THE EFFECT OF (UN)PLEASANT SOUNDS ON THE VISUAL AND OVERALL PLEASANTNESS OF PRODUCTS

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ABSTRACT

A product is a multi-sensory object and each sensory property can contribute to the product experience. In this study, we investigated the effect of sound (pleasant, unpleasant, original, and no sound) on the perceived pleasantness of products (i.e., visual pleasantness and overall pleasantness). Results indicate that ratings for visual and overall pleasantness are similar when no sounds are provided with the products (pictures). When participants are provided with sounds corresponding to the product, however, the overall pleasantness ratings decreased and visual pleasantness increased. Furthermore, while original and unpleasant sounds had a negative effect, pleasant sounds had a positive effect on visual and overall pleasantness ratings. We suggest that if efforts are put into improving the sound quality, users will be more pleased and more willing to interact with products.

KEYWORDS: *product sounds, visual pleasantness, overall pleasantness, experiences, audio-visual interactions.*

INTRODUCTION

Imagine yourself in a store where household appliances are sold. You need a coffee maker for your kitchen. There are several of them on the display and you contemplate each coffee maker in terms of its functionality, ease of use, and looks. You finally choose the one that you like the most. After your purchase you take the product home and plug it in. A wild roaring motor sound emitting from the product startles you. You feel disappointed. The unpleasant sound of the product overshadows the pleasant experience you had in choosing it, and the joy anticipated with the use of the product. You are no longer pleased with your choice.

A product inherently facilitates a multi-sensory experience with its visual, auditory, tactile, and chemosensory properties. During everyday product experiences, people perform actions with the product, they perceive sensory stimulation in different modalities, they become aware of the meanings and values they attach to the product, and they can observe any feelings and emotions that are elicited (e.g., Hekkert & Schifferstein, 2008; Özcan & van Egmond, 2009). As far as product aesthetics are concerned, all the sensory modalities can contribute to pleasant experiences (Suzuki et al. 2006; Fenko et al., 2010; Schifferstein & Hekkert, 2011), and consumer products can evoke feelings of intense enjoyment in multiple ways.

Sound may play an important role in how people perceive and judge products on pleasantness. For instance, for an espresso machine or a sports car the quality of the sound clearly contributes to the pleasantness of their usage experience. However, as exemplified above, the pleasantness of electrical products in the absence of sound may not correspond to their pleasantness during use while producing sound. With regard to our daily interactions with products, we can make conceptual distinctions between different kinds of pleasantness judgments. Ideally, *visual pleasantness* judgments are the result of a perceptual process based solely on the product's appearance, whereas *overall pleasantness* judgments reflect an evaluation based on the multisensory interaction including its tactile, haptic, auditory, and chemosensory properties. However, both visual and overall pleasantness judgments may be influenced not only by the presence of the sound but also by the quality of the sound. That is, pleasant product sounds may facilitate a more pleasant experience with a product compared to the unpleasant sounds, which may cause an undesired experience. There is empirical evidence that users can distinguish between visual pleasantness and overall pleasantness. In a study that tackled the effect of sound on landscape experience, Carles, Barrio and De Lucio (1999) found that pleasantness ratings were higher when landscape sounds or images were rated separately rather than combined. Nonetheless, Carles et al. also showed that sounds with positive associations (e.g., water) increased the overall pleasantness ratings.

Product sounds are mainly consequences of the ways products operate (e.g., motors, fans, and so on) or they give functional feedback on user actions (e.g., button sounds), and they are generally not created to add to the pleasure of product use (Langeveld, et al., 2013). Product sounds are perceived as loud, sharp, and noisy, which leads to unpleasant sensory experiences on psychoacoustical grounds (Özcan, 2008). As a consequence, most product sounds are not evaluated favorably when judged independently (Bijsterveld, 2008; Özcan & van Egmond, 2012). Hence, although product sounds are often necessary in providing information on the stages of product functioning (e.g., washing cycle and spin cycle of washing machines), they are unlikely to enhance overall product pleasantness evaluations if they are perceived as unpleasant.

Sounds in general can affect an experience adversely if listeners do not have control over the production of the sound and its quality (Maris, 2008), which is often the case for product sounds. For example, the loud, rough, and high-pitched sound of a lady epilator can contribute to the negative reactions towards the product itself. An attention demanding sound is more intrusive and, therefore, considered as less pleasant compared to a non-attention demanding sound (Bergman et al., 2009). Nonetheless, if we compare the effects of different types of sounds on product experiences, we expect that products with relatively pleasant sounds will evoke more positive overall evaluations than products with relatively unpleasant sounds. For example, Van Balken (2002) showed that improving the auditory quality of coffee machines through mechanical changes shifted the emotional and semantic experiences of products from negative to positive. Similarly, Lageat, Czellar, and Laurent (2003) established links between the acoustical compositions of sounds to users' experiences of luxury. In Spence and Zampini's (2006) study, participants reported that brushing their teeth with an electric toothbrush felt more pleasant and less rough if either the overall sound level was reduced or the high frequency sounds were attenuated. All these studies indicate that by changing the auditory quality of sounds, designers can obtain more pleasant product experiences.

When people encounter products, different sources of sensory stimulation typically are not perceived simultaneously. From a biological perspective, the sensory channels may operate quite independently in terms of stimulus reception, but psychologically the perception of one type of sensory information is likely to partly shape expectations for the other modalities (e.g., Dagman et al., 2010; Schifferstein & Cleiren, 2004). For instance, seeing a large object is likely to lead to the anticipation of perceiving a heavy object when you try to pick it up, and low-pitched sounds when you put it down. Hence, different types of sensory stimulation seem to go together for everyday products, and people tend to agree on such cross-modal correspondences (e.g., Schifferstein & Tanudjaja, 2004).

Schifferstein et al., (2010) investigated whether and how the overall pleasantness of a multisensory product relates to the pleasantness of its constituents, comprising of different sources of sensory stimulation. In this study, sixteen different product variants (e.g., a table lamp) were evaluated after creating all possible combinations of either a pleasant or unpleasant color (vision), weight distribution (touch), sound and smell. Schifferstein et al. found that the pleasantness of unisensory stimuli influenced the pleasantness of a complex multisensory product only to a very small degree. However, in this particular study the selection of (un)pleasant stimuli for the different sensory modalities was carried out independently for each modality, which may have led to (in)congruous stimulus combinations. Therefore, in the present study the (un)pleasant stimulus sounds are all generated specifically for a particular product context.

This paper studies the effect of (un)pleasant sound on the perceived pleasantness of products. We aim to understand the differences between visual and overall pleasantness judgments involved in product experience, and the kind of effect sound has on these judgments. The experiment measured two dependent variables (visual and overall pleasantness of the product), while one factor (auditory pleasantness) was varied, with four levels of treatment (no-sound (control condition), original sound, pleasant sound, and unpleasant sound).

METHOD

Participants

Sixty participants (34 female and 26 male), students and employees of industrial design engineering at Delft University of Technology, participated. The mean age was 29.7 years. Fifteen participants were randomly assigned to each of the four experimental conditions differing in sound type. All participants reported normal hearing.

Stimuli

In total eight products that are commonly used on a daily basis were chosen for the experiment: dustbuster, epilator, hairdryer, microwave, mixer, shaver, toothbrush, and washing machine. Products were selected to be neither very pleasant nor very unpleasant as regards their visual quality, as confirmed by 25 judges. The lowest rating on a 7-point scale was for the hairdryer (3.72) and the highest rating was for the mixer (5.08). The mean rating for all products was 4.34.

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Figure 1. Examples of two product photos used in the study. Dustbuster on the left and epilator on the right. (Philips my shop Nederland have authorized the use of the Philips product photos for our study.)

Visual stimuli

Products were presented as photos (500 x 500 pixels, 150 dpi) on a computer screen. All products were chosen to have a neutral color and were presented on a white background. Brand information was erased. See Figure 1 for two examples (dustbuster and epilator).

Auditory stimuli

Each product was represented by one corresponding product sound, except for the washing machine, which was represented by two different sounds resulting from different operation cycles (i.e., the washing cycle and the spin cycle). Hence, in total nine original product sounds were used that each lasted three seconds. These sounds were recordings of the main functioning mechanisms of the products.

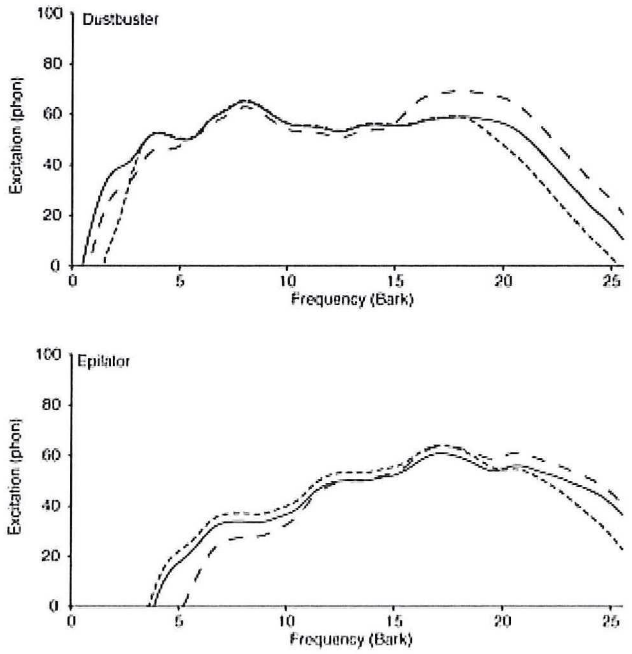

Figure 2. The pleasantness manipulations of sounds presented as barkscales for two products (Dustbuster and Epilator). The full black line indicates the original sounds, the fine dashed line indicates pleasant sounds, and the course dashed line indicates unpleasant sounds.

The pleasantness of the original product sounds was manipulated in Sound Studio three, for three of the four experimental conditions (excluding the no-sound condition): original sound, pleasant sound and unpleasant sound. In total 27 sounds were used (nine products x three pleasantness levels). According to Zwicker & Fastl (2001), the pleasantness of a sound is highly correlated with psychoacoustical parameters: the higher the perceived sharpness or loudness is, the lower the sensory pleasantness is. To make the sounds pleasant, a low-pass filter was used and the amplitude of the lower frequency range of the sounds was slightly increased. To make the sounds unpleasant, a high-pass filter was used and the amplitude of the higher frequency range was slightly increased (see Figure 2 for two examples). During these manipulations, the spectral-temporal composition of a sound was kept as close as possible to the original version of the sounds.

The pleasantness of the manipulated and original sounds was tested in a paired-comparison task by asking 25 judges which sound they thought was the most pleasant. A participant compared three sound pairs for each product type in two presentation orders. Descriptive statistics show that the pleasant sounds were chosen in 53% of the cases ($n = 1350$) as most pleasant, original sounds in 33%, and unpleasant sounds in 14 % of the cases. A repeated measures analysis indicated that the number of choices for pleasant, original, and unpleasant sounds was significantly different from each other [$F(2, 448) = 152.68$, $p < .001$]. These data confirm that pleasant versions of the sounds were perceived as more pleasant than the original versions, and that original versions were perceived as more pleasant than the unpleasant versions. These preference orders were confirmed at the level of the individual products. However, the manipulations of the hairdryer sounds did not yield the predicted preference order. Pleasant sounds in all hairdryer combinations were chosen in 34% of the cases ($n = 150$) as most pleasant, original sounds in 22%, and unpleasant sounds in 44 % of the cases. Therefore, for the hairdryer the unpleasant version of the sounds was used as the pleasant sound condition, the pleasant version of the sounds was used as the original sound condition, and the original version of the sound was used as the unpleasant sound condition in subsequent analyses.

Procedure

A participant was randomly assigned to any of the four experimental conditions: control condition, original sound condition, pleasant sound condition, and unpleasant sound condition. The visual and auditory stimuli were presented using a specially designed application developed using the Trolltech Qt (Mac OS X — free edition) tool kit. The application ran on a Macintosh iMac Intel Core 2 Duo with 19" screen. For the presentation of the auditory stimuli, external headphones (Sennheiser HD 205) were used. Participants were seated in front of the screen at a distance of approximately 50 cm. They were instructed to rate the products presented as photos on the computer screen on the bases of their visual and overall pleasantness. In all conditions, product types were randomly presented for each participant. The entire experiment was self-paced and there were no pauses between the rating trials. One rating session for nine products lasted about five minutes.

In the three experimental conditions (original, pleasant, unpleasant), two rating scales (visual pleasantness and overall pleasantness) appeared simultaneously on the screen, but were initially inactive for rating. The participant was asked to listen to the sound of the product presented on the screen. A participant was allowed to listen to the sound more than once while evaluating the pleasantness. All sounds were presented at a similar, comfortable listening level preserving the natural variation in the loudness of sounds. Participants were not allowed to change the sound levels during the experiment.

After a sound was heard, the rating scales became active. Participants first rated the visual pleasantness and then rated the overall pleasantness of the product under the influence of the sound. They were instructed that visual pleasantness was about a sensory judgment based only on the visual quality of the product. For the overall pleasantness rating, a participant was encouraged to imagine the product as a whole with all sensory properties. Ratings were collected on a seven-point Likert scale (one indicating 'not pleasant' and seven indicating 'very pleasant'). In the control condition, the nine rating trials were completed in the absence of a corresponding product sound.

Data analysis

We analyzed the pleasantness responses in SPSS by doubly multivariate repeated measures analysis of variance (Stevens, 2002, p.538). In this analysis, we used the overall and visual pleasantness ratings as the two dependent variables, while Product was a within-participants variable with nine levels, and Condition differed between participants with four levels (control, original, pleasant, unpleasant sound). For the multivariate effects, we report the values of Rao's F, corresponding to Wilks's □. Significant effects were investigated in more detail by repeated measures analyses for the separate dependent variables. In accordance with Stevens (2002), we corrected the degrees of freedom of the univariate tests with the Greenhouse-Geiser □ if □< 0.7, and we averaged the □ values from Greenhouse-Geiser and Huynh-Feldt, when □> 0.7. Differences between individual samples were investigated by post hoc t-tests with Bonferroni adjustment.

RESULTS

In the multivariate tests, we found significant effects for Condition ($p < 0.001$), Product ($p < 0.001$), and the Condition × Product interaction ($p = 0.024$). However, in the univariate significance tests in the separate analyses for the two types of pleasantness judgments, the Condition × Product interaction did no longer reach significance (overall pleasantness $p > 0.20$; visual pleasantness $p = 0.06$). As we were not primarily interested in the data for the individual products, we decided to perform no additional analyses at the level of the individual products.

If judgments for visual pleasantness are unaffected by the sounds participants hear, we expect responses in the four conditions to be identical. However, the Condition main was statistically significant [$F(3,56) = 3.1$, $p < 0.05$]. Post-hoc tests with Bonferroni adjustment indicate that these outcomes are mainly due to a difference between the control condition and the pleasant condition ($p < 0.05$). A separate analysis comparing only the three experimental conditions shows no Condition main effect [$F(2,42) = 1.6$, $p > 0.20$].

We expect the overall pleasantness judgments to be affected by the product sounds, and this is confirmed by a Condition main effect [$F(3,56) = 4.9$, $p < 0.01$]. Post-hoc tests show differences between the control condition on the one hand and the original and the unpleasant conditions on the other hand ($p < 0.01$ and $p < 0.05$, respectively). Although no other significant differences are found, the separate analysis comparing the three experimental conditions still shows a Condition main effect [$F(2,42) = 3.2$, $p < 0.05$]. Post hoc analyses show no significant differences between the three conditions, although difference between the original and the pleasant condition just failed to reach significance ($p = 0.055$).

These analyses show that the pleasantness judgments in the control condition, where a product is presented without any sound, differ substantially from those in the three experimental conditions. This suggests that the presence or absence of sounds has an important effect on how judgments of both visual and overall pleasantness are formed. In the absence of sound, participants seem to treat the visual and overall pleasantness judgments similarly: The mean ratings are very similar (3.89 for visual, 4.02 for overall pleasantness) and the Pearson correlation coefficient between the visual and overall pleasantness ratings is 0.32 [$N = 135$, $p < 0.001$].

In contrast, in the three sound conditions the means for visual pleasantness are consistently higher than the means for overall pleasantness. Surprisingly, although the differences between the three experimental conditions fail to reach statistical significance, the pattern of means is similar for the visual and overall pleasantness judgments, with the means consistently differing about one unit (Figure 3). The Pearson correlation coefficients between visual and overall pleasantness ratings for these three conditions vary between 0.24 and 0.27 ($N = 135$, $p < 0.01$).

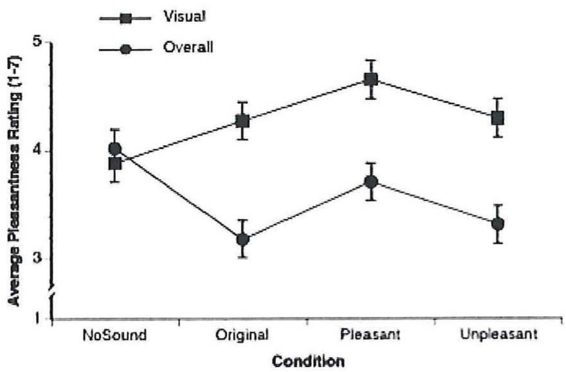

Figure 3. Visual and overall pleasantness ratings (± SEM) in the four experimental conditions.

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DISCUSSION

The present study shows that ratings for visual and overall pleasantness are similar when no sounds are provided with the visual stimuli (pictures). This is not surprising, since participants are not provided with any non-visual information. Hence, when they judge overall pleasantness, they can only base their judgments on the visual information provided. Therefore, the judgments of visual pleasantness are likely to concur with those of overall pleasantness in this comparison.

When participants are provided with product sounds, however, the overall pleasantness data shows a considerable decrease in pleasantness ratings. This decrease may be due to the low appreciation that is generally found for product sounds. In contrast, visual pleasantness increased when sound was added. Possibly, the pleasantness of the pictures contrasted with the low auditory pleasantness of the sounds, and thereby boosted the visual pleasantness ratings in the study (Anderson, 1973). Alternatively, we might suggest that the addition of sound makes the product come alive, which makes the visual representation more interesting and increases its pleasantness.

The finding that the presentation of product sounds affects both overall and visual pleasantness ratings has implications for product development practice, because it indicates that company decisions should not be based on the evaluation of partial data. If participants in consumer panels are provided with limited information, their judgments will only have limited external validity. As we see in the present study, providing additional sensory (auditory) information has a significant impact on both types of pleasantness judgments.

Similarly, sensory processes are likely to affect consumers' buying processes (Lageat et al., 2003; Spence & Gallace, 2011). Consumers often purchase household appliances in stores in the absence of sound. This is even more so for online shopping experiences. In many cases, people who buy products are able to use only a single sensory modality (i.e., vision) to compare products (see Fenko et al., 2009). Thus, their pleasantness judgments are mainly based on product appearance, which may provide different information than the auditory product properties. Multi-sensory experiences only take place in home environments after product purchase, and people's judgments of product pleasantness may need to be adjusted accordingly. As a consequence, many buyers may be disappointed with their purchase, because even the properties of the relatively pleasant sounds may lead to a decrease in overall product evaluation. Moreover, retailers and producers may be confronted with consumer complaints, as the product may not live up to consumer expectations.

The pleasantness ratings in Figure 3 suggest that the original product sounds and the unpleasant versions we created were about equally unpleasant. This indicates that the sound quality of the products currently found in the market does not enable pleasant auditory experiences. The sounds we used belong to everyday products that people use for mundane tasks such as shaving, drying hair, cooking, washing, and so on. These unpleasant sounds may lead to momentary annoyance (e.g., preparing a cake with a loud mixer can disturb the user and other people), the desire to avoid using the product again (e.g., an electric toothbrush producing loud and rough sounds does not invite the improvement of personal hygiene), or even health problems due to sensory fatigue (e.g., being exposed to a loud hissing sound from an air-conditioner may eventually lead to health issues). On the positive side, our results suggest that if efforts are put into improving the sound quality, both the visual and the overall experiences with products are enhanced and, consequently, users will be more pleased and willing to interact with the products.

Furthermore, even though intrinsic sound properties for products may generally be evaluated as unpleasant, some cognitive associations may nonetheless be positive and improve product purchase (Özcan, 2014). For instance, a roaring motor sound may evoke associations with being wild and untamable, and may make the user feel adventurous in the context of a motorbike ride. For a user who likes to feel adventurous, using this product may give him more pleasure, in which case this sound may improve his product evaluation. Hence, making use of expressive sound properties may provide an additional route for improvement in the product design (e.g., Ludden & Schifferstein, 2007).

We have shown that there is interplay between the sensory properties of a product (audio-visual) with regard to the experience of pleasantness. However, our manipulations were restricted to the auditory product properties only and we have not manipulated the contribution of visual product properties. A future study could systematically investigate how each sensory property of a product (e.g., visual and auditory) individually contributes to affective product experiences.

One of the limitations of the current study is the participants' lack of physical experience with the product properties tested (i.e., auditory and visual product properties). In other words, participants' judgments on visual and overall pleasantness are based on the photos and recorded sounds of products instead of the products proper (i.e., tangible or physical products). A future study could investigate whether the effects found would persist if participants interacted with physical products (provided that the physical products can be modified in situ in order to produce pleasant as well as unpleasant sounds). Furthermore, other product experiences pertaining to basic affective responses could also be measured as a continuation of the current study. For example, it could be tested whether the product is perceived as pleasing, stimulating or powerful in relation to the interventions caused by the sounds of the products, perhaps even with different degrees of pleasantness.

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