RUNNING HEAD: DOES EATING IN FRONT OF A MIRROR AFFECT CONSUMPTION?

"Mirror, mirror on the wall": Can visual illusions be used to 'trick' people into eating less?

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ABSTRACT

Given the growing obesity crisis in many parts of the world, and given the seeming failure of conventional strategies to curb it, researchers are increasingly looking to visual illusions, and other 'tricks of the mind', in order to try and help convince us that we are eating more than is, in fact, the case. The hope is that such approaches may help convince people to be satisfied with less. One of the novel solutions that has been proposed recently involves the use of mirrored plateware to double the amount of food that the diner sees placed before them. But will such solutions really help curb our appetites in either the short-, or more importantly, the long-term? And how does this approach compare to other strategies involving the use of the Delboeuf illusion, crinkly curved plateware, and even augmented reality solutions to making smaller portions look a little more substantial? While the idea that mirrored plateware will make us eat less might sound fanciful to some, it is worth pausing for a moment, before dismissing the idea, to consider the effects that mirror therapy have been reported to have on the relief of phantom limb pain, chronic regional pain syndrome, etc. What is more, several published studies have demonstrated that eating in front of a mirror large enough to reflect the person eating can indeed affect taste and consumption – though the direction and magnitude of these effects appears to depend on the food (healthy or not), and who, exactly, is doing the eating (e.g., are they obese and/or concerned about their weight).

KEYWORDS: MIRRORS; CONSUMPTION; APPETITE; MIRROR THERAPY; FOOD ILLUSIONS.

Introduction

Given the growing obesity crisis in many parts of the world (e.g., Lifshitz & Lifshitz, 2014; World Health Organization, 1998), and given the seeming failure of conventional strategies to do much to curb it, researchers are increasingly looking to the use of visual illusions, and other 'tricks of the mind', in order to try and help convince us that we are eating more than is in fact the case (see Klein, 2017). The hope and, in some cases, the promise, is that such unconventional approaches may deliver long-term benefits to our waistlines, given the steady increase in portion sizes that have been documented over recent decades (Marteau, Hollands, Shemilt, & Jebb, 2015; Nielsen & Popkin, 2003; Young & Nestle, 2002, 2013). According to estimates, nearly 70% of adults in the United States are overweight and close to 40% are considered obese (National Center for Health Statistics 2014). One of the novel solutions proposed recently involves the use of mirrored plateware to double the amount of food that the diner sees placed before them (see **Figure 1**). But could such a simple solution (a half plate, bowl or cup, with a mirror attached to the rear side) really have a meaningful effect on people's consumption over the long-term?

Figure 1. Mirrored tableware designed to trick people into changing their eating habits (Anon., 2017).

Over the years, mirrors have often been shown to provide an effective means of changing people's perception of various objects, including the viewer's own body (e.g., Holmes & Spence, 2005; Stratton, 1899). Research using mirror box therapy has proven to be especially effective (at least in the short-term) in reducing phantom limb pain in those for whom conventional approaches (e.g., surgery or medicine) simply don't work (e.g., Ramachandran, Rogers-Ramachandran, & Cobb, 1995). Now, whether the benefit is attributable to what is

seen in the mirror (i.e., to perception), or to the motor imagery that may be encouraged under such conditions of mirror feedback, is unclear, as is the long-term effectiveness of such approaches (see Moseley, Gallace, & Spence, 2008, for a critical view in this regard). Nevertheless, the evidence now incontrovertibly shows that mirrors can be used to convince us that our limbs are located elsewhere than they actually are (e.g., Holmes & Spence, 2005; Nielsen, 1969). Mirror therapy has also been used to help reduce the pain suffered by phantom limb patients (e.g., Chan, Witt, Charrow, Magee, Howard, Pasquina, et al., 2007; Ramachandran & Altschuler, 2009), and chronic regional pain syndrome patients (McCabe, Haigh, Ring, Halligan, Wall, & Blake, 2003; Tichelaar, Geertzen, Keizer, & van Wilgen, 2007) in the short-term, at least if the mirror feedback is used as part of graded motor imagery therapy.

Given such evidence, it doesn't *a priori* seem as unreasonable as perhaps at first it might that mirrored plateware could potentially also be used to help trick the brain into eating less, by making it look like people are eating twice as much as is actually the case. And while the relevant research is yet to be conducted, evidence on the use of other visual illusions to curb consumption (discussed below) suggests that this might well be a promising approach, one that is worthy of empirical investigation. What is more, a growing number of chefs are now starting to challenge the norm as far as what is considered acceptable in terms of plateware (see Spence, 2017b; Spence & Piqueras-Fiszman, 2014). Indeed, some have already tried serving from mirrored plateware though, to date, the aim seems to have been more to do with the delivery of a dramatically-plated dish than necessarily with an eye on the weight control management of their diners. Nevertheless, it can be argued that the culinary landscape would, in many locations at least, now seem ready to embrace unusual plateware such as that shown in **Figure 1**, in a way that was simply not the case even a few years ago.

One concern that the designers of the mirrored plateware may not have considered though is that it guarantees that there will, of course, always be an *even* number of items on the plate i.e., the food items and their mirror reflections. According to traditional kitchen folklore, odd numbers of food items are meant to be preferred over even numbers of items on the plate, and hence one might, on average, expect mirrored plateware to reduce liking somewhat. However, arguing against this putative concern, the latest online research has convincingly demonstrated that what people really care about (or prefer) is the plate with more food on it, and odd vs. even actually seems to have no effect (see Woods, Michel, & Spence, 2016).

Comparing the effects of mirrored plateware to other portion-size illusions

Should future research demonstrate that mirrored plateware really does help curb people's food consumption, two further questions will immediately arise: 1) How long-lasting are the effects? And 2) How do the benefits, in terms of reduced consumption, compare to the other visual illusions that have been shown/suggested to help reduce consumption, e.g., serving from small plates (e.g., Van Ittersum & Wansink, 2012; though see also Holden, Zlatevska, & Dubelaar, 2016; Robinson et al., 2014), or varying plate/bowl rim size to induce the Delboeuf

Illusion (McClain, van den Bos, Matheson, Desai, McClure, & Robinson, 2014; Petit, Velasco, & Spence, submitted). Unfortunately, suggestive early evidence that simply reducing the size of the plateware would provide an effective means of reducing consumption (Wansink & Van Ittersum, 2013; Wansink, van Ittersum, & Painter, 2006) have not been replicated by subsequent authors nor strongly supported by the results of the relevant meta-analyses (e.g., Ayaz, Akyol, Cetin, & Besler, 2016; Hollands, Shemilt, Marteau, Jebb, Lewis, Wei, Higgins, & Ogilvie, 2015).[1] Finally, a Latvian designer recently developed a curved crinkly plate designed to make it look like there is more food on the plate than is actually the case (see Stoppard, 2017).

One intriguing augmented reality (AR) application in this space was reported by Narumi, Ban, Kajinami, Tanikawa, and Hirose (2012). These Japanese scientists developed an AR system that is capable of modifying the visually-perceived size of a hand-held food item. The idea here was that people might eat less if it appears as if they are consuming a larger item of food than is actually the case. The results of preliminary research using this high-tech solution have been encouraging. In particular, Narumi and his colleagues were able to demonstrate (in one experiment) that people consumed less when the food that they had been given to eat (a cookie in this case) was made to look bigger than it actually was.

Eating in front of the mirror

It is worth noting that mirrors may have another function in terms of modulating consumption. In fact, the latest research published by Nakata and Kawai (2017) has demonstrated that for those who dine alone, eating in front of a mirror can actually make food taste better as well as result in people eating *more*, not *less*! These Japanese researchers had older and younger groups of participants eat two types of popcorn (caramel-flavoured and salty) from half-filled paper bowls. The participants tasted each type of popcorn for a period of 90 seconds, rating the following on 6-point scales (anchored at one end with the label "not at all" and "extremely" at the other): "How good is this popcorn?" "How do you feel about the quality of the popcorn?" "How much do you like this popcorn?" "How filling is the popcorn?" "How salty is this popcorn?" "How sweet is this popcorn?" and "How bitter is this popcorn?"

The participants in Nakata and Kawai's (2017) studies evaluated the two flavours of popcorns once while sitting in front of a mirror that reflected themselves from the waist-up, and once when sitting in front of a monitor showing a picture of a wall instead. The results (see **Figure 2**) revealed that regardless of the age of the participants, the popcorn was rated as tasting better and participants ate significantly more of it in the self-reflecting condition than in the monitor condition.

[1] Though see also Robinson (2017); van der Zee, Anaya, & Brown, 2017); and http://www.brianwansink.com/phd-advice/statistical-heartburn-and-long-term-lessons.

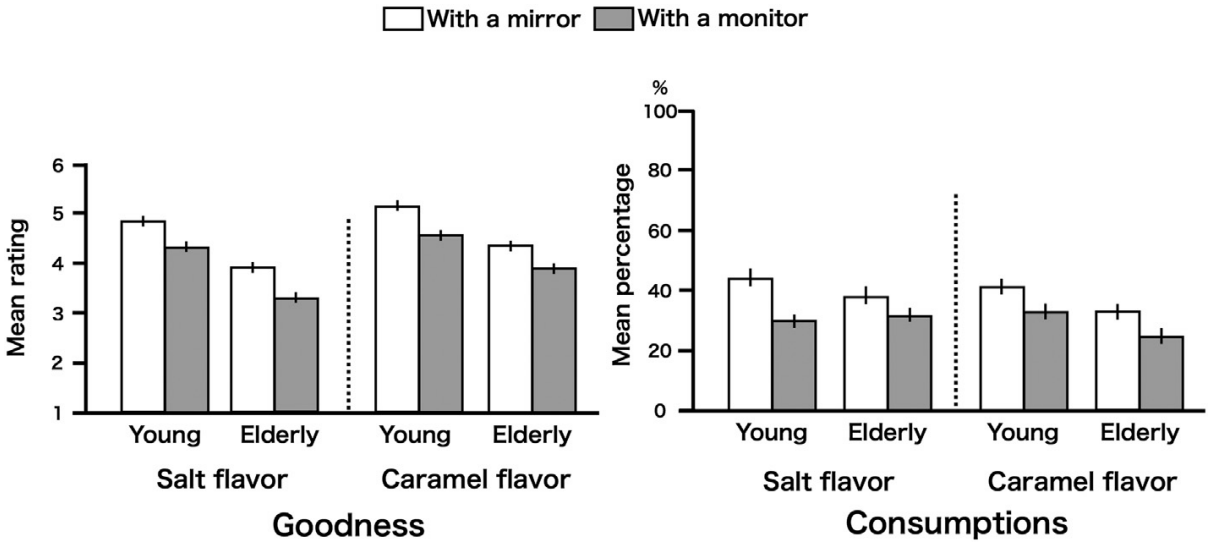

Figure 2. Mean ratings of how good the popcorn tasted and mean consumption ratio among elderly and young adults in Nakata and Kawai's (2017) recent study. The vertical bars represent the standard errors.

Nakata and Kawai (2017) explained their results in terms of the literature on the social facilitation of eating (see Boothby, Clark, & Bargh, 2014; Herman, 2015; Spence, 2017a). They related their findings to the literature showing that people tend to eat more when dining with others than when dining alone. The suggestion was that the dynamic mirror-reflection acted as a 'virtual' dining companion for the participants.[2] The latest research shows that viewing a static smiling face leads to a change in taste ratings when compared to the ratings obtained when people view an unhappy (i.e., crying) face instead (see Wang & Spence, 2017). As such, one might worry that the mirror/static self-image effects could have resulted from the participants seeing their own smiling face and this enhancing their mood (and hence their evaluation, and possibly consumption, of the food).[3] Importantly, however, no change in self-reported mood was documented after (as compared to before) eating the popcorn in any of the conditions/experiments, thus arguing against any kind of mood-based account of Nakata and Kawai's results.

Thus, in contrast, to the claims of those producing the mirrored-plateware (discussed earlier), Nakata and Kawai's (2017) results would appear to demonstrate that eating in front of a mirror can actually lead to an *increase* in consumption, at least if the mirror happens to be large enough for the person to see themselves eating.[4]

[2] Intriguingly, in another of Nakata and Kawai's (2017) experiments, elderly participants also consumed more popcorn when placed in front of a static picture of themselves. Who knows if the social facilitation of eating account can also help explain the phenomenal rise of Mukbang (people tuning in to other people eating over the internet while they eat alone) in Korea and other parts of Asia in recent years (see Vice Foods, 2015.

[3] No mention of the expression adopted by participants is given in the paper itself.

[4] Here it is perhaps also worth noting that the latest research suggests that self-reflection tends to lead to attention shifting downward (Liu, Tong, & Li, 2017).

It is, though, important to remember here that the results of a number of other published studies have shown that whether eating in front of a mirror leads to a change in people's choices/consumption behaviour depends both on the food that they happen to be consuming (e.g., whether it is perceived as healthy or not) and on whether the person in the mirror is obese, overweight, or just concerned about their weight or not (see Alawad, Mahgoup, & Yousef, 2015; Jami, 2016; Pliner & Iuppa, 1978; Sentyrz & Bushman, 1998; see also Goukens, Dewitte, & Warlop, 2009).[5] So, for example, Pliner and Iuppa reported that chicken soup (a not unhealthy comfort food; Spence, 2017c) tasted better when eaten in front of the mirror. Meanwhile, Jami reported a series of four studies showing that unhealthy foods (such as chocolate brownies) could be made less tasty simply by having people eat them in front of a mirror (putatively due to the mirror's effect on increasing the participant's self-awareness that they are going against standards of healthy eating; cf. Heine, Takemoto, Moskalenko, Lasaleta, & Henrich, 2008; Wiekens & Stapel, 2008). Interestingly, research on the impact of plate and bowl size has come to a similar conclusion concerning the importance of individual differences in demonstrating effects on consumption (Holden et al., 2016).

Conclusions

It is currently too early to say whether mirrored-plateware actually does affect people's consumption or not, since the relevant research is yet to be conducted. However, there is, I would argue, sufficient evidence out there, both from the literature on mirror therapy for patients with phantom limb syndrome/chronic regional pain syndrome (e.g., Chan et al., 2007; McCabe et al., 2003; Ramachandran & Altschuler, 2009; Ramachandran et al., 1995; though see also Moseley et al., 2008), and from the use of other visual illusions (e.g., Narumi et al., 2012; Petit et al., submitted; Robinson et al., 2014; see also Wiederhold, Riva, & Gutiérrez-Maldonado, 2016) to make this potential new solution worth investigating empirically. However, the challenge will be to demonstrate that such 'tricks of the mind' have a beneficial effect in the *long*- and not just in the *short*-term. Unfortunately, to date, most of the studies in this area have been restricted to very short-term assessment of the effects of the interventions concerned (e.g., within a single eating episode, or experimental session; see also Spence, Ranasinghe, Velasco, & Obrist, 2017, on this point).

It is in this regard that food illusions may turn out to be fundamentally different from other kinds of multisensory illusions that do not have such obvious consequences for survival (i.e., according to some researchers, food and nutrition is the one area where the brain cannot afford to be fooled (e.g., by such portion size illusions), especially not in the long-term; cf. Koza, Cilmi, Dolese, & Zellner, 2005). As a case in point, one need only consider the impact of low-fat meals on consumption which clearly show that while their introduction may lead to a short-term reduction in consumption, over the longer term people simply end up consuming more as their brains seem to have learned that they are not getting enough (cf. Yeomans,

[5] According to urban myth, the actress Gwyneth Paltrow also recommends eating in front of a mirror to curb consumption.

Lartamo, Procter, Lee, & Gray, 2001). Only time will tell whether the effect of looking in the mirror will turn out to be longer-lasting or not.

Competing interests

The author declares that he has no other competing interests.

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