and external eating. These concepts measure the control that we try to exercise over our eating behaviour and the extent to which our eating is influenced by external factors. These concepts are regularly measured in portion size studies, but in almost none of the studies they moderate the portion size effect (Flood, Roe, & Rolls, 2006; Kral et al., 2004; Rolls et al., 2002; Rolls, Roe, Kral, et al., 2004; Rolls, Roe, Meengs, et al., 2004; Rolls et al., 2006a, Rolls et al., 2007; Rolls et al., 2010). In sum, so far there is little evidence that restrained eaters or those with overweight exhibit a stronger portion size effect than normal eaters. We should note however, that in many portion size studies, participation was restricted to normal, unrestrained eaters (see for example Rolls, Roe, Kral et al., 2004; Rolls, Roe, Meengs, et al., 2004; Rolls et al., 2007). Hence further research is needed in this area.

To conclude, there is some evidence that the portion size effect is weaker for children, for women, when people are focussed on eating, and for unattractive foods. Very tentatively, this could suggest that the portion size effect does not occur completely outside of conscious control. When diet concerns are high (women), when the foods are not particularly liked, and when attention is focused on eating, the portion size seems to exert less influence on the amount consumed. In terms of interventions, this could mean that increasing the motivation to control consumption could weaken the portion size effect. However, although people are able to exert some control over the portion size effect, they do not seem to be in complete control, as the portion size effect was only weakened and not prevented by these moderators. Indeed, the finding that also young children exhibit a portion size effect, seems to show that the portion size effect is to a certain extent an automatic response to the availability of more food. In sum, there is much still to be learned about the conditions under which the portion size effect is weaker and why this is the case.

2.3 Explanations for the portion size effect

Currently, the most prevalent explanation for the portion size effect is that people are uncertain about how much they should eat and as a result rely on the portion size and other external cues to determine the appropriate consumption amount (Cohen & Farley, 2008;

Herman & Polivy, 2005, 2008; Herman et al., 2015; Rolls et al., 2002; Wansink & van Ittersum, 2007). Below, I discuss that this uncertainty occurs because food intake is not well regulated through biological controls. As a result, people need to figure out how much they can eat and need to consciously keep track of consumption, which is difficult. In the current eating environment, people are constantly exposed to conflicting messages about what they should and should not be eating. Furthermore, they easily get distracted when monitoring consumption and fall prey to size estimation biases.

2.3.1 Difficulties in consumption regulation

The evidence that body weight and food intake is not well regulated through biological controls has accumulated rapidly over the past years (Levitsky, 2005). Many authors have argued that consumption does not occur in response to biological signals of hunger and satiety, but instead occurs in response to environmental cues such as the presence of a bowl of snacks, the smell of pizza, or the clock striking twelve indicating lunch time (Cohen & Farley, 2008; Herman & Polivy, 2005, 2008; Schachter, 1968; Wansink, 2010). This can lead to a situation in which people eat much more (or less) than their body needs, with weight gain (or loss) as a consequence. Indeed, it has been argued that food consumption is mainly guided by habits (Van't Riet, Sijtsema, Dagevos, & De Bruijn, 2011) and by whatever people think is "right" for them (Wansink, 2006). In a study by Levitsky, Obarzanek, Mrdjenovic & Strupp (2005) participants ate freely for two weeks, they then were overfed for two weeks, and were then allowed to eat freely again for the last two weeks. Although participants complained strongly about the amount of food they had to consume when being overfed, when allowed to eat freely again they ate the exact same amount as they had done in the first two weeks of the study. In other words, food intake in the last two weeks did not decrease in response to the two weeks of overconsumption, but instead, participants might have picked up their habitual consumption pattern again. It seems that while our body will urge us to eat when deprived of food for a considerable period, it will not urge us to eat less when overfed for a considerable period. Similarly, it has also been shown that people hardly change the amount of food they consume at dinner and lunch when breakfast or snacks are added or removed from their daily menu (Levitsky, 2002; Rolls, Kim, McNelis, et al., 1991). Mattes (1990) showed that there was no relation between people's self-reported hunger and their energy intake throughout the day. Our body thus does not regulate energy intake for us, particularly when it comes to eating too much, and hence we need to find another way to regulate our consumption.

In these efforts at regulation, people encounter many difficulties. As I will discuss in the next section, the current eating environment sends many conflicting signals regarding how much one should eat. Furthermore, monitoring consumption throughout the day is a challenging task which people are easily distracted from (Wansink & Chandon, 2014; Higgs, 2008). And even if people know how much they should eat, and are motivated and able to

keep track of their consumption, they might still get their consumption amounts wrong as their size judgment is prone to all kinds of biases (Chandon & Wansink, 2007; Geier & Rozin, 2009; Ordabayeva & Chandon, 2013).

A confusing eating environment

In the current eating environment, people are constantly exposed to opposing cues regarding what to eat and how much to eat. For example, imagine driving on the highway and passing a billboard with an advertisement for a supersized fast-food meal. While a food expert on the radio discusses the dangers of eating supersized portions, your friend laughs the concerns of this expert away and suggests to take a break from driving and have such a great value meal.

Food marketing generally encourages consumption (Chandon & Wansink, 2011), which can confuse people about what the right consumption quantity is. Commercially available portion sizes are often much larger than recommend amounts (Young & Nestlé, 2002) and advertisements generally portray consumption of large, unhealthy food items as fun and socially rewarding (Chandon & Wansink, 2011). And although many countries do have dietary guidelines, these guidelines are often unclear and difficult to follow (Keenan, AbuSabha, & Robinson, 2002). In this confusing environment, people somehow need to figure out how much they should be eating (Wansink, 2006), which clearly is not an easy task.

Distractions when monitoring consumption

To prevent weight gain (or loss), most people will try to monitor their consumption. By keeping track of what is consumed during the day and how body weight is affected, people should be able to maintain a stable weight. However, keeping track of consumption and determining how much exactly is eaten during each meal, is difficult. People tend to get distracted easily, which decreases their ability to accurately monitor and remember how much they eat (Wansink & Chandon, 2014; Higgs, 2008). Various studies have shown that when participants are distracted while eating, they eat more (Bellisle, Dalix & Slama, 2004; Long, Meyer, Leung & Wallis, 2010), especially restrained eaters (Bellisle & Dalix, 2001; Boon, Stroebe, Schut & IJntema, 2002; Ward & Mann, 2002). For example, in a study by Hetherington, Anderson, Norton & Newson (2006) participants consumed around 14% more when they watched television during lunch than when they ate their lunch without any distractions. Furthermore, when people are distracted during a meal, they might also eat more later in the day because they do not correctly remember how much they ate previously (Higgs, 2008; Higgs & Woodward, 2009).

Hence, people cannot rely on biological cues to regulate consumption and when they try to monitor consumption they get easily distracted and forget how much they have eaten. As a result they are uncertain about how much still can be consumed. The higher the uncertainty, the more likely it is that people will rely on external reference points, such as the portion

size, to determine how much they can eat. Indeed, both Marchiori et al. (2015) and Zlatevska et al. (2014) found in their meta-analysis that the portion size effect was stronger when people were distracted and hence were less able to monitor their consumption. Furthermore, Wansink and Park (2001) found that the influence of pack size on popcorn consumption was partly mediated by the extent to which people said they paid attention to how much they were eating.

However, even when people are highly motivated to keep track of consumption and are undistracted, monitoring might still be inaccurate, as people experience considerable difficulties when making size estimations, as I discuss in the next section.

Size estimation biases

In various reviews of the portion size effect, visual cues have been mentioned as one of the possible explanations for the effect (Benton, 2015; English et al., 2015; Herman et al., 2015). Consumption and satiety are believed to be influenced by what our eyes see. As our size judgment is prone to various biases (Chandon & Wansink, 2007; Geier & Rozin, 2009; Ordabayeva & Chandon, 2013), this can lead to overconsumption from large portions.

People are indeed not very good at estimating sizes and size changes. Chandon and Ordabayeva (2009) and Ordabayeva and Chandon (2013) showed that people were fairly accurate in determining the magnitude of size changes that occurred in only one dimension (for example height only), but greatly underestimated size changes that occurred in three dimensions, hence when the height, width and length all increased at the same time. In addition, Chandon and Wansink (2007) showed that meal size estimations follow a power function; the bigger the meal, the greater the extent to which the meal size was underestimated. Many of the previously discussed portion size studies have a within-participants design, meaning that throughout the study period participants are presented with portions of varying size (see for example: Kral et al., 2004; Roll et al., 2002; Rolls et al., 2007). In such a study participants might underestimate the size changes of the portions they are provided with and as a result might eat more from larger than from smaller portions without realising they do so.

Schwartz and Byrd-Bredbenner (2006) showed that students are not aware of typical portion sizes and their estimates of what a typical portion is for different foods, vary greatly. Wansink and Van Ittersum (2007) argue that because of our inability to accurately estimate the size of portions, we have developed a distorted view of what a “normal” portion is. Portion sizes have increased considerably over the years, and in the US, commercially available portions are often three to four times larger than standard portions in dietary guidelines (Hogbin & Hess, 1999; Young & Nestlé, 2002). Furthermore, the inability to accurately estimate sizes and size changes, can lead people to avoid extremes and to choose the “middle” or “compromise” option (Simonson, 1989; Simonson & Tversky, 1992). This preference for the medium size is however problematic as restaurants and fast-food chains

have a tendency to drop the smallest items from their menus and add bigger items (Young & Nestlé, 2007).

In sum, people are not good at objectively assessing how much food is on a plate or in a pack. This further contributes to the uncertainty about how much has been eaten and how much still can be consumed. Furthermore, because people have a tendency to underestimate size increases, this might also lead to a situation in which people eat more from a portion than they think they do.

2.3.2 The portion size as an indicator of what is socially acceptable to eat

People find it difficult to determine how much they should eat, and in order to simplify the consumption decision, they rely on external reference points such as the portion size. How exactly people use the portion size in their consumption decision is however still unclear. One of the most advocated explanations within portion size research is that the portion size provides normative information about how much is appropriate to eat (Herman & Polivy, 2005, 2008; Rolls et al., 2002; Wansink & van Ittersum, 2007). Herman & Polivy (2005, 2008) argue that people generally want to maximize their consumption, but at the same time do not want to be seen as excessive eaters. Eating the amount of food that is provided will generally not be seen as excessive consumption behaviour, especially not when the amount is determined by someone who can be expected to have knowledge about the "correct" portion size, such as the chef in a restaurant, the manufacturer of frozen meals, or the researcher in a lab. Hence, the portion size acts as an upper limit for intake. When taking this perspective, the portion size thus provides indirect information about what is socially acceptable.

Kerameas, Vartanian, Herman, & Polivy (2015) provided some initial evidence that portion size might indeed signal how much is appropriate to eat. In their study, participants ate cookies, and after consumption, were asked how much would have been appropriate to eat in such a situation. The amount that was considered appropriate fully mediated the relation between portion size and the amount consumed.

Social norms have a very strong and robust effect on food intake, as is for example shown in modelling studies where participants model the consumption behaviour of present or non-present others (for reviews see: Cruwys, Bevelander, & Hermans, 2015; Robinson, Thomas, Aveyard & Higgs, 2014). Even in so-called remote-confederate studies, in which only information is provided about how much others have allegedly consumed and these others are not actually present in the room, the provided information still strongly influenced consumption quantities (Robinson, Benwell & Higgs, 2013). Hence, as long as people believe that the portion size is a good indicator of what others will find an acceptable quantity to eat, they will be inclined to incorporate the portion size in their consumption decision.

The social norms perspective can explain the portion size effect and its moderators quite well. As the portion size is an indicator of how much one may maximally eat, it will not be

relevant when people do not want to maximize consumption, for example when the foods are unattractive. Similarly, as women are generally more concerned about eating healthy (Divine & Lepisto, 2005) and eating little (Vartanian, Herman, & Polivy, 2007) than men, the consumption amount suggested by the portion size might be considered as too much, making the portion size less relevant for the consumption decision, leading to a lower portion size effect for women. When distracted, it will be hard to pay attention to multiple social cues that can suggest the appropriate consumption amount. Hence, the chance that people will only rely on the portion size to determine consumption, will be higher when distracted than when undistracted, leading to a stronger portion size effect when distracted. Previous research has shown that not only adults, but also children as young as 6 years old are influenced by perceived eating norms (Sharps & Robinson, 2015). Hence, for both children and adults the portion size could act as an indicator of what an appropriate amount to eat is and hence cause the portion size effect. The social norms view however does not explain why the magnitude of the portion size effect increases with age.

The social norms view on the portion size effect could also explain why in some studies dishware size influences consumption (Marchiori, Corneille, & Klein, 2012; Wansink, Van Ittersum, & Painter, 2006; Wansink, Van Ittersum, & Payne, 2014). Big plates and bowls might signal to consumers that it is appropriate to eat a large amount, while small plates signal that only a small amount is appropriate.

As up to date no studies have formally tested the social norm explanation for the portion size effect, we performed such a test in Chapter 3. More specifically, we examined whether the portion size effect weakens when the portion size is less likely to be regarded as an indicator of what others will find an acceptable quantity to eat. If the normative relevance of the portion size is lowered, it should influence consumption decisions to a lesser extent. Indeed, previous research has shown that the extent to which consumption of others is modelled depends on who these others are (Cruwys et al., 2012; Hermans, Larsen, Herman, & Engels, 2008; Stok, de Ridder, de Vet, & de Wit, 2012). For example, Cruwys et al. (2012) showed that students only modelled popcorn intake of students from their own university and not of students from a rival university. In Chapter 3 we therefore manipulated the normative relevance of the portion size by either basing it on the consumption behaviour of others that are considered relevant (in-group) or irrelevant (out-group) to the self-identity (Experiment 3.1) or providing information that either a minority or majority of a relevant social group approved of the portion size (Experiment 3.2). Both manipulations indeed influenced the portion size effect, with the effect being weaker when the normative relevance of the portion size was reduced. At the same time, the influence of the normative relevance manipulation was relatively small, and although it weakened the portion size effect, it did not remove it. Hence, we concluded that social norms indeed play a role in the portion size effect, but that other mechanisms are relevant as well.

2.3.3 Other mechanisms underlying the portion size effect

As the social norms view does not seem to be able to fully explain the portion size effect in all situations, I discuss three other explanations for the portion size effect. These explanations all have in common that the portion size is taken as a reference amount when determining how much to eat. The explanations however differ in the way this reference amount is incorporated in the consumption decision, for example the portion size might be taken as the amount one aims to consume or only as a starting point for determination of the consumption amount.

Cleaning the plate

In Western countries children are often told to clean their plate, in other words, to eat all the food on their plate. As a consequence, cleaning the plate can become a habit; an automatic behaviour that is automatically triggered by cues in the environment (a full plate) and that is hard to unlearn (Wood & Neal, 2009). In a study by Levitsky and Youn (2004), students were served a portion that was either 100%, 125% or 150% of their normal intake. When the 125% portion was served, the majority of participants still cleaned their plate, even though this meant eating 25% more than they normally did. This tendency to clean the plate might also explain why both Burger et al. (2011) and Scheibehenne et al. (2010) found a portion size effect in situations in which participants could not see their food, either because they were blindfolded or ate in total darkness. Participants might have tried to eat all the food on their plate, and in doing so, ate more when a large portion was provided instead of small portion.

We should note, however, that the portion size effect also occurs when the portion sizes are so big that plate cleaning no longer occurs (Rolls et al., 2006a; Rolls et al., 2006b). Also, many researchers investigated the impact of so-called "plate cleaners" on the portion size effect and did not find large differences in the magnitude of the effect when these "plate cleaners" were included in the analyses or excluded (for example: Rolls et al., 2010; Rolls et al., 2007). It is also possible that people use a heuristic of eating a certain percentage of the portion provided, for example 80% or half. Or, alternatively, as suggested by Burger et al. (2011), people keep eating until they have cleaned a certain area of their plate.

At the onset of the meal, people might thus start eating with the goal of eating all or a certain part of what is on the plate. Furthermore, this goal might be set separately for each individual food on the plate, as Marchiori et al. (2015) found that the consumption of foods of which the size is not manipulated, does not change when the portion size of the experimental food is changed. Whether or not the eating goal is reached will depend on when feelings of satiation start to develop. The bigger the portion, the more likely it is that people will stop eating before their "cleaning (part of) the plate" goal is reached, which explains the diminishing portion size effect as portion sizes increase (Zlatevska et al., 2014).

The cleaning the plate perspective can explain the moderating influences on the portion size effect quite well. The more attractive the foods are considered to be, the more likely it will be that people set themselves the goal of cleaning the plate. Furthermore, it will be easier to reach this goal when the foods are liked than when they are disliked. Secondly, when distracted, the easiest way to monitor consumption will be to just keep eating till the plate is empty. In contrast, when not distracted, people might make additional efforts towards consumption monitoring and will not solely rely on the portion size, leading to a smaller portion size effect. The weaker portion size effect for women than for men, could be explained by women being less inclined to assume that the portion size is the right quantity for them, because they have lower energy needs than men and tend to be more concerned about eating healthy (Divine & Lepisto, 2005). Hence, women might be less likely to have the goal of cleaning their plate than men. Finally, although children might eat everything on their plate when enjoying the foods, plate cleaning has not yet developed into a habit as is often the case for adults. As a result children can exhibit a weaker portion size effect than adults.

The tendency to clean (part of) the plate, could thus be a viable explanation for the portion size effect for meals. It however does not explain why people also eat more from larger packages with snacks (Raynor & Wing, 2007; Rolls, Roe, Kral, et al., 2004; Stroebele, Ogden & Hill, 2009), as it is unlikely that people will have the goal of eating an entire pack of unhealthy snacks. Hence, the tendency to clean the plate cannot explain the existence of the portion size effect in all consumption situations, but when it concerns consumption of meals, it is likely to play role in the portion size effect.

Unit bias

Related to the tendency to clean the plate, is the tendency to consume one unit or a fixed number of units (Geier et al., 2006). The result of this heuristic is that consumption in units will stay the same as the unit size increases (decreases), and as a consequence energy intake will increase (decrease). Marchiori et al. (2011) showed that consumption of candies can be significantly reduced by splitting the candies in two. In their experiment, candies were presented in their original form or split in two. As the number of candies consumed stayed the same across the conditions, energy intake was significantly reduced by splitting the candies. Similar results were found by Weijzen, Liem, Zandstra, and De Graaf (2008), who showed that energy intake was lower when nibble size snacks were provided instead of bar-size snacks. Also, Geier et al. (2006) showed that people had a tendency to take one unit of a food, regardless of how big it was. There are however other studies that have not found an effect of changing the unit size of food on intake (Devitt & Mattes, 2004; Van Kleef, Bruggers, & De Vet, 2015; Raynor & Wing, 2007). Devitt & Mattes (2004) tested regular foods such as omelettes instead of snack foods. In the small unit size condition, one unit might not have been regarded as a reasonable consumption quantity, and hence, unit bias did

not occur. Taken together, it seems that unit bias can cause the portion size effect when one unit can be regarded as a reasonable consumption quantity, for example a sandwich or a cookie. If the size of the sandwich or cookie increases, it might still be consumed in whole as it is regarded as one unit, and hence unit bias leads to the portion size effect. When a portion, however, is considered to consist of multiple units, unit bias is less likely to play a role in the portion size effect.

The mechanisms underlying unit bias are very similar to plate cleaning. In both cases, consuming the full portion or the whole unit, is considered the right thing to do. Hence, the discussion of the extent to which the moderating influences on the portion size effect can be explained by plate cleaning, are applicable to unit bias as well. People will be more inclined to eat the full unit when the food is attractive, when they are distracted, when they can assume that one unit is the right quantity for them (which is more likely for men than for women), and when they have a habit of eating the full unit.

Portion sizes as anchors

When comparing the portion size effect to the different types of biases that have been shown to occur in human judgment, there is one that has a striking resemblance to the portion size effect, namely anchoring (Marchiori, Papies, & Klein, 2014). Tversky and Kahneman (1974) provide the following definition of anchoring: "the disproportionate influence on decision makers to make judgments that are biased toward an initially presented value". Anchoring occurs when judgments are made under uncertainty. According to Marchiori et al. (2014) consumption quantity decisions can also be regarded as judgments under uncertainty and hence these decisions can be influenced by anchor values such as the portion size. If the portion size indeed acts as anchor, it can be expected to influence consumption regardless of whether it can be regarded as reasonable or as relevant to the consumption quantity decision. Previous research has shown that the anchor can be completely irrelevant for the judgment task at hand and still have an influence on the judgment (Critcher & Gilovich, 2008; Mussweiler & Strack, 2001; Oppenheimer, LeBoeuf & Brewer, 2008; Wilson, Houston, Etling, & Brekke, 1996), such as anchors determined by writing down the last digits of the participants social security number (Ariely, Loewenstein, & Prelec, 2006) or by rolling a dice (Mussweiler & Strack, 2000).

Marchiori et al. (2014) used a typical anchoring paradigm to determine if portion size anchors impact expected consumption in the same way as anchors influence judgments. Their results indeed showed that expected consumption of a variety of foods was higher when participants were presented with a large portion size anchor than when they were presented with a small portion size anchor. Furthermore, the magnitude of the portion size effect was not affected by whether or not participants were told that the portion size anchors were determined randomly. These findings provide preliminary evidence that the portion size effect might indeed be similar to the anchoring effect.

Anchor values do not only influence judgments, they also influence actual behaviour (Cervone & Peake, 1986; Madzharov & Block, 2010; Wansink, Kent & Hoch, 1998). For example, Wansink et al. (1998) showed that the advertisement "buy 18 snicker bars for your freezer" led to significantly higher sales than the advertisement "buy snicker bars for your freezer". Hence, anchors will not only influence judgments about how much can be consumed, but are likely to influence actual consumption as well.

The mechanism that underlies anchoring in still much debated and currently two mechanisms dominate the field: anchoring and adjustment (Epley & Gilovich, 2005; Tversky & Kahneman, 1974) and the selective accessibility model (Chapman & Johnson, 1994; Mussweiler & Strack, 1999). In anchoring and adjustment, the anchors are taken as reference points, and as adjustment away from the reference points is effortful, it is often insufficient, leading to the anchoring effect (Epley & Gilovich, 2001; Simmons, LeBoeuf & Nelson, 2010; Tversky & Kahneman, 1974). In the selective accessibility model, the hypothesis is tested that the anchor is the correct value, which makes information consistent with the anchor more accessible, leading to the anchoring effect (Chapman & Johnson, 1994; Mussweiler & Strack, 1999). In the case of the portion size effect, both processes could play a role. Upon seeing the portion, people might automatically think of reasons why this portion is an appropriate consumption quantity, leading to the portion size effect. It is also possible that the portion size is only used as a starting point to determine consumption, and that participants either adjust their consumption upwards or downwards from the portion size till they reach a consumption quantity they find appropriate. Most importantly, in both mechanisms, seeing a certain quantity of food, will automatically bias the consumption decision towards this quantity, even when it cannot reasonably be regarded as an appropriate consumption amount, such as family bags of chips.

The anchoring view can explain the portion size effect and its moderators fairly well. Simmons, LeBoeuf and Nelson (2010) showed that the motivation to be accurate can weaken anchoring effects. Also, Mussweiler, Strack, and Pfeiffer (2000) showed that generating reason as to why the anchor is inappropriate, can weaken the anchoring effect. Hence, this could explain why the portion size effect is weaker for women and unattractive foods. In case the foods are not liked, or when the motivation to control consumption is high (for women), it is more likely that arguments are generated that argue against the portion size as being a suitable consumption quantity, weakening the portion size effect. Furthermore, when distracted, judgments will be made without much elaboration (Petty & Cacioppo, 1984), which makes it more likely that the judgment will be based on the anchor only, which in some cases can lead to stronger anchoring effects (Wegener, Petty, Blankenship, & Dettweiler-Bedell, 2010) and thus a stronger portion size effect. The finding that the portion size is present (yet slightly weaker) in young children, is perhaps more difficult to explain from an anchoring perspective. Anchoring is a judgmental bias, and it is questionable whether very young children already use decision processes that lead to such biases.

2.3.4 Comparing the different mechanisms

I have identified several different ways through which the portion size can enter the consumption quantity decision, being portion sizes as social norms, cleaning the plate, unit bias, and portion sizes as anchors. Results from our experiments in Chapter 3 showed that social norms indeed play a role in the portion size effect, but that other mechanisms might be at work as well. The mechanisms that I discussed were all fairly well able to explain the moderating influences on the portion size effect, but also left questions unanswered. The tendency to clean the plate, for example, cannot explain why people eat more from snack packages that are clearly not meant to be consumed in one sitting, while the anchoring view cannot explain why very young children show a portion size effect. Furthermore, unit bias can only explain the portion size effect when the provided food can be regarded as one unit, while the social norms view can only explain the effect when it can be expected that others will find the portion size an appropriate consumption quantity. Hence, more research is needed to determine how exactly the portion size is incorporated in the consumption quantity decision. Furthermore, it might be interesting to explore the possibility that the mechanisms underlying the portion size effect might vary depending on the situation, person, and type of food.

2.4 Preventing the portion size effect

At the moment, much is still unclear about how exactly the portion size is incorporated into the consumption decision. Hence, instead of focussing on one specific mechanism when designing interventions to prevent the portion size effect, it might be better to target the use of external reference points in the consumption decision in general. I therefore suggest that interventions could focus on either (1) prevention of the use of external reference point in the consumption decisions, or (2) encouragement of the use of other reference points that do not lead to the portion size effect.

2.4.1 Preventing the use of external reference points

Mindfulness

If people can be encouraged to no longer rely on external reference points when deciding how much to eat, the portion size effect should disappear. As one of the contributors to the portion size effect seems to be people's limited ability to correctly monitor consumption, interventions aimed at increasing this ability could potentially weaken the effect. Mindfulness training has been introduced as a way of making people more aware of internal satiety and hunger cues (Kristeller & Wolever, 2010) and has been shown to reduce impulsive behaviour (Papies, Barsalou, & Custers, 2012). Hence, it could be effective as a means to increase the ability to monitor consumption and to thus reduce reliance on external reference points such as the portion size. Both Marchiori and Papies (2014) and Cavanagh,

Vartanian, Herman, and Polivy (2014) tested if a mindfulness exercise could reduce the portion size effect. Marchiori and Papies (2014) let participants do an exercise that was focused on increasing attention to internal signals, including signals of satiety, while Cavanagh et al. (2014) focused attention on the sensory aspects of the food. In both studies, however, the portion size effect was equally large in the control condition and mindfulness condition. Marchiori and Papies (2014) did find that the mindfulness exercise reduced overeating in response to hunger. Hunger only had a significant positive effect on intake in the control condition and not in the mindfulness condition. Cavanagh et al. (2014) found some evidence that the mindfulness exercise reduced overall consumption, but this effect was only marginally significant. Becoming more mindful of consumption is thus not sufficient to reduce the portion size effect.

Education

Another method to encourage people to rely less on external reference points, is education. Cavanagh et al. (2014) tested whether educating people about the external influences on eating (including the portion size effect) reduced the magnitude of the effect, but found that their education efforts were ineffective in doing so. Similar results were found when students were educated about external influences on eating (Wansink & Cheney, 2005; Wansink & van Ittersum, 2007). These students were invited to a party and offered some snacks. The snacks were either presented in two large bowls, or four medium sized bowls. Despite the efforts at education, students took more from the large bowls than from the medium bowls. Poelman, De Vet, Velema, de Boer, Seidell, and Steenhuis (2015) conducted an extensive portion control intervention study among participants with overweight. The intervention group took part in a portion control program of 3 months, which included trainings on portion size awareness and portion control strategies. In the first 3 months, participants in the intervention group indeed lost some weight compared to the control group. This effect was, however, not sustained at 6 and 12 months. Education alone thus seems insufficient to prevent the effects of portion size on consumption. The fact that most people are reluctant to believe that their consumption is heavily influenced by the environment, is also not very helpful in this respect (Wansink, 2010).

Goal priming

The problem with both the education and mindfulness interventions might be that although these interventions increased people's ability to better monitor consumption, their motivation to do so might still have been limited. In the portion control program of Poelman et al. (2015), for example, it is possible that in the first three months of the intervention program participants were excited about these novel portion control strategies and thus were highly motivated to implement them. However, as time went by, the novelty of these strategies wore off, and although participants were able to implement these strategies, the motivation to do so might have disappeared.

To increase the motivation to control consumption, it might be effective to change the goals that guide eating behaviour. Pursuit of goals has been recognized as an important driver of eating behaviour (Stroebe, van Koningsbruggen, Papies, & Aarts, 2012), and such goals can for example be enjoyment of good food, maximizing consumption within the boundaries of what is socially acceptable (Herman, Roth, & Polivy, 2003), and losing or maintaining weight (Andreyeva, Long, Henderson, & Grode, 2010; Bish et al., 2005). When the goals of food enjoyment or consumption maximization are active, people will have little reason to not eat as much from the portion or pack as they can (Herman & Polivy, 2005, 2014). However, when the goal of dieting is active, people will be motivated to restrict their intake instead of relying on the pack size as a reference point for how much they can maximally eat. The goal of dieting is particularly relevant for restrained eaters, or chronic dieters, who chronically try to restrict their food intake in order to control their body weight. Restrained eaters have been shown to control consumption when reminded of their dieting goals (Anschutz, Van Strien, & Engels, 2008; Papies & Hamstra, 2010; Papies, Potjes, Keesman, Schwinghammer & van Koningsbruggen, 2014; Papies & Veling, 2013), which could weaken the portion size effect.

In Chapter 4, we tested whether reminding restrained eaters of their dieting goal can indeed weaken the portion size effect. In the first experiment, participants indicated expected consumption of a number of unhealthy snacks after having being exposed to either a travel magazine or a diet magazine. In the second experiment, actual consumption of M&M's was measured while participants watched movie-clips and commercials. Participants were reminded of their dieting goal through diet commercials. As expected, the diet prime indeed weakened the portion size effect, and did so most strongly for restrained eaters. It is important to keep in mind that when trying to prime a goal through external cues, this will only be effective when this goal is indeed regarded as desirable (Aarts, Custers, & Veltkamp, 2008; Custers & Aarts, 2005). Hence, in this particular case this means that priming the goal of dieting will only be effective for those actually concerned about dieting.

2.4.2 Encouraging the use of other external reference points

As discussed above, it will not be easy to motivate people to not use external reference points in their consumption decision. Hence, it might be simpler to provide people with an alternative reference point, for example a serving size recommendation.

A number of authors have investigated the influence of serving size labels on consumption and/or the portion size effect. Ueland, Cardello, Merrill and Lesher (2009) provided participants with a 200 gram portion of pasta (with more pasta available in a separate serving dish) and labelled this portion as either being 50%, 100% or 150% of a normal portion. This information should enable people to more accurately assess how big the meal is, and they can adapt the reference point accordingly. Provision of these serving size labels did however not influence intake. Many participants in the study indicated that

they thought the serving size was some kind of standardized unit for nutrition displays and did not see it as being appropriate serving size information for themselves. On the other hand, Wansink and Chandon (2006) found that participants ate less from a package of granola with the label "contains two servings" than from a package with the label "contains one serving". Spanos, Kenda and Vartanian (2015) tested if such a "number of servings" manipulation could also be effective in reducing the portion size effect. They compared pizza consumption across 4 conditions: small – unlabelled, large – unlabelled, large – 2 servings label, and large – 4 servings label. Participants ate significantly less when the 4 servings label was placed on the pack instead of the 2 servings label. Hence, it seems that in both the Wansink and Chandon (2006) study and the Spanos et al. (2015) study, people did not use the whole pack as a reference point in the consumption decision, but changed it to respectively half the pack or one fourth of the pack.

Although the "contains X servings" label might be effective when it is in easily dividable units such as 2 or 4, it might be less effective when a pack contains more servings, such as 6, 10 or 15. It might then become too difficult for people to determine how much this exactly is, and instead they use the pack size as a reference point. Hence, in Chapter 5, we placed a serving size recommendation on packs of unhealthy snacks, which directly suggested to people how much they should eat. We tested two conditions, one in which the serving size recommendation was specified in grams only, and one in which also a picture of the recommended amount of food was included. An advantage of directly showing the serving size is that people can immediately use it as reference point in the consumption decision, instead of first having to divide the total amount of provided food by the number of servings in the pack. As expected, placing a serving size recommendation on a pack of snacks reduced the pack size effect, but only did so when a picture of the recommended amount of food was included. Furthermore, the pack size effect was weakened by the serving size recommendation but did not seem to be eliminated, hence it seems that although an alternative reference point was available, some participants still used the pack size as a reference point. It is possible that these participants thought that the serving size information was not applicable to them, either because they feel they have higher nutritional needs, or because they regularly exercise, or any other reason they might come up with.

In sum, there is evidence that serving size labels can influence consumption and diminish the magnitude of the portion and pack size effect. At the same time, such a recommendation might not be able to completely remove the effect as people might find it difficult to visualize how much the recommendation exactly is or might feel that it is not applicable to them. As we also saw with the mindfulness and education interventions, it is possible that although the serving size recommendation increases the ability to control consumption, the motivation to actually do so might be lacking. For serving size labels to be effective, they thus need to provide unambiguous information about what the appropriate portion size is and to convince people that this is the right quantity for them.

2.5 Conclusion

In this chapter I discussed the moderators of the portion size effect, the various explanations that have been provided for why it occurs, and what might be done to prevent it.

The portion size effect is a robust effect, but nonetheless, a number of moderators have been identified that weaken the effect, being age, gender, food type, and an eating environment without distractions. These moderating influences indicate that the portion size effect might to a certain extent be under conscious control.

In the past years, it has become clear that our body weight is not well regulated through biological controls (Levitsky, 2005), and that most of the time eating occurs in response to environmental cues instead of bodily signals of hunger and satiety (Cohen & Farley, 2008; Herman & Polivy, 2005, 2008; Schachter, 1968; Wansink, 2010). The main underlying cause of the portion size effect thus seems to be the difficulties people experience when trying to determine how much they should eat. Contributors to these difficulties are the confusing food environment, distractions when monitoring consumption, and size estimation biases. To simplify the consumption quantity decision, people therefore rely on external reference points, such as the portion size. How exactly the portion size is incorporated in the consumption quantity decision, is still unclear. Various mechanisms have been suggested, being: portion sizes as social norms, cleaning the plate, unit bias, and portion sizes as anchors. In Chapter 3, we tested whether portion sizes act as social norms, as this is one of the most strongly advocated views on the portion size effect (Herman & Polivy, 2005, 2008; Wansink & van Ittersum, 2007). Results showed that portion sizes indeed seem to communicate how much is socially acceptable to eat, but that other mechanisms are likely to play a role as well. Comparison of these different mechanisms showed that they all were able to explain many of the characteristics of the portion size effect, but left questions unanswered as well. Future research could therefore consider the possibility that different mechanisms might be responsible for the portion size effect in different situations.

As much still needs to be learned about the specific mechanisms that underlie the portion size effect, currently it might be best to not focus interventions on any of these specific mechanisms, but to focus instead on either preventing the use of external reference points in the consumption decision, or on the provision of other, more suitable external reference points.

To prevent the use of external reference points, it might be insufficient to only educate people about the influence of these reference points or to make them more aware of internal signals of hunger and satiety using mindfulness exercises. Although both interventions increase people's ability to monitor consumption and to rely less on external reference points, they might not motivate them sufficiently to actually do so. Therefore, in Chapter 4 we tested an intervention which was focussed on increasing the motivation to not rely on

external reference points, namely reminding restrained eaters of their dieting goal. Such a reminder strongly motivates restrained eaters to control their consumption and our findings showed that it indeed reduced their consumption from large packs, which weakened the pack size effect.

Instead of encouraging people not to rely on external reference points at all in the consumption decision, it might be easier to provide them with an alternative reference point. In Chapter 5, we therefore provided participants with a serving size recommendation that directly suggested to people how much they should eat. The pictorial recommendation weakened the pack size effect, but seemed to not fully remove it. Hence, it seems that not everyone was sufficiently motivated to use this alternative reference point in the consumption decision.

In sum, what is known up to date about the portion size effect is that it occurs for different foods, in different situations and for different people. It is a robust effect, but nonetheless, some moderators, such as gender and food type, have been shown to weaken the effect. Because people find it difficult to determine how much they should eat, they rely on external reference points, such as the portion size, to simplify the consumption quantity decision. As much is still unclear about exactly how the portion size is incorporated in the consumption quantity decision, more research is needed in this area. Interventions to weaken the portion size effect can focus on encouraging people to either rely less on external reference points in the consumption decision or to rely on better reference points such as a serving size recommendation. To achieve this, it will particularly important to sufficiently motivate people to limit their consumption, for example by priming a dieting goal.

Chapter 3

The role of social norms in the portion size effect

This chapter is based on work conducted together with Esther Papies, and is currently under review at Frontiers in Psychology.

An explanation that has often been given for the portion size effect is that the portion size acts as a social norm and as such communicates how much is appropriate to eat. In this chapter, we tested this explanation by examining whether manipulating the relevance of the portion size as a social norm changes the portion size effect. We conducted two experiments in which participants indicated how much they would eat (Exp. 3.1) or serve themselves (Exp. 3.2) from different foods. In Experiment 3.1 (N = 63), we manipulated normative relevance by allegedly basing the portion size on the behaviour of either students of the own university (in-group) or of another university (out-group). In Experiment 3.2 (N = 321), we told participants that either a minority or majority of people similar to them approved of the portion size. In both experiments participants expected to serve themselves and to eat more from larger than from smaller portions. As expected, however, the portion size effect was less pronounced when the reference portions were based on the behaviour of an out-group (Exp. 3.1) or approved only by a minority (Exp. 3.2). These findings suggest that the portion size indeed provides normative information, because participants were less influenced by it if it communicated the behaviours or values of a less relevant social group. In addition, in Experiment 3.2, the relation between portion size and the expected amount served was partially mediated by the amount that was considered appropriate, suggesting that concerns about eating an appropriate amount indeed play a role in the portion size effect. However, since the portion size effect was weakened but not eliminated by the normative relevance manipulation and since mediation was only partial, other mechanism may also play a role.

3.1 Introduction

The aim of this chapter is to increase understanding of how the portion size is incorporated in the consumption quantity decision. We test one of the most prevalent explanations for the portion size effect, namely, that the amount of food provided serves as a cue for what is an 'appropriate' amount to eat (Herman & Polivy, 2005, 2008; Herman, Polivy, Pliner, & Vartanian, 2015; Rolls, Morris, & Roe, 2002; Steenhuis & Vermeer, 2009; Wansink & van Ittersum, 2007). More specifically, according to Herman, Roth, and Polivy (2003) and Herman and Polivy (2014), portion sizes act as upper limits for intake and define how much can be maximally eaten without being perceived as an excessive eater. Excessive eating behaviour can be associated with several negative stereotypes which people want to avoid, such as having low self-control (Puhl & Bronwell, 2001) or as being less attractive (Bock & Kanarek, 1995; Chaiken & Pliner, 1987). Eating the amount of food that is provided will generally not be seen as excessive consumption behavior, especially not when the amount is determined by someone who can be expected to have knowledge about the "correct" portion size, such as the chef in a restaurant, the manufacturer of frozen meals, or the researcher in a lab. The portion size thus provides indirect information about what is socially acceptable eating behavior. As the portion size increases, so does the amount that people maximally allow themselves to eat, resulting in the portion size effect. In the current chapter, we argue that if the portion size indeed acts as a social norm and as such communicates how much is maximally appropriate to eat, then the effect should weaken when people do not actually believe that the portion size communicates a norm that is relevant to them. We tested this in two experiments by leading participants to believe that the portion sizes they were presented with were either based on the values and behaviour of a relevant social group or not, and examined the effect of this manipulation on the effect that the portion sizes had on participants' eating intentions.

3.1.1 The influence of social norms on eating behaviour

People are influenced both by what other people do and by what other people think (Deutsch & Gerard, 1955). The impact of the eating behaviour of others on the amount consumed has been studied extensively (for reviews, see Cruwys, Bevelander, & Hermans, 2015; Higgs, 2015; Vartanian, Spanos, Herman, & Polivy, 2015), and it has been shown that the amount consumed by a person is heavily dependent on the amount others consume (Conger, Conger, Costanzo, Wright, & Matter, 1980; Florack, Palcu, & Friese, 2013; Hermans, Larsen, Herman, & Engels, 2008; Leone, Pliner, & Herman, 2007). These influences even occur when the other person is not physically present in the room or when a so-called remote confederate design is used. In the latter, the information about someone else's consumption is provided for example in the form of written information or through other, more subtle cues, such as by leaving candy wrappers from the "previous participant"

on the table (Feeney, Polivy, Pliner & Sullivan, 2011; Pliner & Mann, 2004; Robinson, Benwell & Higgs, 2013; for a review, see: Robinson, Thomas, Aveyard & Higgs, 2014). Normative cues suggesting appropriate behaviour thus heavily influence people's eating behaviour, even when no other people are physically present.

At the same time, people are not equally influenced by everyone. According to self-categorization theory, social influence is dependent on the social identity of the source and target of influence (Tajfel, 1978; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987; Turner, 1991; Turner & Oakes, 1989). Specifically, people categorize themselves as belonging to certain in-groups, which, depending on the situation, can be very broad, e.g. women, or very narrow, e.g. chess club members (Oakes, 1987). In-group members are viewed as being similar to the self on relevant dimensions and hence their actions and opinions are viewed as relevant and important (Haslam & Turner, 1992; Turner, 1991). Hence, when a certain in-group identity is made salient, people will be influenced by the actions and expectations of this in-group (Platow et al., 2005). Those who do not belong to the in-group, the so-called out-group members, are considered less relevant to the own identity, and hence their actions and expectations affect people to a lesser degree (Haslam & Turner, 1992; Turner, 1991).

The moderating effect of the source of a social norm has clearly been demonstrated in the domain of consumption behaviour. Cruwys et al. (2012), for example, showed that students only modelled popcorn consumption of students from their own university and not of students from another university. Similarly, Stok, de Ridder, de Vet, & De Wit (2012) told participants that either the minority (27%) or the majority (73%) of Dutch students ate "sufficient" fruit. They found that considerably more students intended to eat sufficient fruit when they received majority norm information than when they received minority norm information. Similarly, Hermans et al. (2008) and McFerran, Dahl, Fitzsimons and Morales (2010) showed in a naturalistic setting that people only modelled the consumption and food choice behaviour of others when they had a body type that was similar to their own. Furthermore, Berger and Heath (2008) and Oyserman, Fryberg and Yoder (2007) showed that when the social norm, such as healthy or unhealthy eating, was communicated by out-group members, this even led to reactance against the norm, leading in-group members to adopt norm-incongruent eating behaviours.

Here, we suggest that if the portion size indeed provides normative information about the appropriate amount to eat, its effect on consumption should be reduced when people learn that the portion size is based on the opinion or behaviour of others who are considered irrelevant to oneself. Hence, manipulating the normative relevance of the portion size should change the magnitude of the portion size effect.

3.1.2 Current research

In the current research we manipulated the normative relevance of the portion size by telling participants that it was based on the behaviour of an in-group or an out-group in

Experiment 3.1 (Cruwys et al., 2012), and by providing information that it was approved of by a minority or majority of people similar to the participants in Experiment 3.2 (Smith & Louis, 2008; Stok et al., 2012).

The paradigm used in the current studies was based on Marchiori, Papies, and Klein (2014) who first asked participants to imagine a certain portion of food that they were served in a certain situation, and to indicate if they would eat more or less than the specified portion size. In our study, we simply added the information that this portion size was based on the behaviour of or approved by a certain social group. Then, participants were asked how much exactly they expected to consume. This latter estimation served as the dependent variable and was shown to be affected by the initial portion size that participants had been asked to imagine (Marchiori et al., 2014). Here, we additionally tested whether this effect could be modulated by manipulating the normative relevance of the initial portion size.

3.2 Experiment 3.1

3.2.1 Methods

Design

The experiment had a 2 (normative relevance: in-group vs out-group; between-participants) x 2 (portion size: small vs large; within-participants) mixed design. Participants were provided with a portion size that allegedly was based on the eating behaviour of students from their own university (in-group), or students of literature from another university (out-group).

Participants

The sample consisted of 63 economics students of a Dutch university who followed an advanced market research class. Some participants did not provide their expected consumption of one the foods because they never eat this food, leading to some missing observations (N = 1 for soup, N = 2 for cookies, and N = 7 for cheese cubes). Furthermore, expected consumption of one participant lay more than 5 SD from the mean for one of the foods, and hence this participant was excluded from analyses involving this food.

Foods

Participants indicated how much they expected to consume of two dinner foods (pasta, soup) and two snack foods (mini chocolate chip cookies, cheese cubes). Expected consumption was answered in grams for the pasta, in millilitres for the soup, and in pieces for the cookies and cheese cubes. We based the small and large portion for each of the foods on the average amount consumed per consumption occasion in the Netherlands (Dutch National Food Consumption Survey 2007 – 2010). Depending on the food, the small portion was 20% to 40% smaller than the average consumption amount. The large portion was about 3 times as large as the small portion. We based these amounts on Marchiori et al. (2014),

but made the difference between the small and large portion less extreme to prevent that our cover story would become implausible. See Table 3.1 for the tested portion sizes.

	Occasion	Average consumption quantity[a]	Small portion	Large portion
Pasta	dinner	170 gram	120 gram	400 gram
Soup	dinner	260 ml	200 ml	600 ml
Mini chocolate cookies	snack	5 cookies	3 cookies	10 cookies
Cheese cubes	snack	3 cubes	2 cubes	7 cubes

[a]Based on the Dutch National Food Consumption Survey 2007 – 2010

Table 3.1. Foods and portion sizes in Experiment 3.1.

Procedure

The experiment was administered as a paper-and-pencil questionnaire during a lecture on March 18, 2015. Participation was voluntary and no compensation was provided. Participants' identity as economics students at their university was made salient through the university logo on both the instruction slides and the questionnaire. Participants were first presented with the expected consumption questions. For soup, participants were told: "Imagine that you are going to eat soup tonight. Will your consumption be higher or lower than [200 / 600] millilitre of soup? The quantity of [200 / 600] ml is based on research among [students from *name own university* / literature students from *name other university*]. [200 / 600] ml is the amount that these students on average served themselves." Participants indicated if they would eat more or less than the specified amount and then answered the question: "How much soup will you consume? Please provide your answer in millilitres." For snack foods, participants were asked to imagine taking a snack in the afternoon.

Each participant was presented with a large and small portion for the dinner foods and a small and large portion for the snack foods. The participants either saw a large portion for the pasta and cookies and a small portion for the soup and cheese cubes or vice versa. We did not fully randomize the foods for which respectively a small or large portion was shown to limit the number of questionnaire versions and to allow for a between-participants analysis of the data, despite the relatively small sample. The order in which the foods were presented was counterbalanced with the constraint that the participants always saw the dinner food questions right after each other and the snack food questions right after each other.

Participants then completed a number of other measures (see below), before the researcher collected the questionnaires, and participants were debriefed.

Other measures

We asked participants to indicate their place of residence as the manipulation might be less effective for students who live near the other university. We furthermore asked participants to indicate for how long they had been a student at their current university and which master program they were enrolled in. Finally, depending on whether they received the in-group or out-group manipulation, participants indicated the extent to which they identified with the in-group or out-group using the following two statements measured on a 7-point scale: "I identify with [in-group / out-group]" (Stok et al., 2012) and "I feel a connection to [in-group / out-group]", $\alpha = 0.81$ for the in-group, and $\alpha = 0.79$ for the out-group.

Randomization check

There were no differences across the normative relevance conditions with regards to place of residence and years as a student at the current university (all *p*s > 0.42).

3.2.2 Results

Manipulation check

As expected, participants identified themselves more strongly with economics students from their own university ($M = 4.7$, $SD = 1.3$) than with literature students from another university ($M = 2.5$, $SD = 1.3$), $t(61) = 6.92$, $p < 0.01$. Furthermore, across the four foods, on average 72% indicated they would eat more than the provided portion size when this portion size was small, indicating that this portion was indeed perceived as being small. Similarly, 69% indicated that they would eat less than the provided portion size when this portion was large.

Portion size effect

The average expected consumption of the four foods can be found in Table 3.2. First, we performed a within-participants analysis on the portion size effect and tested whether it was modulated by normative relevance. We calculated the portion size effect for each participant by subtracting the standardized consumption of the foods shown with a small portion size from the standardized consumption of the foods shown with a large portion size. A t-test showed that the portion size effect was indeed significantly larger in the in-group condition than in the out-group condition, $t(50) = 2.29$, $p = 0.03$.

	In-group condition		Out-group condition	
	Small portion	Large portion	Small portion	Large portion
Pasta	176.3 (66.9)	358.7 (164.7)	166.9 (102.1)	300.3 (112.8)
Soup	285.7 (130.7)	584.4 (198.9)	334.4 (181.8)	421.9 (143.7)
Cookies	4.2 (2.3)	6.9 (4.7)	6.1 (5.1)	6.0 (3.3)
Cheese cubes	4.7 (4.1)	5.3 (2.6)	5.8 (3.4)	5.5 (2.9)

Table 3.2. Average expected consumption of each food across experimental conditions in grams for pasta, in millilitre for soup, and in pieces for cookies and cheese cubes. Standard deviations are provided in parentheses.

A drawback of the within-participants analysis is that we calculated the portion size effect using different foods for the small and large portion. Therefore, we also conducted a between-participants analysis in which we compared expected consumption in the small and large portion size condition for the same foods. Participants were always presented with the same portion size for pasta and cookies and for soup and cheese, hence we combined standardized consumption of pasta and cookies, and standardized consumption of soup and cheese. For the combined consumption of pasta and cookies, an ANOVA with portion size and normative relevance as between participant factors, showed that the main effect of portion size was significant, $F(1, 56) = 16.50$, $p < 0.01$, $\eta_p^2 = 0.23$, with expected consumption being higher when the portion size was large than when it was small. The main effect of normative relevance was not significant, $F(1, 56) = 0.21$, $p = 0.65$, $\eta_p^2 < 0.01$, and neither was the interaction between normative relevance and portion size, $F(1, 56) = 1.78$, $p = 0.19$, $\eta_p^2 = 0.03$. To test our specific hypothesis (see Hancock & Klockars, 1996), however, we conducted a simple main effects analysis to determine whether the portion size effect was stronger in the in-group than in the out-group condition, so when the normative relevance of the portion size was high compared to when it was low. As expected and as can be seen in Figure 3.1, the portion size effect was strong and significant in the in-group condition, $F(1, 56) = 14.09$, $p < 0.01$, $\eta_p^2 = 0.20$, but was only marginally significant in the out-group condition, $F(1, 56) = 3.84$, $p = 0.06$, $\eta_p^2 = 0.06$.

The same analysis for the combined consumption of soup and cheese cubes again showed a significant main effect of portion size $F(1, 51) = 8.61$, $p = 0.01$, $\eta_p^2 = 0.14$. The main effect of normative relevance was again not significant, $F(1, 51) = 0.42$, $p = 0.52$, $\eta_p^2 = 0.01$, and its interaction with portion size only marginally significant $F(1, 51) = 3.34$, $p = 0.07$, $\eta_p^2 = 0.06$, respectively. Simple main effects, however, again showed that the portion

size effect was strong and significant in the in-group condition, $F(1, 51) = 10.76$, $p < 0.01$, $\eta_p^2 = 0.17$, but not in the out-group condition, $F(1, 51) = 0.65$, $p = 0.43$, $\eta_p^2 = 0.01$. This is displayed in Figure 3.1.

In sum, although the expected interaction between portion size and normative relevance was not fully significant in the between-participants analysis, the simple main effects were in line with the within-participants results and again confirmed our hypothesis that the portion size effect was weakened by reducing its normative relevance. As the sample size was rather small, the lack of significance of the omnibus interaction in the between-participants analysis might be due to low power.

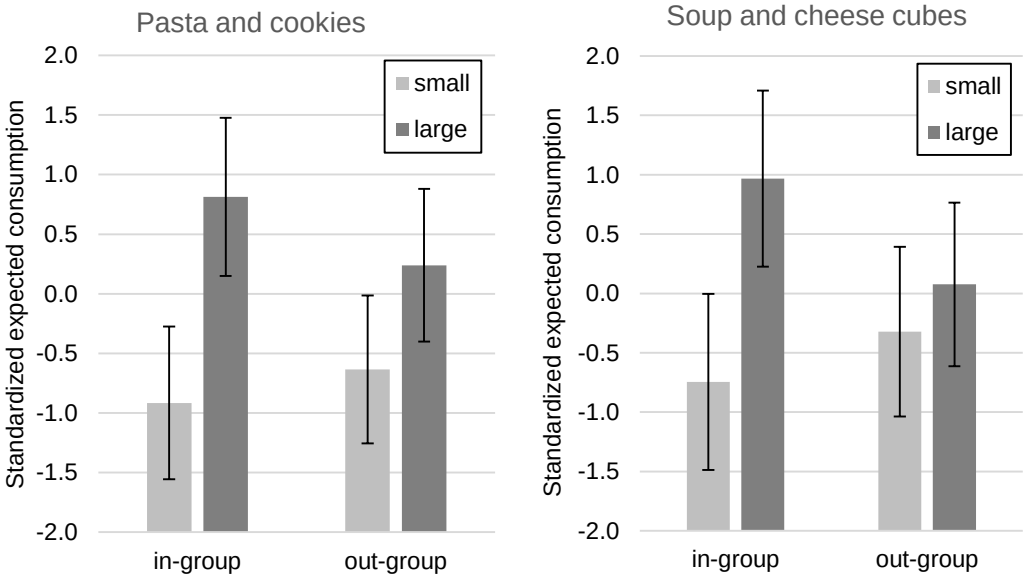

Figure 3.1. Standardized average expected amount consumed across the portion size and normative relevance conditions for (a) pasta and cookies and (b) soup and cheese.

3.2.3 Discussion

The results of this first experiment suggested that the magnitude of the portion size effect indeed depended on the relevance of the portion size as a social norm, as the effect was weaker when the portion size had allegedly been based on the eating behaviour of an out-group than when it had been based on the in-group. Hence, when the portion size was based on the eating behaviour of a social group with which participants did not identify, they were less inclined to use it as a reference point to determine their own consumption. The lack of

significance of the omnibus test in the between-participants analysis might have been due to low power, and hence in Experiment 3.2 we recruited a larger sample size.

3.3 Experiment 3.2

In Experiment 3.2, we recruited a sufficiently large sample for a between-participants analysis of the effect of the normative relevance manipulation on the portion size effect. Furthermore, as students are a very specific group whose behaviours and attitudes are not always representative of older adults (Sears, 1986), we used a general sample of the Dutch population.

Importantly, in Experiment 3.2 we manipulated the normative relevance of the portion size by providing information about whether it was allegedly approved of by a majority or minority of people similar to the participants. Previous research has shown that the extent to which others (dis)approve of a behaviour can have a strong influence on people's actions (Cialdini, Kallgren, & Reno, 1991; Reno, Cialdini, & Kallgren, 1993; Smith & Louis, 2008). If we follow the reasoning of Herman et al. (2003) and Herman and Polivy (2014), people mainly use the portion size as a reference point in their consumption decision to gain social approval. In their view, the portion size indicates the maximum people can eat without coming across as an excessive eater. Thus, manipulating to what extent relevant others allegedly *approve* of the portion size should be a direct test of the notion that people use the portion size as an indicator of what is socially acceptable. More specifically, we provided information about the percentage of Dutch women who considered the portion size to be appropriate. We chose to conduct the study among women, as they tend to be more concerned about their eating behaviour than men (Divine & Lepisto, 2005; Mori, Chaiken, & Pliner, 1987). Furthermore, in the current experiment we asked how much participants expected to serve themselves rather than how much they would consume, as this judgment might be easier to make in an online setting.

Experiment 3.2 was also designed to include mediation analysis to test whether considering a larger portion "appropriate" is an underlying mechanism for the finding that larger portions increase intake (see also Kerameas, Vartanian, Herman, and Polivy, 2015). To this end, we asked participants to indicate the amount that they considered appropriate to serve themselves in each consumption situation, and we included this variable in a moderated mediation analysis. Here, we expected that the effect of a large portion increasing intake would be mediated by participants finding a larger portion appropriate. At the same time, this effect should be weaker in the condition of low normative relevance where participants learned that only a small percentage of similar others approved of the portion.

Finally, we also examined the effect of adding pictures of the foods to facilitate portion size estimation. People find it difficult to interpret food amounts in grams (Faulkner et al., 2012). Since in Experiment 3.1, expected consumption of two of the foods had to be

estimated in grams and also the portion size information was only provided in grams, this might have made the task to estimate consumption difficult, which could have artificially strengthened the portion size effect. Therefore, we predicted in Experiment 3.2 that providing a picture of the food portions would weaken the portion size effect, and that it would also strengthen the moderating effect of the normative relevance manipulation.

3.3.1 Methods

Design

The experiment had a 2 (portion size: small vs large) x 2 (normative relevance: minority vs majority) x 2 (picture of portion size: absent vs present) between-participants design.

Participants

The sample consisted of Dutch females between 18 and 55 years old who had eaten the foods in the study at least once in the past. Participants were not allowed to continue with the questions if they could not remember the normative relevance manipulation correctly.[4] We used this screening procedure to prevent individuals from participating in the study who would not carefully read our instructions and questions, which can be a problem in online questionnaires (see Berinsky, Margoles, & Sances, 2013; Oppenheimer, Meyvis, & Davidenko, 2009). A total of 347 participants completed the questionnaire. Nine participants were excluded from analyses because of bad data quality, which either meant that they gave the same answer to at least 26 of the 28 agree/disagree and true/false statements or filled in the questionnaire in less than 5 minutes (mean completion time was 15 minutes (*SD* = 10)). Furthermore, another 14 participants were excluded because they wrongly interpreted the expected amount served questions for pasta and rice. We specifically asked participants to indicate the amount including other ingredients such as vegetables, meat and sauce. Some participants, however, indicated in the open-ended questions that they provided their answers regarding the amount of (dry) pasta or rice excluding any other ingredients. Hence, these participants were excluded from analyses. Last, we excluded three outliers, as the amount they expected to serve lay more than 5 SD from the mean amount served for one or more of the foods. This led to a final sample of 321 participants, who had a mean age of 36.7 (*SD* = 10.6).

[4] The participant was presented with the percentage of women that approved of the portion sizes the participant was about to see. The participant was then asked to recall this percentage. If she filled in the wrong percentage, she was asked to re-read the information. If the participant then again filled in the wrong percentage, she could no longer continue, which happened to a total of 41 potential participants.

Foods

We tested two dinner foods (pasta; Indonesian fried rice) and two snack foods (mini ginger cookies, in Dutch "kruidnoten"; potato chips). The order in which the foods were presented, was randomized. The expected amount served was asked in grams for each food. We based the small and large portion for each of the foods on the average amount consumed per consumption occasion in the Netherlands (Dutch National Food Consumption Survey 2007 – 2010) and on the portion size information on the pack of the manufacturer. Depending on the food, the small portion was 40% - 50% smaller than the average consumption amount. We made the small portions somewhat smaller than in Experiment 3.1 to make sure they would look sufficiently small on the pictures. For the dinner foods, the large portion was three times as large as the small portion, for the snack foods, it was four times as large (see Table 3.3). For the condition which included pictures of the food portions, we photographed each food on a white plate. As a size reference, we put a pen and a glass of water next to the plate. For the dinner foods, we also included a knife and fork. For example pictures, please refer to Appendix 3.1.

	Occasion	Average consumption amount[a]	Small portion	Large portion
Pasta	dinner	350 gram	200 gram	600 gram
Fried rice	dinner	300 gram	170 gram	500 gram
Mini ginger cookies	snack	25 gram	15 gram	60 gram
Chips	snack	40 gram	20 gram	80 gram

[a]Based on the Dutch National Food Consumption Survey 2007 – 2010 and manufacturer information.

Table 3.3. Foods and portion sizes in Experiment 3.2.

Procedure

Participants were recruited by panel agency GMI, who also provided them with a small monetary compensation for participation. Fieldwork was conducted in the period September 24 to September 28, 2015. The questionnaire was administered in Dutch. Participants were randomly allocated to 1 of the 8 experimental conditions. After the screening questions, the participants read a brief text about previous portion size research that had been conducted among Dutch women and that had shown that the portion sizes the participants were about the see were regarded as appropriate by [10% / 80%] of Dutch women. After participants

were asked to recall the percentage, they were presented with the scenarios in which we asked how much they would serve themselves of four different foods. For pasta, participants were told: "Imagine that you are going to eat pasta tonight. There is more than enough and you serve yourself a portion. In previous research we asked Dutch women what they think about a portion of [200 / 600] grams of pasta. According to this research, [only 10% / as much as 80%] of women find this portion appropriate. Would you serve yourself more or less than [200 / 600] grams of pasta? Please note that you should indicate the amount of pasta including sauce and other ingredients." Participants indicated if they would serve more or less than the specified amount and then answered the question: "How much pasta would you serve yourself? Please provide your answer in grams." In the picture condition, a picture of the portion of [200 / 600] grams was included. This procedure was repeated for all foods. The order in which the foods were shown was randomized. Participants then completed a number of other measures (see below), after which they were thanked and debriefed.

Other measures

The measures that are included in the subsequent analyses are listed here. For all other measures please refer to Appendix 3.2. All scales are 7-point scales, unless stated otherwise. We first asked age and frequency of consumption of the four foods in the study. After the consumption scenarios, participants were asked to explain for two foods in an open ended question how they had determined their expected amount served. Participants then indicated how difficult or easy it was for them to indicate their expected amount served of all four foods and indicated whether they thought the portion size they saw was too small or too large. In case participants saw a photo of each of the food portions, they indicated how attractive the foods on each photo looked. All participants then indicated liking of each of the four foods. Participants then again saw the scenarios, only now we asked them to not indicate the amount they expected to serve themselves, but the amount that they thought would be appropriate to serve in this situation, which served as the mediator in the moderated mediation analyses. Next, we asked participants on a 5-point scale whether they had expected the percentage of women that found the portion appropriate to be higher or lower. We also asked how believable they found the cover story which contained the normative relevance manipulation. Participants then moved on to the dietary restraint subscale of the Three Factor Eating Questionnaire (Stunkard & Messick, 1985; $\alpha = 0.88$). Next, participants indicated if they were currently trying to lose weight (yes, a bit, no) and completed the perceived self-regulatory success scale (Fishbach, Friedman, & Kruglanski, 2003; $\alpha = 0.79$). To measure social identification with the in-group / out-group we also included items from the Social Identification Scale from Leach et al. (2008), "I feel a bond with Dutch women", "I feel solidarity with Dutch women", "I think that Dutch women have a lot to be proud of", "I have a lot in common with the average Dutch woman", and from Stok et al. (2012) we included "I identify with Dutch women", with $\alpha = 0.90$. Robinson, Tobias, Shaw, Freeman

& Higgs (2011) showed that the degree of social modelling was moderated by trait self-esteem, with social modelling being higher when self-esteem was low. We therefore also included the 10-item self-esteem scale of Rosenberg (1965), $\alpha = 0.90$. We assessed current hunger by two statements ('How hungry are you at this moment'; 'How much could you eat right now'; $\alpha = 0.85$). Next, participants provided their gender, weight and height. Finally, participants wrote down what they thought the purpose of the study was, after which they were debriefed and could write down comments.

Randomization check

Using an ANOVA with portion size, normative relevance and presence of a picture as factors, we found no significant differences across conditions with regard to BMI, dietary restraint, current dieting behaviour, attractiveness of the food pictures, hunger, self-esteem, and liking and consumption frequency of the foods (all *ps* > 0.05). The extent to which participants identified themselves with Dutch women varied per portion size condition, $F(1, 313) = 4.49$, $p = 0.03$, with identification being lower in small portion size condition ($M = 3.99$, $SD = 1.21$) than in the large portion size condition ($M = 4.28$, $SD = 1.26$). Note that the answer to this question might have been influenced by the portion size and social information condition the participant was presented with.

3.3.2 Results

Manipulation check

The large portion was considered to be significantly larger than the small portion, all *p*s < 0.01. Furthermore, across the four foods, on average 71% indicated they would eat more than the provided portion size when this portion size was small, indicating that this portion was indeed perceived as being small. Similarly, 72% indicated that they would eat less than the provided portion size when this portion was large. Finally, as expected, it was considered more difficult to estimate the expected amount served when no picture was included than when a picture was included, all *p*s < 0.02.

Portion size effect

The average expected amount served of the four foods can be found in Table 3.4.We standardized expected consumption of each food and calculated the average expected consumption across the four foods. A 2 x 2 x 2 ANOVA with portion size, normative relevance and presence of a portion size picture as factors revealed a main effect of portion size, $F(1, 313) = 207.54$, $p < 0.01$, $\eta_p^2 = 0.40$. As expected, participants expected to serve themselves considerably more when presented with the large portion than when presented with the small portion. Importantly, the hypothesized interaction between portion size and normative relevance was also significant, $F(1, 313) = 6.23$, $p = 0.01$, $\eta_p^2 = 0.02$. This effect is displayed in Figure 3.2. Simple main effects revealed that although the portion size effect

was significant in both the majority and minority condition, $F(1, 313) = 136.10$, $p < 0.01$, $\eta_p^2 = 0.30$, and $F(1, 313) = 74.63$, $p < 0.01$, $\eta_p^2 = 0.19$, respectively, it was weaker in the minority condition, with the estimated mean difference between the small and large portion in the majority condition being $M = 1.11$ ($SE = 0.10$) and in the minority condition being $M = 0.78$ ($SE = 0.09$). Further follow-up analyses showed that this was due to low normative relevance reducing how much participants would serve themselves in the large portion condition, $F(1, 313) = 9.55$, $p < 0.01$, $\eta_p^2 = 0.03$, while normative relevance had no effect in the small portion condition $F(1, 313) = 0.21$, $p = 0.65$, $\eta_p^2 < 0.01$. Taken together, the portion size effect was smaller in the minority condition than in the majority condition, due to the decrease in expected amount served in the large portion condition.

Normative relevance also had a marginally significant main effect on expected serving size, $F(1, 313) = 3.41$, $p = 0.07$, $\eta_p^2 = 0.01$, with expected amount served being higher in the majority condition than in the minority condition. The presence of a picture of the portion size had no main or interaction effects, all ps > 0.10.

	Majority condition (80% approves)		Minority condition (10% approves)	
	Small portion	Large portion	Small portion	Large portion
Pasta	213.5 (84.7)	434.0 (116.7)	235.6 (87.6)	362.9 (157.1)
Fried rice	198.5 (65.4)	387.6 (120.0)	209.0 (72.7)	348.8 (132.5)
Mini ginger cookies	39.9 (32.5)	73.1 (45.4)	40.3 (35.2)	64.4 (43.1)
Chips	55.1 (50.5)	86.4 (44.6)	52.0 (33.4)	80.9 (46.1)

Table 3.4. Average expected amount served of each food across experimental conditions. Standard deviations are provided in parentheses.

Additional analyses

Additional regression analyses within the General Linear Model showed that dietary restraint, perceived self-regulatory success, BMI, hunger, social identification with Dutch women, and self-esteem did not moderate the effect of portion size, normative relevance nor the interaction between normative relevance and portion size (all ps > 0.10). We did find an interaction between believability of the cover story and portion size, $F(1, 309) = 11.20$, $p < 0.01$, $\eta_p^2 = 0.03$. Simple slopes analysis revealed that the portion size effect was considerably

stronger when believability was high (1 SD above the mean) than when believability was low (1 SD below the mean) (Aiken & West, 1991).

Finally, we ran a repeated measures ANOVA to determine if the effect of normative relevance differed across the four foods. As Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(5)= 147.16$, $p < 0.01$, we used a Greenhouse-Geisser degrees of freedom correction.[5] The specific food item did not moderate the main effect of normative relevance, $F(2.42, 757.18) = 0.17$, $p = 0.88$, $\eta_p^2 < 0.01$, and neither did it moderate the interaction between portion size and normative relevance, $F(2.42, 757.18) = 2.31$, $p = 0.09$, $\eta_p^2 = 0.01$.

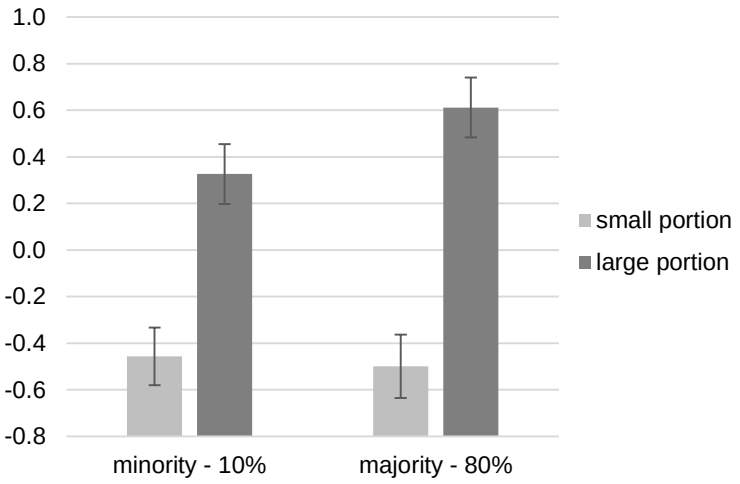

Figure 3.2. Standardized average expected amount served across the portion size and normative relevance conditions

Mediating effect of appropriate consumption

We performed a moderated mediation analysis to test whether the relation between portion size and expected amount served was mediated by the amount that was considered appropriate, and whether this mediation effect differed in the minority and majority condition. Using bootstrapping (Preacher & Hayes, 2009) we found that in both the minority and majority condition, the amount that was considered appropriate indeed mediated the

[5] The assumption of sphericity refers to the assumption that the variances of the differences between all groups are equal. Violation of this assumption can increase the chance of Type 1 error. The Greenhouse-Geisser correction lowers the degrees of freedom based on an estimate of how severe the violation of sphericity is (ε), and as such corrects the estimated p-value.

relation between portion size and expected amount served, with the indirect effect respectively being $B = 0.71$ ($SE = 0.08$), 95% CI [0.57, 0.88] in the minority condition, and $B = 0.89$ ($SE = 0.08$), 95% CI [0.75, 1.07] in the majority condition. A significant moderation effect showed that in line with our hypothesis, the indirect effect was stronger in the majority condition than in the minority condition, $B = 0.19$ ($SE = 0.09$), 95% CI [0.02, 0.35]. As can be seen in Figure 3.3, the stronger indirect effect in the majority condition can be attributed to the moderating effect of social information on appropriate intake, with the effect of portion size on the appropriate amount being stronger in the majority than in the minority condition. The direct effect of portion size on expected amount served was also significant, $B = 0.15$ ($SE = 0.07$), 95% CI [0.02, 0.29].

In sum, the amount that was considered appropriate partially mediated the relation between portion size and the expected amount served. Furthermore, the influence of portion size on the amount that was considered appropriate, and therefore on the amount served, was stronger when a majority found the portion appropriate than when a minority found it appropriate. In other words, a larger portion led to larger expected servings because larger servings seemed appropriate, but especially when a majority approved of the large portion.

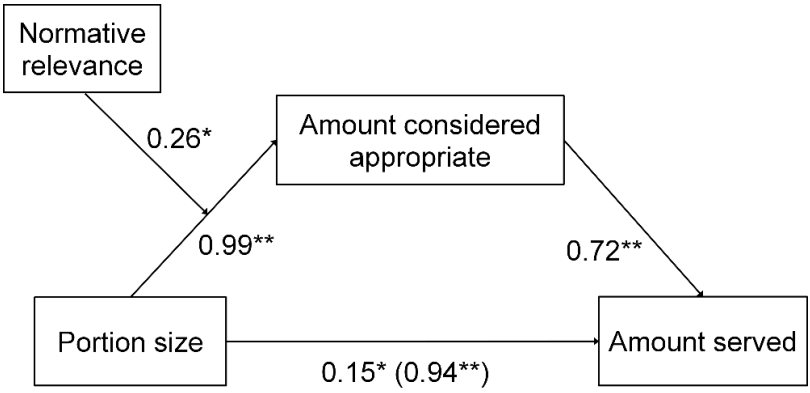

Figure 3.3. Unstandardized regression coefficients of the moderated mediation analysis. The coefficient in parentheses denotes the coefficient for the direct effect of portion size on amount served. * $p < 0.05$ ** $p < 0.01$

3.3.3 Discussion

The results of Experiment 3.2 provided further evidence that the magnitude of the portion size effect depends on the relevance of the portion size as a social norm. The portion size effect was weaker when the portion size was allegedly approved of only by a minority

(10% of women) than when it was approved of by a majority (80% of women). Hence, when the normative relevance of the portion size was reduced, people relied less on it to determine how much to eat. The portion size effect was reduced in the minority condition mainly through a reduction in expected amount served in the large portion size condition, and not from an increase in the amount served in the small portion size condition. In other words, participants decided to serve themselves less when only a minority approved of the large portion, but did not decide to serve themselves more when only a minority approved of the small portion. This is in line with Herman et al. (2003) who suggest that people are mainly concerned about eating too much, rather than too little. This concern might be even greater for women, as positive stereotypes are attached to women who eat small amounts, such as being attractive and feminine (Vartanian, Herman, & Polivy, 2007).

We should note that effect size of the normative relevance manipulation was rather small. In addition, even though the portion size effect was smaller in the minority condition than in the majority condition, it remained significant and substantial. Hence, even when the portion size was not considered as very informative, participants still used it to determine the amount they expected to serve themselves. Hence, other mechanisms might also play a role in the portion size effect.

The moderated mediation showed that people indeed used the portion size to determine how much was appropriate to serve themselves, and chose an amount similar to what they considered appropriate. Furthermore, as we expected, participants were more inclined to base the amount they found appropriate on the portion size when the majority approved of the portion size than when it was approved of by only a minority. This finding thus provides further support for the claim that the portion size provides normative information, indicating how much is appropriate to eat (Herman & Polivy, 2005, 2008; Rolls, Morris, & Roe, 2002; Wansink & van Ittersum, 2007). At the same time, the mediation effect was only partial and people thus seem to have other reasons as well to use the portion size as a reference point to determine consumption, besides the need to eat appropriately.

We should note that the mediating effect might have been somewhat inflated due to the way we measured the amount that was considered appropriate. The question format was the same as the format with which we measured expected amount served. The answers given to the expected amount served questions might have been top of mind while answering the amount appropriate questions, leading to answers that were very similar. Hence, other reasons for people to base their consumption on the portion size besides eating appropriately, could play even a bigger role than suggested by the current results.

We had expected that the portion size effect would be stronger when the portion size information was only provided in grams without any visual information, but found no evidence to support this. The portion size effect was equally strong when a picture of the portion was shown than when no picture was shown. We did find a stronger portion size effect when believability of the cover story was higher, which further confirmed that the

portion size effect was dependent on whether the portion size information was considered relevant for the consumption decision.

3.4 General discussion

Two experiments examined the role social norms play in the portion size effect. Building on previous suggestions that the portion size signals how much is "appropriate" to eat (Herman & Polivy, 2005, 2008; Rolls et al., 2002; Wansink & van Ittersum, 2007), we hypothesized that the magnitude of the portion size effect would depend on whether it is perceived to be relevant as a social norm. We presented participants with a small or large portion of different foods and asked them to indicate how much they expected to eat or serve themselves. We found a strong portion size effect, which was moderated by the normative relevance of the portion size. The portion size effect was weaker when the portion size was allegedly based on the behaviour of an out-group or when it was approved by only a minority. Our findings further suggested that larger portions increased servings because larger servings seemed appropriate, but again this was especially the case if a majority approved of the larger portion.

A limitation of this research is that we measured expected consumption and expected amount served, rather than actual consumption and actual amount served. We argued, however, that uncertainty about how much is appropriate to eat or serve will be quite similar in an actual consumption setting. As Experiment 3.2 showed, reducing the uncertainty about how big the portion size is by providing a picture did not diminish the portion size effect and neither did it moderate the effect of the social norm manipulation. In addition, portion size preferences that were measured using food pictures (Wilkinson et al., 2012) or food replicas (Bucher, van der Horst & Siegrist, 2012), showed that these align well with actual consumption amounts. Also, various studies have shown that the portion size effect is also present when measuring expected consumption using consumption scenarios (Marchiori et al., 2014; Robinson, Te Raa, & Hardman, 2015). Nonetheless, important determinants of consumption such as taste and feelings of satiety are not taken into account in scenario studies such as these, and hence conducting a similar study in which actual consumption is measured, is an important direction for future research.

Another limitation is that we did not include control conditions without information about the normative relevance of the portion sizes. Hence, we cannot disentangle the specific effects of the in-group and majority versus the out-group and minority conditions compared to a standard portion size control condition. Including such a condition will be an important direction for future research.

This research suggests that the portion size acts as a social norm, because its effect was reduced when its normative relevance was reduced. However, this does not answer the question *why* the portion size acts as a social norm. In Experiment 3.2, we found evidence

that the amount that was considered appropriate partially mediated the influence of portion size on the expected amount served. We do not know, however, whether this appropriateness refers to the perceived social effect of eating that amount, to the perceived healthiness, expected satiation, or other ways in which participants might construe "appropriateness". In addition to wanting to eat in line with what is socially acceptable (Herman et al., 2003), people might also use portion sizes as social information about correct amounts to eat in terms of nutrition (i.e., as informational social influence, see Deutsch & Gerard, 1955). An important avenue for further research will be to disentangle these meanings of appropriateness. Furthermore, the amount that was considered appropriate only partially mediated the relation between portion size and expected amount served. It will thus also be important to determine exactly how important the need to eat appropriately is when people determine how much to eat, and which other mechanisms lead them to use the portion size in their consumption decision.

In addition it would be interesting to compare the effectiveness of different types of social information about the portion size as a means to reduce the portion size effect. In the current experiments, we used social groups (students, women) that were neutral with regard to eating behaviour. Future research could for example examine if using other social groups, such as fast-food lovers or individuals with a different body type than the participant, would make the normative relevance manipulation more effective. Furthermore, in the current study we did not specify whether the portion size was considered too small or too large by those who did not find it appropriate. Clearly specifying that large portions are considered to be too large by relevant others could further improve the effectiveness of the normative relevance manipulation, but due to the possibility for demand effects, it would not allow us to test the subtle role of social norms in the occurrence of the portion size effect.

In sum, to our knowledge our studies are the first to formally test whether the portion size signals to consumers how much is appropriate to eat. While we found strong evidence supporting the normative interpretation of the portion size effect, we should also note that reducing the normative relevance of the portion size did not fully remove the portion size effect in Experiment 3.2. In addition, the effect size of the normative relevance manipulation was relatively small, and the amount that was considered appropriate only partially mediated the relation between portion size and expected amount served. Hence a critical evaluation of the various mechanisms that might together underlie the portion size effect remains important. Factors such as uncertainty, anchoring on the portion size (Marchiori et al., 2014), and automatic eating when food is available (Wansink, Painter, & Lee, 2006), might all play a role in the effect, and future research might try to establish their importance in different situations and for different groups of consumers.

Chapter 4

Eating less from bigger packs: Preventing the pack size effect with diet primes

This chapter is based on work conducted together with Esther Papies, and is forthcoming in Appetite.

An increase in the package size of food has been shown to lead to an increase in energy intake from this food, the so-called pack size effect. Previous research has shown that providing diet-concerned individuals with a reminder, or prime, of their dieting goal can help them control their consumption. Here, we investigated if providing such a prime is also effective for reducing the magnitude of the pack size effect. We conducted two experiments in which the cover of a dieting magazine (Experiment 4.1) and diet-related commercials (Experiment 4.2) served as diet goal primes. Both experiments had a 2 (pack size: small vs. large) x 2 (prime: diet vs. control) x 2 (dietary restraint: high vs. low) between participants design. We measured expected consumption of four snack foods in Experiment 4.1 (N = 477), and actual consumption of M&M's in Experiment 4.2 (N = 224). Results showed that the diet prime reduced the pack size effect for both restrained and unrestrained eaters in Experiment 4.1 and for restrained eaters only in Experiment 4.2. Although effect sizes were small, these findings suggest that a diet prime motivates restrained eaters to limit their consumption, and as a result the pack size has less influence on the amount consumed. We discuss limitations of this research as well as potential avenues for further research and theoretical and practical implications.

4.1 Introduction

In this chapter, we tested whether exposure to a diet goal prime can influence consumption quantity decision of restraint eaters and diminish the pack size effect.

Pursuit of goals has been recognized as an important driver of consumer behaviour in general (Kopetz, Kruglanski, Arens, Etkin, & Johnson, 2012; Osselaer & Janiszewski, 2012) and eating behaviour in particular (Stroebe, van Koningsbruggen, Papies, & Aarts, 2013). For many people, eating behaviour is influenced by the goal to stay slim or even lose weight (Andreyeva, Long, Henderson, & Grode, 2010; Bish et al., 2005). One group that has received particular research attention are restrained eaters, or chronic dieters, who chronically try to restrict their food intake in order to control their body weight. While these dieters often overeat when exposed to attractive food cues (Fedoroff, Polivy, & Herman, 1997, 2003; Harris, Bargh, & Bronwell, 2009) they do manage to control their consumption when exposed to reminders of their dieting goal (Anschutz, Van Strien, & Engels, 2008; Papies & Hamstra, 2010; Buckland, Finlayson, Edge, & Hetherington, 2014; Papies, Potjes, Keesman, Schwinghammer & van Koningsbruggen, 2014; Papies & Veling, 2013). Papies and Hamstra (2010), for example, showed that the number of meat snacks consumed by restrained eaters was significantly lower when they were exposed to a poster with health and diet words than when they were not exposed to such a poster. Similarly, Buckland et al. (2014) showed that dieters reduced their intake of a tempting snack when exposed to diet-congruent images instead of control images. These findings are consistent with goal priming research more generally which has shown that priming a goal by external cues can trigger goal-directed behaviour, if the primed goal is indeed regarded as desirable (Aarts, Custers, & Veltkamp, 2008; Custers & Aarts, 2005).

While this work suggests that a diet prime can reduce consumption of restrained eaters, we do not yet know whether it can also reduce the pack size effect. A prominent explanation for the pack size effect is that the portion or pack size communicates a consumption norm that people use as a guidance for how much is appropriate to eat (Rolls, Morris, & Roe, 2002; Wansink, 2010; Wansink & van Ittersum, 2007; Wansink & Chandon, 2014). More specifically, Herman, Roth & Polivy (2003) and Herman and Polivy (2005, 2014) argue that portion and pack sizes act as upper limits for intake and define how much can be maximally eaten without being perceived as an excessive eater. As a result, bigger packs thus allow greater consumption. Here, we suggest that if restrained eaters are reminded of their dieting goal, for example through a diet prime, they will be motivated to restrict their intake in order to pursue the dieting goal, instead of relying on the pack size as a reference point for how much to eat. Since pursuing the dieting goal will decrease intake especially from large packs, and not so much affect the already reduced intake from smaller packs, this will weaken the pack size effect. We thus hypothesized that for restrained eaters, a diet prime would reduce consumption from large packs and hence diminish the magnitude of the pack size effect.

Since for unrestrained eaters, dieting is not a relevant goal, they should, in contrast, not be affected by the diet prime.

To test these predictions, we conducted one online experiment and one laboratory experiment. In the online experiment, we measured expected consumption and tested if exposure to a diet prime (the cover of a dieting magazine) would lower the pack size effect for restrained but not unrestrained eaters. We chose an online method for our initial study as previous work has shown that the portion and pack size effect is also present when measuring expected consumption instead of actual consumption (Marchiori, Papies, & Klein, 2014; Robinson, Te Raa, & Hardman, 2015). In the laboratory experiment, we measured actual consumption of candies and again tested if exposure to a diet prime (dieting commercials) would affect the pack size effect for restrained eaters.

4.2 Experiment 4.1

In this experiment, we investigated the effect of a diet prime on the expected consumption of four tempting snacks. Participants took part in two ostensibly unrelated studies. In the first study, they were asked to evaluate a magazine cover on a number of characteristics. As in Van Koningsbruggen, Stroebe, and Aarts (2011), half of the participants were presented with the cover of a dieting magazine, while the other half saw the cover of a travel magazine. In the second study, participants indicated how much they expected to eat from four snacks, which were presented in either large or small packs.

4.2.1 Methods

Design

The experiment had a 2 (pack size: large vs. small) X 2 (prime: dieting goal vs. control) X 2 (dietary restraint: high vs. low) between participants design. Participants were randomly assigned to the one of the four experimental conditions, and dietary restraint was assessed as a continuous individual difference variable.

Participants

The sample consisted of members of the general Dutch population between 18 and 55 years old. Participation was restricted to consumers without a food allergy and who were not on a diet that would prohibit them from eating the snack foods in the study. As participants had to estimate their consumption, we expected that the variance in the data would be relatively high, and that effect sizes would thus be relatively low. Hence, we recruited a large sample size to obtain sufficient power. We aimed to recruit around 500 participants, for a power of 0.99 with an effect size of 0.2, and a power of 0.61 with an effect size of 0.1 (Cohen, 1988; Zhang & Yuan, 2015). A total of 556 participants began participating in the study, and 510 completed it. Of these, 19 participants were excluded from analysis because

of poor data quality (completing the survey in less than 5 minutes, while the mean completion time was 15 minutes (*SD* = 11); giving the same answer to at least 21 of the 22 *agree*/*disagree* and *true*/*false* statements). Another 2 participants were excluded because they correctly guessed the purpose of the study as investigating the impact of the magazine cover on expected consumption. Finally, 12 participants misunderstood the expected consumption question and were therefore excluded[6]. This led to a final sample of 477 participants, of which 244 were women. The mean age was 40 years (*SD* = 11).

Procedure

Participants were recruited by panel agency GMI, who also provided them with a small monetary compensation for participation. Fieldwork was conducted in the period March 10 to March 16, 2015. The questionnaire was administered in Dutch. Participants were informed that they would be participating in two separate studies of a Dutch University. After introductory questions about food allergies and age, participants were presented with either the cover of the dieting magazine 'Get in shape' or the cover of the travel magazine 'Time for travel'. After participants answered the questions about the magazine cover, they were directed to the second study. Here, they were presented with snack eating scenarios to assess expected consumption of the four snack foods. For chocolate, participants were presented with a picture of a chocolate bar in its actual size and with the following scenario: 'Imagine that it is afternoon and you feel like eating something tasty. You decide to unwrap the chocolate bar shown below. The total weight of the bar is 180 (75) gram. How many pieces of chocolate do you think you will eat?'. Participants then typed the number of chocolate pieces in an input box to indicate their expected consumption. To clarify what we meant by a piece of chocolate, we displayed a picture of one chocolate piece next to the input box. The scenario for M&M's, chips and cocktail nuts was similar, only in this case, consumption was asked in 'hands' instead of 'pieces'. The screen showed a picture of a hand holding a small amount of the snack, and we asked participants how many of these hands they expected to eat. Table 4.1 gives an overview of the snack foods and pack sizes used in the study. Please refer to Appendix 4.1 for screenshots of the consumption scenarios. The order in which the four foods were presented was randomized. Finally, participants completed a number of additional questionnaires and were debriefed.

[6]Two of these participants indicated in the open-ended answers that they indicated consumption in units (instead of the requested 'hands') and another 10 provided extremely high expected consumption amounts (> 80 hands).

	Size small pack	Size large pack	Measurement unit for expected consumption (DV)
Milk chocolate	75gr	180gr	Pieces
Peanut M&M's	165gr	400gr	Hands
Chips with paprika flavour	120gr	300gr	Hands
Cocktail nuts (peanuts in a crispy coating)	120gr	300gr	Hands

Table 4.1. Pack size and measurement of expected consumption of the four snack foods in Experiment 4.1.

Materials

The health magazine 'Get in shape' featured a photo of the silhouette of a woman jumping into the arms of a man. Both models had a healthy weight. The headlines on the cover referred to weight loss, diets, discipline, and fitness. The travel magazine was a 'city special' which showed images of London and featured headlines related to city trips. The design and colour palette of both magazines was similar (see Appendix 4.2).

For the consumption scenario of the chocolate, we showed a picture of either a 180 gram (30 pieces) or a 75 gram (14 pieces) plain milk chocolate bar of the Dutch brand Verkade. For the cocktail nuts, the large pack was represented by a 300 gram bag of the Dutch brand Duyvis. At the time of the research, the cocktail nuts were not commercially available in a small pack size, hence the image of the large pack was manipulated in Jasc Paint Shop Pro (Version 7, Jasc Software, Inc.) to look like a 120 gram pack. For M&M's, we used the Dutch 'Maxi' bag to represent a large pack (400 gr), and a portion bag available in the US to represent a smaller pack (165 gr). The small and large bag of chips were represented by an image of respectively a 120 gram bag and a 300 gram bag of paprika-flavoured chips of the brand Lays. All packs were shown at their actual size, except for the bags of chips which were shown at approximately 65% to make them fit on the screen. All packs were visibly held by a hand which served as a size reference to judge the actual size of the pack. In case nutrition information was visible on the front of the pack, this was removed.

Other measures

The measures that are included in the subsequent analyses are listed here. For all other measures please refer to Appendix 4.3. All scales are 7-point scales, unless stated otherwise. For two randomly selected snacks we asked participants to explain how they had determined their expected consumption (open-ended question). Next, participants indicated their size impression (*very small* to *very big*, *don't remember*) of each pack of snack food shown in

the expected consumption questions. We then asked how difficult or easy it was for the participants to indicate their expected consumption. To measure participants' general portion size preferences, we asked them to evaluate a 30 gram portion of each snack food (*way too little* to *way too much*). Participants then filled in the dietary restraint subscale of the Three Factor Eating Questionnaire (Stunkard & Messick, 1985; $\alpha = 0.86$). Next, participants indicated if they were currently trying to lose weight (yes, a bit, no) and completed the perceived self-regulatory success scale (Fishbach, Friedman & Kruglanski, 2003; $\alpha = 0.84$). This was followed by statements regarding the tendency to eat the whole pack: 'If I open a package with sweets or salty snacks, I usually eat the whole package, regardless of its size', 'It is easy for me to close a package from which I am eating, so I can save some for later, and 'I almost never eat the whole contents of a package', $\alpha = 0.79$. We then asked some questions about each of the snack foods in the study, including consumption frequency (eat at least once a week; eat at least once a month; eat at least once a year; ate it in the past, but not in the past year; I never eat it) and liking. We assessed current hunger by two questions ('How hungry are you at this moment?'; 'How much could you eat right now?'; $\alpha = 0.87$). Next, participants provided their gender, weight and height. Finally, participants wrote down what they thought the purpose of each of the two studies was, before they were debriefed and could write down general comments.

4.2.2 Data analysis

Statistical methods

We used two-way analysis of variance (ANOVA) and chi-square tests to determine if there were differences between experimental conditions with regard to participant characteristics. To test our hypothesis concerning the effect of diet prime and pack size on expected consumption of restrained eaters, we used a general linear model (GLM) to conduct regression analyses in which pack size and prime were included as factors and dietary restraint as a continuous variable, as well as all interaction terms. To further examine the nature of the interactions with the continuous restraint variable, we used a simple slopes analysis as described by Aiken and West (1991), to compare the effects of pack size and diet prime at a high score on dietary restraint (1 SD above the mean) and a low score on dietary restraint (1 SD below the mean). Furthermore, as we made a specific a-priori prediction regarding the effect of the diet prime on restrained eaters who were provided with a large pack of snack food, we tested this effect directly using the relevant contrast, rather than relying merely on the three-way interaction omnibus test (see Hancock & Klockars, 1996). We tested this contrast within the GLM, and using simple slopes analysis, we compared expected consumption from a large pack in the diet prime and control conditions at a dietary restraint score that lay 1 SD above the mean. Finally, to examine potential effects of other variables such as BMI and self-regulatory success, we included them in the GLM, and in

case of a significant moderating influence, we used simple slopes analyses to further examine their effect on pack size or prime.

Data transformation

Although data of participants who indicated extreme expected consumption amounts were excluded as described above, there were still participants who indicated that they would consume more than the contents of the whole pack. The answers to the open-ended questions suggested that many of these participants assumed that the amount they filled in corresponded to eating the whole pack. It is thus likely that most of these answers were simply wrong estimations of how much is in the pack. We therefore replaced these answers by the contents of the whole pack, which resulted in replacements for respectively 10 and 34 participants in the large and small pack condition. In addition, however, we provide the results without replacements or when excluding these participants, which leads to similar conclusions as our main analyses.

4.2.3 Results

Randomization check

There were no significant differences between the four conditions with regard to gender, BMI, dietary restraint, current dieting behaviour, hunger, liking of the snacks, consumption frequency of the snacks, general portion size preferences and tendency to eat the whole pack (all *p*s > 0.10).

As can been seen in Table 4.2, participants in the control condition had a somewhat higher score on the perceived self-regulatory success scale than those in the diet prime condition, $F(1, 473) = 5.01$, $p = 0.03$, $\eta_p^2 = 0.01$. Since including this variable as a covariate did not change any of the results reported below, we report results without self-regulatory success as a covariate.

	Control condition		Diet prime condition	
	Small pack	Large pack	Small pack	Large pack
% Female	56%	51%	49%	49%
% Currently dieting	57%	50%	52%	57%
BMI	25.37 (5.21)	25.11 (5.48)	25.83 (4.65)	26.12 (5.15)
Dietary restraint	7.81 (4.78)	7.94 (4.96)	7.23 (4.46)	7.15 (5.23)
Self-regulatory success	4.12 (1.49)	4.24 (1.49)	3.87 (1.46)	3.87 (1.51)
Hunger	3.11 (1.47)	3.12 (1.49)	3.29 (1.56)	2.86 (1.48)

Table 4.2. Participants' characteristics across conditions. Standard deviations are provided in parentheses.

Effect of pack size, prime, and dietary restraint

We transformed expected consumption from pieces / hands to grams and averaged consumption across the four snack foods. Average expected consumption was 52.7 grams (*SD* = 43.6). Men expected to consume around 9 grams more than women, $t(475) = 2.29$, $p = 0.02$. Sixteen participants reported that they would not eat anything from any of the snacks. We did not exclude these participants, however, as not expecting to eat anything could be the result of our diet prime.

Our main regression analysis conducted in the general linear model (GLM) showed that both prime and pack size had a main effect on expected consumption, $F(1, 469) = 5.78$, $p = 0.02$, $\eta_p^2 = 0.01$, and $F(1, 469) = 4.68$, $p = 0.03$, $\eta_p^2 = 0.01$, respectively. The interaction of prime and pack size was also significant, $F(1, 469) = 4.42$, $p = 0.04$, $\eta_p^2 = 0.01$, and can be seen in Figure 4.1. To examine this interaction further, we analysed the simple main effects of pack size in the control and diet prime conditions separately. This showed that the pack size effect was significant in the control condition, $F(1, 469) = 9.40$, $p < 0.01$, $\eta_p^2 = 0.02$, but not in the diet prime condition, $F(1, 469) < 0.01$, $p = 0.97$. Thus, the diet prime reduced the pack size effect.

In addition, dietary restraint had a main effect on expected consumption, $F(1, 469) = 20.35$, $p < 0.01$, $\eta_p^2 = 0.04$, such that participants with higher restraint scores expected to eat less of the snacks. However, contrary to our prediction, restraint did not moderate the effect of pack size, prime or their interaction, all *p*s > 0.14.

Finally, we directly contrasted consumption in the diet prime condition with consumption in the control condition separately for restrained eaters and for unrestrained eaters who were presented with a large pack. A simple slopes analysis revealed that expected consumption of restrained eaters (1 SD above the mean) in the large pack condition, was significantly lower in the diet prime condition than in the control condition, $F(1, 469) = 4.25$, $p = 0.04$, $\eta_p^2 = 0.01$. The diet prime was equally effective, however, for unrestrained eaters in the large pack condition, $F(1, 469) = 7.04$, $p = 0.01$, $\eta_p^2 = 0.01$.

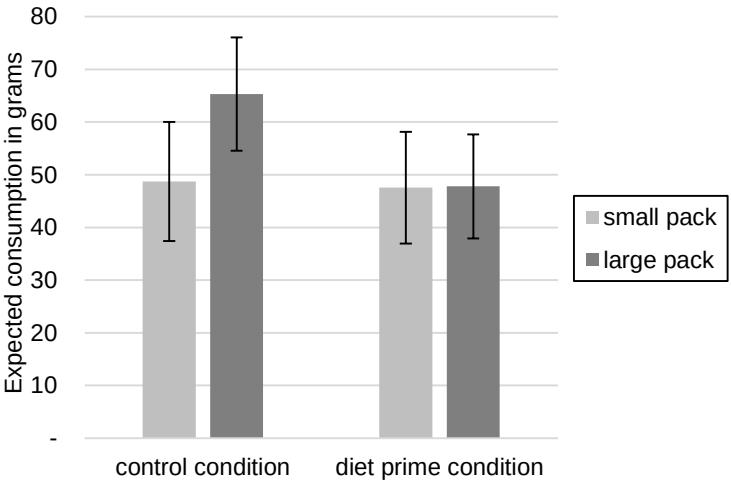

Figure 4.1. Average expected consumption in the control and diet prime conditions when presented with a large or a small pack of snack foods.

Assessing the influence of "whole pack eaters"

As indicated previously, some participants reported that they would eat an amount equal to or greater than the contents of the whole pack. In the preceding analysis we replaced these answers by the maximum amount in the pack. To assess the impact of this transformation, we conducted two additional analyses: using the untransformed data and excluding these participants from analysis.

The GLM with the untransformed data showed a main effect of prime, $F(1, 469) = 5.56$, $p = 0.02$, $\eta_p^2 = 0.01$, no main effect of pack size, $F(1, 469) = 1.01$, $p = 0.32$, $\eta_p^2 < 0.01$, and an interaction of prime and pack size, $F(1, 469) = 4.09$, $p = 0.04$, $\eta_p^2 = 0.01$. Again, the pack size effect was significant in the control condition, $F(1, 469) = 4.74$, $p = 0.03$, $\eta_p^2 = 0.01$, but not in the diet prime condition, $F(1, 469) = 0.50$, $p = 0.48$, $\eta_p^2 < 0.01$.

Repeating the analysis without the 44 participants for which replacements were made, showed a main effect of pack size, $F(1, 425) = 8.23$, $p < 0.01$, $\eta_p^2 = 0.02$, no main effect of prime, $F(1, 425) = 1.06$, $p = 0.30$, and a marginally significant interaction, $F(1, 425) = 2.71$, $p = 0.10$, $\eta_p^2 = 0.01$. Again, the pack size effect was significant in the control condition, $F(1, 425) = 10.16$, $p < 0.01$, $\eta_p^2 = 0.02$, but not in the diet prime condition, $F(1, 425) = 0.73$, $p = 0.39$.

In sum, using either the untransformed data or removing "extreme" responses did not lead to different conclusions than our main analysis. In all three analyses, the diet prime reduced the pack size effect.

Additional analyses

Additional regression analyses showed that hunger, liking of the snack foods, BMI and gender did not moderate the effect of either pack size or prime on expected consumption, all *p*s > 0.09. Perceived self-regulatory success showed a significant interaction with pack size, $F(1, 466) = 4.83$, $p = 0.03$, $\eta_p^2 = 0.01$, such that the pack size effect was only significant at low perceived self-regulatory success, $F(1, 466) = 9.85$, $p < 0.01$, $\eta_p^2 = 0.02$, and not at high success, $F(1, 466) < 0.01$, $p = 0.99$.

4.2.4 Discussion

This experiment confirmed that a diet prime can diminish the pack size effect. This suggests that a diet prime motivates consumers to keep their consumption under control, and as a result they rely less on the pack size to determine the appropriate consumption amount. Contrary to our hypothesis, however, the effect of the diet prime was not moderated by dietary restraint. A possible explanation is that the diet prime not only activated a health goal, but also communicated the social norm of keeping consumption under control. To not come across as excessive eaters, both restrained and unrestrained eaters might have limited their consumption after having been exposed to the magazine cover displaying social reminders of a healthy lifestyle (Herman, Roth & Polivy, 2003; Herman & Polivy, 2014).

Although this experiment provided some initial support for diet primes as effective ways to reduce the pack size effect, there are also some important limitations. First, we only measured expected consumption, such that participants made a single decision about how much they would eat in a hypothetical situation. In addition, no actual food was present, and participants did not have to monitor their consumption while actually eating and enjoying the food. Both of these factors might have made it relatively easy for participants to regulate their expected consumption. To determine if diet primes also reduce the pack size effect when participants actually eat from a tempting snack, Experiment 4.2 was designed to replicate the design of Experiment 4.1, while including actual snack consumption as our dependent variable. This also allowed us to examine whether the effect of a diet prime would be moderated by participants' restrained status when in an actual eating situation, as we

initially hypothesized. Finally, although the findings of Experiment 4.1 were promising, effect sizes were rather small. This might be due to the large variance in the hypothetical consumption amounts that participants provided, and might also be different in an actual eating situation.

4.3 Experiment 4.2

In Experiment 4.2, we investigated the effect of pack size and diet prime on consumption of M&M's in a laboratory setting. Participants could freely eat from either a large or small bag of M&M's while watching movie clips and commercials. Exposure to the diet prime was manipulated via these commercials, which were either about diet-related products or about products unrelated to dieting or food.

4.3.1 Methods

Design

The design was the same as in Experiment 4.1.

Participants

Dutch university students between 18 and 26 years participated for course credit or a small monetary compensation. We expected that the variance in the data would be less than in Experiment 4.1, as we now measured actual consumption instead of expected consumption. Based on an expected effect size of 0.2, we aimed to recruit at least 200 participants to obtain 0.80 power (Cohen, 1988; Zhang & Yuan, 2015). When signing up for the study, participants were informed that they would be asked to watch and evaluate movie clips. The provision of a snack was not mentioned in the study description. We excluded participants with food-related allergies or diseases from analyses (N = 15). We furthermore excluded participants who guessed that our study purpose was to assess the effect of the movie clips / commercials on the amount of M&M's consumed (N = 19). The final sample consisted of 224 participants (92 women). Their mean age was 21 years (*SD* = 1.6). The experiment was approved by the ERIM Internal Review Board of Erasmus University.

Procedure

The data were collected in the period May 27 to June 4, 2015. Upon arrival in the lab, participants were brought to individual cubicles by the experimenter and received an instruction sheet. Participants were informed that they were about to watch a number of different movie clips and that some snacks would be available which they could eat freely while watching. An open package of M&M's, water and a napkin were present on the desk in each cubicle. All other materials and questions were presented on the computer. The participants first answered a question about the instructions to make sure participants had read them. After completing some mood ratings, which also unobtrusively included

questions assessing current hunger and satiety, participants started with the first of three blocks of clips. Each block consisted of two commercials and a movie clip. After each block, participants were asked to recall both the movie and the products advertised in the commercials. They also rated the movie clip on different aspects. When participants finished the rating of the third movie clip, they were instructed to call the experimenter, who removed the pack of M&M's and started the second part of the questionnaire, which contained eating and diet-related questions. Debriefing information was provided via an e-mail which was sent the day after the last day of the experiment. Before and after each session, the M&M packages were weighed to determine how much each participant had consumed.

Materials

The diet commercials were chosen to prime a dieting goal without inducing negative body-related affect in restrained eaters. The diet commercials were about Dannon Light & Fit yoghurt, Weight Watchers, Nike Basketball, and Special K breakfast cereals. The message of each commercial was focussed on resisting tempting foods, starting with dieting, setting and reaching your goals, and a weight loss plan. The non-diet-related commercials were for Ikea garden furniture, Intel, Philips Ambilight, Jeep Renegade, Amazon Kindle, and FedEx. In these commercials and in the movie clips, no references were made to dieting, food, or exercise. In the diet prime condition, blocks 1 and 3 showed one 30 second commercial about a diet-related product and one 30 second commercial unrelated to dieting, so that participants would be less likely to guess the purpose of the study. In block 2, we showed a dieting commercial of 30 seconds and a motivational exercise commercial of 90 seconds. The exercise commercial was included to appeal to males, as commercials for dieting products are almost exclusively aimed at females. To make the viewing experience realistic, we chose the length of the commercials such that the commercial block would not last longer than the movie clip. In the diet prime condition, participants were thus exposed to four diet-related commercials which took up 2 minutes and 30 seconds of the total viewing time of 16 minutes.

Participants received peanut M&M's in either a 'Maxi' 400 gram bag or a 200 gram bag. The opening of the bag was cut to about 6 cm, large enough for the M&M's to pour out easily, but small enough to prevent participants from reaching into the bag with their hand. Water was provided in a 0.5L jug.

Other measures

The measures that were included in the subsequent analyses are listed here. For all other measures please refer to Appendix 4.4. Before watching the clips, feelings of hunger and satiation were assessed together with a number of other feelings, including happy, sad, relaxed, irritated, enthusiastic and thirsty. These questions were framed as 'to what extent do you feel…' (1 = *not at all* to 7 = *very much*), and they were repeated at the end of the experiment, before the demographic questions. Just before the researcher removed the bag

of M&M's, participants were asked what they thought the purpose of the first part of the study was. Liking, consumption frequency of M&M's, and general portion size preference were assessed with the same questions as in Experiment 4.1. The measures for dietary restraint ($\alpha = 0.88$), current dieting behaviour, perceived self-regulatory success ($\alpha = 0.67$), and tendency to eat the whole pack ($\alpha = 0.79$) were also the same as in Experiment 4.1. Finally, participants indicated their gender, height and weight.

4.3.2 Data analysis

The same analysis procedures were used as in Experiment 4.1.

4.3.3 Results

Randomization check

There were no significant differences between the four experimental conditions with regard to perceived self-regulatory success, dietary restraint, gender, BMI, current dieting behaviour, hunger, satiation, liking of the M&M's, consumption frequency of the M&M's, and general portion size preference (all *ps* > 0.05, see Table 4.3).

	Control condition		Diet prime condition	
	Small pack	Large pack	Small pack	Large pack
% Female	48%	43%	34%	36%
% Currently dieting	33%	13%	28%	27%
BMI	22.24 (2.28)	21.65 (2.2)	21.86 (2.14)	22.76 (2.8)
Dietary restraint	8.14 (5.33)	6.89 (4.26)	7.43 (4.80)	7.04 (5.26)
Self-regulatory success	4.27 (1.30)	4.40 (1.23)	4.47 (1.14)	4.45 (1.19)
Hunger (before eating)	3.55 (1.75)	3.79 (1.57)	3.77 (1.58)	3.71 (1.85)
Satiation (before eating)	3.79 (1.41)	3.43 (1.29)	3.55 (1.28)	3.60 (1.44)

Table 4.3. Participants' characteristics across conditions. Standard deviations are provided in parentheses.

Effect of pack size, prime, and dietary restraint

Average consumption was $M = 41.9$ ($SD = 39.0$) grams of M&M's which translates into 214 kcal. Men and women consumed similar amounts, $t(222) = 1.53$, $p = 0.13$. Fifty-nine

participants ate nothing from the M&M's.[7] We did not exclude these participants from analyses as the study instructions did not require participants to eat something. Furthermore, not eating could also be the result of our diet prime.[8]

Results showed that, contrary to our hypothesis, there was no main effect of pack size, $F(1, 216) = 0.69$, $p = 0.41$. The main effect of prime, however, was marginally significant, $F(1, 216) = 3.72$, $p = 0.06$, $\eta_p^2 = 0.02$, such that participants who were exposed to diet commercials ($M = 36.9$, $SD = 33.3$) consumed somewhat less than control participants ($M = 46.0$, SD = 42.9). Again in contrast to Experiment 4.1, the interaction of prime and pack size was not significant, $F(1, 216) = 1.62$, $p = 0.20$. Restraint did not significantly moderate the effect of pack size, prime or their interaction, all ps > 0.12, and also did not have a main effect on consumption, $F(1, 216) = 0.30$, $p = 0.59$.

Based on our a-priori prediction, we then directly contrasted consumption in the diet prime condition with consumption in the control condition separately for restrained eaters and for unrestrained eaters who were provided with a large pack. As predicted, consumption of restrained eaters (1 SD above the mean) in the large pack condition, was significantly lower in the diet prime condition ($M = 24.98$, $SE = 7.54$) than in the control condition ($M = 55.47$, $SE = 8.56$), $F(1, 216) = 7.15$, $p < 0.01$, $\eta_p^2 = 0.03$. Restrained eaters thus ate about 156 calories less when reminded of their dieting goal. Also as predicted, unrestrained eaters (1 SD below the mean) eating from large packs were not affected by the prime, $F(1, 216) = 0.09$, $p = 0.76$. Similarly, restrained and unrestrained eaters eating from small packs were not affected by the diet prime, all ps > 0.50. In other words, restrained eaters significantly reduced their consumption from large packs when primed with a dieting goal and therefore displayed a smaller pack size effect, as we had hypothesized, while unrestrained eaters were not influenced by the prime. These findings are displayed in Figure 4.2.

[7]The relatively large percentage of participants who ate nothing led to a skewness in the data. However, inspection of the residuals did not reveal any major problems, and we continued our analysis with the GLM.

[8]Comparison of the percentage of participants who ate nothing across the conditions revealed that this percentage was indeed much higher in the diet prime – restrained eaters – large pack condition (52%) than in any of the other conditions (24%), $x^2(1, N=224) = 8.10$, $p < 0.01$. Not eating thus might have been a strategy that restrained eaters used to keep consumption from large packs under control.

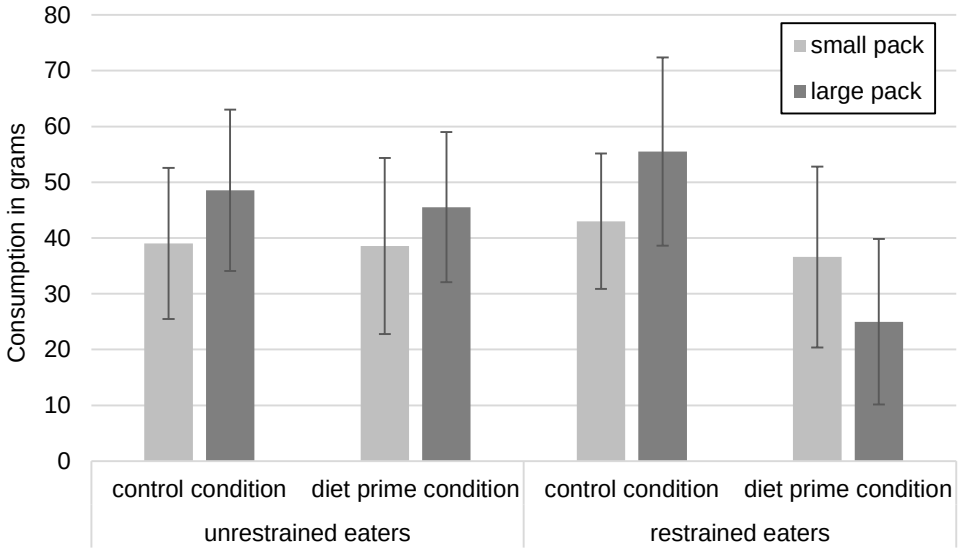

Figure 4.2. Snack consumption of restrained eaters (1 *SD* above the mean, see Aiken & West, 1991) and unrestrained eaters (1 *SD* below the mean) in the control and diet prime conditions when eating from a large or a small pack of M&M's.

Potential effects of time of day

In line with Boland, Connell and Vallen (2013), we explored the effect of time of day of the experiment (9 am to 12 pm vs. 12 pm to 5 pm) as an additional factor. Time of day had a main effect on consumption, $F(1, 213) = 15.16$, $p < 0.01$, $\eta_p^2 = 0.07$. It did not interact with prime, $F(1, 213) = 0.04$, $p = 0.84$, but interacted with pack size, $F(1, 213) = 4.98$, $p = 0.03$, $\eta_p^2 = 0.02$. Simple main effects showed that there was no pack size effect in the morning, $F(1, 213) = 2.03$, $p = 0.16$, $\eta_p^2 = 0.01$, with consumption from the small and large pack respectively being $M = 34.03$ ($SE = 5.62$), and $M = 22.08$ ($SE = 6.22$), while there was a marginally significant pack size effect in the afternoon, $F(1, 213) = 3.28$, $p = 0.07$, $\eta_p^2 = 0.02$, with consumption from the small and large pack respectively being $M = 42.75$ ($SE = 4.62$), and $M = 54.2$ ($SE = 4.33$). We therefore ran an additional analysis testing our main hypothesis only among afternoon participants, which showed that prime and pack size both had a marginally significant main effect, $F(1, 135) = 2.77$, $p < 0.10$, $\eta_p^2 = 0.02$, and $F(1, 135) = 3.12$, $p = 0.08$, $\eta_p^2 = 0.02$, respectively. The interaction of prime and dietary restraint reached marginal significance, $F(1, 135) = 3.32$, $p = 0.07$, $\eta_p^2 = 0.02$, and so did the three-way interaction of dietary restraint, prime and pack size, $F(1, 135) = 2.72$, $p = 0.10$, $\eta_p^2 =$

0.02, such that restrained eaters presented with a large pack ate significantly less in the diet prime condition than in the control condition, $F(1, 135) = 8.82$, $p < 0.01$, $\eta_p^2 = 0.06$. Unrestrained eaters and restrained eaters presented with a small pack were not affected by the prime, all *p*s > 0.72.

Additional analyses

Additional regression analyses showed that perceived self-regulatory success in dieting, hunger, satiation, BMI, liking of the M&M's, consumption frequency of the M&M's, and gender did not moderate the effect of the pack size and diet prime, all *p*s > 0.05.

4.3.4 Discussion

This experiment was designed to replicate Experiment 4.1 in an actual consumption setting. Although the conventional omnibus test only revealed a marginally significant main effect of the diet prime, with consumption being lower in the diet prime condition than in the control condition, specific contrasts revealed the expected effects of the diet prime on restrained eaters. As hypothesized, the diet prime reduced restrained eaters' consumption from large packs, and as a result diminished the pack size effect. Also in line with our expectations, but contrary to Experiment 4.2, the diet prime was not effective for unrestrained eaters. We should note that many participants did not eat any M&M's, and while this could be the result of their dieting goal, it led to a high number of zero's in the data, so that these findings should be interpreted with caution. While this is a drawback of the procedure used, we did not want to focus participants' attention on the fact that we were interested in their eating behaviour by requiring them to eat some of the tempting snack, in order to reduce demand and observer effects.

4.4 General Discussion

We conducted two experiments that tested whether exposure to a diet prime influences consumption quantity decisions of restrained eaters and diminishes the pack size effect. As hypothesized, the diet prime reduced restrained eaters' expected and actual consumption from large packs. In line with other goal priming studies in the domain of eating behaviour, these findings suggest that activating the goal of dieting can help dieters control their intake even in the presence of large quantities of tempting snacks. Thus, goal primes may offer a promising strategy to curb the pack-size effect among diet-concerned individuals.

Two unexpected findings warrant further discussion. In Experiment 4.1, unrestrained eaters unexpectedly reported to eat less when they had been primed with the dieting goal. It is possible that in addition to a reminder of one's goal of dieting, the prime we used also communicated the social norm of moderating one's consumption, and thus affected unrestrained eaters, but only when self-reports of expected consumption were assessed.

Furthermore, Experiment 4.2 did not show a significant pack size effect, which is in contrast with numerous previous studies showing this effect for both meals and for snacks (see Zlatevska et al., 2014; Marchiori et al., 2015, for meta-analyses). Possibly, this difference is due to our experimental procedure, which differed in important ways from many other studies. First of all, participants did not eat directly from an open container but had to pour the M&M's from the bag. This action required participants to take their eyes off the screen and focus on the M&M's, which might have made eating less automatic and more deliberative (Cheema & Soman, 2008; Geier, Wansink & Rozin, 2012; Painter, Wansink, & Hieggelke, 2002), and thus decreased the pack size effect. We also found that time of day moderated the pack size effect, with the effect being stronger in the afternoon than in the morning. Possibly, self-regulatory resources are depleted in the afternoon, and a chocolate snack seems more desirable in the afternoon (see Papies, 2013), which makes it more difficult to resist the temptations of a large pack of M&M's (Boland et al., 2013). Thus, the fact that Experiment 4.2 was conducted in both morning and afternoon sessions could explain why the overall pack size effect was relatively weak.

4.4.1 Limitations and future research

Effect sizes in our experiments were small, making replication of these results important. We conducted our experiments in settings that encouraged natural eating decisions, which allowed for considerable variance in consumption data due to factors such as hunger, time of day, and liking of the foods[9]. This may have made it relatively hard to detect the effects of pack size and prime. At the same time, these are the conditions under which intervention tools to curb the portion size effect will have to be effective outside the laboratory. It is therefore informative that systematic effects of diet primes were still found as predicted among those who value the goal of dieting. Future research could use a within-participants design to more accurately assess on an individual level how interventions such as exposure to a diet prime impact the pack size effect. However, preventing demand effects in such a set-up will be challenging as it will be much easier for participants to guess the purpose of the study. To reduce variance in consumption data in a between-participants design, it should be considered to require that participants refrain from eating for a specific period before the study or to possibly provide participants with a fixed meal a few hours before the experiment (Blundell et al., 2010).

The difference in outcome between Experiment 4.1 and Experiment 4.2 suggests that the two experimental methods measure different aspects of consumption. In Experiment 4.1 participants reported what they would do in their natural, at-home situation, while in Experiment 4.2 participants had the hedonic experience of actually eating the food. Ideally,

[9]In Experiment 4.2, both hunger and liking had a substantial effect on the amount consumed, $F(1, 213) = 31.59$, $p < 0.01$, $\eta_p^2 = 0.13$, and $F(1, 213) = 28.28$, $p < 0.01$, $\eta_p^2 = 0.12$, respectively.

future research would combine these two methods by measuring actual consumption in a more naturalistic eating environment.

The results of the current experiments are in contrast to some studies that did not find an effect of a diet prime on consumption (Peláez-Fernández & Extremera, 2011) or even found that a diet prime increased instead of decreased consumption among restrained eaters (Seddon & Berry, 1996; Strauss, Doyle, & Kreipe, 1994; Warren, Strauss, Taska, & Sullivan, 2005). What these studies have in common is that they all exposed participants to images of thin, beautiful women, rather than other, direct reminders of dieting. Such images can lead to negative body-related affect in restrained eaters (Groesz, Levine, & Murnen, 2002), which can trigger overeating. Furthermore, length and frequency of exposure and the degree to which attention is drawn to the diet primes, could also impact their effectiveness. In Peláez-Fernández & Extremera (2011), for example, participants were not asked to read or look at the magazine that was used as the diet prime, whereas in the current studies, the primes were explicitly integrated into the experimental procedures. Future research could focus on identifying how different types of diet primes and the ways of exposing participants to them impact eating.

The scale used to identify restrained eaters could also influence whether effects of primes on restrained eaters' consumption are found.[10] In studies where pictures of attractive models were used as diet primes, consumption among restrained eaters increased in response to the diet primes when restraint was measured using the Revised Restrained Scale (RS; Herman & Polivy, 1980) (Warren et al., 2005, Seddon & Berry, 1996; Strauss et al., 1994), but decreased when restraint was measured using the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986) (Anschutz et al., 2008). It has been argued that the RS tends to mainly measure behaviours and consequences related to unsuccessful dieting (Stice, Ozer, & Kees, 1997), while other scales such as the DEBQ and the Three Factor Eating Questionnaire (Stunkard & Messick, 1985) measure successful dieting behaviour (Laessle, Tuschl, Kotthaus, & Pirke, 1989; Lowe, 1993). Diet primes with images of thin models might induce less negative affect in successful dieters than in unsuccessful dieters, and hence reduce consumption when dietary restraint is measured using the DEBQ or TFEQ, but increase consumption when the RS is used to measure restraint. More research is needed to determine how different ways of measuring dietary restraint can influence study results.

4.4.2 Conclusion

The present research presents initial evidence that diet primes can reduce the pack size effect for restrained eaters. The diet prime is likely to activate the dieting goal (Papies, 2012) and in this way, it will motivate restrained eaters, who value this goal, to keep their

[10]We thank an anonymous reviewer for providing this suggestion.

consumption under control. These findings suggest that the pack size effect is not an inevitable consequence of the current eating environment which can only be prevented by structurally changing this environment (Cohen & Farley, 2008; Wansink, 2010). Instead, we show that if consumers are sufficiently motivated to limit their consumption and are reminded of this motivation at the right time, the pack size effect can be weakened.

Chapter 5

Preventing the pack size effect: Exploring the effectiveness of pictorial and non-pictorial serving size recommendations[11]

This chapter is based on work conducted together with Esther Papies and David Marchiori, and has been published in Appetite.

In this chapter we hypothesized that providing a serving size recommendation would reduce the influence of the pack size on consumption and would thus diminish the pack size effect. Moreover, we hypothesized that a pictorial serving size recommendation, displaying food amounts visually, would be more effective than a non-pictorial recommendation that communicates the recommended amount in grams only. We tested these hypotheses in two online experiments (N = 317 and N = 324) and in one lab experiment (N = 89). In the online experiments, participants were shown a small or a large pack of unhealthy snacks, with or without a serving size recommendation. The main outcome measure was expected consumption. Replicating the pack size effect in an online setting, we found that participants expected to consume more food from large than from small packs. Furthermore, the pack size effect was considerably stronger for men than for women. Importantly, when including portion size preferences as a covariate, the pictorial serving size recommendation significantly reduced expected consumption, especially when placed on a large pack, as hypothesized. The non-pictorial serving size recommendation had no effect. In the lab experiment, students received a large bag of M&M's which did or did not contain the pictorial serving size recommendation. We again included general portion size preferences as a covariate. The serving size recommendation significantly lowered the amount of M&M's that participants served themselves, but only when participants reported to have noticed the serving size recommendation. We conclude that providing a pictorial serving size recommendation can be an effective intervention strategy to reduce the pack size effect, if it attracts sufficient attention.

[11] This chapter is an abbreviated version of: Versluis, I., Papies. E.K., Marchiori, D. (2015). Preventing the pack size effect: Exploring the effectiveness of pictorial and non-pictorial serving size recommendations, *Appetite, 87*, 116-126.

5.1 Introduction

In this chapter we test if providing consumers with a serving size recommendation can prevent the pack size effect. As discussed in Chapter 2, people are uncertain about how much they should eat, and as a result, rely on external reference points, such as the portion or pack size, to determine how much they should eat (Herman & Polivy, 2005, 2008; Rolls, Morris, & Roe, 2002; Wansink & van Ittersum, 2007). More specifically, Marchiori, Papies and Klein (2014) suggested that portion and pack sizes are used as anchor quantities, such that consumers take the size of the portion or pack as a reference amount. Although they may then adjust their consumption somewhat from this reference amount, this adjustment is typically insufficient (Epley & Gilovich, 2001; Tversky & Kahneman, 1974), so that the larger the pack becomes, the larger the consumption amount will be. To prevent this reliance on the pack size, we propose to provide consumers with a more suitable quantity on which they can base their consumption. We suggest providing consumers with a serving size recommendation that clearly visualizes how much they are advised to eat. We reason that if this serving size recommendation is available, consumers may use this as a reference amount to base their consumption on, and rely less on the size of the pack. As a result the pack size effect will be smaller, or even absent. We thus predict that a serving size recommendation that is smaller than the pack will reduce consumption, and that it will be particularly effective on large packs, as these typically lead to high consumption.

We furthermore suggest that a serving size recommendation will most likely be used in the consumption decision if it is presented with a picture. Earlier research has suggested that people typically represent the portions they eat visually (Wilkinson et al., 2012) or in easily countable units (Geier, Rozin, & Doros, 2006; Marchiori, Waroquier, & Klein, 2011). Similarly, people often have difficulty understanding serving size recommendations in grams (Faulkner et al., 2012). In other words, a serving size recommendation might be most effective if it is presented in the way in which food portions are typically and easily processed, which is why a pictorial serving size recommendation might be more effective than numerical information.

5.1.1 The current research

We investigated to what extent a serving size recommendation on a snack package can diminish the pack size effect. We conducted two experiments in an online setting and one experiment in a lab setting.

In the online experiments participants indicated how much of a snack food they would consume. Snack foods were presented either in large or small packs, and the packs did or did not include a serving size recommendation. In Experiment 5.1, we varied the pack size of a chocolate bar (either small or large) and the presence or absence of a pictorial serving size recommendation. In Experiment 5.2, we extended this design to include other snack

foods (i.e., M&M's, salty crackers, cocktail nuts). We furthermore compared the effectiveness of the pictorial serving size recommendation to a non-pictorial serving size recommendation that only presented the recommended amount in grams.

Finally, in Experiment 5.3, students served themselves from a large bag of M&M's that either did or did not contain the serving size recommendation, and we measured both the amount served and the amount consumed.

5.2 Experiment 5.1

5.2.1 Methods

Design

The experiment had a 2 (pack size: large vs. small) X 2 (pictorial serving size recommendation: present vs. absent) between-participants design, and participants were randomly assigned to conditions.

Participants

The sample consisted of members of the general Dutch population between 18 and 65 years old. Participants who indicated that they never eat milk chocolate or indicated that they would eat zero pieces of the presented chocolate bar, were told that they did not belong to the target group of the study and hence could not continue. This led to an initial sample of 362 participants. We removed 27 participants because they did not finish the survey and another 17 because of poor data quality. Data quality was defined to be poor when participants answered the survey in less than 4 minutes (the average time needed to fill in the questionnaire was 12 minutes (SD = 8)), or when they gave the same answer to at least 21 of the 22 *agree*/*disagree* and *true*/*false* statements. Finally, 1 participant was removed because she indicated to strongly dislike both milk chocolate and the brand of chocolate used in this study. This led to a final sample of 317 participants, of which 159 were female. Their mean age was 44 (SD = 12) years.

Procedure

Participants were recruited by panel agency GMI, who also provided them with a small monetary compensation for participation. Fieldwork was conducted in the period August 5 to August 7, 2013. During recruitment, the study was announced as a consumer market research study. The questionnaire was administered in Dutch. After some introductory questions about age, gender and consumption frequency of milk chocolate, participants were presented with the chocolate eating scenario that we used for our experimental manipulation and to assess expected consumption. Participants were presented with the picture of the chocolate bar and the following scenario: "Imagine that it is afternoon and you feel like eating something tasty. You decide to unwrap the chocolate bar shown below. The total weight of the bar is 75 gr (180 gr). How many pieces of chocolate do you think you will

eat?". Participants then typed the number of chocolate pieces in an input box to indicate their expected consumption. To clarify what we meant by a piece of chocolate, we displayed a picture of one chocolate piece next to the input box (see Appendix 5.1 for a screenshot). Participants then completed a number of additional questionnaires. Finally, participants were debriefed by means of a short text, and had the opportunity to write down any comments they might have.

Materials

In the critical scenario, we presented participants with a picture of the chocolate bar. The screen showed either a small (75gr, 14 pieces) or a large (180gr, 30 pieces) plain milk chocolate bar of the Dutch brand Verkade. The bars were shown in their actual size, and a standard pen was shown below the package as a size reference. In the serving size recommendation condition, the serving size recommendation sticker was shown on the front of the pack. It included a picture of four pieces of chocolate and the text: "recommended serving: 4 pieces". The sticker had a white background and a pink border that matched the package. We chose the serving size to be somewhat lower than the average amount of chocolate consumed per consumption occasion in The Netherlands (Dutch National Food Consumption Survey 2007 – 2010). The recommended serving size of four pieces equals about 23 grams. See Appendix 5.1 for an overview of the pictures used.

Other measures

The measures that are included in the subsequent analyses are listed here. For all other measures please refer to Appendix 5.2. We asked participants in the serving size recommendation condition if they remembered the amount stated on the recommended serving and if yes, if they could specify how much it was (in number of pieces). We asked participants in the control condition what size they would suggest as an appropriate recommended serving size. Next, all participants were asked to evaluate the size of the recommended serving of 4 pieces (1 = *way too little* to 7 = *way too much*). Then, they completed the dietary restraint subscale of the Three Factor Eating Questionnaire (Stunkard & Messick, 1985; $\alpha = 0.86$). We also asked if participants were currently trying to lose weight (*yes* or *no*). We then included three items to assess perceived self-regulatory success (Fishbach, Friedman, & Kruglanski, 2003; $\alpha = 0.81$). We measured the tendency to eat the whole package on a 7-point scale (1 = *strongly agree* to 7 = *strongly disagree*) using the following statements: "When I open a package with candy or salty snacks, I usually empty the whole package, regardless of its size"; "It is easy for me to close a package from which I have been eating, so I can save some food for a later time (recoded)"; "I almost never eat the whole contents of a package (recoded)" ($\alpha = 0.73$). Next, we assessed frequency of snacking in the afternoon (*0-7* days a week). Then, the frequency of consuming milk chocolate was measured (*multiple times a day; once a day; multiple times a week; once a week; 1-3 times per month; once a month; less than once a month; never)*. We then assessed

liking of Verkade chocolate (the brand used here) and of milk chocolate in general (1 = *do not like it at all* to 7 = *like it very much*). We assessed current hunger by two statements ("How hungry are you at this moment"; "How much could you eat right now"; $\alpha = 0.81$) using a 7-point scale (1 = *not hungry at all* to 7 = *very hungry*; 1 = *nothing at all* to 7 = *a lot*). Finally, participants provided their weight and height. The other demographic questions included education, household income and living situation.

There were no significant differences across the four experimental conditions with regard to gender, age, BMI, living situation, education and household income (all *p*s > 0.4). Participants in the four conditions also did not differ with respect to hunger, dietary restraint, consumption frequency of milk chocolate, liking of milk chocolate or Verkade chocolate, current dieting behaviour, perceived self-regulatory success, tendency to eat the whole pack and frequency of snacking in the afternoon (all *p*s > 0.05). The evaluation of the size of the recommended serving differed between conditions, as indicated by a main effect of the presence of the serving size recommendation, $F(1, 313) = 4.04$, $p = 0.05$, $\eta_p^2 = 0.01$, and an interaction between the pack size and serving size recommendation, $F(1, 313) = 4.22$, $p = 0.04$, $\eta_p^2 = 0.01$. Simple main effects showed that in the condition without the serving size recommendation, the size of the recommended serving was evaluated as significantly more appropriate in the small pack condition ($M = 3.92$, $SD = 1.09$) than in the large pack condition ($M = 3.46$, $SD = 1.31$), $F(1, 313) = 5.43$, $p = 0.02$, $\eta_p^2 = 0.02$. In the condition with the serving size recommendation, the evaluation of the size of the recommended serving was similar in both pack size conditions. In other words, participants in the no serving size recommendation condition were more positive about the appropriateness of the size when they had just seen a small pack than when they had just seen a large pack. The evaluation of the recommended serving size was included as a covariate in one of the analyses reported below.

5.2.2 Results

Expected chocolate consumption

The number of chocolate pieces that participants expected to consume varied between 1 and 30 for the small bar ($M = 7.24$, $SD = 4.39$) and between 1 and 36 for the large bar ($M = 9.30$, $SD = 7.23$). We transformed expected consumption from pieces to grams.

A 2x2 ANOVA with pack size and the presence of the serving size recommendation as factors revealed a main effect of pack size, $F(1, 313) = 9.27$, $p < 0.01$, $\eta_p^2 = 0.03$ such that mean expected consumption in grams from the small bar ($M = 39.86$, $SD = 24.17$) was significantly lower than mean expected consumption from the large bar ($M = 51.16$, $SD = 39.78$). This indicates that the predicted pack size effect occurred.

The main effect of the serving size recommendation approached significance, $F(1, 313) = 2.60$, $p = 0.11$, $\eta_p^2 = 0.01$ with mean consumption somewhat lower when a serving size recommendation was shown ($M = 42.49$, $SD = 31.48$) compared to when no serving size

recommendation was shown (M = 48.62, SD = 35.00). Contrary to our hypothesis, the interaction between pack size and serving size recommendation was not significant, $F(1, 313) = 0.73$, $p = 0.39$.

We then explored the potential role of pre-existing portion size preferences by including the evaluation of the recommended serving size as a covariate. The ANCOVA showed that this variable indeed had a strong effect on expected consumption, $F(1, 312) = 79.86$, $p < 0.01$, $\eta_p^2 = 0.20$. Participants who felt that the recommended serving size was too small indicated that they would eat much more chocolate than those who felt that the recommended serving size was too large. Including this covariate thus controlled for participants' general notions of what an appropriate portion size of chocolate is. When controlling for the evaluation of the size of the recommended serving, both the main effect of pack size, $F(1, 312) = 7.64$, $p = 0.01$, $\eta_p^2 = 0.02$ and the main effect of the serving size recommendation were highly significant, $F(1, 312) = 7.84$, $p = 0.01$, $\eta_p^2 = 0.02$. Expected consumption was significantly lower in the serving size recommendation condition than in the control condition. Again, the interaction between pack size and serving size recommendation was not significant, $F(1,312) = 0.01$, $p = 0.94$. Figure 5.1 illustrates the effectiveness of the serving size recommendation across the different conditions.

The effect of the serving size recommendation was not moderated by hunger, liking of the chocolate, dietary restraint, perceived self-regulatory success, tendency to eat the whole pack, BMI, and gender (all ps > 0.14), which we tested in a series of regression analyses in the General Linear Model.

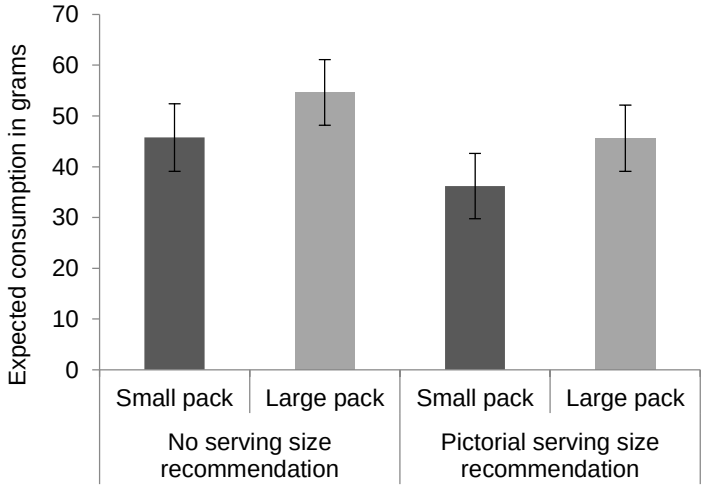

Figure 5.1. Mean expected chocolate consumption in grams, when controlling for the evaluation of the size of the recommended serving

Moderating role of gender on the pack size effect

We additionally explored if in this study, as in previous studies, women showed a smaller pack size effect than men (Rolls, Roe, Kral, et al., 2004; Rolls, Roe & Meengs, 2006a; Rolls, Roe, Meengs, et al., 2004). An ANCOVA with pack size, serving size recommendation and gender as factors, and evaluation of the size of the recommended serving as covariate, showed that gender had a significant main effect on consumption, $F(1, 310) = 14.35$, $p < 0.01$, $\eta_p^2 = 0.04$, such that men ($M = 53.19$, $SD = 39.28$) consumed more than women ($M = 37.91$, $SD = 23.99$). In line with earlier findings, gender also interacted significantly with pack size, $F(1, 310) = 7.22$, $p = 0.01$, $\eta_p^2 = 0.02$, such that the pack size effect was only significant for men, $F(1, 310) = 15.54$, $p < 0.01$, $\eta_p^2 = 0.05$, and not for women, $F(1, 310) = 0.03$, $p = 0.87$.

Remembering the magnitude of the recommended serving

We assessed whether participants recalled the exact amount stated on the serving size recommendation. Of the participants in the serving size recommendation condition, the majority (81%) remembered the correct amount. We furthermore examined if participants felt that the size of the recommended serving of 4 chocolate pieces was appropriate. On a 7-point scale ranging from *way too little* to *way too much*, the recommended serving size scored $M = 3.55$ ($SD = 1.25$), suggesting that participants found it appropriate.

5.2.3 Discussion

This experiment provided a first test of the effect of a pictorial serving size recommendation on expected chocolate consumption, in an online setting. Our results showed a clear pack size effect, with participants expecting to consume about 10 grams (56 kcal) more from the large chocolate bar than from the small chocolate bar. In line with previous findings, we also found that the pack size effect only occurred for men, and was actually negligible for women (Rolls et al., 2006a; Rolls, Roe, Kral, et al., 2004; Rolls, Roe, Meengs, et al., 2004). These findings suggest that an online setting, using expected consumption scenarios rather than measuring actual consumption, can be used to study the psychological mechanisms leading to the pack size effect.

We further found that when controlling for the evaluation of the size of the recommended serving, the pictorial serving size recommendation significantly lowered expected consumption, by approximately 9 grams of chocolate (50 kcal). Contrary to our hypothesis, however, the serving size recommendation decreased expected consumption equally for the small and for the large pack. Thus, although the serving size recommendation had beneficial effects, it did not prevent the pack size effect.

In Experiment 5.2, we attempted to replicate and extend our findings to other snacks, including non-countable snack foods. Including several snacks might increase the power of our experiment and thus provide a stronger test of the effectiveness of the serving size

recommendation. In addition, Experiment 5.2 was designed to also test the effectiveness of a non-pictorial serving size recommendation, which merely communicates the recommended amount in grams and without a picture. Consumers need to be able to incorporate the serving size information in their consumption quantity decision, and they might find this more difficult when the serving size recommendation is conveyed in grams only (Faulkner et al., 2012). Therefore, we hypothesized that only the pictorial serving size recommendation would reduce expected consumption and possibly reduce the pack size effect.

5.3 Experiment 5.2

This experiment included four snack foods: chocolate, peanut M&M's, TUC savoury crackers, and cocktail nuts (peanuts in a crispy coating; Dutch: *borrelnootjes*). The foods thus varied in whether they are sweet or savoury, and in the extent to which they are easily countable. The experiment was again conducted online.

5.3.1 Methods

Design

The experiment had a 2 (pack size: large vs. small) X 3 (serving size recommendation: pictorial vs. non-pictorial vs. absent) between-participants design, and participants were randomly assigned to conditions.

Participants

The sample consisted of members of the general population between 18 and 55 years old. Participants who had never eaten one or more of the snacks in the survey were told that they did not belong to the target group of the study and hence could not continue. This led to an initial sample of 372 participants. We removed 31 participants because they did not finish the survey and another 15 because of poor data quality. The criteria for poor data quality were the same as in Experiment 5.1, except that we now set the minimum completion time at 5 minutes (the average time needed to fill in the questionnaire was 14 minutes (SD = 9)). Finally, two extreme responses (an expected consumption of 50 hands of M&M's and 60 TUC crackers, both 5 SD from the mean consumption in the large pack condition), were excluded as outliers. This led to a final sample of 324 participants, of which 154 were female. Their mean age was 38 (*SD* = 11) years.

Procedure

The same procedure was followed as in Experiment 5.1. Participants were again recruited by panel agency GMI, who also provided them with a small monetary compensation for participation. Fieldwork was conducted in the period February 3 to February 6, 2014. Instead of answering the expected consumption question for only

chocolate, participants now answered this question for all four snack foods. The order in which the four snacks were presented was randomized. As in Experiment 5.1, expected consumption of chocolate was measured in pieces. Expected consumption of the TUC crackers was measured in number of crackers. For the M&M's and cocktail peanuts, expected consumption was measured in "hands". For these foods, the screen showed a hand holding respectively 7 M&M's (about 15 gr) and 15 cocktail peanuts (about 12 gr). Participants indicated how many of these "hands" they expected to eat (see Appendix 5.3 for a screenshot). An important difference with Experiment 5.1 was that we also included an "I would eat the whole pack" option. Before conducting Experiment 5.2, we conducted a small pilot study among university staff (N = 34) to determine how we could best assess expected consumption for the non-countable foods, such as M&M's and nuts. Both in Experiment 5.1 and in this pilot study for Experiment 5.2, we noticed that many participants indicated an amount that was close to eating the whole pack. Furthermore, pilot participants often commented that they wanted to eat the whole pack but were not sure how to indicate this. To make it possible for participants to indicate this choice, we therefore included an "I would eat the whole pack" answer option. This answer option was shown as a box that participants could check, and was located below the answer field where participants could fill in their expected consumption amount in pieces or hands. Some participants filled in their expected consumption in pieces or hands and also ticked the "I would eat the whole pack" option. In this case we assumed that participants wanted to eat the whole pack, as these participants' numerical responses were also very close to eating the whole pack / or they expected to eat whole pack for the other snacks.

Participants then completed a number of additional questionnaires. Finally, they were debriefed by means of a short text, and had the opportunity to write down any comments they might have.

Materials

The pictures used for the chocolate bar were the same as in Experiment 5.1. For the M&M's, we used the Dutch "Maxi" bag to represent a large pack (400 gr), and an American portion bag to represent a smaller pack (165 gr). The TUC crackers were only available in one pack size. We therefore manipulated the image of a 100 gr pack to resemble a small 60 gr pack and a large 120 gr pack using Jasc Paint Shop Pro (Version 7, Jasc Software, Inc.). We used a similar procedure for the bag of cocktail nuts and thus visually created a 300 gr and a 125 gr bag (see Appendix 5.4 for example pictures). In case a nutrition panel was visible on front of the pack, this was removed. In all pictures, the pack was held by a hand which served as a size reference to judge the actual size of the pack.

The design of the pictorial serving size recommendation sticker was similar to Experiment 5.1. For chocolate, we again included a picture of four pieces of chocolate. For the TUC crackers, four crackers were shown. For M&M's and cocktail nuts, the

recommended serving of 30 grams was displayed with the corresponding food amount lying on a hand. The non-pictorial serving size recommendation sticker only said: "recommended serving: XX grams" (see Table 5.1) and did not include a picture of the foods. As in Experiment 5.1, we set the recommended serving for each snack somewhat lower than the average consumption amount per consumption occasion in The Netherlands (Dutch National Food Consumption Survey 2007 – 2010). Table 5.1 gives an overview of the snacks, the pack sizes, the size of the recommended servings, and how we measured expected consumption for each snack. See Appendix 5.4 for example pictures.

Food	Size small / large pack	Size of recommended serving	Measurement unit for expected consumption (DV)
Milk chocolate	75 gr / 180 gr	4 pieces (20 gr)	Pieces
Peanut M&M's	165 gr / 400 gr	30 gr	Hands
TUC crackers	60 gr / 120 gr	4 crackers (15 gr)	Crackers
Cocktail nuts	125 gr / 300 gr	30 gr	Hands

Table 5.1. Pack size, recommended serving size, and measurement of expected consumption of the four snack foods in Experiment 5.2.

Other measures

The measures that are included in the subsequent analyses are listed here. For all other measures, please refer to Appendix 5.5. In case the same question was asked for all four snack foods, the order in which the foods were presented per question was always randomized.

We first asked all participants to indicate what they thought the optimal recommended serving size would be for each of the four snacks. Next, we asked participants in both serving size recommendation conditions if they remembered the size of the recommended serving for each of the four foods, and if yes, we asked them to indicate what the size was. As a manipulation check, we assessed how participants perceived the size of the packs (1 = *very small* to 7 = *very large*). We also asked how realistic participants thought the packs looked (1 = *not realistic at all* to 7 = *very realistic*). We next included a number of the same measures as in Experiment 5.1: the evaluation of the size of the recommended serving, dietary restraint ($\alpha = 0.87$), currently trying to lose weight, perceived self-regulatory success ($\alpha = 0.78$), tendency to eat the whole pack ($\alpha = 0.81$), frequency of snacking in the afternoon,

consumption frequency of the snacks, liking of the snacks, hunger ($\alpha = 0.87$), weight, height, living situation and education.

There were no significant differences across the six experimental conditions with regard to gender, age, BMI, living situation and education (all *ps* > 0.18). Participants in the six conditions also did not differ with respect to hunger, dietary restraint, consumption frequency of the snacks, liking of the snacks, current dieting behaviour, perceived self-regulatory success, tendency to eat the whole pack, frequency of snacking in the afternoon, and evaluation of the size of the recommended serving (all *ps* > 0.07).

5.3.2 Results

Manipulation check

For all snacks, the size of the pack was perceived to be significantly bigger in the large pack condition than in the small pack condition, $t(322) > 3.09$ and $p < 0.01$ for all snacks. Participants also found the packs to look realistic, $M = 5.41$ ($SD = 1.03$).

Expected consumption

In a 2x3 ANOVA, we tested whether the pack size and serving size recommendation affected the expected consumption of the four snack foods. In case a participant had indicated to eat the whole pack, we used the contents of the whole pack in grams as their expected consumption.

This ANOVA revealed a significant main effect of pack size, $F(1, 318) = 13.81$, $p < 0.01$, $\eta_p^2 = 0.04$, such that expected consumption from the small packs ($M = 59.10$, $SD = 31.86$) was smaller than from the large packs ($M = 80.74$, $SD = 65.87$). This is again strongly consistent with earlier findings and Experiment 5.1. The serving size recommendation did not have a significant main effect, $F(2, 318) = 1.72$, $p = 0.18$, with expected consumption in the no recommendation, non-pictorial recommendation, and pictorial recommendation conditions being $M = 75.48$ ($SD = 61.16$), $M = 72.52$ ($SD = 52.85$), and $M = 62.35$ ($SD = 43.12$), respectively. Thus, although these means were in the expected direction, the main effect of the serving size manipulation did not reach significance. The interaction between pack size and serving size recommendation was not significant, $F(2, 318) = 1.32$, $p = 0.27$.

As in Experiment 5.1, we then added the evaluation of the recommended serving size as a covariate. This variable again had a strong main effect on expected consumption, $F(1, 317) = 20.59$, $p < 0.01$, $\eta_p^2 = 0.06$. As in Experiment 5.1, participants who felt the recommended serving was too little consumed significantly more than those who felt it was too much. However, including this covariate did not change the other findings: the main effect of pack size was again significant, $F(1, 317) = 17.96$, $p < 0.01$, $\eta_p^2 = 0.05$, while the main effect of the serving size recommendation, $F(2, 317) = 1.26$, $p = 0.29$, and the interaction, $F(2, 317) = 1.40$, $p = 0.25$, were not significant.

A variable that could also have a significant influence on expected consumption is the tendency to eat the whole pack. It is likely that participants who scored high on the statements regarding the tendency to keep eating until the pack is empty, checked the "I would eat the whole pack" answer option, thus significantly increasing their consumption over that of others. Indeed, participants who indicated for at least one snack that they would eat the whole pack (N =148) had an average consumption of M = 106.44 grams (SD = 57.04), while participants who did not indicate this for any of the snacks (N =178) had an average consumption of only M = 40.21 grams (SD = 21.64), $t(179.23) = 13.27$, $p < 0.01$. The provision of the "I would eat the whole pack" option thus significantly increased the variance in the data. Therefore, we explored the effects of including the tendency to eat the whole pack as an additional covariate. Indeed, an ANCOVA showed that the covariates "evaluation of the recommended serving size" and "tendency to eat the whole pack" had a significant main effect on expected consumption, $F(1, 316) = 10.47$, $p < 0.01$, $\eta_p^2 = 0.03$, and $F(1, 316) = 108.45$, $p < 0.01$, $\eta_p^2 = 0.26$, respectively. The main effect of pack size was significant, $F(1, 316) = 28.22$, $p < 0.01$, $\eta_p^2 = 0.08$, and was qualified by the hypothesized interaction between pack size and serving size recommendation, $F(2, 316) = 3.80$, $p = 0.02$, $\eta_p^2 = 0.02$. Figure 5.2 displays the effect of the serving size recommendation across conditions.

We then analyzed the simple main effects to test our hypothesis that only the pictorial serving size recommendation would reduce expected consumption and prevent the pack size effect. Indeed, and as can be seen in Figure 5.2, the pack size effect was significant in the control condition and in the non-pictorial serving size condition, $F(1, 316) = 23.25$, $p < 0.01$, $\eta_p^2 = 0.07$ and $F(1,316) = 11.29$, $p < 0.01$ $\eta_p^2 = 0.03$, respectively. Importantly, however, there was no pack size effect in the pictorial serving size recommendation condition, $F(1, 316) = 1.02$, $p = 0.31$, which is in line with our hypothesis. This implies that participants expected to eat similar, small amounts when a pictorial serving size recommendation was displayed, irrespective of the size of the pack, and confirms our hypothesis that the pictorial serving size recommendation can diminish the pack size effect.

In addition, we examined the simple main effects to determine if the pictorial serving size recommendation only significantly reduced consumption from the large pack and not from the small pack. Indeed, expected consumption from the large pack was significantly lower in the pictorial serving size recommendation condition than in the control condition, $F(1, 316) = 8.04$, $p = 0.01$, $\eta_p^2 = 0.02$. In contrast, expected consumption from the small pack was not affected by the pictorial serving size recommendation, $F(1, 316) = 1.05$, $p = 0.31$.

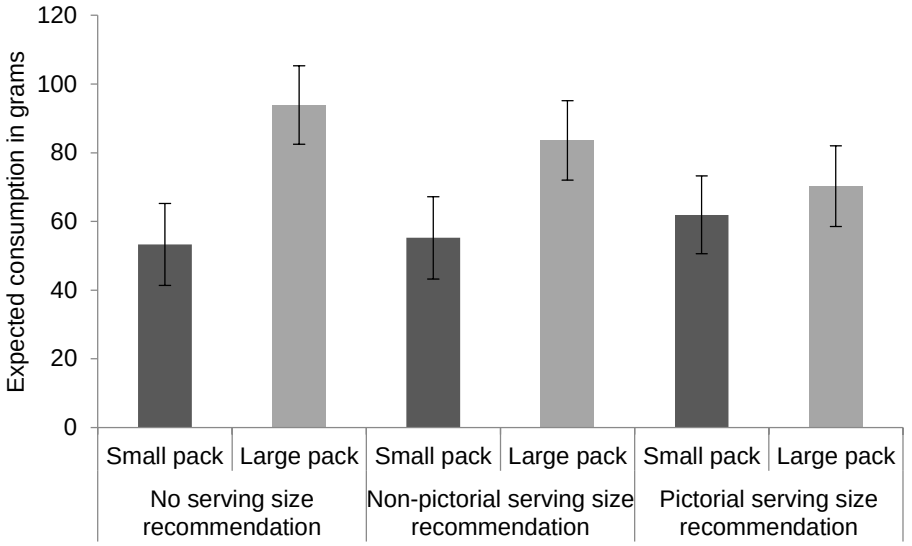

Figure 5.2. Mean expected consumption of the four snack foods in grams when controlling for the evaluation of the recommended serving size and the tendency to eat the whole pack.

Additional regression analyses in the General Linear Model showed that the effect of the serving size recommendation was not moderated by hunger, dietary restraint, tendency to eat the whole pack, BMI and gender (all *p*s > 0.26). The serving size recommendation significantly interacted with perceived self-regulatory success, $F(2, 310) = 3.74$, $p = 0.03$, $\eta_p^2 = 0.02$. The three-way interaction between pack size, serving size recommendation and perceived self-regulatory success reached marginal significance, $F(2, 310) = 2.94$, $p = 0.05$, $\eta_p^2 = 0.02$. Using simple slopes analysis we examined the effect of pack size and the serving size recommendation on expected consumption at 1 SD above and 1 SD below the mean of self-regulatory success (Aiken and West, 1991). Expected consumption from the large pack was significantly lower in the pictorial serving size recommendation condition than in the control condition only for those participants who scored low on perceived self-regulatory success. In other words, the pictorial serving size recommendation lowered consumption from the large pack most for those who find it difficult to control their weight. The interaction between the serving size recommendation and average liking of the four snacks was also significant, $F(2, 310) = 3.11$, $p = 0.05$, $\eta_p^2 = 0.02$. Simple slopes analyses showed that the pictorial serving size recommendation only significantly lowered consumption when participants had a high liking for the snacks and not when they had a low liking for the snacks.

Differences across foods

To explore whether the effects of pack size and serving size recommendation differed across the four food items, we ran a repeated measures ANCOVA with food item as the within-subjects factor and pack size and serving size recommendation as between subject factors. Evaluation of the recommended serving size and tendency to eat the whole pack were again included as covariates. As Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(5) = 146.00$, $p < 0.01$, we used a Greenhouse-Geisser degrees of freedom correction. As expected, there was a main effect of food item on the excepted consumption in grams, $F(2.47, 781.92) = 91.82$, $p < 0.01$, $\eta_p^2 = 0.23$. Food item also significantly interacted with pack size, $F(2.47, 781.92) = 4.30$, $p = 0.01$, $\eta_p^2 = 0.01$, but importantly, it did not interact with serving size recommendation, $F(4.95, 781.92) = 1.07$, $p = 0.38$. The effect of pack size thus differed across the foods, but the effect of the serving size recommendation did not.

Moderating role of gender on the pack size effect

An ANCOVA with pack size, the serving size recommendation and gender as factors, and evaluation of the recommended serving size and tendency to eat the whole pack as covariates, showed that gender had a significant main effect on consumption, $F(1, 310) = 5.92$, $p = 0.02$, $\eta_p^2 = 0.02$, such that men ($M = 79.91$, $SD = 57.82$) consumed more than women ($M = 59.17$, $SD = 44.78$). As in Experiment 5.1, gender also interacted significantly with pack size, $F(1, 310) = 6.35$, $p = 0.01$, $\eta_p^2 = 0.02$. Although the pack size effect was significant for both men and women, $F(1, 310) = 33.24$, $p < 0.01$, $\eta_p^2 = 0.10$ and $F(1, 310) = 4.17$, $p = 0.04$, $\eta_p^2 = 0.01$ respectively, it was considerably larger for men.

Effect of the serving size recommendation on the choice to eat the whole pack

Using binary logistic regression analysis, we determined whether the serving size recommendation lowered the odds of eating the whole pack. The dependent variable measured whether or not the participant opted to eat the whole pack, the independent variables included were size, the non-pictorial and pictorial serving size recommendation, and the interaction between the size and serving size recommendations. The serving size recommendation, the pack size, and their interaction did not have a significant impact on the odds of eating the whole pack for any of the foods.

Remembering the magnitude of recommended serving

We assessed whether participants recalled the exact amount stated on the serving size recommendation. The percentage of participants that correctly recalled the amount was 43% (averaged across the four foods) in the pictorial serving size recommendation condition, while this was only 12% in the non-pictorial serving size recommendation condition. We furthermore examined whether participants felt that the recommended serving size was appropriate. On a 7-point scale ranging from *way too little* to *way too much*, the

recommended serving size scored *M* = 3.58 (*SD* = 1.29) for chocolate, *M* = 3.29 (*SD* = 1.20) for M&M's, *M* = 3.69 (*SD* = 1.32) for TUC crackers, and *M* = 3.72 (*SD* = 1.21) for cocktail nuts. These findings suggest that the size of the recommended serving was appropriate.

5.3.3 Discussion

As in Experiment 5.1, we again found a pack size effect, such that participants expected to consume about 22 grams more from large packs than from small packs. Contrary to Experiment 5.1, there was no main effect of including a serving size recommendation. When controlling for the evaluation of the size of the recommended serving and the tendency to eat the whole pack, however, results showed the predicted interaction between the pack size and serving size recommendation. As hypothesized, only the pictorial serving size recommendation lowered consumption, and it did so only for the large pack. Consumption from the large pack was about 23 grams lower when the pictorial serving size recommendation was displayed on the pack than when no recommendation was displayed. As a result, the pictorial serving size recommendation weakened the pack size effect. As hypothesized, expected consumption and the pack size effect were not affected by the non-pictorial serving size recommendation.

5.4 Experiment 5.3

In Experiment 5.3, we investigated the effect of the pictorial serving size recommendation on actual consumption instead of expected consumption. Participants were invited to serve themselves a portion of M&M's, and to eat this while watching movie trailers. As Experiment 5.2 showed that the pictorial serving size recommendation is most effective on large packs, we only included large packs in this experiment.

5.4.1 Methods

Design

The experiment had a 2-group (pictorial serving size recommendation: present vs. absent) between-participants design, and participants were randomly assigned to conditions.

Participants

Students aged between 17 and 25 years from a Dutch university participated for course credit. Before signing up for the study, students were informed that they could only participate if they liked M&M's with peanuts and were willing to eat them during the experiment. The total sample consisted of 89 participants (51 women). Their mean age was 20 (*SD* = 1.5) years.

Procedure

The data were collected in the period May 30 to June 4, 2014. Upon arrival in the lab, participants were brought to the cubicle section by the experimenter and received an instruction sheet. To hide the true purpose of the experiment, participants were told that we were investigating the effect of eating a tasty snack on the TV viewing experience. They were furthermore asked to imagine that they were at home, studying, and were about to take a break in which they watch TV and eat some M&M's. In the cubicle, an open package of M&M's and a bowl were present in which participants could pour the amount of M&M's they would like to eat while watching movie trailers. Participants then took their bowl with M&M's to a second cubicle where they watched the trailers and filled in the computerized questionnaire. In case the participants emptied their bowl and wanted to eat more M&M's, they were instructed to call the experimenter. The trailers did not contain any references to food, weight or dieting. After participants saw the trailers and answered some questions about them, the experimenter took away the bowl of M&M's and started the second part of the questionnaire, which is described below. Debriefing information was provided to the participants via a website, which was made available the day after the last day of the experiment. Before the start of each session, the M&M packages were weighed. After the experiment, both the package and the amount left in the bowl were weighed to determine how much participants served themselves and how much they had consumed.

Materials

We used 400 gram "Maxi" packages of M&M's with peanuts. To ensure that the opening was the same in all packages (+/- 7 cm) the bag was cut open by the experimenter before the participants arrived. The design of the serving size recommendation sticker was similar to Experiment 5.2, with the exception of the color of the border, which was changed to brown to make it blend more naturally with the pack. The sticker was placed on the right above the center of the package, so that it was well visible when the pack stood upright. The nutrition and portion size information in the lower, right corner of the front of the bag was covered up by a yellow sticker. Participants poured the M&M's in stoneware bowls that were big enough to contain the content of the whole pack (see Appendix 5.6).

Other measures

The measures that are included in the subsequent analyses are listed here. For all other measures please refer to Appendix 5.7. Before watching the trailers, feelings of hunger and satiation were asked together with a number of other feelings, including happy, sad, relaxed, irritated, enthusiastic and thirsty. This question was framed as "to what extent do you feel…" (1 = *not at all* to 7 = *very much*) and was repeated at the end of the experiment, before the demographic questions. After watching each trailer, participants rated the trailer on a number of aspects (see Appendix 5.7). Liking of the M&M's was assessed on a 7-point scale (1 = *do not like at all* to 7 = *like very much*). Frequency of consumption of peanut M&M's was

assessed using the following categories: *at least once a week; at least once a month; at least once a year; ate them in the past but not in the past year; never.* The tendency to eat the whole pack was assessed with two items ("If I take a snack, I keep eating until the package is empty"; "I often eat more from snacks than I initially intended to", $\alpha = 0.77$). The measures for dietary restraint ($\alpha = 0.88$), current dieting behaviour, perceived self-regulatory success ($\alpha = 0.66$), and preferred size of the recommended serving were similar to Experiment 5.1 and 5.2. We furthermore measured whether respondents remembered seeing the sticker on the pack using the question: "Some M&M packages had a sticker with the recommended serving size. Did the bag from which you took M&M's contain such a sticker?" (*yes*, *no*, or *don't know*). We asked those who remembered seeing the sticker whether they remembered the recommended amount (*yes, the number of grams was…,* or *no*), and what they thought when seeing the sticker (open-ended question). We then assessed the evaluation of the size of the recommended serving, using the same question as in Experiment 5.1 and 5.2. Finally, participants indicated their gender, age, height and weight, and what they thought the purpose of the study was.

There were no significant differences between the two experimental conditions with regard to gender, age, and BMI (all *ps* > 0.09). Participants in the two conditions also did not differ with respect to hunger and satiation (pre and post eating), dietary restraint, consumption frequency of M&M's, current dieting behaviour, perceived self-regulatory success, evaluation of the size of the recommended serving, and tendency to eat the whole pack (all *ps* > 0.13). Liking of the M&M's was somewhat higher in the condition without the serving size recommendation, $t(80.60) = 1.92$, $p = 0.06$.

5.4.2 Results

Amount of M&M's taken

An ANOVA without covariates showed that the presence of the serving size recommendation sticker did not significantly influence the amount of M&M's participants served themselves, $F(1, 87) = 1.10$, $p = 0.30$. As in Experiment 5.1 and 5.2, we then added the evaluation of the size of the recommended serving as a covariate. The effect of the evaluation of the size of the recommended serving on the amount of M&M's taken was significant, $F(1, 86) = 10.17$, $p < 0.01$, $\eta_p^2 = 0.11$, and the effect of the recommended serving approached significance, $F(1, 86) = 2.56$, $p = 0.11$, $\eta_p^2 = 0.03$.

We therefore explored the hypothesis that the serving size recommendation is only effective for participants who noticed it consciously (see also Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014). A considerable part of the participants in the serving size recommendation condition indicated that they did not know if there was a serving size recommendation present on the pack, and one participant even indicated that it was not present. We therefore split the complete sample in three groups: (1) those in the no

serving size recommendation condition (N = 42), (2) those in the serving size recommendation condition who indicated that they noticed the sticker (N = 14), and (3) those in the serving size recommendation condition who did not notice the sticker (N = 33). We ran an ANCOVA with these 3 groups as a factor, and with evaluation of the size of the recommended serving as a covariate. Evaluation of the size of the recommended serving was again significant, $F(1, 85) = 11.14$, $p < 0.01$, $\eta_p^2 = 0.12$. The effect of group was marginally significant, $F(1, 85) = 2.54$, $p = 0.09$, $\eta_p^2 = 0.06$. As expected, simple main effects analysis confirmed that the amount served was significantly lower among participants who had noticed the serving size recommendation compared to control participants who received a package without serving size recommendation, $F(1, 85) = 5.06$, $p = 0.03$, $\eta_p^2 = 0.06$. Participants who did not notice the serving size recommendation did not take less than control participants, $F(1, 85) = 2.47$, $p = 0.12$. These results are displayed in Figure 5.3.

To examine whether those who noticed the serving size recommendation served themselves less because they are restrained eaters or successful dieters, we conducted additional regression analyses in which we included either restrained eating or perceived self-regulatory success in dieting as potential moderators of the effect of the serving size recommendation. These analyses showed, however, that neither restraint nor dieting success moderated the effect of the serving size recommendation on the amount of M&M's served, all *p*s > 0.55. Furthermore, additional regression analyses revealed that the effect of the serving size recommendation on amount taken was also not moderated by hunger, liking of the M&M's, tendency to eat the whole pack, BMI and gender, all *p*s > 0.28.

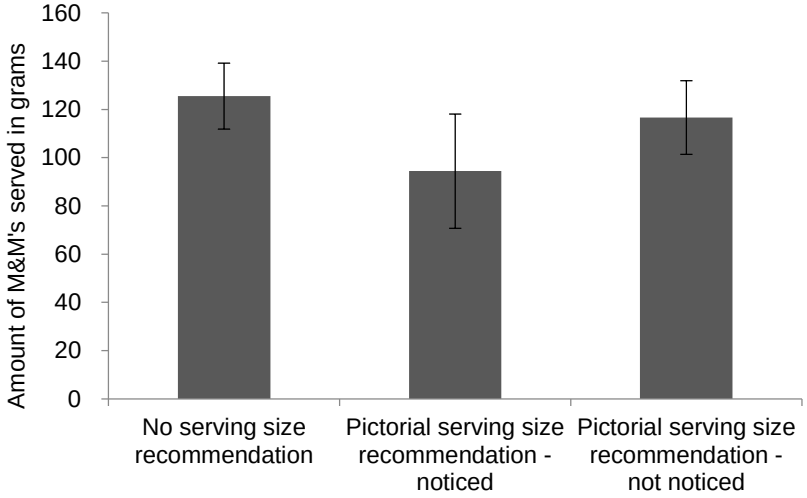

Figure 5.3. Mean amount of M&M's that participants served themselves, when they were not provided with a serving size recommendation, when they were provided with a recommendation but did not notice it, and when they did notice the serving size recommendation, while controlling for the evaluation of the recommended serving size.

Amount of M&M's eaten

The same ANCOVA as described above but with the amount of M&M's eaten again showed an effect of the covariate, $F(1, 85) = 7.08$, $p = 0.01$, $\eta_p^2 = 0.08$, but no effect of the serving size recommendation, $F(1, 85) = 0.54$, $p = 0.59$. Note that only 10 participants finished the M&M's they took, probably due to time constraints, as they only had 13 minutes to eat an average of 117 grams.

Remembering the magnitude of the recommended serving

Of the 14 participants that noticed the serving size recommendation, 9 correctly remembered that the magnitude of the recommended serving was 30 grams. On a 7-point scale ranging from *way too little* to *way too much*, the recommended serving size scored $M = 3.26$ ($SD = 1.01$), suggesting that participants found it appropriate.

Thoughts about the serving size recommendation and the goal of the study

When asked what participants thought when they saw the serving size recommendation on the pack, no participants mentioned that they thought they were not allowed to take more than 30 grams or that they thought it was expected of them to take about 30 grams. Only 4 participants indicated that they thought that the serving size recommendation had something

to do with the purpose of experiment. Of these, only 1 participant indicated that she was influenced by the recommendation. When asked about the goal of the study only 6 participants mentioned that investigating the effect of the serving size recommendation sticker on consumption probably was one of the goals of the study. Together, these findings suggest that it is unlikely that our results were driven by demand effects.

5.4.3 Discussion

This study was designed to test whether a serving size recommendation on a large snack package can reduce the amount that participants serve themselves in an actual eating situation. Our results showed that the serving size recommendation significantly lowered the amount of M&M's taken, but only when participants consciously noticed it. This effect was not due to participants' dietary restraint or other participant characteristics. Hence, we conclude that it is indeed important for consumers to become aware of the serving size recommendation, in order for it to be effective in reducing consumption. As in Experiment 5.1 and 5.2, we again found that the evaluation of the size of the recommended serving had a significant influence on the amount of M&M's taken and consumed. The amount of snack food that people take thus clearly depends on people's general notions of what a small, reasonable or large portion size is (Brunstrom & Shakeshaft, 2009; Wilkinson et al., 2012) and is not only influenced by environmental factors.

5.5 General discussion

We presented three experiments that investigated whether displaying a pictorial serving size recommendation on food packages affects food quantity decisions and can diminish or even prevent the pack size effect. We argued that consumers are less likely to use the pack size as a reference amount when provided with a serving size recommendation. We conducted two online experiments in which we measured the expected consumption of a number of common, high-calorie snack foods, and one lab experiment in which we assessed how the serving size recommendation affected how much participants served and consumed from a large pack of an unhealthy snack.

Both in Experiment 5.1 and 5.2 we found a robust pack size effect, such that participants indicated to eat more from a large than from a smaller pack. The impact of the serving size recommendation, however, differed slightly across the experiments. In Experiment 5.1, when controlling for the covariate "evaluation of the size of the recommended serving", the serving size recommendation had a main effect such that it lowered consumption to the same extent for both the small and large pack. Although this is a beneficial effect with potentially important health implications, it did not confirm our hypothesis that the pack size effect would be prevented by a clear, pictorial serving size recommendation. In Experiment 5.2, we therefore included more snack foods to increase statistical power. Because we now also

included non-countable food items we added the "I would eat the whole pack" option to the assessment of our dependent variable. We also added the tendency to eat the whole pack as a covariate in order to control for the variance in the data caused by the high consumption of participants who have a tendency to finish a package once they open it. The results of this experiment confirmed our expectation that the pictorial serving size recommendation lowers consumption for large packs but not for small packs, and therefore weakens the pack size effect. Finally, Experiment 5.3 showed that the serving size recommendation lowered the amount of M&M's participants served themselves, but only when it was noticed by the participants.

5.5.1 Potential Implications

Based on the above described findings, we suggest that providing consumers with an alternative reference point for the amount of snack food to consume, can be an effective way of reducing the pack size effect. For the serving size recommendation to be effective, consumers do need to be aware of its presence and need to process it so that it can indeed affect food quantity decisions.

We replicated the portion size effect that typically occurs in actual eating situations in an online paradigm with food pictures. Our findings correspond with previous research showing that the portion size preferences that people provide while using food pictures (Wilkinson et al., 2012) or food replicas (Bucher, van der Horst & Siegrist, 2012) align well with actual consumption amounts. Furthermore, our results showed that the pack size effect is also visible when measuring expected consumption. An advantage of online methods is that they provide the researcher with more flexibility, and can be administered quickly and for relatively low costs. Nonetheless, replication in an actual consumption setting remains important. Our lab experiment showed that the percentage of participants who remembered the serving size recommendation was considerably lower in the lab setting than in the online setting. This may be due to the fact that in the lab setting, many other cues compete for a participant's attention than on the computer screen, where a product can be centrally displayed in a very controlled way. This finding indicates that for a serving size recommendation to be effective, consumers' attention needs to be drawn to it, which could be achieved, for example, with highly salient visual cues, and supported with advertising campaigns.

Our finding in Experiment 5.3 that many participants did not notice the serving size recommendation also has implications for the effectiveness of front-of-pack nutrition labelling. Current front-of-pack nutrition information boxes tend to be rather small and not easily noticeable. If consumers do not even notice a rather big serving size recommendation which includes a picture, it seems highly unlikely that they will consciously notice and use front-of-pack nutrition information.

The findings of Experiment 5.2 also confirmed our hypothesis that a non-pictorial serving size recommendation in grams is not effective in reducing expected consumption. This finding has important implications for the effectiveness of the serving size information as it is currently displayed on food packages. Serving size recommendations are typically displayed as part of the nutrition label, and particularly for non-countable foods, they are usually presented in grams. Based on our findings, we suggest that such labels are unlikely to reduce consumption.

In all three experiments, the evaluation of the size of the recommended serving had a significant effect on our dependent measures. Despite the influence of external factors on portion size selection, people also have inherent beliefs about what an ideal portion of a given food looks like (Brunstrom & Shakeshaft, 2009; Wilkinson et al., 2012). It is thus important to realise that the amount that people eat is not only determined by environmental factors but also by pre-existing portion size preferences (see also Fay et al., 2011). The importance of other factors in the consumption quantity decision was also visible in the relatively small effect sizes of the pack size and serving size recommendation. This also implies that in studies that investigate the portion or pack size effect and ways to prevent it using a between-subjects design, it is advisable to include a measure of general portion size preferences for the food under study. When controlling for the variance in portion size preferences across individuals, the effect of the manipulations can be measured more accurately. Furthermore, in a real world setting, the effect of a serving size recommendation will be relative, such that it may mostly change consumption from a large amount to a slightly smaller amount.

5.5.2 Limitations

A potential limitation of our study is the sensitivity of this type of research to demand effects. Showing a serving size recommendation sticker on a pack and then asking people how much they expect they will eat, could lead to demand effects. To prevent such effects as much as possible, we selected an online consumer panel that usually completes marketing studies for companies, rather than for universities. These participants were thus unfamiliar with experimental research in general, and with research focusing on eating behaviour. This will have made it less likely that they guessed the purpose of the study and answered accordingly. In addition, and importantly, the non-pictorial serving size recommendation should also have strongly reduced consumption and the pack size effect, if our findings were merely due to demand effects. However, the non-pictorial serving size recommendation did not affect participants' expected consumption. In Experiment 5.2 we asked how participants determined their expected consumption. Only very few participants directly referred to the serving size recommendation. Finally, also in Experiment 5.3, very few participants correctly guessed the purpose of the study. Nonetheless, a study in a natural setting in which

participants are not aware that their consumption is monitored could be an interesting direction for future research.

In Experiment 5.3, the lower amount of M&M's taken did not translate into a lower amount of M&M's consumed. This might have been caused by the relatively short time period in which participants could eat. In future research participants could be given more time to finish their desired amount of snack food.

5.5.3 Future research

The exact underlying mechanism by which the serving size recommendation diminishes the pack size effect warrants further investigation. For example, when the serving size recommendation is provided, do consumers only take into account the serving size recommendation when making their consumption quantity decision, or do they then take into account both the pack size and the serving size recommendation? Future research could also study how much attention people need to give to the serving size recommendation for it to be effective.

In line with previous research (Rolls et al., 2006a; Rolls, Roe, Kral, et al., 2004; Rolls, Roe, Meengs, et al., 2004), we found that the pack size effect was considerably smaller for women than for men. Women are in general more concerned about maintaining a healthy lifestyle than men (Divine & Lepisto, 2005). As a result, women might for example be more likely to have their own consumption rules regarding unhealthy snacks, such as "I should eat no more than 4 pieces of chocolate a day". Investigating why women are less susceptible to the pack size effect than men is an interesting topic for further research.

Another interesting avenue for further study is to determine how providing a serving size recommendation on the pack impacts the consumption experience. In Experiment 5.1, we measured expected consumption guilt and did not find any differences across conditions and across participants that did or did not follow the serving size recommendation. In Experiment 5.3, however, liking of the M&M's was somewhat lower in the condition with the serving size recommendation than in the control condition. However as our experiment was not set up to measure the impact of the serving size recommendation on the consumption experience, we cannot easily conclude whether the difference in liking of the M&M's was caused by the presence of the serving size recommendation, and which mechanisms might potentially be responsible. This therefore remains an interesting topic for further investigation, along with developing ways of preventing a potential negative impact of portion size recommendations on product perceptions. Importantly, while adhering to the serving size recommendation could make the consumption experience less indulgent, and not adhering to it could lead to feelings of guilt, the overall effect of limiting the consumption of high-calorie snacks might be an important health benefit.

5.6 Conclusion

The portion and pack size effect are likely to be at least partially responsible for the rise in overweight and obesity (Chandon, 2013; Hill & Peters, 1998; Rozin, et al., 2003; Young & Nestlé, 2012). The current findings suggest that providing a clear and noticeable reference amount for the consumption decision in the form of a pictorial serving size recommendation can reduce the pack size effect, and we suggest that this approach may constitute a promising topic for further research and a useful strategy for potential interventions.

Chapter 6

Conclusion

6.1 General discussion

In this thesis I aimed to provide insight into the mechanisms underlying the portion size effect and to provide suggestions for effective interventions that can prevent the effect from occurring. The portion size effect seems to occur because people experience difficulties when they try to determine how much to eat. To simplify the consumption quantity decision, they rely on external reference points, such as the portion size. I have identified a number of factors that influence whether the portion size is used as a reference point in the consumption decision, being normative relevance of the portion size, active eating goals, and availability of other reference points, and which could thus impact the magnitude of the portion size effect.

Chapter 3 showed that the extent to which the portion size provides normative information about what others find an acceptable amount to eat, influences the portion size effect. According to Herman and Polivy (2005, 2014), people use the portion size as an indicator of how much they can maximally eat without coming across as an excessive eater. In other words, the portion size provides information about what is socially acceptable. As to our knowledge no studies have formally tested this explanation for the portion size effect, we did so in Chapter 3. Indeed, when in Chapter 3 the normative relevance of the portion size was reduced by providing information that the portion size communicated the behaviours or values of irrelevant others, the portion size effect weakened. Nonetheless, although the portion size effect weakened, it was not prevented. Hence, although social concerns play a role in the portion size effect, there may be other reasons as well why people use the portion size in their consumption quantity decision. In Chapter 2 I have identified several other ways through which the portion size can enter the consumption decision, being the tendency to clean the plate, unit bias, or the use of portion sizes as anchors. Neither of these mechanisms was however able to fully explain all aspects of the portion size effect. Hence, more research is needed to better understand which mechanisms are responsible for the portion size effect in different situations.

Chapter 4 showed that the goals that are active with regard to eating can influence the portion size effect. Pursuit of goals is an important driver of eating behaviour, and such goals can for example be enjoyment of good food, maximizing consumption within the boundaries of what is socially acceptable (Roth, Herman, & Polivy, 2003), and losing or maintaining weight (Andreyeva, Long, Henderson, & Grode, 2010; Bish et al., 2005). When the goals of

food enjoyment or consumption maximization are active, people will have little reason to not eat as much from the portion or pack as they can (Herman & Polivy, 2005, 2014). Indeed, activation of such goals might explain why education (Cavanagh, Vartanian, Herman, & Polivy, 2014; Poelman et al., 2015; Wansink & Cheney, 2005; Wansink & van Ittersum, 2007) and mindfulness interventions (Marchiori & Papies, 2014; Cavanagh et al., 2014) have not been successful in weakening the portion size effect. Although these interventions teach people to be aware of environmental influences and to pay attention to internal cues of satiety and hunger, they might not be sufficiently motivated to actually do so. When however the dieting goal is active, people are focussed on controlling consumption, and might be much less inclined to base their consumption on the amount of food provided. The dieting goal is mainly relevant for so-called restrained eaters who chronically try to restrict their food intake in order to control their body weight. Indeed, Chapter 4 showed that restrained eaters who are reminded of their dieting goals through a diet prime, did not show a pack size effect.

Chapter 5 showed that provision of an alternative reference point in the form of a serving size recommendation weakens the portion size effect. As I argued in Chapter 2, it might be easier to motivate people to use a different reference point in their consumption decision, than to motivate them not to use an external reference point at all. Furthermore, although in Chapter 4 a diet prime provided sufficient motivation for restrained eaters to no longer incorporate the portion size in the consumption decision, such an approach is much less effective for unrestrained eaters, as the dieting goal is not relevant for them. Results of the experiments in Chapter 5 showed that reducing uncertainty about the appropriate consumption quantity by placing a serving size recommendation on the pack, indeed weakened the pack size effect. However, although the pack size effect weakened, it did not seem to be fully prevented, and hence, some participants might still have used the pack size in their consumption decision. Not all participants might have been sufficiently motivated to incorporate a reference point in their consumption decision that suggests a smaller consumption amount than the pack size.

Taken together, the portion size thus exerts less influence on consumption when it is no longer regarded as being useful for the consumption quantity decision. Making the portion size less useful as an indicator of the quantity that can be consumed, is difficult, but not impossible, as is shown in this thesis. Reducing the normative relevance of the portion size, activating the dieting goal in restrained eaters, and providing an alternative, better reference point, all weakened the portion size effect. An important implication of these findings is that the extent to which portion and pack sizes influence consumption, is at least to a certain extent under conscious control. We show that with sufficient help, people are able to rely less on environmental cues, such as the portion size, when making consumption decisions.

6.2 Directions for future research

An important direction for further research will be to better understand the underlying causes of the portion size effect in different eating situations. Although most authors have focussed on finding one overarching explanation for the portion size effect (for example, Herman & Polivy, 2005; Marchiori et al., 2015; Wansink, 2010), perhaps it would be better to look at specific eating situations. The way people cope with the uncertainty regarding how much to eat and how the portion size is incorporated in the consumption decision could vary per eating situation. For example, when eating in a restaurant (or in the lab), the provided portion size might automatically be regarded as an appropriate consumption quantity and consumption will be guided by the goal of cleaning the plate. When however eating from a family size bag of chips, the pack size cannot be assumed to be an appropriate consumption quantity. In this case, the bag might be used as an anchor and effortful downward adjustment takes place from the anchor to determine the right consumption amount.

In this respect, studies that formally test the impact of moderator variables such as age, BMI, dietary restraint, food type, and distractions on the portion size effect, are also important. The knowledge that we currently have of these moderators comes mainly from meta-analyses (Hollands et al., 2015; Marchiori et al., 2015; Zlatevska et al., 2014), which provide little direct evidence as to why these moderators do or do not have an influence on the portion size effect. For example, studies that independently manipulate energy density, healthiness, and attractiveness of foods, can provide important insight into why the portion size effect is weaker for some types of foods than for others. The effect of distractions on consumption monitoring and hence the portion size effect, could be further examined by letting people eat under high or low cognitive load, and by asking participants to recall how much they have eaten.

When it concerns prevention of the portion size effect, there are many other interventions that can be explored. For example, pairing serving size recommendations with reminders of the dangers of overeating from large portions, could be effective in both motivating people to not base consumption on the portion size and by providing them with an alternative reference point to incorporate in the consumption decision. Alternatively, interventions focussed on making eating less automatic, for example by increasing the effort needed to obtain the foods, as in Experiment 4.2, might increase the ability to accurately monitor consumption, leading to less reliance on the portion size to determine the appropriate consumption amount. Or, to take a different angle, instead of trying to motivate people to eat less overall from large portions, one could motivate them to take smaller bites. It has been shown that the portion size effect is accompanied by an increase in bite size (Almiron-Roiga, Tsiountsiouraa, Lewisa, Wua,Solis-Trapalaa, & Jebba, 2015; Burger et al., 2011; Fisher, 2007). Hence, people eat more from larger than from smaller portions, not because they take more bites of the food, but because they take bigger bites. Hence, training

people to always take the same sized bites regardless of the portion size, or the use of an augmented fork that gives a warning signal when bite size becomes too large (Hermans, 2015), could be effective.

Another area for future research is to investigate the extent to which the research method used, impacts the portion size effect. A lab setting has as advantage that participants eat in a controlled environment which prevents any other influences on consumption except those manipulated by the researcher. But the lab environment is at the same time a very unnatural environment for the participant, which could also make eating behaviour less natural. Participants might for example suspect that their consumption is monitored. Online research has the advantage that the research is truly anonymous and the participant can answer in the comfort of their own home. The answers given might therefore be more representative of what happens in real life than the answers provided in a lab setting. However, a problem with online studies is that participants do not actually eat the foods and are thus not exposed to the hedonic and satiating qualities of the foods. Hence, combining the best of lab studies and online studies would be ideal, but is challenging. Participants could receive foods that they consume at home, but measuring how much they consumed and making sure other family members do not eat from the foods, can be a problem. Also, delivering interventions is difficult as there is little control over when and where the participant is exposed to these interventions. Conducting studies in a restaurant or movie theatre could be a good alternative, but again it should be kept in mind that in a restaurant, consumption might be influenced by different factors and motives than in an at-home setting.

In sum, much still needs to be learned about why the portion size effect occurs and how it can be prevented. With this thesis, I hoped to have provided a suitable starting point for further research.

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Appendices Chapter 3

Appendix 3.1
Portion size pictures for the picture condition in Experiment 2

Figure 3.1.1 Pasta – small and large portion

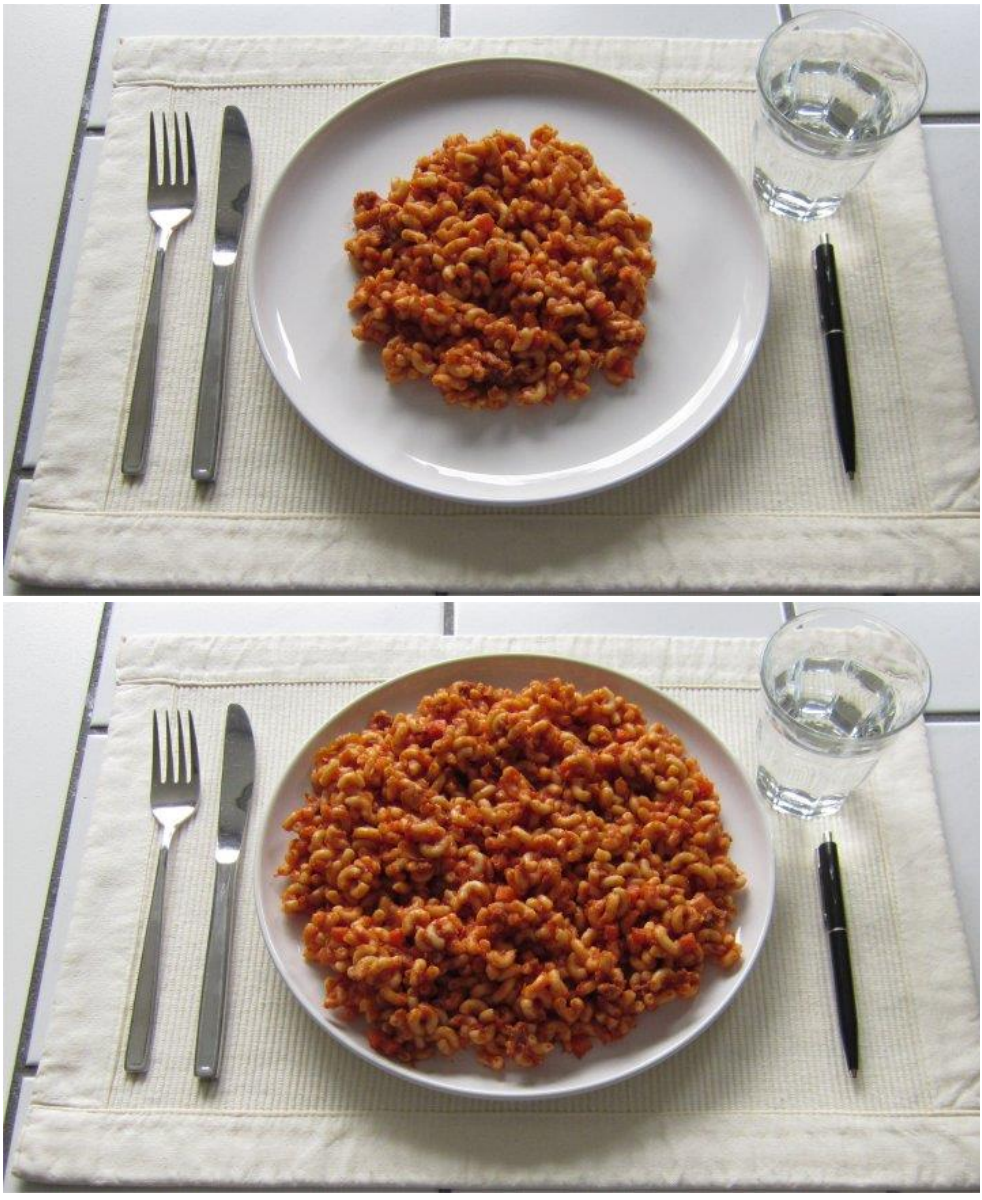


Figure 3.1.2 Indonesian fried rice– small and large portion

Figure 3.1.3 Mini ginger cookies – small and large portion

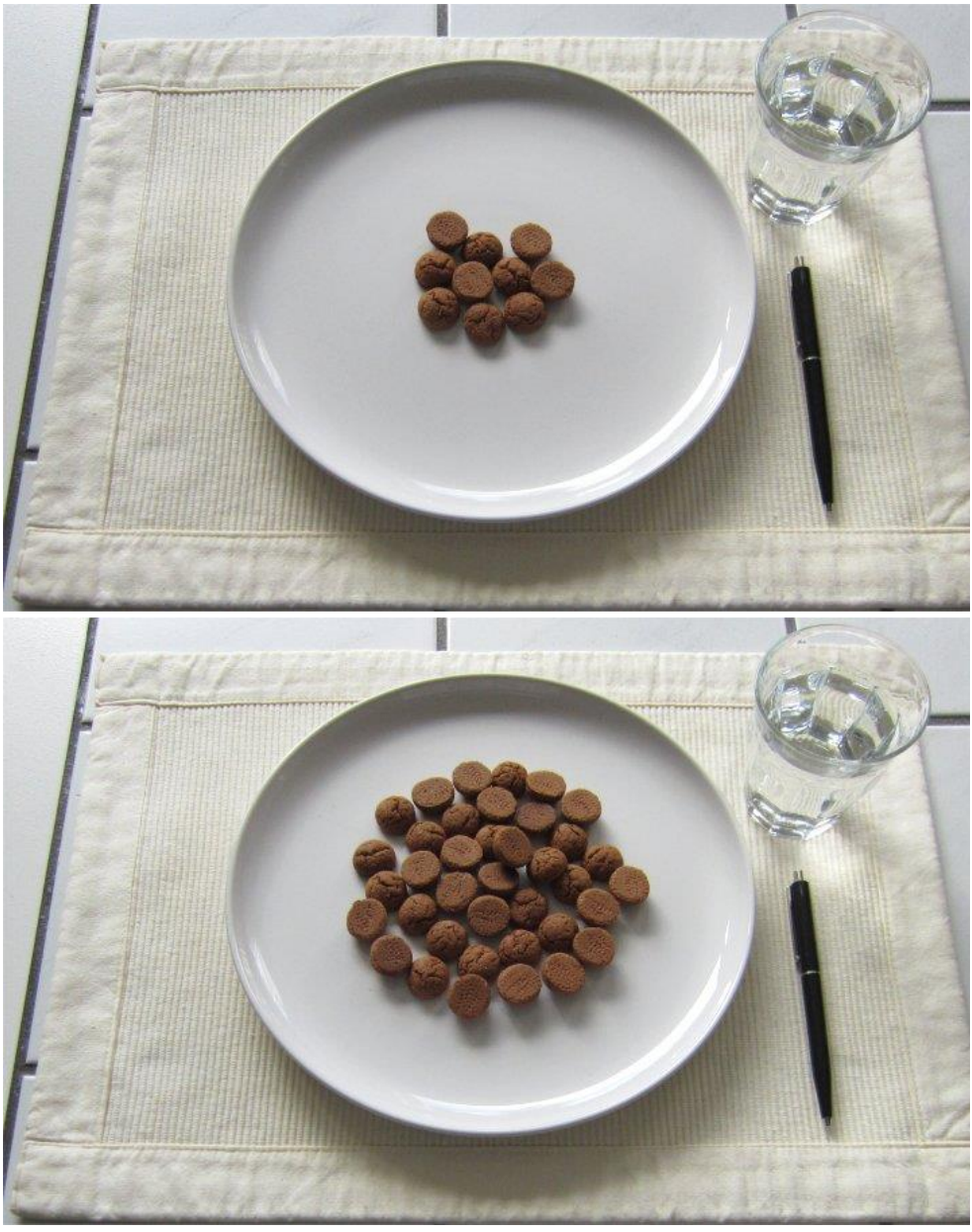
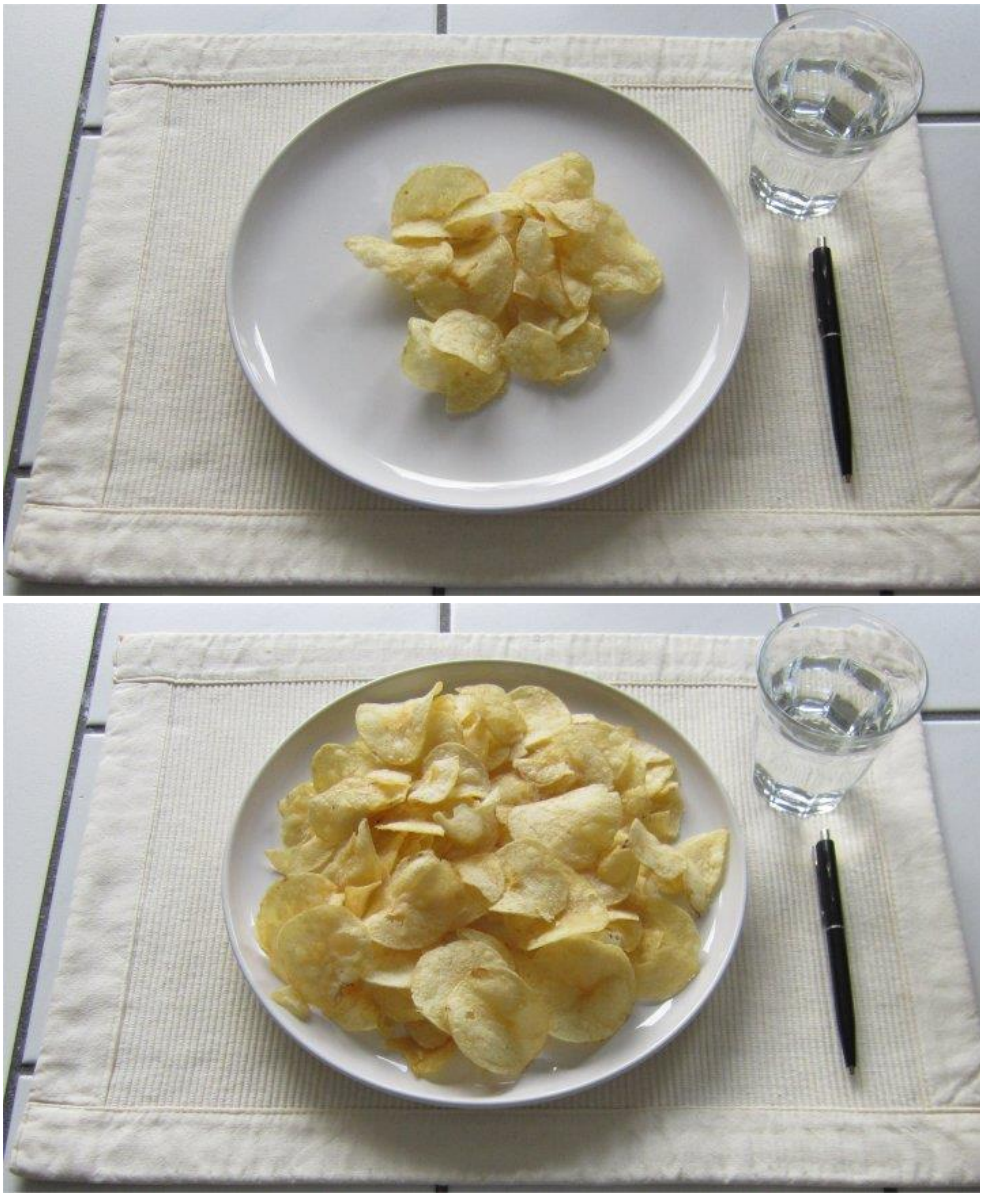


Figure 3.1.4. Chips– small and large portion



Appendix 3.2
Additional measures included in Experiment 2

Measure	Scale
Statements regarding the extent to which participants make their own portion size choices / are influenced by others: • I know very well what a suitable portion size for me is • I often check the package to see what the right portion size is • I honestly do not know if the portion sizes that I eat are suitable for me • To determine how much I can eat of something, I look at what others eat • I don't care how much others eat, I determine how much I eat	1 = *strongly disagree* to 7 = *strongly agree*
Identification with eating habits of Dutch women: • My eating habits are very similar to Dutch women • I have different eating habits than most Dutch women • My eating habits are healthier than those of the average Dutch woman • Most Dutch women are knowledgeable about eating healthily • Most Dutch women are knowledgeable about eating tasty	1 = *strongly disagree* to 7 = *strongly agree*
How often do you prepare an evening meal with fresh ingredients?	*0 – 7* times a week
How often do you use a kitchen scale when preparing a meal? How often do you use a measuring cup when preparing a meal?	1 = *never* to 7 = *always*
Currently pregnant or breastfeeding?	Yes/no
Currently using medicines that influence appetite?	Yes/no
Do you follow any of the following diets?	Participants that followed diets displayed in italics were not allowed to continue with the questionnaire. *cow-milk free* / *lactose free* / *diet for allergy nuts and peanuts* / *diet for diabetics* / protein restricted / fat or cholesterol restricted / *colour agent free* / energy or protein rich diet / I follow none of the above specified diets
Now or in the past diagnosed with an eating disorder?	Yes/no/no answer
Highest completed education	Lager onderwijs (LO) / Lager beroepsonderwijs (LBO) of Voorbereidend Middelbaar Beroepsonderwijs (VMBO) / MAVO / HAVO or VWO / MBO / HBO / Universitair / Other
Living situation	Living alone / Living with parents or family / Living with friends or students / Married or living with partner

Appendices Chapter 4

Appendix 4.1
Screenshots of the expected consumption questions – Experiment 1

Figure 4.1.1 Expected consumption question - chocolate large

Figure 4.1.2 Expected consumption question - M&M's with peanuts large

Figure 4.1.3 Expected consumption question – Chips large

Imagine that it is afternoon and you feel like eating something tasty. You decide to open the bag of chips shown below. The total weight of the bag is 300 grams.

On the picture below you see a hand of chips. How many of these hands of chips do you think you will eat?

Verder

Figure 4.1.4 Expected consumption question – Nuts large

Imagine that it is afternoon and you feel like eating something tasty. You decide to open the bag of cocktail nuts shown below. The total weight of the bag is 300 grams.

On the picture below you see a hand of cocktail nuts. How many of these hands of cocktail nuts do you think you will eat?

Appendix 4.2
Covers of the magazines – Experiment 1

Figure 4.2.1 Cover of the dieting magazine (diet prime condition)

Translation

From XXL to M! Sanne and Tim did it.

Discipline. Get it and hold on to it!

The newest fitness trends.

Tested: Losing weight. No diet, no muscle pain.

Win: A personal trainer worth €10.000!

Figure 4.2.2 Cover of the travel magazine (control condition)

Translation

Local in London. Unique, undiscovered places.

Amsterdam. Looking for Rembrandt.

Undiscovered cities: Krakow, Bern, Antwerp, Lille, Trier

Romantic Vienna

Win. Luxury weekend in Paris.

Appendix 4.3
Additional measures included in Experiment 1

Measure	Scale
Do you follow any of the following diets?	*cow-milk free* / *lactose free* / *diet for allergy nuts and peanuts* / *diet for diabetics* / protein restricted / fat or cholesterol restricted / *colour agent free* / energy or protein rich diet / I follow none of the above specified diets* * Participants that followed diets displayed in italics were not allowed to continue with the questionnaire.
What is your age?	Open-ended question
First impression of the magazine cover.	1 = *unattractive* to 5 = *attractive* 1 = *does not appeal to me* to 5 = *appeals to me* 1 = *does not attract attention* to 5 = *attracts attention* 1 = *busy* to 5 = *calm* 1 = *does not fit the content* to 5 = *fits the content*
Ranking of the 5 topics on the cover.	Most appealing topic gets a 1, least appealing topic gets a 5.
Evaluation of the colour scheme of the cover	1 = *does not attract attention* to 5 = *attracts attention* 1 = *busy* to 5 = *calm* 1 = *does not fit the content* to 5 = *fits the content*
Extent of (dis)agreement with a number of statements about the cover, such as: 'The topics on the cover are appealing' and 'I would pick up this magazine and leaf through it'	1 = *strongly disagree* to 7 = *strongly agree*
What price would you find reasonable for the magazine? Would you buy the magazine for that price?	Open-ended question I would definitely buy it; I might buy it; I would probably not buy it; I would definitely not buy it; I don't know
Selection of statements about snacking, including: 'When I take a snack, I determine upfront how much I will eat' and 'When I take a snack, I keep eating till I am no longer hungry'	1 = *strongly disagree* to 7 = *strongly agree*
Frequency of snacking in the afternoon	0-7 days a week
Currently pregnant or breastfeeding?	Yes/no
Currently using medicines that influence appetite?	Yes/no
Now or in the past diagnosed with an eating disorder?	Yes/no/no answer
Highest completed education	Lager onderwijs (LO) / Lager beroepsonderwijs (LBO) of Voorbereidend Middelbaar Beroepsonderwijs (VMBO) / MAVO / HAVO or VWO / MBO / HBO / Universitair / Other
Living situation	Living alone / Living with parents or family / Living with friends or students / Married or living with partner
Children below 18 living in the household	Yes/no
My expected consumption of the snacks was lower because I saw the health magazine.	1 = *strongly disagree* to 7 = *strongly agree*

Appendix 4.4
Additional measures included in Experiment 2

Measure	Scale
The trailer from <insert name movie>… / The short movie… - Made me sad - Made me laugh - Was exciting - Captured my attention - Trailers only: Gives a good overview of the content of the movie - Trailers only: I would like to see this movie - Short movie only: Was enjoyable	1 = *strongly disagree* to 7 = *strongly agree*
During the 15 minutes in which you watched the movie clips and ate M&M's, to what extent was your attention focused on the movie clips?	1 = *not at all focused on the movie clips* to 7 = *very much focused on the movie clips*
During the 15 minutes in which you watched the trailers and ate M&M's, to what extent was your attention focused on eating the M&M's?	1 = *not at all focused on eating the M&M's* to 7 = *very much focused on eating the M&M's*
How often do you eat a snack while watching tv?	1 = *never* to 7 = *always*
On how many days in the week do you take a snack?	Morning: *0 – 7* days Afternoon: *0 – 7* days Evening: *0 – 7* days
Selection of statements about snacking behaviour, including: 'When I take a snack, I determine upfront how much I will eat' and 'When I take a snack, I keep eating till I am no longer hungry'	1 = *strongly disagree* to 7 = *strongly agree*
Selection of statements from the appearance subscale of the State Self Esteem scale (Heatherton & Polivy, 1991), such as 'I feel satisfied with the way my body looks right now.'	1 = *strongly disagree* to 7 = *strongly agree*
Currently using medicines that influence appetite?	Yes/no
Do you follow any of the below diets?	*cow-milk free* / *lactose free* / *diet for allergy nuts and peanuts* / *diet for diabetics* / protein restricted / fat or cholesterol restricted / *colour agent free* / energy or protein rich diet / I follow none of the above specified diets* *Participants that followed diets displayed in italics were excluded from analyses.
Now or in the past diagnosed with an eating disorder?	Yes/no/no answer
I ate less from the M&M's because I saw commercials about dieting and sports.	1 = *strongly disagree* to 7 = *strongly agree*

Appendices Chapter 5

Appendix 5.1
Screenshots of the expected consumption questions – Experiment 1

Figure 5.1.1 Large chocolate bar – serving size recommendation

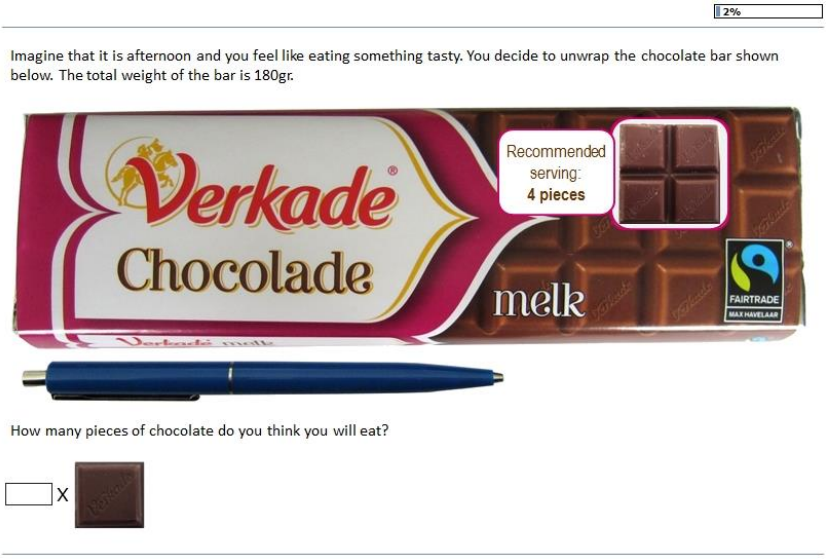
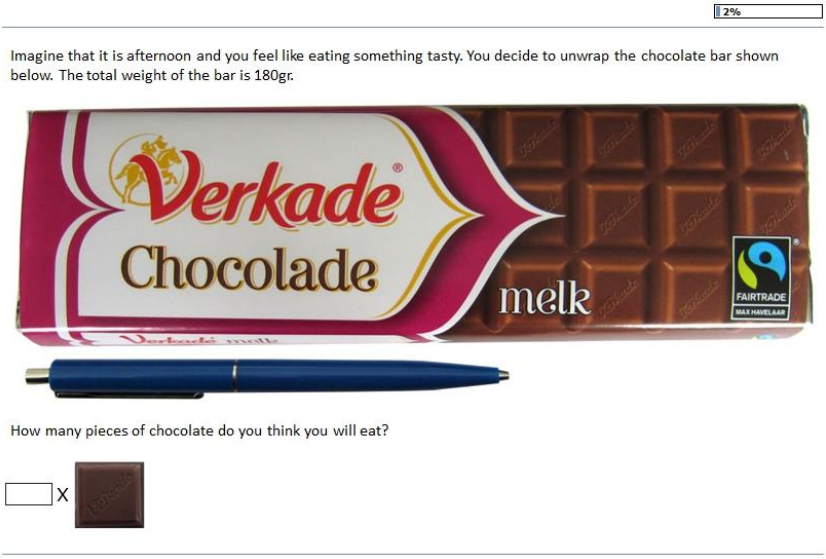


Figure 5.1.2 Large chocolate bar – no serving size recommendation



Appendix 5.2

Additional measures included in Experiment 1

Measure	Scale
Expected fullness after consuming the selected amount of chocolate	1 = *not full at all* to 7 = *very full*
Expected guilt after consuming the selected amount of chocolate	1 = *not guilty at all* to 7 = *very guilty*
Evaluation pack design*	Grade given to the package on a scale from 1 (*very bad*) to 10 (*very good*)
Whether or not the pack design gives a good impression of the product inside*	1 = *not good at all* to 7 = *very good*
Evaluation Verkade logo: recognizable; modern; trustworthy; conveys trust.*	1 = *not applicable at all* to 7 = *very much applicable*
Fullness after eating 4 pieces of chocolate	1 = *not full at all* to 7 = *very full*
Whether or not the picture conveyed the size of the recommended serving well	1 = *not good at all* to 7 = *very good*
The extent to which 4 pieces of chocolate is regarded as a sufficiently large portion size	1 = *clearly not enough* to 7 = *more than enough*
General opinion about the recommended serving size. Measured using 6 statements. For example: "I think it is a good idea to show the recommended serving size on the package."	1 = *strongly disagree* to 7 = *strongly agree*
Current dieting behavior	Currently tries to lose weight?: yes / no What kind of weight loss methods are used: list of weight loss methods popular in the Netherlands
Plate cleaning tendency	1 = *I never clean my plate* to 7 = *I always clean my plate*
Portion size control during the meal. Measured using 3 statements. For example: "Before the meal starts I determine how much I am going to eat and stick to that amount."	1 = *strongly disagree* to 7 = *strongly agree*
Saving food in the package. Measured using 2 statements. For example: "I don't like to keep food in opened packages, as the food will lose its freshness."	1 = *strongly disagree* to 7 = *strongly agree*
Frequency of preparing an evening meal with fresh ingredients	0-7 days a week
Use of a kitchen scale when preparing a meal Use of a measuring cup when preparing a meal	1 = *never to* 7 = *always*
Type of products for which nutrition labels are read	No products; products that are bought for the first time; products that are regularly bought; both products that are bought regularly and for the first time
Frequency of reading nutrition labels	Sometimes; regularly; always

*included to hide the true purpose of the study

Appendix 5.3
Screenshot of the expected consumption questions – Experiment 2

Figure 5.3.1 Small M&M bag – pictorial serving size recommendation

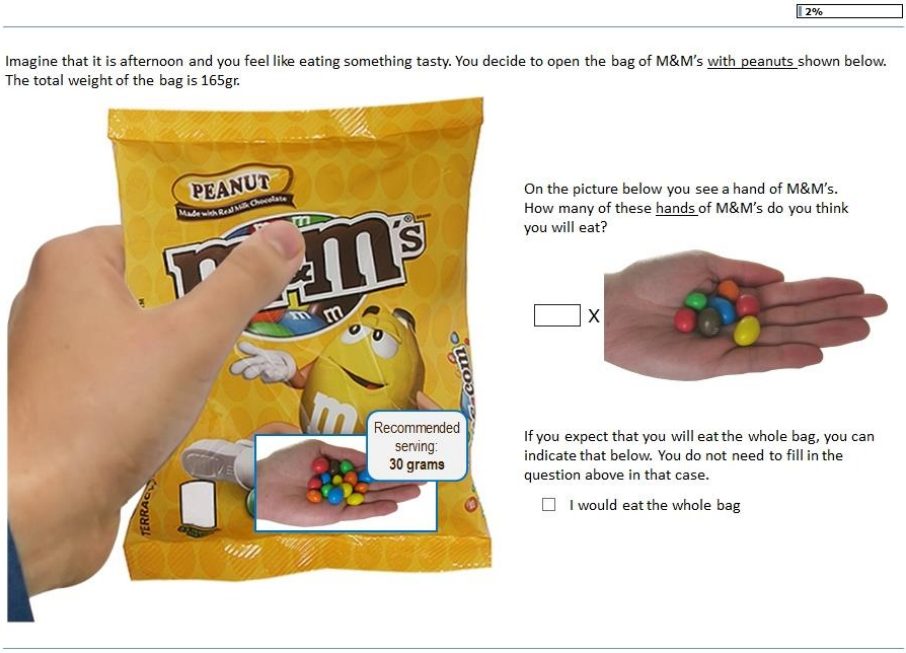


Figure 5.3.2 Small M&M bag – no serving size recommendation

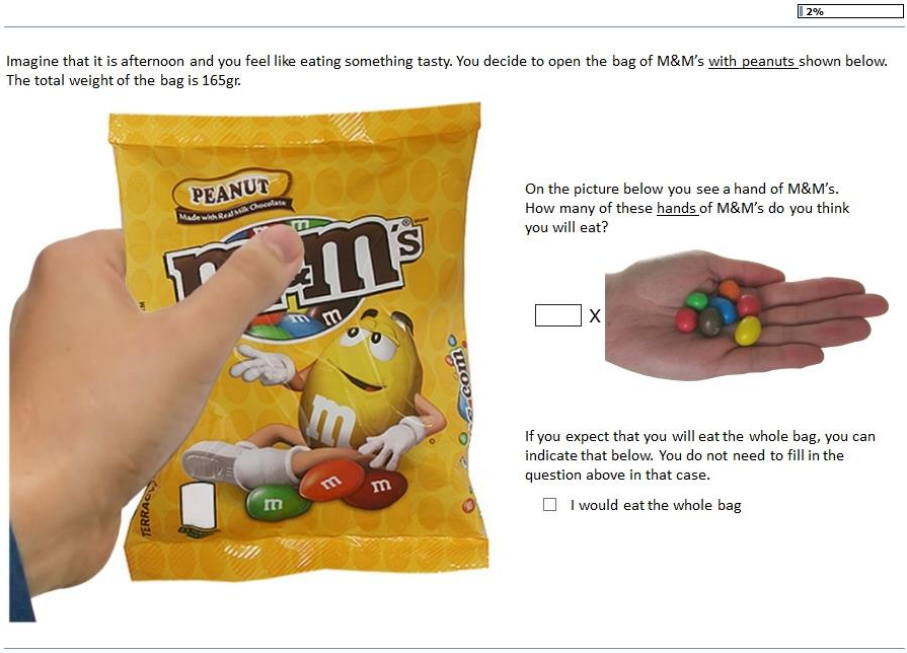
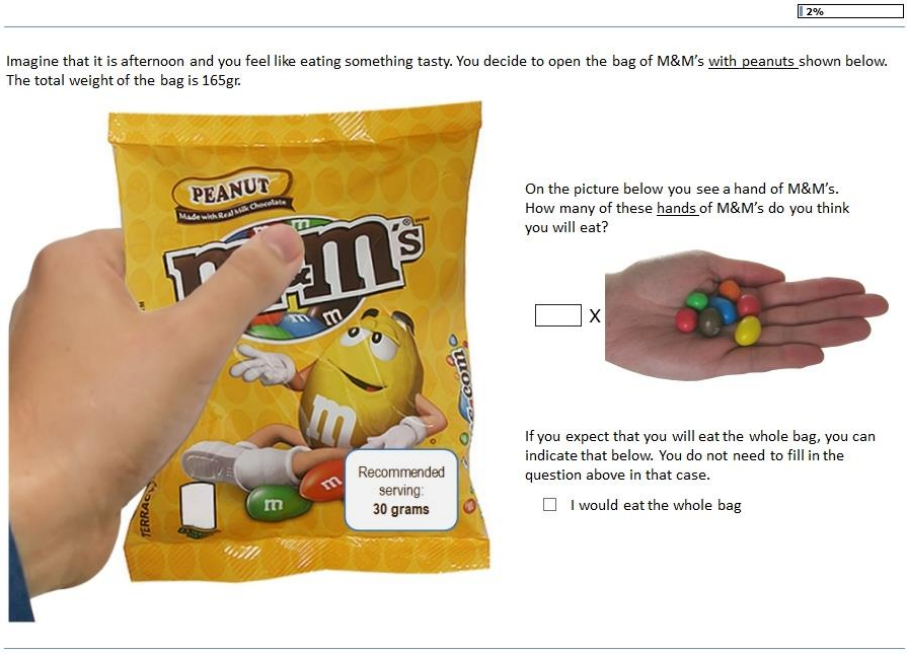


Figure 5.3.3 Small M&M bag – non-pictorial serving size recommendation



Appendix 5.4
The four snack types used in Experiment 2

Figure 5.4.1 Small and large pack of milk chocolate

Figure 5.4.2 Small and large bag of M&M's with peanuts

Figure 5.4.3 Small and large pack of TUC salty crackers

Figure 5.4.4 Small and large bag of cocktail nuts

Appendix 5.5
Additional measures included in Experiment 2

Measure	Scale
How participants determined their expected consumption amount for two randomly selected snacks.	Open-ended question
Difficulty indicating expected consumption of each of the four snacks	1 = *very difficult* to 7 = *very easy*
Non-pictorial serving size recommendation condition only: Participants gave an estimate of how much they thought the recommended serving in grams was in pieces or hands.	Estimate in pieces for chocolate and TUC crackers. Estimate in hands for M&M's and cocktail nuts.
General opinion about the recommended serving size. Measured using 6 statements. For example: "I think it is a good idea to show the recommended serving size on the package."	1 = *strongly disagree* to 7 = *strongly agree*
Current dieting behaviour	Currently tries to lose weight?: yes / no What kind of weight loss methods are used: list of weight loss methods popular in the Netherlands
Control over snacking behaviour. Measured using 7 statements. For example: "I often eat more from a snack than I intended to."	1 = *strongly disagree* to 7 = *strongly agree*
Saving food in the package. Measured using 2 statements. For example: "I don't like to keep food in opened packages, as the food will lose its freshness."	1 = *strongly disagree* to 7 = *strongly agree*
Currently pregnant or breastfeeding?	Yes/no
Currently using medicines that influence appetite?	Yes/no
Currently following specific diets? Currently following dietary rules?	List of diets List of dietary rules
Living situation	Living alone, living with parents or family, living with friends/students, married or living with partner
Presence of children in the household.	Yes/no

Appendix 5.6
Stimuli as used in Experiment 3

Figure 5.6.1 The bag of M&M's with the serving size recommendation and the bowl

Appendix 5.7
Additional measures included in Experiment 3

Measure	Scale
The trailer from <insert name movie>… Made me sad Made me laugh Was exciting Gives a good overview of the content of the movie Captured my attention I would like to see this movie	1 = *strongly disagree* to 7 = *strongly agree*
When eating the M&M's, how pleasant was… The taste of the M&M's The appearance of the M&M's The texture of the M&M's	1 = *not pleasant at all* to 7 = *very pleasant*
During the 10 minutes in which you watched the trailers and ate M&M's, to what extent was your attention focused on the trailers?	1 = *not at all focused on the trailers* to 7 = *very much focused on the trailers*
During the 10 minutes in which you watched the trailers and ate M&M's, to what extent was your attention focused on eating the M&M's?	1 = *not at all focused on eating the M&M's* to 7 = *very much focused on eating the M&M's*
How many hours per day do you spend watching TV? This includes the time you spend on watching programs via Netflix, Youtube, or other online services.	Less than half an hour, half an hour to an hour, an hour to two hours, two to three hours, three hours or more
Which types of movies do you prefer? Select a maximum of three.	Action, adventure, comedy, crime, fantasy, historic, horror, mystery, political, romantic, science fiction, thriller, other
To what extent did you took less M&M's than you wanted because of the presence of the sticker?	1 = *did not take less at all* to 7 = *took certainly less*

Summary

An increase in the portion size leads to an increase in energy intake, a phenomenon which is also referred to as the portion size effect. Previous research has shown that this effect occurs for different kinds of people, in different settings, and for different foods. Furthermore, the portion size effect persists over longer periods of time and has therefore been connected to the worldwide increase in overweight and obesity. Portion and pack sizes have increased in recent years and it is thus important to find ways to prevent the occurrence of the portion size effect.

In Chapter 2 I review what is known about the portion size effect to date and discuss possible causes of the effect. I expand on the view that consumers are uncertain about how much they should eat and therefore rely on external reference points, such as the portion size, to determine their consumption amount. The way the portion size is incorporated in the consumption quantity decision can vary, which leads to four different explanations for the portion size effect: cleaning the plate, unit bias, anchoring, and portion sizes as social norms. To prevent the portion size effect, people can be encouraged either to rely less on external reference points or to use other external reference points in the consumption decision.

In Chapter 3, we tested whether the portion size acts as a social norm and as such communicates how much is appropriate to eat. In two online experiments, we manipulated the normative relevance of the portion size, either by providing information that the portion size communicated the behaviours of an in-group (own university students) or out-group (students from a different university), or that it was approved by a minority or majority of a relevant social group. Results showed that participants expected to eat and serve more from larger than from smaller portions, but that this portion size effect was less pronounced when the normative relevance of the portion size was decreased. Furthermore, in Experiment 3.2, the relation between portion size and the expected amount served was partly mediated by the amount that was considered appropriate, providing further evidence that the portion size is indeed an indicator of the appropriate amount to eat. At the same time, mediation was only partial, and although the normative relevance manipulation weakened the portion size effect, it did not prevent it. Hence, social concerns about eating appropriately certainly play a role in the portion size effect, but there seem to be other causes as well.

In Chapter 4, we focussed on preventing the portion size effect by motivating people not to use external reference points, such as the portion size, in their consumption quantity decision. Previous research has shown that providing diet-concerned individuals with a reminder of their dieting goal can help them control their consumption, and we investigated whether such a reminder would also be effective in reducing the pack size effect. In Experiment 4.1, expected consumption of a number of snack foods was measured, and a dieting magazine served as the diet prime. In Experiment 4.2, actual consumption of M&M's was measured, and dieting commercials served as diet primes. The results of both

experiments indeed showed that restrained eaters lowered their (expected) consumption from large snack packages when exposed to a diet prime and as a result the pack size effect disappeared.

In Chapter 5, we tested whether instead of motivating people not to use an external reference point in the consumption decision, it might be effective to provide people with an alternative, better reference point in the form of a serving size recommendation. In three experiments, we measured (expected) consumption of unhealthy snack foods which were provided in either a small or large package which did or did not contain the serving size recommendation. Furthermore, we tested both a pictorial serving size recommendation, which displayed food amounts visually and a non-pictorial recommendation, which communicated the recommended amount in grams only. Only the pictorial recommendation reduced (expected) consumption from large packs and hence weakened the pack size effect. Although the serving size recommendation reduced the pack size effect, it did not seem to fully remove it, suggesting that it might not have provided sufficient motivation for everyone to no longer incorporate the portion size in the consumption quantity decision.

In summary, it is difficult, but not impossible to weaken the portion and pack size effect. These findings also imply that the tendency to eat more when more food is provided, is to a certain extent under conscious control. This means, that with sufficient help, people will be able to rely less on environmental cues, such as the portion size, when making consumption decisions.

Samenvatting

Een toename in de portiegrootte leidt tot een toename in energie inname. Dit fenomeen wordt ook wel het portiegrootte effect genoemd. Eerder onderzoek heeft laten zien dat dit effect zich voordoet voor verschillende typen mensen, in verschillende omstandigheden, en voor verschillende etenswaren. Bovendien houdt het portiegrootte effect ook over langere periodes aan en is het in verband gebracht met de wereldwijde toename in overgewicht en obesitas. Porties en verpakkingen zijn de afgelopen jaren in omvang toegenomen, en het is dus belangrijk om manieren te vinden om het portiegrootte effect te voorkomen.

In hoofdstuk 2 geef ik een overzicht van wat we tot nu toe weten van het portiegrootte effect en bespreek ik mogelijke oorzaken van het effect. Ik bouw voort op het perspectief dat consumenten onzeker zijn over hoeveel ze moeten eten en daarom hun consumptie baseren op externe referentiepunten, zoals de portiegrootte. De manier waarop de portiegrootte in de consumptiebeslissing wordt meegenomen, kan variëren, wat leidt tot verschillende verklaringen voor het portiegrootte effect, zijnde: de neiging om het bord leeg te eten, unit bias, het gebruik van de portiegrootte als een anker (anchoring), en de portiegrootte als sociale norm. Om het portiegrootte effect te voorkomen, kunnen mensen worden aangemoedigd om ofwel minder op externe referentiepunten te vertrouwen of om andere externe referentiepunten in de consumptiebeslissing te gebruiken.

In hoofdstuk 3 hebben we getest of de portiegrootte gebruikt wordt als een sociale norm die aangeeft hoeveel maximaal fatsoenlijk is om te eten. In twee online experimenten hebben we de normatieve relevantie van de portiegrootte gemanipuleerd, door ofwel informatie te verstrekken dat de portiegrootte is gebaseerd op eetgedrag van een zogenaamde in-group (studenten van de eigen universiteit) of out-group (studenten andere universiteit), of door participanten te laten geloven dat een meerderheid of een minderheid van een relevante sociale groep de portiegrootte een goede hoeveelheid vindt. De resultaten lieten zien dat de participanten verwachten meer te eten en te serveren van een grote portie dan van een kleine portie, maar dat dit portiegrootte effect minder sterk was indien de normatieve relevantie van de portiegrootte lager was. Bovendien werd in experiment 3.2 de relatie tussen portiegrootte en de verwachtte geserveerde hoeveelheid gemedieerd door the hoeveelheid die men fatsoenlijk vond, wat verdere ondersteuning biedt aan het perspectief dat de portiegrootte een indicator is van hoeveel fatsoenlijk is om te eten. Echter, de mediatie was slechts gedeeltelijk, en ondanks dat de normatieve relevantie manipulatie het portiegrootte effect verzwakte, werd het effect niet voorkomen. Dit betekent dat sociale normen zeker een rol spelen in het portiegrootte effect, maar dat er ook andere oorzaken lijken te zijn.

In hoofdstuk 4 hebben we geprobeerd het portiegrootte effect te voorkomen, door mensen te motiveren niet langer externe referentiepunten, zoals de portiegrootte, te gebruiken bij het bepalen van de consumptiehoeveelheid. Eerder onderzoek heeft laten zien dat mensen die zich zorgen maken over de lijn, hun consumptie onder controle houden als

ze herinnerd worden aan hun lijndoelen. We hebben daarom onderzocht of een dergelijke herinnering ook het portiegrootte effect kan verminderen. In Experiment 4.1 hebben we verwachte consumptie van een aantal snacks gemeten, en een dieet magazine diende als herinnering aan de lijndoelen. In Experiment 4.2, hebben we daadwerkelijke consumptie van M&M's gemeten, en dieetcommercials dienden als lijnherinnering. De resultaten van beide experimenten lieten zien dat participanten die zich zorgen maakten over de lijn, inderdaad hun (verwachte) consumptie uit grote verpakkingen verminderden na het zien van de lijnherinnering, waardoor het portiegrootte effect verdween.

In hoofdstuk 5 hebben we in plaats van te proberen om mensen te motiveren geen externe referentiepunten in hun consumptiebeslissing te gebruiken, ze gemotiveerd om een alternatief, beter referentiepunt te gebruiken, in de vorm van een aanbevolen portiegrootte. In drie experimenten, hebben we (verwachte) consumptie van ongezonde snacks gemeten, die ofwel in een kleine of grote verpakking werden aangeboden, waarop wel of niet een aanbevolen portiegrootte stond. Tevens hebben we zowel een aanbevolen portiegrootte inclusief plaatje van de portie getest, als een aanbevolen portiegrootte die alleen in grammen werd weergegeven. Alleen de aanbevolen portiegrootte met plaatje verminderde (verwachte) consumptie uit grote verpakkingen, en verzwakte dus het portiegrootte effect. Ondanks dat het portiegrootte effect werd verminderd door de aanbevolen portiegrootte leek het effect niet volledig te verdwijnen. Dit suggereert dat de aanbevolen portiegrootte niet iedereen voldoende motiveerde om niet langer hun consumptie op de verpakkingsgrootte te baseren.

We kunnen concluderen dat het moeilijk, maar niet onmogelijk is, om het portiegrootte effect te verminderen. Deze bevindingen impliceren ook dat de neiging om meer te eten als er meer eten beschikbaar is, tot op zekere hoogte onder bewuste controle is. Dit betekent dat met voldoende hulp, mensen in staat zijn hun consumptiebeslissingen minder te laten beïnvloeden door omgevingsfactoren.

About the author

Iris Versluis was born on June 12, 1984 in Sliedrecht, The Netherlands. She received her B.Sc. degree in Economics and Business (cum-laude) from Erasmus School of Economics. She received her M.Sc. degree in Marketing Research (cum-laude) from the same school. After her studies, Iris worked as a professional market researcher at agency SKIM for five years. Here, she specialized in discrete choice modelling and worked with various multinationals including Unilever and Procter & Gamble.

In 2012 she started as a PhD-candidate at the Erasmus Research Institute of Management (ERIM) under supervision of Prof. Philip Hans Franses. In 2013, Dr. Esther Papies joined the supervisory team. Iris' main research interests are in the area of eating behaviour, focusing specifically on portion sizes, restrained eating, goal activation, health claims, and social norms. Her work has been published in *Appetite* and she presented her research findings on various conferences including the Annual Meeting of the British Food and Drink Group, the General Meeting of the European Association of Social Psychology, and the INFORMS Marketing Science Conference. Her work has also been covered in both national and international media, including Business News Radio, Reformatorisch Dagblad and Men's Health.

Portfolio

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TEACHING

Erasmus School of Economics:
Supervision master theses Marketing, 2011 - 2015
Guest lecture on Experimental Methods (*BA3*), January 2015 / 2016
Marketing tutorials (*BA1*), 2014, International Bachelor Economics and Business Economics
Marketing tutorials (*BA1*), 2013, Economie & Bedrijfseconomie
Guest lectures on Choice Based Conjoint Analysis (*BA3*), 2009 - 2011
Supervision bachelor theses Marketing, 2005 - 2006

CONFERENCE PRESENTATIONS / POSTERS

Poster: The effect of a serving size recommendation on the amount of snack food served and on the magnitude of the pack size effect. Annual Meeting British Feeding & Drinking Group (BFDG), 2015, Wageningen, NL

Poster: Preventing the pack size effect: Effectiveness of serving size recommendations European Association of Social Psychology General Meeting, 2014, Amsterdam, NL

Talk: Preventing the pack size effect: Effectiveness of serving size recommendations
Annual Meeting British Feeding & Drinking Group (BFDG), 2014, Portsmouth, UK

Talk: Can Anchoring Effects be Used to Increase the Consumption of Fruit and Vegetables?
Marketing Science Conference, 2012, Boston, US

PHD COURSES

Erasmus Research Institute of Management (ERIM):
Research Methodology and Measurement
Statistical Methods
Applied Econometrics
Topics in Consumer Behavior
Experimental Methods in Business Research
Behavioral Foundations
Data Analysis with R

VLAG Graduate School: Sensory Perception and Food Preference

CentER Graduate School: Consumer Behavior

MEDIA COVERAGE

Seeing is Slimming, Men's Health US, June, 2015
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Cambridge English: Proficiency (CPE): A-level

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DISSERTATIONS LAST FIVE YEARS

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PREVENTION OF THE PORTION SIZE EFFECT

An increase in the portion size leads to an increase in energy intake, a phenomenon which is also referred to as the portion size effect. The increase in portion sizes in recent years is regarded as an important contributor to the increase in the prevalence of obesity. Hence, the aim of this thesis is to better understand why the portion size effect occurs and what can be done to prevent it.

We found that one of the reasons why people rely on the portion size when determining how much to eat, is because it is an indicator of what others will find an appropriate consumption quantity. To prevent the portion size effect, we explored whether it would be effective to remind diet-concerned people of their dieting goal. Such a reminder motivates diet-concerned people to control consumption, which makes it less likely that they will use the portion size as an indicator of how much they can eat. We indeed found that this reminder prevented the portion size effect. Finally, we showed that provision of a pictorial serving size recommendation can also weaken the portion size effect. A serving size recommendation provides people with an alternative reference point to rely on when determining their consumption amount, and hence they don't need to rely on the portion size.

We conclude that with sufficient help, people will be able to rely less on environmental cues, such as the portion size, when making consumption decisions.

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