

Crossmodal correspondence between sound and smells in marketing

A study investigating the effect of sound-odour congruence on attitude towards an advertisement, brand, product and brand memory.

Master thesis Communication and Influence

Supervisors: I., Croijmans & L., Speed

Second reader: B., Hilberink-Schulpen

Radboud University Nijmegen

18 July, 2016

Student: Marijn Peters Rit

Student number: s4227409

E-mail: marijnpr@msn.com



Radboud Universiteit Nijmegen

Abstract

As humans we tend to match stimuli from different sensory modalities together. This is called ‘crossmodal correspondence’. Previous studies have already explored congruence effects. However, few studies have looked at the influence of sound-odour congruence on attitude and memory, while simultaneously also taking notice of marketing implications. Therefore, this experimental study looked at the sound-odour congruence effects on people’s evaluation of advertisements, brands and products and on people’s brand memory. In addition, the possible differences in congruence effects between familiar and unfamiliar brands were tested.

This was done by letting participants smell odours, half of them high and half of them low arousal. After each odour, an advertisement with a high or low arousal jingle and a familiar or unfamiliar brand was presented to them. Based on participants’ evaluation of the advert, brand and product, the existence of congruence effects on attitude was determined. Participants’ memory was tested with a recognition task. Based on their recognition accuracy and reaction times, possible congruence effects on memory were measured.

In general, no sound-odour congruence effect was found on people’s attitudes, irrespective of brand familiarity. This shows that congruence in sounds and odours will not always be helpful in creating more positive attitudes. However, individuals’ need for arousal did influence people’s attitude towards the advertisement. Individuals with a relatively high need for arousal preferred advertisements with high arousal sounds compared with low arousal sounds. In addition, a congruence effect was found on memory. When odour and sound were congruent in terms of high arousal, individuals’ reaction times were faster than in case of incongruence. This means that sound-odour congruence, under certain conditions, can positive influence memory. In addition, familiar brands were faster recognized than unfamiliar brands, but only when sound and odour arousal were high.

By looking at the (combined) effects of sound and odour on attitude and brand memory, this study created some insight into the if and when sound and odours can be used for marketing.

1. Introduction

Crossmodal correspondence between sounds and smells in the marketing industry

Our senses have to deal with many sensory signals every single second. Consequently, we need to determine which part of the diverse set of signals belongs to the same object, whilst separating the signals that do not. Our brain prefers some sensory combinations over others, due to our implicit mappings (Simner, Cuskley, & Kirby, 2010). Consequently, crossmodal matches can occur between distinct sensory dimensions: crossmodal correspondence.

Crossmodal correspondence is ‘a tendency for a sensory feature, or attribute, in one modality, either physically present or merely imagined, to be matched (or associated) with a sensory feature in another sensory modality’ (Spence & Parise, 2012, p. 410).

Crossmodal correspondences are most likely to manifest themselves when stimuli from different modalities are presented around the same time (Spence, 2011). Moreover, they occur between a variety of modalities. Studies supporting the idea of crossmodal correspondence have revealed that people consistently match certain modalities together when asked. In such crossmodal matching experiments subjects have to match one or more standard items from one modality with comparison items from another modality.

An example of this is a study about pitch and vision which showed the preference of combining larger objects with low-pitched sounds and smaller objects with higher-pitched sounds (Evans & Treisman, 2009). In addition Hubbard and Ramachandran (2001; 2003) have shown crossmodal correspondence between shapes and words. When people were asked to match shapes to the word “bouba”; they consistently matched it to a curvy shape. In contrast, when they were asked to match shapes to the word “kiki”, it was consistently matched with angular shapes. Likewise, crossmodal matches have been found between vision and touch, vision and odour, audition and touch, colour and audition, audition and flavours and tastes, audition and odours, and colours and tastes, flavours and scents (as cited in Spence, 2011). Further examples supporting the idea of crossmodal correspondences can be found in Spence’s review (2011). All these correspondences exist because they help us to make more sense of our environment (Spence, 2011).

Since crossmodal correspondences occur between many modalities, the importance of the phenomenon cannot be overlooked. Crossmodal correspondence can influence people’s perception and behaviour (Spence, 2011). It is therefore not surprising that it has reached the interests of many fields of research, for example the field of marketing and consumer

research. If crossmodal correspondence can influence behaviour, it might play a significant role in stimulating buying behaviour and other marketing related processes.

The main step from here is to decide which out of the set of five modalities can influence consumer behaviour and how. Our sense of touch is important for normal functioning but it is less influential in direct advertising, since touch is not the most important sensory dimension when watching/seeing an advertisement or buying a product in a store. Tastes can be important because they determine whether we like certain products. Sound, vision and smell, can also be essential for marketers: hearing an advertisement, seeing an advertisement and scenting a shop. Since the effects of crossmodal correspondence between our visual and gustatory (taste) system have already been studied frequently (Spence, 2011), and our sense of touch is less applicable in advertisements, more insight is necessary into the two other types of sensory systems: the olfactory and auditory system.

One of the main reasons that processes of our olfactory system are interesting for marketers, is that smell is believed to be closely linked to memory and emotion, according to Vroom (1995) and Draaisma (2001) (as cited in Davies, Kooijman, & Ward, 2003). Moreover, unlike with other stimuli, at first, we tend not to consciously think before we respond to smells (Vlahos, 2007). Smelling is initially an unconscious process that later on can surpass the threshold of awareness (Vlahos, 2007). This is interesting for marketers because of the potential automatic responses to marketing stimuli (Bradford & Desrochers, 2009). Besides smell, sound has also proven to be of use in the field of marketing. Music is capable of influencing people's moods and affect (Kellaris & Kent, 1993). Furthermore, music appears to affect cognitive and behavioural responses, which makes it interesting for marketers.

In sum, researchers have already looked at the influence of sound on behaviour and emotion (Kellaris & Kent, 1993), and at the effect of certain odours on emotion (Davies et al., 2003). However, little research has combined both modalities *whilst* looking at practical implications for the marketing industry. Therefore, this study will look at the influence of crossmodal congruence between sounds and smells and its marketing potential.

Each modality (sound and smell) will in turn be described before they will be considered together. This study will focus on the influence of crossmodal correspondence on people's attitudes towards advertisements, brands and products, and people's brand memory, whilst examining potential differences between familiar and unfamiliar brands. Overall, this study will investigate if and how crossmodal correspondences affect people's attitudes and memory, while looking at familiar versus unfamiliar brands.

1.1. Auditory system

Sounds are of extreme importance in the marketing industry. All radio and almost all television commercials contain sounds to make the presented product or service more appealing to the audience. Further important characteristics of sound are its ability to influence people's behaviour, moods and affect (Kellaris & Kent, 1993). According to Gabrielsson (2001) musical stimuli are part of the group of the most powerful triggers of strong emotion (as cited in Rickard, 2004). When presented with an advertisement, music can change how the consumer feels when seeing the advertisement (Morris & Boone, 1998). Stores already respond to this by trying to influence consumers' buying behaviour by creating a better atmosphere with sounds and consequently increase profit (Petruzzellis, Chebat, & Palumbo, 2014).

Many studies have already looked at this implication of sound. For instance, a recent study showed that sounds associated with certain products (e.g. the crunching of potato chips) can facilitate consumers' search and selection of those products (Knoeferle, Knoeferle, Velasco, & Spence, 2014). This facilitation could even manifest itself in case of new associations with unfamiliar brands (Knoeferle et al., 2014). In addition, Hul, Dube and Chebat (1997) investigated the impact of music on consumers' reactions to waiting for services in a bank, and found that music can influence the perceived waiting time. Music overall appeared to positively influence the way in which the environment of the service was evaluated. Positively valenced music lead to more positive emotional responses to the wait and to more approach behaviour towards the organization presenting the service (Hul et al., 1997).

In line with this, music genre can influence the perceived pleasantness of flavours and the overall impression of emotional food stimuli (e.g. chocolate) (Fiegel, Meullenet, Harrington, Humble, & Seo, 2014). Food stimuli were liked more when participants listened to jazz music instead of hip-hop. However, the difference in liking between genres was only found for music of single performers, not for multiple performers. A possible explanation is that music by multiple performers is seen as more complex, which may lead to reduced variations in elicited emotion between the different genres.

The studies above support the assumption that music can influence consumer behaviour. When looking at the existence of relations between sounds and behaviour, marketers could influence buying behaviour by varying the sounds in stores, and jingles in adverts. Nevertheless, some critics have pointed out that in-store music perhaps only affects a small percentage of the customers, as conscious appreciation or awareness of the music are

rarely initiated (Hynes, & Manson, 2016). Hence, more research is needed to investigate under which conditions music can positively influence consumer behaviour.

The influence of sounds on behaviour has been studied in combination with other stimuli such as visuals and smells often in crossmodal matching experiments (Spence, 2011). In case of crossmodal correspondence between sounds and other modalities, sounds are matched with specific characteristics regarding vision, smell, touch or taste (Spence, 2011). The following section will elaborate on examples of these crossmodal (matching) experiments and their implication for the marketing industry.

1.1.1. Crossmodal correspondence with sound

Many studies have already shown that specific sounds are preferably matched with certain characteristics of other modalities. For example, one study looked at background sounds and their effect on perception of taste (Crisinel et al., 2012). Changing the pitch of sounds in the background influenced the taste of food. Participants had to taste four pieces of honeycomb while listening to two soundtracks. One of them fitted better with sweet-tasting food, the other with bitter-tasting food. The soundtracks were based on Crisinel and Spence (2012), who showed that low-pitched brass notes were associated with bitter taste and high-pitched piano notes with sweet taste. The honeycomb tasted significantly more bitter while listening to sounds that were more crossmodally congruent with bitter tastes (low pitch). In contrast, the toffees tasted sweeter when listening to the 'sweet', higher pitched, soundtrack.

Another study showed the influence of sound combined with visual aspects on people's perception of flavour. Three different environmental settings were created: the grassy, woody and sweet room. The grassy room contained plants and sounded like a summer meadow, the woody room contained wood and contained sounds like creaking timbers, and the sweet room consisted of red globes and sounded like tinkling bells. The participants walked through the three different rooms with a glass of whisky. The whisky was perceived as significantly more grassy in the grassy room, sweet in the sweet room, and woody in the woody room. The experiment suggests that audiovisual stimuli can influence perception. However, it is likely that participants were aware of the idea behind the study, since they had to evaluate whiskey in all three rooms. They might have acted accordingly (Velasco, Jones, King, & Spence, 2013).

These results imply that crossmodal congruence occurs between sounds and other modalities and can affect people's perception. Even though the above studies support the existence of crossmodal correspondence, researchers only employed matching and rating

methods and did not look at the actual behavioural consequences of the correspondences. Because of the possible gap between people's reported evaluation and actual behaviour it is important to take more studies into consideration that have looked at the behavioural consequences of crossmodal correspondences.

An example of a study that investigated real marketing behaviour is a field study by North, Hargreaves and McKendrick (1998). They showed that music in stores influences the type of wine bought. On days when French music was played, French wines outsold the German wines. On days of German music German wines outsold the French. However, important to note is that the researchers did not look beyond the wine sale and there was no baseline. An explanation given in the article for the difference in sales is that music can prime related knowledge and can consequently draw attention to products that are linked with that knowledge. Thus, the French music reminded people more of France than of Germany and vice versa. Customers appeared to be unaware of the effects that the music had on their buying behaviour.

In addition, a study by Yalch and Spangenberg (1993) showed that when music in different departments in a store matched the department, for example background music instead of foreground music in the department for older women, people made more purchases and spent more money. This is an indication of the occurrence of crossmodal correspondence, since the link between sound and visual environment mattered in influencing buying behaviour. In line with this, another study showed that when music was congruent with the atmosphere of a restaurant, the perceived quality of the service and the environment increased (Demoulin, 2011).

Overall, sounds combined with stimuli from other modalities seem to be able to influence people's behaviour, especially in cases when the diverse set of stimuli are congruent in terms of product exterior, setting, and sound. Hence, it would be beneficial for marketers to gain more insight under which circumstances sound congruence can influence customers' behaviour and memory. Another important sense for marketers is our sense of smell. As is already highlighted above, smells play an important role in many marketing activities. For example, the production of shampoos and fragrances, the interior design of cars and the production of food (Moeran, 2007). Despite this, our sense of smell is often overlooked (Moeran, 2007). Therefore, the next section will elaborate on our olfactory system.

1.2. Olfactory system

Similar to sounds (Rickard, 2004), smells trigger powerful emotional responses. Unlike our other senses, our sense of smell is believed to instigate an immediate, instinctive response (Vlahos, 2007). Another aspect of smell interesting for marketers is the direct connection between smell and emotion. The olfactory bulb is directly linked with the system in the brain that is responsible for emotion, the limbic system (Bradford & Desrochers, 2009). Smells are also influential in the process of attraction. Pleasant scents have been shown to be capable of increasing attraction (Baron, 1981).

Many studies have already looked at the behavioural consequences of certain smells. For instance, Holland, Hendriks and Aarts (2005) revealed that odours can influence people's cognition and cleaning behaviour. The experiment consisted of two groups. One group was exposed to a citrus-scented all-purpose cleaner without their awareness, and the other group was not exposed to any smell. When participants were exposed to the cleaning scent they identified cleaning-related words in a lexical decision task faster. Moreover, they more frequently put down activities related to cleaning as future-activities than the control group. They also kept their environment cleaner whilst eating. The cleaning scent enhanced the accessibility of cleaning-related thoughts in the brains of the participants and activated related behaviour (Liljenquist, Zhong, & Galinsky, 2009). In addition, cleaning scents can prevent people from exploiting other people, stimulate reciprocity and can enhance interest in voluntary work and tendency to donate money (Liljenquist et al., 2009).

Moreover, ambient scents in a mall can contribute in creating a favourable perception of that environment and indirectly of the quality of its products (Chebat & Michon, 2003). Therefore, it is not strange that companies have already employed smells in their business strategy, for example scenting the bread department of a supermarket with freshly baked products, or scenting a brand new car (Bradford & Desrochers, 2009). However, odours not only influence behaviour by themselves, they can also be effective in combination with other modalities.

1.2.1. Crossmodal correspondence with smell

The influence of crossmodal correspondence between smells and other modalities has already been studied. For example, crossmodal correspondence can occur between odours and visual shapes (Hanson-Vaux, Crisinel, & Spence, 2013). Lemon and pepper odours were often associated with angular shape, whilst vanilla and raspberry were preferably matched with round shapes. Thus, more intense and unpleasant odours were often matched with angular

shapes, whereas more subtle odours were more associated with rounded shape (Hanson-Vaux, Crisinel & Spence, 2012). In another but somewhat related experiment participants were asked to match different odours with abstract symbols. Roughly, odours that were considered as pleasant (e.g. melon) were matched with circle or curvy shapes, whereas odours that were perceived as unpleasant (e.g. pepper) were associated with square or angular shapes (Seo et al., 2010).

In addition, odours can influence perceived softness of fabric. In an experiment, participants had to rate the softness of a fabric after having been presented with a particular odour (Demattè, Sanabria, Sugarman, & Spence, 2006). They perceived pieces of fabric as significantly softer when they were presented with a lemon odour instead of an animal-like odour. This supports the idea of crossmodal interaction between smell and touch.

In explicit marketing contexts the use of smell combined with other modalities is not uncommon either. Smells have repeatedly proven to affect the consumers' buying process, especially in case of congruence. When an ambient odour was congruent with the presented product, meaning a flowery scent in case of flower related products and chocolate scent in case of chocolate products, the information was processed more thoroughly and holistically: people looked at all the attributes instead of just the salient ones (Mitchell, Kahn, & Knasko, 1995).

Even technological areas appear to catch up and combine modalities to improve experience. A study by Aravinda and Krishnaiah (2013) introduced the smelling screen, 'a new olfactory display that can generate a localized odour distribution on a two-dimensional display screen', potentially enhancing the experience of for example watching a movie (Aravinda & Krishnaiah, 2013, p. 227).

In summary, congruence between odours and other modalities has proven to positively influence behaviour. Odours can be a useful tool to sell (maybe even create) products or to create brand awareness. Thus, just like sounds, odours can be used to stimulate marketing related processes. We now know that congruence works with sounds and smells separately, but what is their combined influence on behaviour?

1.3. Sound-odour congruence in terms of arousal

Before elaborating on sound-odour congruence, it is important to consider the different bases on which stimuli can be congruent. As crossmodal correspondence can be initiated in many ways, different methods have been employed to measure sound-odour congruence effects. For example, certain odours could be matched with certain pitches (Belkin, Martin, Kemp, & Gilbert, 1997) or odours could be matched with sounds of the same product (e.g. smell and sound of crisps) (Seo, & Hummel, 2011). However, the use of pitches can be quite complex, because they can vary in loudness and in tone. Moreover, the effects of pitches are quite specific which makes it hard to replicate (Belkin et al., 1997). Congruence on the basis of the same product seems a bit obvious. Another way odours and sounds can be congruent is in terms of arousal. Berlyne (1960) considered arousal as ‘a motivational state pertaining to the level of alertness or activation of an individual, ranging on a continuum from extreme drowsiness to extreme wakefulness’ (as cited in Laviolette, Lefebvre, & Brunel, 2010, p. 728). Compared with tone or pitch, arousal is a more basic level that applies to many different senses. For this and the above reasons, this study will look at congruence on the basis of arousal.

Previous studies have provided us with evidence that it is interesting to look at arousal. For example, Mattila and Wirtz (2001) investigated the influence of congruence in arousal between music and smell on pleasure, approach and impulse buying behaviour, satisfaction and evaluation of the environment. The experiment contained for both modalities a low, high and no arousal condition. It was conducted in a retail outlet, whilst the scent was spread by means of a diffuser. They used lavender for the low arousal condition, and grapefruit for the high arousal condition. The low arousing music was slow-tempo music, whilst the high arousal music featured fast-tempo music. The environmental evaluation and buying behaviour were measured using questionnaires. It was revealed that congruence in the arousing qualities of ambient smells and music enhanced people’s environmental evaluation, approach buying behaviour and people’s overall satisfaction with the shopping experience (Mattila & Wirtz, 2001).

In addition, another study showed that arousal induced by smells and sounds can influence people’s experience. Congruence between high-volume music and the arousing vanilla aroma resulted in enhanced pleasure levels, approach behaviour and enhanced satisfaction. Moreover, customers’ arousal levels had a positive effect on their approach behaviour and satisfaction with the shopping experience (Morrison, Gan, Dubelaar, & Oppewal, 2011).

Because of the relevance of arousal in influencing behaviour, congruence in terms of arousal will be further investigated. This study will shed some light on two aspects of crossmodal correspondence that are of relevance for marketers: the influence of crossmodal correspondence on people's attitudes and people's brand memory (while looking at familiar and unfamiliar brands).

1.3.1. Sound-odour congruence and people's attitudes

Sound-odour congruence has shown to positively influence people's attitudes towards odours (Seo & Hummel, 2011). In an experiment participants rated odours as more pleasant while listening to a congruent (e.g. potato chip odour and the sound of someone eating potato chips) instead of an incongruent sound. This was especially the case when those individuals perceived the odour to be congruent with the sound. Important to mention is that the hedonic value of the sound influenced the pleasantness of the subsequent odour. In addition, sound-odour congruence has shown to positively influence people's attitudes towards the environment (Mattila & Wirtz, 2001; Morrison et al., 2011).

Previous studies have shown the influence of crossmodal correspondence between sounds and odours on people's attitude towards the environment and towards odours. Since sound-odour congruence can positively influence the attitude towards the environment and odours, it is possible that sound-odour congruence can also affect other stimuli that are (almost) simultaneously presented with the sound-odour congruence. In this study, that would be an advertisement with a brand and product. This could mean that sound-odour congruence, as opposed to incongruence, would not only positively influence people's evaluation of the environment and odour, but also the way people look at the corresponding advertisement, brand and product. Since this would be essential for marketing and because few studies have looked at this aspect of sound-odour congruence, the following hypothesis was introduced:

H1: People's attitudes towards a presented advertisement, brand and product are more positive in cases of sound-odour congruence than incongruence.

1.3.2. Sound-odour congruence, people's attitudes and familiar and unfamiliar brands

Knowledge of brands is very important for marketers. A brand is much more than a name. Brands evoke emotions, create beliefs and social value (Kotler & Gertner, 2002). Therefore, marketers need to know what factors potentially influence the evaluation and memory of brands, familiar as well as unfamiliar. Tapping into that knowledge can help them to gain

better understanding of customers' brand orientation. Previous research has looked at the influence that odours can have on evaluation of familiar and unfamiliar brands. For example, Morrin and Ratneshwar (2000) showed that a pleasant ambient scent lead to more positive brand evaluations, in particular for unfamiliar brands. The pleasant scent also improved brand recall but only for unfamiliar brands. Possibly, people's attitudes towards familiar brands are much stronger and less easily changed.

Since the positive effect of pleasant scents on brand evaluation was particularly present in case of unfamiliar brands, it could be that the potential positive effect of crossmodal congruence, as opposed to incongruence, would also be especially effective in enhancing people's evaluation in case of unfamiliar brands. Since little is known about the connection between brand familiarity and crossmodal correspondence and it is important for marketers to know under which conditions crossmodal correspondence is most efficient, the following hypothesis was introduced.

H2: The positive effect of crossmodal correspondence on people's attitudes is more prominent in case of an unfamiliar brand compared with a familiar brand.

1.3.3. Sound-odour congruence and memory facilitation

Brand memory has shown to have a great impact on consumer choice (Hoyer & Brown, 1990). If you can help customers to remember a product, they are more likely to buy it or talk about it with their friends. Therefore, it is beneficial for companies if they have knowledge on whether and how they can influence brand memory.

Congruency between sounds and vision appears to be able to have such influence on short term memory (Chen, & Spence, 2009). In an experiment, congruence facilitated identification of pictures. Participants accurately identified the masked picture more often in case of sound-picture congruent than incongruent or neutral settings (Chen, & Spence, 2009).

Furthermore, other studies have looked at the effect of congruence between language and smell on memory. In certain languages nouns possess grammatical gender, which can be either masculine, feminine or neutral. This is for instance the case in German and French. Speed and Majid (2016) investigated whether crossmodal correspondence occurred between odours that were for women and men and feminine and masculine grammatical words. They found that odours were better remembered (recognition) when odour gender matched with the grammatical gender than when they did not match.

However, congruence does not necessarily have more positive effect on memory than incongruence. An experiment by Morrin and Ratneswar (2003) showed that congruency of product and scent, in this case geranium instead of clove with toiletry and household cleaning products, did not seem to enhance brand recall and recognition.

This raises the question whether crossmodal correspondence between sound and smell facilitates brand memory. Ambient scents in general can increase people's attention during stimulus viewing, making retrieval of memory traces easier (Morrin & Ratneshwar, 2003). Perhaps retrieval of memory traces is even more facilitated in case of crossmodal congruence. More insight is needed regarding the effect of congruence on brand memory. Because consumers' buying decisions depend strongly on the recognition of brands in stores, this study will focus in particular on brand recognition. Hence, the following research question was initiated:

RQ: Does crossmodal correspondence between sounds and odours facilitate brand recognition in familiar and/or unfamiliar brands?

1.3.4. Need for arousal and Brand value

The design of the study makes it conceivable that congruence effects are more prominent in certain types of individuals. Since this study will look at congruence in terms of arousal, individuals' need for arousal will be taken into account (Figner, Mackinlay, Wilkening, & Weber, 2009). Each individual has his/her own optimum stimulation level, at which he/she feels most at ease. Individuals who are more in need for stimulation, tend to favour high arousing stimuli while the opposite occurs when people are in low need for stimulation (Steenkamp, Baumgartner & Van der Wulp, 1996). It is possible than individuals with a high need for arousal, are more in need for stimulation and consequently engage in more arousing activities. In addition, individuals in high need for arousal might prefer arousing stimuli in general.

Besides need for arousal another potential moderator was added to the analyses, i.e. individuals' proneness to brands. Individuals who are more prone to brands prefer private brands and buy more private labels (Richardson, Jain, & Dick, 1996). Consequently, they might know familiar brands and brands in general better and value them differently. As this study looks at the influence of familiar versus unfamiliar brands, individuals' proneness to brands will be included as well. Because brand proneness might not be a self-explanatory

definition, the term brand value will be used to refer to brand proneness in the rest of this study.

In short, this study will investigate whether crossmodal correspondence between smell and sound increases perceived liking of an advertisement, brand and product and enhances brand recognition, for familiar versus unfamiliar brands. Sound-smell congruence is expected to increase people's attitudes, especially for unfamiliar brands. Potentially, sound-smell congruence could facilitate the retrieval of memory traces, improving brand recognition. All congruence effects will be analysed whilst taking notice of individuals' need for arousal and brand value.

2. Method

2.1. Participants

Fifty-eight participants took part in the experiment (31 female, 4 gender unknown, mean age 28 (range 18-68)). Their educational background was university level (31), HBO level (17), MBO level (5) and high school level (1), unknown (4). Because of some technical problems, only the data of 52 participants was used. All participants were Dutch, except for one participant, who has lived in the Netherlands for over three years. All participants consented to take part in the study by signing a consent form before the experiment began.

2.2. Materials

Three types of stimuli were manipulated: sounds, odours and brands.

The sounds were taken from freesound.org and were chosen on the basis of their tempo to reflect arousal. The low arousal sounds consisted of slow-tempo music fragments and the high arousal sounds of high-tempo music fragments. The sound fragments were cut up with the program 'Ocenaudio' to ensure that they were the same length: 3 seconds.

The odours were either essential oils, like orange oil, or pieces of the actual fruit, vegetable, plant or tea, e.g. grapefruit. The odours were presented in a brown jar and made by either putting a few drops of oil on a cotton pad or by putting pieces of the product on the cotton pad. The cotton pad with substance was then covered with fiber stuffing so participants would not see the content of the jar when the lid was off. A list of the odours and sounds used in this study can be found in Appendix B.

A total of 16 products was used and each product had a familiar and unfamiliar brand, like 'Coca Cola' (familiar) and 'Go' (unfamiliar) with the product 'cola'. The products consisted of food, drinks and body products, because those were expected to be frequently bought by the participants. The products were presented as images with a white background. It was ensured that they were comparable in size, by using 'Microsoft office picture manager'. A list of the products used during the experiment can be found in Appendix B.

2.2.1. Pre-test

To ensure that the odours and sounds were sufficient representatives of either low or high-arousing stimuli, 26 odours and 24 sounds were pre-tested on their level of arousal, their pleasantness, their intensity and their familiarity. Moreover, to check for brand familiarity, 24 products were pretested on their pleasantness and familiarity. Each product was presented as a

familiar and unfamiliar brand, e.g. 'Kleenex' and 'Sublimo' for tissues, making 48 product stimuli in total.

The pre-test was conducted in Dutch with the online program Qualtrics. The level of arousal of the stimuli was measured using pictures of manikins: the 9-point-self-assessment-manikin-scales (SAM-scales) (Morris, 1995). The pleasantness of the stimuli was also measured by (different) 9-point-SAM-scales. The intensity and familiarity was measured with 7-point semantic scales with the questions 'How intense did you find ...' and 'How familiar did you find...'.

A total of 10 participants took part in the pre-test (6 females; mean age 28, range 21-56). Nine participants were university schooled; 1 participant was schooled at a University of Applied science.

By looking at the means and standard deviations of the arousal variable, the 8 best examples of low arousing and high arousing stimuli for odours and sounds were selected for the experiment. The odours and sounds with the lowest means (and SD) were selected for the low arousing category, while the odours and sounds with the highest means (and lowest SD) were selected for the high arousing category. Both the odours ($t(7) = 9.71, p < .001$) and sounds ($t(7) = 19.93, p < .001$) differed significantly in terms of arousal.

In addition, the 16 products (32 brands) from which the familiar and unfamiliar brand varied the most from each other were selected for the experiment. The selected familiar brands differed significantly from the unfamiliar brands on ratings of familiarity ($t(15) = 48.25, p < .001$). During the experiment, 16 products were shown, of which 8 with a familiar and 8 with an unfamiliar brand. The other 16 brands were used as 'new' in the recognition task.

Table 1 and 2 show the overall means and standard deviations of the high and low arousing odours and sounds, and the familiar and unfamiliar brands of the pre-test. The questionnaire of the pre-test can be found in Appendix C. More information about names, standard deviations and means of the odours, sounds and products used during the pre-test can be found in Appendix D.

Table 1. Overall means and standard deviations of the high arousing and low arousing odours and sounds of the pre-test ($n = 10$) (1= low arousal, 9 = high arousal).

	High Arousal	Low Arousal
Odours	6.28 (.32)	4.29 (.48)
Sounds	6.79 (.29)	3.56 (.37)

Table 2. Overall means and standard deviations of the familiar and unfamiliar brands of the pre-test ($n = 10$) (1= unfamiliar, 7 = familiar).

Familiar	Unfamiliar
6.68 (.22)	1.38 (.34)

2.3. Instrumentation

During the experiment the following dependent variables were tested: attitude towards the advertisement, brand attitude, product attitude, recognition accuracy and reaction times.

2.3.1. Manipulation check

Relaxing qualities of music

Because the level of arousal of the sound fragments was mostly determined by tempo, participants were asked whether they thought slow and upbeat music in general was relaxing. This was measured with two 7-point Likert scales by statements like ‘Upbeat music relaxes me’.

Music preference

Participants music preference was measured by two 7-point Likert scales by statements like ‘In my spare time I frequently listen to upbeat music’.

2.3.2. Covariates

Odour pleasantness

Odour pleasantness was measured by one semantic differential scale (1 to 7). The scale ranged from unpleasant to pleasant and was measured with the sentence ‘I found the smell...’.

Sound pleasantness

Sound pleasantness was measured by one semantic differential scale (1 to 7). The scale ranged from unpleasant to pleasant and was measured with the statement 'I found the sound fragment of the advertisement...'.

2.3.3. Main analyses

2.3.3.1. Attitudes

The attitude-scales were based on a study by Voss, Spangenberg and Ghohmann (2003), but were shortened in order to reduce the length of the experiment.

Attitude towards the advertisement

The attitude towards the advertisement was measured by means of two semantic differential scales ranging from 1 to 7. The scale covering 'excitement' ranged from boring to exciting, whilst the scale measuring 'pleasantness' ranged from unpleasant to pleasant. Both scales were measured with the sentence 'I found the advertisement'. The reliability of 'Attitude towards the advertisement' consisting of two items was good: $\alpha = .86$. Because the reliability was good, the mean of both statements was used in the analyses.

Brand attitude

Brand attitude was measured by two semantic differential scales ranging from 1 to 7. 'excitement' was measured by a scale ranging from boring to exciting. 'pleasantness' consisted of a scale ranging from unpleasant to pleasant. Both scales were measured with the statement 'I found the brand in the advertisement'. The reliability of 'Brand attitude' consisting of two items was good: $\alpha = .88$. Because the reliability was good, the mean of both statements was used in the analyses.

Product attitude

Product attitude was measured by two semantic differential scales ranging from 1 to 7. The scale covering 'excitement' ranged from boring to exciting, whilst the scale measuring 'pleasantness' ranged from unpleasant till pleasant. Both scales were measured with the sentence 'I found the product of the advertisement'. The reliability of 'Product attitude' consisting of two items was adequate: $\alpha = .79$. Because the reliability was adequate, the mean of both statements was used in the analyses.

2.3.3.2. Memory

Recognition accuracy

Recognition accuracy was measured with a recognition task, using the number of correct responses.

Response times

Response times were measured by means of a recognition task, using the response times of the accurately remembered brands.

2.3.4. Moderators

Need for Arousal

Participants were asked to give information about their need for arousal based on Figner, Mackinlay, Wilkening and Weber (2009). The need for arousal was measured by eight 7-point Likert scales with statements like ‘I like a lot of variety’.

Brand value

Brand value was measured by two 7-point Likert scales, covering statements like ‘I value brands when doing my groceries’. The reliability of ‘Brand value’ consisting of two items was good: $\alpha = .89$. Because the reliability was good, the mean of both statements was used in the analyses.

The questionnaire with the items can be found in Appendix A (Dutch) and E (English).

2.4. Procedure

Testing took place in the CLS lab at the Radboud University and at the researcher’s house in the living room. The experiment was performed using E-prime Version 2.0. Participants were told that the experiment investigated the effectiveness of advertisements. They had to smell 16 brown jars in total. After having smelled the jar, they had to press space, where after an advertisement with a jingle was presented. They evaluated the advertisement, brand, product, odour and sound, by clicking on one of seven squares in a row. The squares represented the numbers 1 to 7 of the Likert scale and semantic differential scale. Participants wore headphones during the experiment.

After all stimuli were evaluated, the participants answered some questions about their need for arousal, their music preferences and their brand value.

The final part of the experiment consisted of a recognition task. The participants were presented with a series of products (32), half were new and half were old. ‘Old’ items were the products that were presented to them in the first phase of the experiment. ‘New’ items were products that participants had not seen during the experiment. Participants had to decide whether they had previously seen the product by clicking on a square stating either ‘new’ or ‘old’.

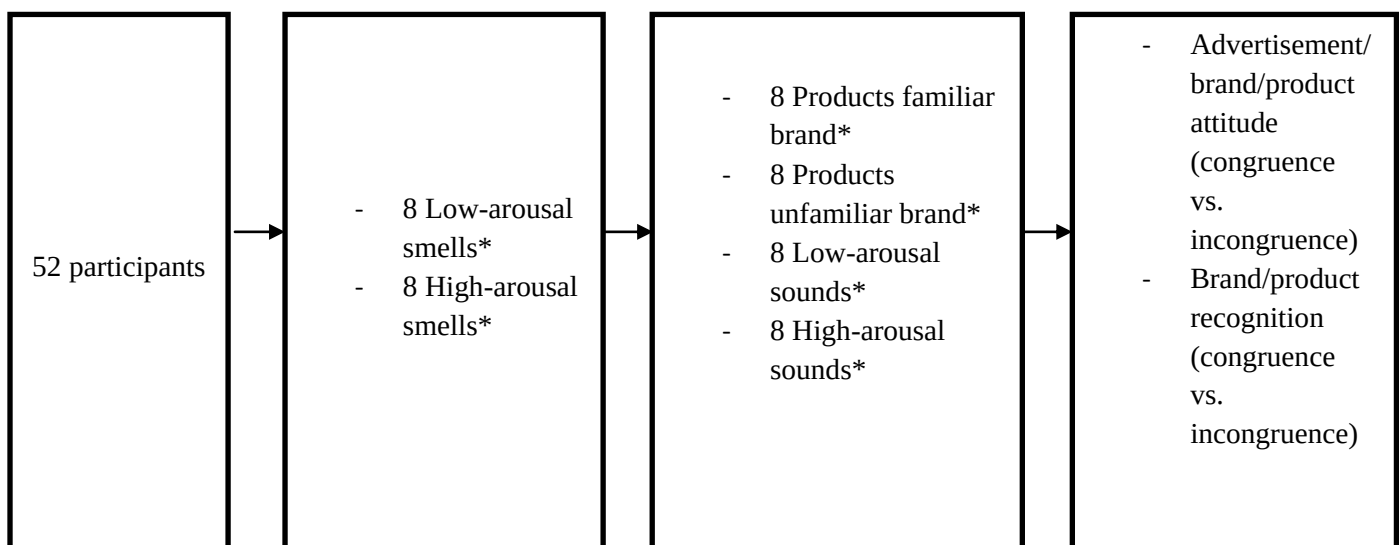
After the recognition task participants filled in their age, educational background and gender on the computer. They were also asked what they believed the purpose of the study was. No one guessed the purpose of the study. Finally participants were thanked for their participation. The experiment took around 25 minutes.

2.5. Research design

A 2 x 2 x 2 design was used with two within-subjects factors, the type of sound (high versus low arousal) and type of odour (high versus low arousal), and one between- and within-subjects factor brand familiarity (familiar versus unfamiliar).

During the experiment, participants saw an advertisement of a product. Each product was shown to the participants once, either containing a familiar or an unfamiliar brand. The product was presented with either a low arousing or high arousing sound and low arousing or high arousal smell. The sound appeared to be part of the advertisement. For every product type the familiar brand was just as often presented as the unfamiliar brand.

Figure 1: Research design



**Sound, product & odour type are randomized.*

2.6. Statistics

SPSS 21 was used to analyze the data for the manipulation check and the covariates. The manipulation and covariates were checked by means of paired samples and independent t-tests. The data was checked for normality with the normality plots explore function in SPSS.

To test for congruence effects while controlling for other variables, such as pleasantness of sound and smell, linear mixed effect models were used. These were conducted with R (R 3.3.0), using the lme4 package (Bates, Maechler, Bolker, & Walker, 2014). The p-values were calculated using the normal approximation in R.

3. Results

3.1. Manipulation check

3.1.1. Relaxing qualities of music

Even though the sound fragments had been pre-tested on their level of arousal, some additional questions were added to the experiment to check the arousing qualities of the sound fragments. Because the level of arousal of the sound fragments was mostly determined by tempo, participants were asked whether they thought slow and upbeat music in general was relaxing. In order to test whether this was the case, a dependent samples t-test was conducted.

A paired-samples t-test for Relaxing qualities of music with Type of music as within subject factor revealed a significant difference between Slow music and Upbeat music ($t(51) = 8.24, p < .001$). Participants found slow music more relaxing than upbeat music (Table 3). Therefore, the choice of sounds was justified.

3.1.2. Music preference

In addition it was checked whether participants listened frequently to slow or upbeat music. A paired-samples t-test for Music preference with Type of music as within subject factor revealed no significant difference between Slow music and Upbeat music ($t(51) = .79, p = .431$). Therefore, if effects of sounds were found, there were not just due to sound preference.

Table 3. Means and standard deviations of Relaxing qualities of and Spare time music preference of slow music and upbeat music ($n = 52$) (1 = completely disagree, 7 = completely agree).

	Slow music	Upbeat music
Relaxing qualities of music.	5.62 (.89)	3.33 (1.54)
Spare time music preferences.	4.48 (1.31)	4.19 (1.65)

The odours were not checked on relaxing qualities and spare time preference. People tend to spend more spare time with their music preference than with their odour preference.

Therefore, it is difficult for people to determine what type of odour they find relaxing in general. Moreover, the arousing qualities of odours could not easily be separated on one dimension, like slow vs. fast tempo for music. People can probably at most indicate how pleasant an odour is (Olofsson, Bowman, & Gottfield, 2013; Yeshurun & Sobel, 2010). For

these reasons, it was decided not to measure the relaxing properties and preference of odours directly.

3.2. Covariates

3.2.1. *Odour pleasantness*

It is possible that the pleasantness of the odour influenced the attitude towards the advertisement, brand and product. Thus, an independent samples t-test was conducted. The t-test for Odour pleasantness with Type of odour arousal as factor revealed no significant difference between Low arousal and High arousal odours ($t(10) = .95, p = .366$). This shows there was no difference in pleasantness of the two odour types.

3.2.2. *Sound pleasantness*

It is possible that the pleasantness of the sound of the advertisement influenced the attitude towards the advertisement, brand and product. Because this could potentially disrupt the results an independent samples t-test was conducted. An independent-samples t-test for Sound pleasantness with Type of arousal as factor revealed no significant difference between High arousal and Low arousal sounds ($t(10) = .88, p = .402$) (Table 4).

Table 4. Means and standard deviations of Odour and Sound pleasantness of Type of arousal ($n = 52$) (1 = unpleasant, 7 = pleasant).

	High arousing	Low arousing
Odour pleasantness.	3.50 (1.32)	3.98 (.60)
Sound pleasantness.	4.13 (.38)	3.87 (.76)

Though there were no significant differences in pleasantness of sound or odour between the two arousal conditions, it still seemed wise to add them as covariates in the main analyses. Adding them as covariates enables testing for more precise effects and gives even more certainty that no effects were found due to odour or sound pleasantness.

3.3. Main analyses

3.3.1. Attitude

¹In order to test whether the attitude towards the advertisement, brand and product were more positive in case of congruence compared with incongruence, a linear mixed effect model was used. The model also checked for potential differences in congruence effects between familiar and unfamiliar brands. The LME-model of Attitude towards the advertisement, Brand and Product contained Odour arousal, Sound arousal and Familiarity as fixed factors and Odour pleasantness ratings and Sound pleasantness ratings as covariates. Subjects, odours and sounds were random factors.

In order to test whether the effects on attitude towards the advertisement, brand and product differed between those with high and low need for arousal and those with high and low brand value a linear mixed effect model was used. The LME-model contained Sound arousal, Odour arousal, Familiarity, Need for Arousal and Brand value as fixed factors and Sound pleasantness ratings and Odour pleasantness ratings as covariates.

For the moderators, Need for arousal and Brand value, only the most important analyses will be reported. For Need for arousal this covers all analyses with sound arousal and odour arousal as factors. For Brand value this covers all analyses that test sound-odour congruence and the analyses with brand familiarity as factor.

For all analyses the non-standardised beta's will be reported.

3.3.1.1. Attitude towards the advertisement

The LME-analysis revealed a significant main effect of Sound arousal ($t = 5.90, p < .001, \beta = .81$). Advertisements with high arousing sounds ($M = 4.39, SD = 1.15$) were more positively evaluated than those with low arousing sounds ($M = 3.68, SD = 1.18$). No significant main effect of Odour arousal ($t = .89, p = .376, \beta = .09$) and Familiarity ($t = 1.57, p = .118, \beta = .17$) was found.

The analysis revealed no significant interaction between Odour arousal and Familiarity ($t = .05, p = .959, \beta = .01$), or Sound arousal and Familiarity ($t = .56, p = .576, \beta = .08$) on Attitude towards the advertisement.

In addition, the analysis revealed no significant interaction between Odour arousal and Sound arousal ($t = .19, p = .850, \beta = .03$) and no significant three-way interaction between Odour arousal, Sound arousal and Familiarity ($t = 1.05, p = .292, \beta = .23$). Therefore, there

¹ Initially 58 participants took part in the study. Due to missing data, only the data of 52 participants was used in the analyses.

was no sound-odour congruency effect on attitude towards the advertisement, even when considering brand familiarity.

Table 5. Means and standard deviations of Attitude towards the advertisements of type of Sound, Odour and Brand Familiarity ($n = 52$) (1 = boring/unpleasant, 7 = exciting/pleasant).

	Familiar brand		Unfamiliar brand	
	High Arousal	Low Arousal	High Arousal	Low Arousal
	Sound	Sound	Sound	Sound
High Arousal	4.45 (1.19)	3.72 (1.19)	4.12 (1.20)	3.54 (1.23)
Odour				
Low Arousal	4.51 (1.04)	3.86 (1.18)	4.48 (1.12)	3.60 (1.09)
Odour				

Moderators: Need for arousal & Brand value

Need for arousal

There was no significant main effect of Need for Arousal on Attitude towards the advertisement ($t = 1.07$, $p = .285$, $\beta = .38$).

The analysis revealed a significant interaction between Sound arousal and Need for arousal ($t = 2.01$, $p = .044$, $\beta = .81$). Follow-up analyses revealed no significant main effect of Need for Arousal when Sound arousal was low ($t = 1.26$, $p = .209$, $\beta = .48$) or when Sound arousal was high ($t = 1.07$, $p = .283$, $\beta = .37$). But there was a significant main effect of Sound arousal on Attitude towards the advertisement when Need for Arousal was high ($t = 2.94$, $p = .003$, $\beta = 1.23$). Individuals with a high need for arousal had a more positive attitude towards the advertisement in case of high arousing sounds compared with low arousing sounds. The LME- analysis found no such effect when Need for Arousal was low ($t = 1.75$, $p = .081$, $\beta = .65$) (Table 6). People with a high need for arousal prefer advertisements with high arousing sounds over those with low arousing sounds.

No significant interaction was found between Odour arousal and Need for arousal ($t = .39$, $p = .694$, $\beta = .16$) on Attitude towards the advertisement.

In addition, no significant interaction was found between Odour arousal, Sound arousal and Need for arousal ($t = 1.75$, $p = .080$, $\beta = 1.00$). Therefore, there was no difference

in sound-odour congruence effect on attitude towards the advertisement after having looked at need for arousal.

Brand value

The analysis revealed no significant main effect of Brand value ($t = 1.58, p = .114, \beta = .56$) and no significant interaction between Familiarity and Brand value ($t = 1.72, p = .086, \beta = .69$) on Attitude towards the advertisement.

In addition, no significant three-way interaction between Odour arousal, Sound arousal and Brand value ($t = 1.75, p = .079, \beta = .99$) and no significant four-way interaction between Odour arousal, Sound arousal, Familiarity and Brand value ($t = 1.70, p = .089, \beta = 1.37$) was found on Attitude towards the advertisement. Therefore, there was no difference in sound-odour congruence effect on attitude towards the advertisement after having looked at brand value, even when considering brand familiarity.

Table 6. Means and standard deviations of Attitude towards the advertisements of type of Sound and Need for arousal ($n = 52$) (1 = boring/unpleasant, 7 = exciting/pleasant).

	High Arousal Sound	Low Arousal Sound
High Need for Arousal	4.35 (1.23)	3.53 (1.18)
Low Need for Arousal	4.43 (1.06)	3.84 (1.15)

3.3.1.2. Attitude towards the brand

The LME for Attitude towards the brand revealed a significant main effect of Familiarity ($t = 5.55, p < .001, \beta = .75$). The attitude towards familiar brands was more positive ($M = 4.49, SD = 1.19$) than towards unfamiliar brands ($M = 3.63, SD = 1.13$).

The analysis showed no significant main effect of Sound arousal ($t = 1.65, p = .098, \beta = .22$), no significant main effect of Odour arousal ($t = .15, p = .883, \beta = .02$), no significant interaction between Odour arousal and Familiarity ($t = .23, p = .821, \beta = .04$), and no significant interaction between Sound arousal and Familiarity ($t = .77, p = .439, \beta = .15$) on Attitude towards the brand.

In addition, no significant interaction between Odour arousal and Sound arousal ($t = .72, p = .473, \beta = .14$) and no significant three-way interaction between Odour arousal, Sound arousal and Familiarity ($t = .55, p = .584, \beta = .15$) was found on Attitude towards the brand.

Therefore, there was no odour-sound congruency effect on attitude towards the brand, even when considering brand familiarity.

Table 7. Means and standard deviations of Attitude towards the brand of type of Sound, Odour and Brand Familiarity ($n = 52$) (1 = boring/unpleasant, 7 = exciting, pleasant).

	Familiar brand		Unfamiliar brand	
	High Arousal Sound	Low Arousal Sound	High Arousal Sound	Low Arousal Sound
High Arousal Odour	4.57 (1.24)	4.35 (1.20)	3.73 (1.19)	3.42 (1.00)
Low Arousal Odour	4.55 (1.16)	4.49 (1.18)	3.88 (1.15)	3.50 (1.11)

Moderators: Need for arousal & Brand value

Need for arousal

The LME-analysis revealed no significant main effect of Need for Arousal ($t = 1.26$, $p = .208$, $\beta = .57$), no significant interaction between Odour arousal and Need for arousal ($t = .97$, $p = .334$, $\beta = .49$) or between Sound arousal and Need for arousal ($t = .68$, $p = .494$, $\beta = .35$) on Attitude towards the brand.

In addition, there was no significant three-way interaction between Odour arousal, Sound arousal and Need for arousal ($t = .99$, $p = .321$, $\beta = .71$). Therefore, there was no difference in sound-odour congruence effect on attitude towards the brand after having looked at need for arousal.

Brand value

The analysis revealed no significant main effect of Brand value ($t = 1.75$, $p = .081$, $\beta = .78$) and no significant interaction between Familiarity and Brand value ($t = .56$, $p = .577$, $\beta = .28$) on Attitude towards the brand.

In addition, no significant three-way interaction was found between Odour arousal, Sound arousal and Brand value ($t = .92$, $p = .358$, $\beta = .65$) and no significant four-way interaction was found between Odour arousal, Sound arousal, Familiarity and Brand value (t

= .26, $p = .795$, $\beta = .26$). Therefore, individuals' brand value did not seem to influence the appearance of sound-odour congruence effects on attitude towards the brand, even when considering brand familiarity.

3.3.1.3. Attitude towards the product

The LME-analysis revealed a significant main effect of Familiarity ($t = 2.86$, $p = .004$, $\beta = .41$). The attitude towards the product was more positive in case of familiar brands ($M = 4.44$, $SD = 1.18$) compared with unfamiliar brands ($M = 3.98$, $SD = 1.26$).

The analysis showed no significant main effect of Odour arousal ($t = 1.41$, $p = .157$, $\beta = .20$) or Sound arousal ($t = .07$, $p = .944$, $\beta = .01$) and no significant interaction between Odour arousal and Familiarity ($t = .13$, $p = .899$, $\beta = .03$), or Sound arousal and Familiarity ($t = .65$, $p = .516$, $\beta = .13$) on Attitude towards the product.

In addition, the analysis revealed no significant interaction between Odour arousal and Sound arousal ($t = 1.82$, $p = .069$, $\beta = .36$) and no significant three-way interaction between Odour arousal, Sound arousal and Familiarity on Attitude towards the product ($t = .62$, $p = .533$, $\beta = .18$). Therefore, there was no sound-odour congruency effect on attitude towards the product even when considering brand familiarity.

Table 8. Means and standard deviations of Attitude towards the product of type of Sound, Odour and Brand Familiarity ($n = 52$) (1 = boring/unpleasant, 7 = exciting/pleasant).

	Familiar brand		Unfamiliar brand	
	High Arousal	Low Arousal	High Arousal	Low Arousal
	Sound	Sound	Sound	Sound
High Arousal Odour	4.40 (1.28)	4.43 (1.15)	3.88 (1.18)	3.85 (1.26)
Low Arousal Odour	4.62 (1.13)	4.30 (1.15)	4.24 (1.30)	3.94 (1.27)

Moderators: Need for arousal & Brand value

Need for arousal

The LME-analysis revealed a significant main effect of Need for Arousal on Attitude towards the product ($t = 2.10$, $p = .036$, $\beta = .94$). Individuals with a high Need for Arousal evaluated products less positively ($M = 4.10$, $SD = 1.35$) than those with a low Need for Arousal ($M = 4.33$, $SD = 1.09$).

No significant interaction between Odour arousal and Need for arousal ($t = 1.42$, $p = .155$, $\beta = .76$) or between Sound arousal and Need for arousal ($t = 1.13$, $p = .258$, $\beta = .60$) was found on Attitude towards the product.

There was no significant three-way interaction between Odour arousal, Sound arousal and Need for arousal ($t = .37$, $p = .708$, $\beta = .28$). Therefore, individuals' need for arousal did not seem to affect the occurrence of a sound-odour congruence effect on attitude towards the product.

Brand value

The LME-analysis revealed a significant main effect of Brand value on Attitude towards the product ($t = 2.44$, $p = .015$, $\beta = 1.09$). Individuals who scored high in brand value had a relatively more positive attitude towards the products in the advertisement ($M = 4.31$, $SD = 1.29$) than individuals who scored lower in brand value ($M = 4.12$, $SD = 1.19$).

The analysis showed no significant interaction between Familiarity and Brand value ($t = 1.10$, $p = .271$, $\beta = .58$) on Attitude towards the product.

No significant three-way interaction was found between Odour arousal, Sound arousal and Brand value ($t = .40$, $p = .688$, $\beta = .30$) and no significant four-way interaction was found between Odour arousal, Sound arousal, Familiarity and Brand value ($t = .29$, $p = .771$, $\beta = .31$). Therefore, individuals' brand value did not seem to influence the occurrence of a sound-odour congruence effect on attitude towards the product, irrespective of brand familiarity.

3.3.2. Memory

In order to test whether individuals' memory for products was greater in case of congruence compared with incongruence, a linear mixed effect model was used. The model also checked for potential differences in congruence effects between familiar and unfamiliar brands. The LME-model for Recognition accuracy and Reaction times contained Odour arousal, Sound arousal and Familiarity as fixed factors and Odour pleasantness ratings and Sound pleasantness ratings as covariates. Subjects, odours and sounds were random factors. For recognition accuracy a loglinear model was used.

In order to test whether the effects on memory differed between those with high need for arousal and those with low need for arousal and those with high brand value and low brand value a linear mixed effect model was used with Sound arousal, Odour arousal, Familiarity, Need for Arousal and Brand value as fixed factors and Sound pleasantness ratings and Odour pleasantness ratings as covariates. Again only the analyses of main importance for the hypotheses were reported for the moderators.

3.3.2.1. Recognition accuracy

The linear mixed effect model revealed no significant main effect of Odour arousal ($z = .87$, $p = .383$, $\beta = .82$), Sound arousal ($z = 1.20$, $p = .229$, $\beta = .60$) or Familiarity ($z = 1.05$, $p = .296$, $\beta = .51$), no significant interaction between Sound arousal and Familiarity ($z = 1.86$, $p = .063$, $\beta = 1.31$) or Odour arousal and Familiarity ($z = .27$, $p = .791$, $\beta = .18$) on Recognition accuracy.

In addition, the analysis showed no significant interaction between Odour arousal and Sound arousal ($z = 1.01$, $p = .314$, $\beta = .69$) and no significant three-way interaction between Odour arousal, Sound arousal and Familiarity ($z = .51$, $p = .608$, $\beta = .50$) on Recognition accuracy. Therefore, there was no odour-sound congruency effect on recognition accuracy, even when considering brand familiarity.

Moderators: Need for arousal & Brand value

Need for arousal

The LME-analysis revealed no significant main effect of Need for Arousal ($z = .08$, $p = .935$, $\beta = .14$), no significant interaction between Sound arousal and Need for arousal ($z = .67$, $p = .501$, $\beta = 1.67$) or between Odour arousal and Need for arousal ($z = .94$, $p = .350$, $\beta = 2.03$) on Recognition accuracy.

There was no significant three-way interaction between Odour arousal, Sound arousal and Need for arousal ($z = 1.15$, $p = .250$, $\beta = 3.73$). Therefore, individuals' need for arousal did not influence whether sound-odour congruence effects occurred on recognition accuracy.

Brand value

The LME-analysis revealed no significant main effect of Brand value ($z = .96$, $p = .337$, $\beta = 1.88$) and no significant interaction between Familiarity and Brand value ($z = .62$, $p = .537$, $\beta = 1.42$) on Recognition accuracy.

No significant three-way interaction was found between Odour arousal, Sound arousal and Brand value ($z = 1.47$, $p = .143$, $\beta = 4.75$) and no significant four-way interaction was found between Odour arousal, Sound arousal, Familiarity and Brand value ($z = .69$, $p = .488$, $\beta = 3.06$). Therefore, individuals' brand value did not seem to affect whether sound-odour congruence effects occurred on recognition accuracy, irrespective of familiarity.

3.3.2.2. Reaction Times of accurately remembered products

The LME-model revealed a significant main effect of Sound arousal ($t = 2.26$, $p = .024$, $\beta = .05$), Odour arousal ($t = 2.12$, $p = .034$, $\beta = .05$) and Familiarity ($t = 3.93$, $p < .001$, $\beta = .09$).

²People recognized products more quickly in case of low arousing sounds ($M = 1672.94$, $SD = 870.45$) compared with high arousing sounds ($M = 1686.79$, $SD = 942.61$). People recognized products more quickly in case of low arousing odours ($M = 1655.78$, $SD = 833.60$) compared with high arousing odours ($M = 1703.64$, $SD = 973.44$). Familiar brands were recognized more quickly ($M = 1601.61$, $SD = 867.86$) than unfamiliar products ($M = 1757.66$, $SD = 937.22$).

The analysis revealed a significant interaction between Sound arousal and Familiarity ($t = 2.34$, $p = .019$, $\beta = .08$). Follow-up analyses revealed a main effect of Familiarity on Reaction time when Sound arousal was high ($t = 3.90$, $p < .001$, $\beta = .09$). Familiar brands ($M = 1543.60$, $SD = 821.06$) were recognized more quickly than unfamiliar brands ($M = 1836.53$, $SD = 1036.22$) when Sound arousal was high. No such effect was found when Sound arousal was low ($t = .76$, $p = .447$, $\beta = .02$). A follow-up analysis revealed no significant main effect of Sound arousal on Reaction time in case of familiar brands ($t = 1.94$, $p = .053$, $\beta = .06$) or in

² The log-transformed Reaction Times were used in the linear mixed effect models in order to test for significance. However, to make the results more understandable, the actual reaction times and standard deviations are reported.

case of unfamiliar brands ($t = 1.10, p = .271, \beta = .03$). Therefore, only when sound arousal was high familiar brands were recognized more quickly than unfamiliar brands.

There was a significant interaction between Odour arousal and Familiarity ($t = 2.35, p = .019, \beta = .09$) on Reaction time. A follow-up analysis revealed a significant main effect of Odour arousal on Reaction time in case of familiar brands ($t = 2.00, p = .045, \beta = .05$). Familiar brands were recognized more quickly in case of high arousing odours ($M = 1586.41, SD = 892.70$) than low arousing odours ($M = 1616.81, SD = 844.49$). No such effects were found in case of unfamiliar brands ($t = 1.21, p = .227, \beta = .03$). In addition, only in case of high arousing odours, familiar brands were recognized more quickly ($M = 1586.41, SD = 892.70$) than unfamiliar brands ($M = 1820.23, SD = 1036.92$) ($t = 3.83, p < .001, \beta = .09$). No effect occurred in case of low arousing odours ($t = .72, p = .471, \beta = .02$). This matches with the sound results. High arousing odours, as opposed to low arousing odours, seemed to facilitate brand recognition, but only of familiar brands. Moreover, familiar brands were only recognized more quickly than unfamiliar brands in case of high arousing odours.

The LME-analysis revealed a significant interaction between Odour arousal and Sound arousal on Reaction time ($t = 2.20, p = .028, \beta = .07$). When Sound arousal was high, there was a significant main effect of Odour arousal on Reaction time ($t = 2.46, p = .014, \beta = .06$). Brands were more quickly recognized in case of high arousing odours ($M = 1665.03, SD = 951.16$) than low arousing odours ($M = 1709.05, SD = 935.96$). No effects appeared when Sound arousal was low ($t = .62, p = .535, \beta = .01$). In addition, only when Odour arousal was high, brands were more quickly recognized in case of high arousing sounds ($M = 1665.03, SD = 951.16$) than in case of low arousing sounds ($M = 1741.62, SD = 995.99$) ($t = 2.19, p = .029, \beta = .05$). No effects appeared when Odour arousal was low ($t = .66, p = .507, \beta = .02$). There appears to be a sound-odour congruence effect on reaction time, but only in case of high arousal congruence.

There was no significant three-way interaction between Odour arousal, Sound arousal and Familiarity on Reaction time ($t = 1.65, p = .099, \beta = .08$). Hence, there was no difference in sound-odour congruency effect on Reaction time between familiar and unfamiliar brands.

Table 9. Means and standard deviations of Reaction times of type of Sound, Odour and Brand Familiarity ($n = 52$).

	Familiar brand		Unfamiliar brand	
	High Arousal	Low Arousal	High Arousal	Low Arousal
	Sound	Sound	Sound	Sound
High Arousal	1436.99	1742.54	1906.02	1740.76
Odour	(586.60)	(1109.56)	(1180.51)	(882.44)
Low Arousal	1653.77	1580.66	1766.24	1629.27
Odour	(999.37)	(662.59)	(867.60)	(778.86)

Moderators: Need for arousal & Brand value

Need for arousal

The LME-analysis revealed no significant main effect of Need for Arousal ($t = .51$, $p = .613$, $\beta = .04$), no significant interaction between Odour arousal and Need for arousal ($t = .84$, $p = .402$, $\beta = .07$), or between Sound arousal and Need for arousal ($t = .24$, $p = .808$, $\beta = .02$) on Reaction time.

In addition, there was no significant three-way interaction between Odour arousal, Sound arousal and Need for arousal ($t = .86$, $p = .390$, $\beta = .11$). Therefore, individuals' need for arousal did not seem to influence the effect of sound-odour congruence on reaction times.

Brand value

The LME-analysis revealed no significant main effect of Brand value ($t = .75$, $p = .454$, $\beta = .06$) and no significant interaction between Familiarity and Brand value ($t = .48$, $p = .631$, $\beta = .04$) on Reaction time.

In addition, no significant three-way interaction between Odour arousal, Sound arousal and Brand value ($t = .64$, $p = .524$, $\beta = .08$) and no significant four-way interaction between Odour arousal, Sound arousal, Familiarity and Brand value ($t = .02$, $p = .987$, $\beta < .01$) was found. Individuals' brand value did not influence the effect of sound-odour congruence on reaction time, regardless of familiarity.

4. General discussion

Humans tend to match stimuli from different sensory modalities together (Spence & Parise, 2012). This crossmodal matching can occur between different sensory combinations, influencing people's perception and behaviour: crossmodal correspondence (Spence, 2011). This study looked at the possible crossmodal matching between our olfactory and auditory system. In particular, the possible marketing effects were explored. This study not only investigated the effects of crossmodal correspondence on people's evaluation of advertisements, brands and products, but people's brand memory was also assessed. In addition, the possible differences in congruence effects between familiar and unfamiliar brands were tested.

During the experiment, participants smelled odours, either high or low arousal, followed by the presentation of an advertisement with a high or low arousal jingle and a familiar or unfamiliar brand. They then evaluated the advertisement, brand and product. Finally, participants' recognition memory for the products was tested.

In general, no sound-odour congruence effect was found on people's attitudes, irrespective of brand familiarity. However, individuals' need for arousal appeared to influence people's attitude towards the advertisement. Sound-odour congruence affected performance in the recognition task. When odour and sound were congruent in terms of high arousal, individuals' reaction times were faster than in case of incongruence. In addition, sound arousal and odour arousal affected people's reaction times.

4.1. Sound-odour congruence and attitude towards the advertisement, brand and product.

Crossmodal correspondence between sounds and odours has shown to be connected with perceived pleasantness of an odour (Seo & Hummel, 2011; Seo et al., 2014) and environment (Mattila & Wirtz, 2001; Morrison et al., 2011). Since sound-odour congruence can enhance the pleasantness of the previously presented odour and of the environment, it is possible that the effect of sound-odour congruence is also influential on other stimuli that are (almost) simultaneously presented with the congruent stimuli. This could mean that sound-odour congruence, as opposed to incongruence, could not only positively influence people's evaluation of odours and environment, but also how people look at the corresponding advertisement, brand and product.

However, in the present study, there was no effect of sound-odour congruence on people's attitudes towards the presented advertisement, brand or product. This might be

because people tend to pay more attention to visual than olfactory stimuli (Smeets & Dijksterhuis, 2014) and might consequently often be more aware of them. Therefore, people might respond differently to, and be more aware of, visual and auditory stimuli compared with odours. Therefore, despite success in earlier studies (Morrin & Ratneswar, 2000), self-report-measures might not always be the right measure to test odour effects. With an eye to marketing, future studies could for example focus more on the effects of odours on actual buying behaviour. Perhaps varying scents in shops could influence what and how much people buy, without them necessarily being aware of this.

Despite the absence of a sound-odour congruence effect on people's attitudes, a main effect of sound arousal on people's attitudes was found. In particular, high arousing sounds led to more positive evaluations of the advertisement than low arousing sounds. A possible explanation for the effect of sound arousal on attitude toward the advertisement is that it is more common in advertisements to use upbeat music than slow tempo music. Consequently, this might be a classic case of the familiarity or mere-exposure principle (Zajonc, 1968); people might prefer the high arousing music because they are more familiar with it.

Another reason for high arousing sounds overpowering low arousing sounds is the concept of arousal itself. Arousing advertisements have shown to produce more positive attitudes towards advertised brands and have led to higher purchase intentions (Yoon, Bolls, & Lang, 1998). In addition, emotional arousal evoked by a story can increase liking of that story (Vettehen, Nuijten, & Peeters, 2008). This could also be applicable for advertisements. Advertisements containing high arousing sounds should be more arousing, which could explain the positive effect they had on attitudes towards advertisements. The lack of a further effect of sound arousal on brand and product attitude might be because the sound fragment was part of the actual advertisement. Therefore, the link between the two might have been stronger.

Contrary to sounds, the level of odour arousal did not have an effect on the evaluation of the advertisement (brand and product). This could be because nearly all brand communication responds to just two senses: vision and hearing (Lindstrom, 2005). Therefore, people are not used to linking what they smell to what they hear and see in an advertisement.

In short, there was no effect of sound-odour congruence on people's attitudes towards the presented advertisement, brand or product. However, sound arousal had an effect by itself, as high arousing sounds led to more positive evaluations of the advertisement than low arousing sounds. The level of odour arousal did not affect the evaluation of the advertisement.

4.2. Sound-odour congruence and brand familiarity.

Few studies have explored the connection between brand familiarity and crossmodal correspondence. As it is important for marketers to know under which conditions crossmodal correspondence is most efficient, the element of familiar versus unfamiliar brands was added in this study. Morrin and Ratneshwar (2000) showed that a pleasant ambient scent lead to more positive brand evaluations, in particular for unfamiliar brands. Possibly, people's attitudes towards familiar brands are much stronger and less easily changed. This could mean that crossmodal congruence, as opposed to incongruence, would be especially effective in enhancing people's evaluation in case of unfamiliar brands compared with familiar brands.

However, there was no effect of sound-odour congruence when brand familiarity was taken into account. Thus, sound-odour congruence does not seem to affect evaluation of a brand, product or advertisement, regardless of brand familiarity. A possible explanation is, as previously mentioned, that sound-odour congruence might be difficult to measure with self-report scales. Consequently, it is also difficult to measure the difference in congruence effect between familiar and unfamiliar brands with the same method.

Even though there was no difference in the effect of sound-odour congruence between familiar and unfamiliar brands, familiarity did have an effect by itself on people's attitudes. Individuals' attitude towards the advertisement, brand and product was more positive in case of familiar compared with unfamiliar brands (indicating that familiarity was successfully manipulated). This can again be explained by the mere-exposure principle (Zajonc, 1968). Since, people are more exposed to familiar brands than unfamiliar brands and people tend to like things that they are familiar with more, it makes sense that people's attitudes adjust accordingly.

Another possibility is that people's attitudes towards familiar brands are stronger than people's attitudes towards unfamiliar brands. Therefore, a greater amount of people might have neutral feelings towards unfamiliar brands as opposed to familiar brands. Consequently, people might frequently evaluate unfamiliar brands as neutral, irrespective of environmental cues. This could explain why the evaluation of unfamiliar brands ($M = 3.85$) is closer to the middle of the 7-point-Likert-scale than familiar brands ($M = 4.35$). Since the evaluation of the familiar brands is higher than neutral, the close to neutral evaluation of the unfamiliar brands is automatically lower.

Altogether, individuals' attitude towards the advertisement, brand and product was more positive in case of familiar compared with unfamiliar brands. However, there was no effect of sound-odour congruence. Self-report-measures might not always be the right

measure to test odour effects. Perhaps sound-odour congruence effects are visible in memory tests.

4.3. Sound-odour congruence and memory

It is beneficial for companies to be able to affect customers' brand memory, as it has shown to have a great impact on consumer choice (Hoyer & Brown, 1990). Crossmodal congruence could play an important role in this process, as congruency between for example sound and vision can influence short term memory (Chen & Spence, 2009). Therefore, it was important that the influence of crossmodal correspondence on brand memory was investigated. Brand memory was measured by means of a recognition task which measured recognition accuracy and reaction times.

4.3.1. Recognition accuracy

There was no difference between sound-odour congruence and incongruence on individuals' recognition accuracy. In addition, there was no difference in recognition accuracy between familiar and unfamiliar brands. Arousal by itself did not affect recognition accuracy. Perhaps the measurement of recognition accuracy was not precise enough to detect potential differences between congruence and incongruence and between familiar and unfamiliar brands. It could be that reaction times are more sensitive than accuracy ratings. In that case, it is expected that the difference in performance between familiar and unfamiliar brands is more detectable in people's reaction times.

4.3.2. Reaction times of accurately remembered brands.

A sound-odour congruence effect was found on reaction time, but only for high arousal stimuli; there was only an advantage of congruence over incongruence when both sound arousal and odour arousal were high. The high arousal congruence advantage could be explained by the actual arousal level and desired arousal level (Wirtz, Mattila, & Tan, 2007). When participants smelled an arousing odour, that odour produced an expected arousal level. When the following sound fragment turned out to be low arousing, under-stimulation created a gap between the expected arousal level and the desired arousal level. However, when the following odour was high arousing as well, no gap appeared which had a more positive effect on memory.

However, this theory does not explain the lack of congruence effect for the low arousal stimuli. Perhaps arousal by itself positively influences memory. However, people

recognized brands more quickly in case of low arousal sounds compared with high arousal sounds and low arousal odours compared with high arousal odours. Therefore, arousal by itself does not necessarily positively influence memory. Another explanation is that low arousal sounds and smells do not lower arousal, but that high arousal sounds and smell do enhance it. That way, low arousal stimuli might not lower participants' initial level of arousal, which means that no actual congruence occurred for the low arousal stimuli. That would explain the lack of positive effect of low arousal congruence on reaction times.

In addition to the congruence effect, familiar brands were recognized more quickly than unfamiliar brands in general. However, this effect only occurred when sound arousal or odour arousal was high. Thus, high sound and odour arousal appeared to enhance the difference in reaction times between familiar and unfamiliar brands. This is partly in line with a study that showed that high arousing pictures produced faster reaction times than low arousing pictures (Bradley, Greenwald, Petry, & Lang, 1992). Perhaps the difference in the effect of high arousal stimuli regarding familiarity is because high arousal stimuli would excite people and consequently facilitate brand memory of well-known brands. However, this excitement might not facilitate memory for unfamiliar brands, since it usually takes more effort for people to remember those.

Finally, there was no difference in sound-odour congruency effect on reaction time between familiar and unfamiliar brands. It is possible that people respond the same to congruence overall, regardless of whether the presented brand in the advertisement is familiar or unfamiliar.

To sum up, no effects in recognition accuracy were found. There was only an advantage of congruence over incongruence on reaction times when both sound arousal and odour arousal were high. Participants recognized brands more quickly in case of low arousing sounds and odours compared with high arousing sounds and odours. Familiar brands were recognized more quickly than unfamiliar brands when sound arousal or odour arousal was high. Finally, there was no difference in sound-odour congruency effect on Reaction time between familiar and unfamiliar brands.

4.4. Potential moderators: Need for Arousal & Brand value

Since this study focuses on congruence in terms of arousal, it is important to take note of individual characteristics that are connected with arousal. People are expected to vary quite a lot on such characteristics. Therefore, the moderator 'Need for Arousal' was added to the analyses (Figner et al., 2009). Each individual has his/her own optimum stimulation level, at

which he/she feels most at ease. Individuals with a high need for arousal might need more stimulation and are therefore more likely to engage in risky activities in order to reach that stimulation level, while individuals with a low need for arousal might try to avoid such activities (Steenkamp, Baumgartner, & Van der Wulp, 1996).

The characteristic 'Brand value' was added because the effect of congruence in combination with brand familiarity is thoroughly discussed in this study (Richardson et al., 1996). Individuals who are more prone to brands (high brand value) tend to prefer familiar brands over unfamiliar brands more than individuals who are less prone to brands (lower brand value) (Richardson et al., 1996). Because this could influence the results, 'Brand value' was added as a moderator.

4.4.1. Need for arousal

Individuals' need for arousal influenced their evaluation of an advertisement based on the arousing qualities of the sound. Participants with a higher need for arousal had a more positive attitude towards the advertisement in case of high arousing sounds compared with low arousing sounds. No such effect was found for individuals with a lower need for arousal. This could be explained by their difference in need for stimulation. People in high need for arousal need more thrills to reach their comfortable stimulation level than individuals low in need for arousal (Steenkamp, et al., 1996).

In addition, individuals with a high Need for Arousal evaluated products less positively than those with a low Need for Arousal. This could also be explained by differences in basic stimulation levels. The products used in this study were relatively common. Perhaps people with a high need for arousal need more exciting products to be satisfied, while people with a lower need for arousal are content with ordinary products.

No effects were found for Need for Arousal on memory. A possible explanation is that individuals' need for arousal is more based on physiological and affective aspects than on cognitive aspects (Bosnjak, Galesic, & Tuten, 2007).

4.4.2. Brand value

Individuals' brand value influenced the way in which they evaluated products in the advertisement. Individuals who scored high in brand value (high in proneness to private brands) had a relatively more positive attitude towards the products in the advertisement than individuals who scored lower in brand value. Perhaps, individuals with a high brand value tend to like products better in general, because they pay more attention to them while shopping. There was no effect of brand value on people's attitude towards a brand in general. Since the package of a product is also determined by the brand, perhaps people had a hard time evaluating just the brand without the packaging.

Overall, individuals' need for arousal was especially influential in case of sound arousal. Participants with a higher need for arousal had a more positive attitude towards the advertisement in case of high arousing sounds compared with low arousing sounds. No such difference was found for individuals in low need for arousal.

People's brand value was important when rating products of advertisements. Individuals who scored high in brand value had a relatively more positive attitude towards products in advertisements than individuals who scored low in brand value.

4.5. Limitations

Before discussing the conclusion and practical implications of this study, it is important to take note of some limitations. First, though the smell and sound were presented really quickly after one another, they were not presented simultaneously. This made the stimuli less congruent and could have influenced the results. According to Spence (2011) crossmodal correspondences are most likely to manifest themselves when the stimuli are presented around the same time. The bigger the time gap the more likely it is that the stimuli are processed as separate entities. It could be argued that when the stimuli would have been presented simultaneously, congruence effects would have occurred.

Secondly, a relatively big part of the study consists of self-report measures, which might not be the most effective method for measuring odour effects. As previously mentioned, people tend to pay more attention to visual than olfactory stimuli (Smeets, & Dijksterhuis, 2014) and might as a result be more aware of them. Therefore, people might respond differently, to visual and auditory stimuli than to odours. Future studies could try other measures, such as buying behaviour and looking time with eyetracking.

In addition, the sound fragments of the advertisements might have been too short for participants to process. However, they were cut this short because all fragments had to be the same length (as the shortest original sound fragment). In addition, real-life advertisements get more expensive the longer they are (Singh, & Cole, 1993) and marketers aim for the shortest advertisement possible because this is more economical. For this reason, a relatively short duration for the fragments was chosen.

There was no set time between participants' exposure to the advertisement and their exposure to the product later on during the recognition task. Perhaps the interval was too short, making the memory test relatively easy. Previous studies have used bigger time intervals, such as 24 hours (Morris & Ratneshwar, 2003). Perhaps the differences in reaction times and accuracy ratings would have been bigger when more time would have been between the first phase and the memory phase of the experiment.

Lastly, the concept of arousal remains vague. Berlyne (1960) argued that arousal is 'a motivational state pertaining to the level of alertness or activation of an individual, ranging on a continuum from extreme drowsiness to extreme wakefulness' (as cited in Laviolette et al., 2010, p. 728). Other studies added motor activity and emotional reactivity to the concept of arousal (Pfaff, Frohlich, & Morgan, 2002). There is a lack of one operational definition of arousal, making it less clear what arousal is and how it has to be measured.

4.6. Conclusion and practical implications

In recent years many studies have caught up to the concept of crossmodal congruence (Spence, 2011). This study focused in particular on consumer behaviour, as it is important for companies and marketers to know what triggers behaviour. Because few studies have looked at the influence of smell and sound together and because both are of great importance in the marketing field, this study looked at sound-odour congruence on people's attitude towards advertisements, products and brands and people's memory of brands.

There was no effect of sound-odour congruence on people's attitude towards the advertisement, product and brand, irrespective of brand familiarity. Therefore, it might be wise for marketers when they want to make use of sound and odours and their intent is to change attitudes, not to use congruence in terms of arousal. However, even though the congruence effect on attitude in general was not very apparent, marketers do not need to be worried when using both odour and sounds, since the combined effect is not negative either.

In addition, there was an effect of sound-odour congruence on memory, since high arousal congruence led to faster reaction times. This could help marketers in stimulating

consumers to faster remember brands. For example, storeowners could distribute a high arousal odour in store and simultaneously play high arousal music, helping people to remember brands in the shop faster. This could lead to people buying products faster, which could be convenient for marketers.

Sound had an effect on people's attitudes towards the advertisement. This is probably not new for marketers. However, the fact that high arousal sounds worked better than low arousal sounds for individuals in high need for arousal could be useful. Often in stores, slow music is played and perhaps it is more efficient to change that to upbeat music on some occasions. This also raises the question for marketers whether individuals with a high need for arousal could and should be targeted differently from individuals with a low need for arousal.

In addition, an effect of odour arousal and sound arousal was found as high arousal odours and sounds, as opposed to low, negatively affected people's reaction times. Hence, when using aroma billboards, *especially for less familiar brands*, it might be better to use aromas that are not high arousal, since those will not help customers with fast recognition of the brand.

Finally, it is important to note that whatever method marketers choose to apply, they always have to take notice of customers' feelings. They should always be reminded and never lose sight of the ethical side of persuasive communication.

4.7. Recommendation for future studies

Since it is unclear whether odour in general or odour in terms of arousal lacks the power to influence people's attitudes, it is important that further research explores this topic. Perhaps future studies could make use of more implicit methods to measure effects of odours. They could for example focus more on (impulse) buying behaviour.

Further studies could also look at the effects of sound arousal on customer behaviour and memory. More specifically, they could elaborate on the effects of sound arousal in combination with individuals' need for arousal. Individuals in high need for arousal preferred advertisement with high sound arousal. Perhaps such preference also occurs for shops with high sound arousal. For example, they could test whether high sound arousal compared with low sound arousal in shops also positively affects the attitudes towards the shop and the shopping experience of individuals with a high and low need for arousal.

More insight is also needed on the effect that high arousal sounds and odours, compared with low arousal sound and odours, have on people's reaction times. Why are the reaction times slower in case of high arousal stimuli and under which circumstances? That

way, marketers gain more insight into how they can stimulate people to remember brands faster.

Lastly, it is important not to let go of the concept of sound-smell congruence. Future studies could look at sound-smell congruence in marketing context not on the basis of arousal, but perhaps on a semantic level. That would put more focus on congruence in terms of meaning. For example, participants could be exposed to sounds by hearing a commercial. While they hear the radio commercial a smell is spread across the room. Sound-smell congruence could for example occur when the radio commercial is about chicken and the smell resembles chicken. It is likely that participants will try to make sense of both stimuli and attach meaning to them 'chicken'. Then researchers could test what happens to the evaluation of for example the environment and commercial in case of congruence compared with incongruence.

This study has created some insight into the marketing effects of sound and odour separately as well as combined. Hopefully, future studies will create even more insight into the power of sounds and odours in marketing. This could help marketers to come up with new and improved strategies on how to apply sounds and odours to influence customer attitudes and memory. In addition, it would help to create more insight into customer behaviour overall, which is useful for marketers as well as customers themselves.

Appendix A: Questionnaire experiment Dutch

Beste participant,

Bedankt dat u deel wilt nemen aan mijn masteronderzoek. Het onderzoek zal gaan over de effectiviteit van advertenties.

Indien u vragen hebt gedurende het experiment, dan kunt u die aan mij stellen.

De door u verstrekte gegevens zullen uitsluitend voor dit onderzoek gebruikt worden en zullen vertrouwelijk worden behandeld.

Het onderzoek zal maximaal 30 minuten duren.

Mocht u na het onderzoek interesse hebben in de bevindingen van het onderzoek of vragen hebben, dan kunt u contact met mij opnemen: marijn.petersrit@student.ru.nl

U kunt nu verder gaan met het onderzoek.

Gedurende dit onderzoek zult u in totaal 16 geuren te ruiken krijgen. Na iedere geur zult u een advertentie te zien krijgen. De advertentie zal bestaan uit een plaatje van een product in combinatie met een geluid. Na elke advertentie zullen er een aantal vragen gesteld worden over de advertentie. Vervolgens zal er, nadat u alle advertenties heeft gezien, een korte test volgen over de producten in de advertenties.

De onderzoeker zal u de geuren een voor een laten ruiken. U kunt nu verder gaan naar de eerste geur.

Ruik potje X

U kunt verder gaan met de advertentie door op de spatiebalk te drukken

Attitudes

Klik op het bolletje dat het meest op u van toepassing is.

Ik vond de advertentie:

Saai	1	2	3	4	5	6	7	Opwindend
Niet plezierig	1	2	3	4	5	6	7	Plezierig

Ik vond het merk in de advertentie:

Saai	1	2	3	4	5	6	7	Opwindend
Niet plezierig	1	2	3	4	5	6	7	Plezierig

Ik vond het product uit de advertentie:

Saai	1	2	3	4	5	6	7	Opwindend
Niet plezierig	1	2	3	4	5	6	7	Plezierig

Ik vond het geluidsfragment van de advertentie:

Niet plezierig	1	2	3	4	5	6	7	Plezierig
----------------	---	---	---	---	---	---	---	-----------

Ik vond de geur voor de advertentie:

Niet plezierig	1	2	3	4	5	6	7	Plezierig
----------------	---	---	---	---	---	---	---	-----------

U heeft nu het eind bereikt van het eerste deel van het onderzoek. Er zal u nu eerst worden gevraagd om een aantal vragen in te vullen. U kunt nu verder gaan met de vragen.

Buying behaviour

Geef aan in hoeverre deze stellingen op u van toepassing zijn:

Ik koop voornamelijk A-merken (bekende merken) als ik mijn boodschappen doe.

Helemaal mee oneens	1	2	3	4	5	6	7	Helemaal mee eens
---------------------	---	---	---	---	---	---	---	-------------------

Ik hecht veel waarde aan merken als ik mijn boodschappen doe.

Helemaal mee oneens	1	2	3	4	5	6	7	Helemaal mee eens
---------------------	---	---	---	---	---	---	---	-------------------

Music preference

Geef aan in hoeverre deze stellingen op u van toepassing zijn:

In mijn vrije tijd luister ik vaak naar rustige muziek.

Helemaal mee oneens	1	2	3	4	5	6	7	Helemaal mee eens
---------------------	---	---	---	---	---	---	---	-------------------

In mijn vrije tijd luister ik vaak naar upbeat (snelle) muziek.

Helemaal mee oneens	1	2	3	4	5	6	7	Helemaal mee eens
---------------------	---	---	---	---	---	---	---	-------------------

Rustige muziek ontspant me

Helemaal mee oneens	1	2	3	4	5	6	7	Helemaal mee eens
---------------------	---	---	---	---	---	---	---	-------------------

Upbeat muziek ontspant me.

Helemaal mee oneens	1	2	3	4	5	6	7	Helemaal mee eens
---------------------	---	---	---	---	---	---	---	-------------------

Need for Arousal

Geef aan in hoeverre onderstaande stellingen betrekking hebben op u:

Ik houd erg van variatie

Helemaal niet	1	2	3	4	5	6	7	Helemaal
---------------	---	---	---	---	---	---	---	----------

Te veel opwindning maakt me van slag

Helemaal niet	1	2	3	4	5	6	7	Helemaal
---------------	---	---	---	---	---	---	---	----------

Ik ben graag in staat om te voorspellen wat komen gaat

Helemaal niet	1	2	3	4	5	6	7	Helemaal
---------------	---	---	---	---	---	---	---	----------

Vaak breng ik mezelf bewust in een spannende/gevaarlijke situatie

Helemaal niet 1 2 3 4 5 6 7 Helemaal

Ik heb vaak de neiging om uit te gaan en dingen te ondernemen

Helemaal niet 1 2 3 4 5 6 7 Helemaal

Ik blijf graag bij mijn eigen routines

Helemaal niet 1 2 3 4 5 6 7 Helemaal

Ik houd van spanning en opwindning

Helemaal niet 1 2 3 4 5 6 7 Helemaal

In het algemeen, probeer ik gevaarlijke situaties te vermijden (bijvoorbeeld in het verkeer)

Helemaal niet 1 2 3 4 5 6 7 Helemaal

Geheugentest

Demografische gegevens

Wat is uw geslacht?

Man/Vrouw

Wat is uw leeftijd?

18-24

25-34

35-44

45-54

55+

Wat is uw nationaliteit?

Nederlands

Anders

Wat is uw hoogst genoten opleiding (u kunt er nog mee bezig zijn)?

Middelbare school

MBO

HBO

WO

Anders

Wat denkt u dat het doel van het onderzoek was?

Appendix B: Stimuli experiment

B1: Odours

Bottle nr:	Odour:
1	Cucumber
2	Leather
3	Garlic
4	Chamomile
5	Green tea
6	Grapefruit
7	Gasoline
8	Mint
9	Soap
10	Cocos
11	Vanilla
12	Coffee
13	Milk
14	Jasmine
15	Orange
16	Valerian root

Appendix B2: Sounds

All sounds were downloaded from freesound.org. Because they were downloaded, there are no links to the sound fragments used in this study. The files are available on request.

Appendix B3: Products

Product 1: Cornflakes

Familiar brand



Unfamiliar brand



Product 2: Crisps

Familiar brand



Unfamiliar brand



Product 3: Milk

Familiar brand



Unfamiliar brand



Product 4: Orange juice

Familiar brand



Unfamiliar brand



Product 5: Water

Familiar brand



Unfamiliar brand



Product 6: Spinach

Familiar brand



Unfamiliar brand



Product 7: Coke

Familiar brand



Unfamiliar brand



Product 8: Hagelslag

Familiar brand



Unfamiliar brand



Product 9: Peas

Familiar brand



Unfamiliar brand



Product 10: Tomato soup

Familiar brand



Unfamiliar brand



Product 11: Tissues

Familiar brand



Unfamiliar brand



Product 12: Body crème

Familiar brand



Unfamiliar brand



Product 13: Tomato ketchup

Familiar brand



Unfamiliar brand



Product 14: washing up liquid

Familiar brand



Unfamiliar brand



Product 15: detergent

Familiar brand



Unfamiliar brand



Product 16: Olive oil

Familiar brand



Unfamiliar brand



Appendix C: Questionnaire pre-test Dutch

Bedankt dat u deel wilt nemen aan de pre-test van ons onderzoek naar advertenties. U zult in totaal 24 geluidsfragmenten, 26 geuren en 48 merken evalueren. De pre-test duurt ongeveer 30 minuten.

U zult eerst 24 geluidsfragmenten te horen krijgen. Na elk fragment wordt u een aantal vragen gesteld.

Onder dit bericht vindt u een geluidsicoontje. Zodra u op het geluidsicoontje klikt, zult u een geluid te horen krijgen. Vervolgens zullen er een paar vragen worden gesteld over het geluidsfragment. U kunt nu op het geluidsicoontje klikken

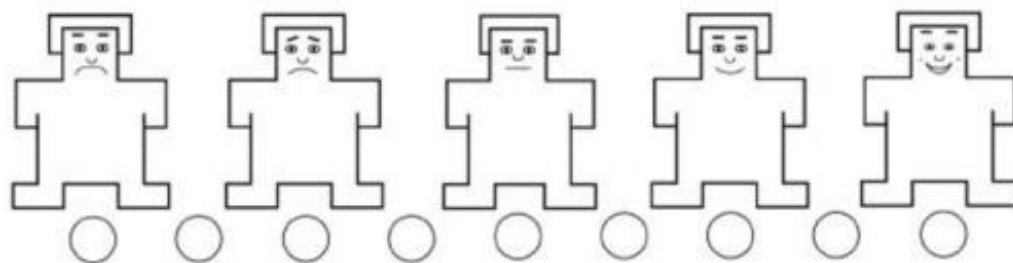
Geluid

Plezierig

Kunt u aangeven hoe plezierig u het geluidsfragment vond? U kunt het bolletje aanklikken dat het meest op u van toepassing is.

Erg onplezierig

Erg plezierig

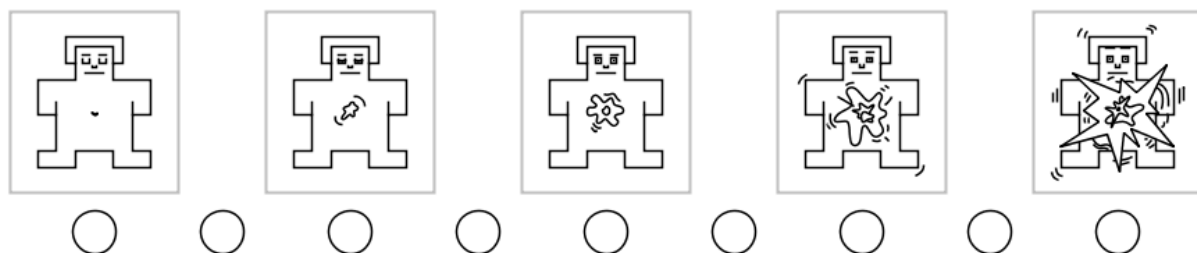


Opwindend

Kunt u aangeven hoe opwindend u het geluidsfragment vond? U kunt het bolletje aanklikken dat het meest op u van toepassing is.

Niet opwindend

Erg opwindend



Intensiteit

Kunt u aangeven hoe intens u het geluidsfragment vond? U kunt het bolletje aanklikken dat het meest op u van toepassing is.

Niet intens, 'zwak' geluid

–

Intens/sterk geluid



Bekendheid

Kunt u aangeven hoe bekend het geluidsfragment voor u is? U kunt het bolletje aanklikken dat het meest op u van toepassing was.

Onbekend

-

Bekend



Volgend geluidsfragment

Geur

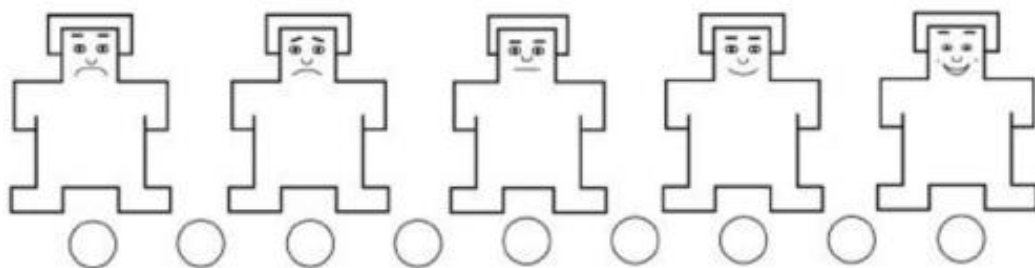
U heeft nu alle geluidsfragmenten beoordeeld. U zult nu 26 geuren gepresenteerd krijgen. De onderzoeker zal u nu eerst de eerste geur geven. Vervolgens zullen er een aantal vragen worden gesteld over de geur. Vervolgens zal de onderzoeker u de tweede geur laten ruiken etc.

Plezierig

Kunt u aangeven hoe plezierig u de geur vond? U kunt het bolletje aanklikken dat het meest op u van toepassing is.

Erg onplezierig

Erg plezierig

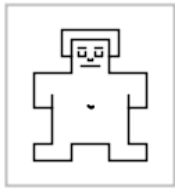
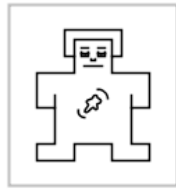
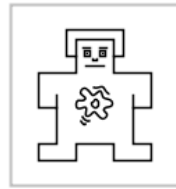
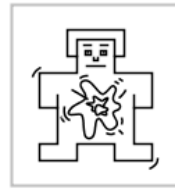
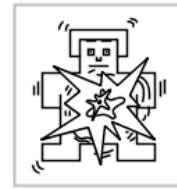


Opwindend

Kunt u aangeven hoe opwindend u de geur vond? U kunt het bolletje aanklikken dat het meest op u van toepassing is.

Niet opwindend

Erg opwindend

				
☐	☐	☐	☐	☐

Intensiteit

Kunt u aangeven hoe intens u de geur vond? U kunt het bolletje aanklikken dat het meest op u van toepassing is.

Niet intens, 'zwak' geluid

—

Intens/sterk geluid

☐	☐	☐	☐	☐	☐	☐
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

Bekendheid

Kunt u aangeven hoe bekend de geur voor u is? U kunt het bolletje aanklikken dat het meest op u van toepassing was.

Onbekend

-

Bekend

☐	☐	☐	☐	☐	☐	☐
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

Volgende geur

Merk

U bent nu aangekomen bij het laatste onderdeel van de pre-test. Hierbij zult u 48 merken te zien krijgen. Per merk zal u een aantal vragen worden gesteld. U zult nu het eerste merk te zien krijgen.

[*Plaatje merk*]

Bekendheid

Kunt u aangeven hoe bekend het merk voor u is? U kunt het bolletje aanklikken dat het meest op u van toepassing was.

Onbekend

-

Bekend

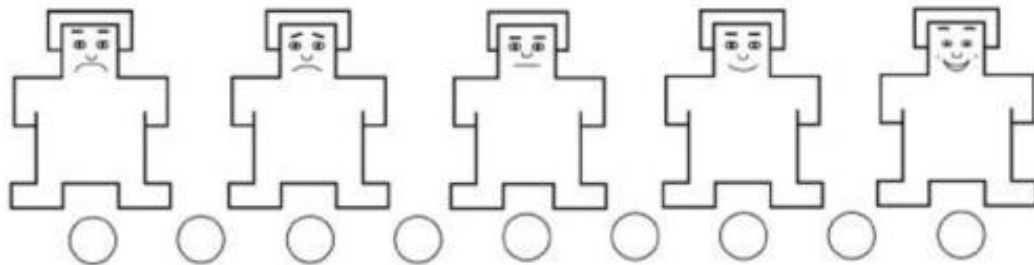


Plezierig

Kunt u aangeven hoe plezierig u het merk vond? U kunt het bolletje aanklikken dat het meest op u van toepassing is.

Erg onplezierig

Erg plezierig



Dit is het einde van de pre-test. De onderzoeker zal u nog kort even vragen enkele gegevens in te vullen.

Wat is uw geslacht?

- Man/vrouw

Wat is uw leeftijd?

- 18 - 25

- 26 - 35

- 36 - 45

- 46 – 55

- 55 +

Wat is uw hoogst genoten opleiding?

- Middelbare school

- Bachelor universiteit

- Master universiteit
- HBO-bachelor
- MBO
- Anders nl:

Dit is het einde van de pre-test. Hartelijk dank voor uw deelname!

Appendix D: Stimuli pre-test

Appendix D1: Odours

The products that were selected for the experiment are bold.

Odour	Pleasantness M	Pleasantness SD	Arousing M	Arousing SD
1. Incense	6.30	1.42	5.00	2.06
2. Cocos	5.90	1.85	4.60	2.07
3. Gasoline	4.30	2.36	6.00	2.11
4. Zwitsal	7.30	1.06	5.80	2.47
5. ³ Red Bull	5.20	2.49	4.80	1.81
6. Vanilla	5.70	1.64	6.10	1.60
7. Milk	3.10	1.60	4.50	2.42
8. Orange	7.20	1.23	6.60	.84
9. Valerian Root	2.40	1.43	6.60	1.08
10. Ginger	2.00	.82	5.60	2.07
11. Lavender	6.40	2.07	5.10	2.60
12. Coffee	6.10	2.42	6.30	2.00
13. Green tea	4.00	1.70	4.00	1.56
14. Chamomile	2.30	1.16	6.70	2.21
15. Cucumber	4.80	1.62	3.70	2.06
16. Garlic	2.70	1.06	5.90	2.28
17. Grapefruit	5.60	1.08	4.10	1.66
18. Cinnamon	5.90	1.20	5.30	2.16
19. Jasmine	6.10	.74	5.00	1.16
20. Pine ⁴	4.90	1.66	5.90	1.85 ⁵
21. Eucalyptus	5.20	2.20	5.30	2.98
22. Yogi Tea Classis	6.80	.79	5.50	1.78
23. Mint	6.20	2.40	6.00	2.16
24. Lemon grass	6.60	1.78	5.70	1.83
25. Leather	5.10	1.66	3.70	1.95
26. Soap	7.20	.63	4.70	2.50

Appendix D2: Sounds

All sounds were downloaded from freesound.org. Because they were downloaded, there are no links to the sound fragments used in this study. The sound files used in the study are available on request.

Appendix D3: Pictures of products

³ Based on the Arousal means Red Bull was officially part of the low arousing category. However, this was very counterintuitive and consequently Jasmine was taken instead.

⁴ Based on the Arousal means and Standard Deviations Pine was officially part of the high arousing category. However, this was very counterintuitive and therefore an odour with the same Arousal mean was taken: garlic.

Product 1: Chocolate milk

Familiar brand



Unfamiliar brand



Product 2: Cornflakes

Familiar brand



Unfamiliar brand



Product 3: Crisps

Familiar brand



Unfamiliar brand



Product 4: Milk

Familiar brand



Unfamiliar brand



Product 5: Orange juice

Familiar brand



Unfamiliar brand



Product 6: Water

Familiar brand



Unfamiliar brand



Product 7: Spinach

Familiar brand



Unfamiliar brand



Product 8: strawberry yoghurt

Familiar brand



Unfamiliar brand



Product 9: lollipops

Familiar brand



Unfamiliar brand



Product 10: Coke

Familiar brand



Unfamiliar brand



Product 11: peanut butter

Familiar brand



Unfamiliar brand



Product 12: Hagelslag

Familiar brand



Unfamiliar brand



Product 13: Chocolate bar

Familiar brand



Unfamiliar brand



Product 14: Cookies

Familiar brand



Unfamiliar brand



Product 15: Peas

Familiar brand



Unfamiliar brand



Product 16: Tomato soup

Familiar brand



Unfamiliar brand



Product 17: instant noodles

Familiar brand



Unfamiliar brand



Product 18: Tissues

Familiar brand



Unfamiliar brand



Product 19: Hairspray

Familiar brand



Unfamiliar brand



Product 20: Body crème

Familiar brand



Unfamiliar brand



Product 21: Tomato ketchup

Familiar brand



Unfamiliar brand



Product 22: washing up liquid

Familiar brand



Unfamiliar brand



Product 23: detergent

Familiar brand



Unfamiliar brand



Product 24: Olive oil

Familiar brand



Unfamiliar brand



Appendix D4: M & SD products

The means and standard deviations of the familiar and unfamiliar products of the pre-test.

The products that were selected for the experiment are bold.

Product	Mean Familiar	Mean Unfamiliar	SD Familiar	SD Unfamiliar
1. Chocolate milk	6.5	2.4	1.58	1.84
2. Water	6.9	1.5	.32	1.58
3. Spinach	6.4	1.5	.84	.71
4. Lollipops	6.4	2.1	.84	2.13
5. Coke	7.0	1.1	.00	.32
6. Peanut butter	7	3.5	.00	2.72
7. Hair spray	5.5	1.0	1.78	.00
8. Orange Juice	6.8	1.1	.63	.32
9. Hagelslag	6.2	1.7	1.87	1.49
10. Chocolate bar	6.9	2.9	.32	2.28
11. Chocolate chip cookies	6.3	2.0	1.25	1.49
12. Peas	6.6	1.4	.70	.70
13. Cornflakes	6.4	1.3	.70	.68
14. Tomato soup	6.8	1.0	.42	.00
15. Noodles	6.6	4.9	.70	2.03
16. Tissues	6.4	1.1	.84	.32
17. Body cream	6.8	1.0	.42	.00
18. Ketchup	6.9	1.9	.32	1.91
19. Washing up liquid (afwasmiddel)	6.7	1.6	.48	1.90
20. Detergent (wasmiddel)	6.7	1.0	.48	.00
21. Olive oil	6.6	1.6	.70	1.58
22. Crisps	6.8	1.1	.63	.32
23. Milk	6.8	2.1	.42	1.66
24. ⁶ Quark	6.5	1.1	.53	.32

⁶ Looking at the difference between the familiar and unfamiliar brand for quark, the product should have been selected for the experiment. However, the picture of the unfamiliar brand the not meet the quality and white background requirements. Hence, the product hagelslag was chosen as an replacement.

Appendix E: Questionnaire experiment English

Attitudes

Attitude towards the advertisement

I found the advertisement.

Boring	1	2	3	4	5	6	7	exciting
Unpleasant	1	2	3	4	5	6	7	Pleasant

Brand attitude

I found the brand of the advertisement.

Boring	1	2	3	4	5	6	7	exciting
Unpleasant	1	2	3	4	5	6	7	Pleasant

Product attitude

I found the product of the advertisement.

Boring	1	2	3	4	5	6	7	exciting
Unpleasant	1	2	3	4	5	6	7	Pleasant

Covariates

Odour pleasantness

I found the odour.

Unpleasant	1	2	3	4	5	6	7	Pleasant
------------	---	---	---	---	---	---	---	----------

Sound pleasantness

I found the sound fragment of the advertisement.

Unpleasant	1	2	3	4	5	6	7	Pleasant
------------	---	---	---	---	---	---	---	----------

Moderators

Proneness to brand names

I value brands when doing my groceries.

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

I mainly buy leading brands when doing my groceries.

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

Need for Arousal

I like a lot of variety.

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

Too much excitement tends to upset my stomach.

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

I prefer to be able to predict what will happen next.

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

I often position myself in an exciting/dangerous situation on purpose.

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

I often feel the urge to go out and do things

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

I like sticking to my routines.

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

I love thrills and excitement.

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

In general, I try to avoid dangerous situation (for example in traffic)

Doesn't apply at all 1 2 3 4 5 6 7 Strongly applies

Music preference

In my spare time I often listen to upbeat music

Stongly disagree 1 2 3 4 5 6 7 Strongly agree

In my spare time I often listen to slow temp music

Stongly disagree 1 2 3 4 5 6 7 Strongly agree

I found upbeat music relaxing.

Stongly disagree 1 2 3 4 5 6 7 Strongly agree

I found slow tempo music relaxing.

Stongly disagree 1 2 3 4 5 6 7 Strongly agree

Memory task

(Demographics: gender, age, educational background)

References

- Aravinda, C., & Krishnaiah, D. (2013). Smell-o-vision-the future digital display device. *Internation Journal of Computer Science and Mobile Computing*, 2(9), 227-234.
- Baron, R. A. (1981). Olfaction and Human Social Behavior Effects of a Pleasant Scent on Attraction and Social Perception. *Personality and Social Psychology Bulletin*, 7(4), 611-616.
- Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1-48. doi:10.18637/jss.v067.i01.
- Belkin, K., Martin, R., Kemp, S. E., & Gilbert, A. N. (1997). Auditory pitch as a perceptual analogue to odor quality. *Psychological Science*, 8(4), 340-342.
- Bosnjak, M., Galesic, M., & Tuten, T. (2007). Personality determinants of online shopping: Explaining online purchase intentions using a hierarchical approach. *Journal of Business Research*, 60(6), 597-605.
- Bradford, K. D., & Desrochers, D. M. (2009). The use of scents to influence consumers: The sense of using scents to make cents. *Journal of Business Ethics*, 90(2), 141-153.
- Bradley, M. M., Greenwald, M. K., Petry, M. C., & Lang, P. J. (1992). Remembering pictures: pleasure and arousal in memory. *Journal of experimental psychology: Learning, Memory, and Cognition*, 18(2), 379-390.
- Chebat, J. C., & Michon, R. (2003). Impact of ambient odors on mall shoppers' emotions, cognition, and spending: A test of competitive causal theories. *Journal of Business Research*, 56(7), 529-539.
- Chen, Y. C., & Spence, C. (2010). When hearing the bark helps to identify the dog: Semantically-congruent sounds modulate the identification of masked pictures. *Cognition*, 114(3), 389-404.
- Crisinel, A. S., Cosser, S., King, S., Jones, R., Petrie, J., & Spence, C. (2012). A bittersweet symphony: systematically modulating the taste of food by changing the sonic properties of the soundtrack playing in the background. *Food Quality and Preference*, 24(1), 201-204.
- Crisinel, A. S., & Spence, C. (2012). A fruity note: Crossmodal associations between odors and musical notes. *Chemical Senses*, 37(2), 151-158.
- Davies, B. J., Kooijman, D., & Ward, P. (2003). The sweet smell of success: olfaction in retailing. *Journal of Marketing Management*, 19(5-6), 611-627.
- Dematte, M. L., Sanabria, D., Sugarman, R., & Spence, C. (2006). Cross-modal interactions between olfaction and touch. *Chemical Senses*, 31(4), 291-300.

- Demoulin, N. T. (2011). Music congruency in a service setting: The mediating role of emotional and cognitive responses. *Journal of Retailing and Consumer Services*, 18(1), 10-18.
- Evans, K. K., & Treisman, A. (2009). Natural cross-modal mappings between visual and auditory features. *Journal of vision*, 10(1), 6-6.
- Fiegel, A., Meullenet, J.-F., Harrington, R. J., Humble, R., & Seo, H.-S. (2014). Background music genre can modulate flavor pleasantness and overall impression of food stimuli. *Appetite*, 76, 144–152.
- Figner, B., Mackinlay, R. J., Wilkening, F., & Weber, E. U. (2009). Affective and deliberative processes in risky choice: Age differences in risk taking in the Columbia Card Task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 35(3), 709-730.
- Hanson-Vaux, G., Crisinel, A. S., & Spence, C. (2013). Smelling shapes: Crossmodal correspondences between odors and shapes. *Chemical senses*, 38(2), 161-166.
- Holland, R. W., Hendriks, M., & Aarts, H. (2005). Smells Like Clean Spirit Nonconscious Effects of Scent on Cognition and Behavior. *Psychological Science*, 16(9), 689-693.
- Hoyer, W. D., & Brown, S. P. (1990). Effects of brand awareness on choice for a common, repeat-purchase product. *Journal of consumer research*, 17(2), 141-148.
- Hubbard, E., & Ramachandran, V. S. (2003). The phenomenology of synaesthesia. *Journal of consciousness studies*, 10(8), 49-57.
- Hul, M. K., Dube, L., & Chebat, J. C. (1997). The impact of music on consumers' reactions to waiting for services. *Journal of Retailing*, 73(1), 87-104.
- Hynes, N., & Manson, S. (2016). The sound of silence: Why music in supermarkets is just a distraction. *Journal of Retailing and Consumer Services*, 28, 171-178.
- Kellaris, J. J., & Kent, R. J. (1993). An exploratory investigation of responses elicited by music varying in tempo, tonality, and texture. *Journal of Consumer Psychology*, 2(4), 381-401.
- Knoeferle, K., Knoeferle, P., Velasco, C., & Spence, C. (2014). Multisensory Brand Search: How the Meaning of Sound Guides Consumers' Visual Attention. *NA-Advances in Consumer Research*, 42, 552-553.
- Kotler, P., & Gertner, D. (2002). Country as brand, product, and beyond: A place marketing and brand management perspective. *Journal of brand management*, 9(4), 249-261.

- Laviolette, E. M., Radu Lefebvre, M., & Brunel, O. (2012). The impact of story bound entrepreneurial role models on self-efficacy and entrepreneurial intention. *International Journal of Entrepreneurial Behavior & Research*, 18(6), 720-742.
- Liljenquist, K., Zhong, C. B., & Galinsky, A. D. (2010). The smell of virtue clean scents promote reciprocity and charity. *Psychological Science*, 21(3), 381-383.
- Lindstrom, M. (2005). Broad sensory branding. *Journal of Product & Brand Management*, 14(2), 84-87.
- Mattila, A. S., & Wirtz, J. (2001). Congruency of scent and music as a driver of in-store evaluations and behavior. *Journal of retailing*, 77(2), 273-289.
- Mitchell, D. J., Kahn, B. E., & Knasko, S. C. (1995). There's something in the air: effects of congruent or incongruent ambient odor on consumer decision making. *Journal of Consumer Research*, 22(2), 229-238.
- Moeran, B. (2007). Marketing scents and the anthropology of smell. *Social anthropology*, 15(2), 153-168.
- Morrin, M., & Ratneshwar, S. (2003). Does it make sense to use scents to enhance brand memory?. *Journal of Marketing Research*, 40(1), 10-25.
- Morrin, M., & Ratneshwar, S. (2000). The impact of ambient scent on evaluation, attention, and memory for familiar and unfamiliar brands. *Journal of Business Research*, 49(2), 157-165.
- Morris, J. D. (1995). Observations: SAM: the Self-Assessment Manikin; an efficient cross-cultural measurement of emotional response. *Journal of advertising research*, 35(6), 63-68.
- Morris, J. D., & Boone, M. A. (1998). The effects of music on emotional response, brand attitude, and purchase intent in an emotional advertising condition. *Advances in Consumer Research*, 25(1), 518-526.
- Morrison, M., Gan, S., Dubelaar, C., & Oppewal, H. (2011). In-store music and aroma influences on shopper behavior and satisfaction. *Journal of Business Research*, 64(6), 558-564.
- North, A. C., Hargreaves, D. J., & McKendrick, J. (1999). The influence on in-store music on wine selections. *Journal of Applied psychology*, 84(2), 271-276.
- Olofsson, J. K., Bowman, N. E., & Gottfried, J. A. (2013). High and low roads to odor valence? A choice response-time study. *Journal of experimental psychology: human perception and performance*, 39(5), 1205-1211.

- Petruzzellis, L., Chebat, J. C., & Palumbo, A. (2014). "Hey Dee-Jay Let's Play that Song and Keep Me Shopping All Day Long": The Effect of Famous Background Music on Consumer Shopping Behavior. *Journal of Marketing Development and Competitiveness*, 8(2), 38-49.
- Pfaff, D., Frohlich, J., & Morgan, M. (2002). Hormonal and genetic influences on arousal—sexual and otherwise. *Trends in neurosciences*, 25(1), 45-50.
- Ramachandran, V. S., & Hubbard, E. M. (2001). Synaesthesia—a window into perception, thought and language. *Journal of consciousness studies*, 8(12), 3-34.
- Richardson, P. S., Jain, A. K., & Dick, A. (1996). Household store brand proneness: a framework. *Journal of retailing*, 72(2), 159-185.
- Rickard, N. S. (2004). Intense emotional responses to music: a test of the physiological arousal hypothesis. *Psychology of music*, 32(4), 371-388.
- Seo, H. S., & Hummel, T. (2011). Auditory—olfactory integration: congruent or pleasant sounds amplify odor pleasantness. *Chemical senses*, 36(3), 301-309.
- Seo, H. S., Arshamian, A., Schemmer, K., Scheer, I., Sander, T., Ritter, G., & Hummel, T. (2010). Cross-modal integration between odors and abstract symbols. *Neuroscience letters*, 478(3), 175-178.
- Seo, H. S., Lohse, F., Luckett, C. R., & Hummel, T. (2014). Congruent sound can modulate odor pleasantness. *Chemical senses*, 39(3), 215-228.
- Simner, J., Cuskley, C., & Kirby, S. (2010). What sound does that taste? Cross-modal mappings across gustation and audition. *Perception*, 39(4), 553-569.
- Singh, S. N., & Cole, C. A. (1993). The effects of length, content, and repetition on television commercial effectiveness. *Journal of Marketing Research*, 30, 91-104.
- Smeets, M. A. M., & Dijksterhuis, G. B. (2014). Smelly primes—when olfactory primes do or do not work. *Applied Olfactory Cognition*, 96(5), 1-10.
- Speed, L. J. & Majid, A. (2016). Grammatical gender affects odor cognition. *Proceedings of the 38 Annual Conference of the Cognitive Science Society*. Philadelphia, PA: Cognitive Science Society.
- Spence, C. (2011). Crossmodal correspondences: A tutorial review. *Attention, Perception, & Psychophysics*, 73(4), 971-995.
- Steenkamp, J. B. E., Baumgartner, H., & Van der Wulp, E. (1996). The relationships among arousal potential, arousal and stimulus evaluation, and the moderating role of need for stimulation. *International Journal of Research in Marketing*, 13(4), 319-329.

- Velasco, C., Jones, R., King, S., & Spence, C. (2013). Assessing the influence of the multisensory environment on the whisky drinking experience. *Flavour*, 2(1), 1-11.
- Vettehen, P. H., Nuijten, K., & Peeters, A. (2008). Explaining effects of sensationalism on liking of television news stories: The role of emotional arousal. *Communication Research*, 35, 319-338.
- Vlahos, J. (2007, 9 September). Scent and sensibility. *New York Times*. Retrieved from http://www.oasis.ua/oasis/files/File/Scent%20and%20Sensibility_nytimes.pdf.
- Voss, K. E., Spangenberg, E. R., & Grohmann, B. (2003). Measuring the hedonic and utilitarian dimensions of consumer attitude. *Journal of marketing research*, 40(3), 310-320.
- Wirtz, J., Mattila, A. S., & Tan, R. L. (2007). The role of arousal congruency in influencing consumers' satisfaction evaluations and in-store behaviors. *International Journal of Service Industry Management*, 18(1), 6-24.
- Yalch, R. F., & Spangenberg, E. (1993). Using store music for retail zoning: a field experiment. *Advances in consumer research*, 20(1), 632-636.
- Yeshurun, Y., & Sobel, N. (2010). An odor is not worth a thousand words: from multidimensional odors to unidimensional odor objects. *Annual review of psychology*, 61, 219-241.
- Yoon, K., Bolls, P., & Lang, A. (1998). The effects of arousal on liking and believability of commercials. *Journal of Marketing Communications*, 4(2), 101-114.
- Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of personality and social psychology*, 9(2), 1-27.