Investigations on subconscious perception of product sounds

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Introduction

Product sound design is related to several different product categories. Probably the most well-known scope of application is the automotive industry but also different types of food, household appliances, and electronic devices are optimized in terms of their acoustical behaviour. In this context particularly popular science and advertising industry draw on the subconscious effect of product sounds. In psychological research subconscious priming has been subject of controversy for many years. Since 'consciousness' is a very vague construct this contribution deals with inattentional processing of sound instead. However, providing empirical evidence on this is a particular challenge with regard to the test design.

Since the evaluation of product sound quality is usually carried out in listening studies, the test participants' attention is focussed on the auditory stimuli being evaluated, due to the experimental task. This significantly affects the evaluation behaviour and is often not congruent with listening in everyday life, where this kind of artificial attention focusing on sound does not necessarily occur. In terms of ecologically valid assessments it therefore must be considered what kind of test design is suitable to investigate the effect of product sounds.

In everyday life humans are exposed to multiple sensory impressions, and judgement formation is subject of several different cognitive processes [1]. According to the dual-processing theory [2] human cognition is based on two systems. The first system is processing information intuitively and fast without requiring attention, whereas the second system is governed by reasoning, limited in its capacity, and thus working slower [3]. In addition, the latter system requires attention. Against this background the question arises how sounds affect the overall evaluation of a product when people do not pay special attention to the product's acoustical behaviour. This also implies the general question which target group is basically addressed with product sound design.

In the course of a former study on the evaluation of different household appliances it was shown that in a test setup with a high degree of realism, where the test persons interacted with the devices and were not focussed on the operating noise, no significant differences in ratings between the devices were found, when the operating sounds had a low saliency [4]. Based on these results a hypothesis was proposed and investigated:

H 1: The modification of a device's operating noise does not affect the overall evaluation of the device, when a test person's attention is not explicitly focused on sound.

Instead of a listening study a product test was performed on capsule coffee machines, a familiar product category which offers the opportunity to investigate cross-modal effects, like for example the influence of product sounds on taste perception [5].

Test design

To avoid test-dependent attention focusing on sounds the product test was carried out as a deception experiment. It was announced as an evaluation of design and usability of different capsule coffee machines. After the experiment was finished, the participants of course were informed about the real aims of the experiment.

Sample

A total of 96 employees and students at the Düsseldorf University of Applied Sciences aged between 19 and 66 years (mean age: 30.1 years) attended the product test. 70.8% of the test participants were male and 29.2% female. A between-subject design was applied, so the treatment group consisted of 50 persons and the control group of 46 persons. Both groups were equally distributed according to age and gender.

Devices

Three capsule coffee machines of different manufacturers were presented in the test, each device with one individual type of espresso capsules. Both test groups passed the experiment under equal conditions, so every participant had to test each of the three devices. Therefore the individual characteristics of the devices, e.g. design and haptics, had the same influence in both groups. The only variable being modified in the treatment group was the operating noise of one device.

Sound modification

The capsule coffee machines differed from each other to a large extent concerning their acoustical behaviour. One device with a very silent operating sound (device 2) was chosen for modification. The operating noise was deteriorated by adding the rough and sharp sound of a portafilter machine during the brewing process. An audio exciter attached to the inner body at the front of the device played back the additional sound. The playback was triggered by the water pump of the coffee machine, so the additional sound occurred only during the brewing process and thus could be related to the device characteristics by the test persons in the treatment group.

In order to attribute possible differences in evaluation clearly to the sound modification the other two devices were presented as constant 'anchors' and thus equally in both groups. Since evaluations carried out in experiments are determined by the test participants' frames of reference and beyond that are subject to relative comparisons, any additional sound modification would possibly have distorted the results.

Test procedure

The capsule coffee machines were presented to both test groups in randomized order. To avoid attention focusing and because the experiment was announced as a usability test, the participants had to interact with the devices. They were asked to prepare an espresso with each coffee machine according to written step-by-step instructions and to taste the coffee afterwards. The evaluation consisted of two parts and was explained to each test person before starting the product test. After having tested the first coffee machine the participants initially had to rate the device and the coffee separately in terms of German school grades, which is a 6-step scale. The grades were written down by the investigator. At this point the test person did not have any comparison with the other devices yet. Subsequently the participant was asked to continue with the next device after having neutralized his taste with water or white bread. During the test the investigator was monitoring if the test person paid attention to the devices' noise behaviour. If so, this was marked in the questionnaire, and the ratings were analysed separately in the test evaluation later. After having tested all three devices, the participant was asked to fill out a questionnaire with some more detailed questions about the devices and the coffees.

Questionnaire

To keep the impression of a real product test the questionnaire consisted of 6-step verbal rating scales with 4 detailed questions about each device and 4 questions about the corresponding espresso. The coffee temperature was rated on a 5-point just-about-right (JAR) scale. One of the questions was related to the operational noise because on the one hand the absence of this category would have raised suspicion. On the other hand this question gave the opportunity to find out whether a processing of sound had happened during the test. Moreover at this point of the test the crucial initial ratings already had been carried out. For each coffee machine there was an additional rating scale for a final overall evaluation of the device. This was to compare if the test persons' initial rating during the test differs from a probably more analytical final rating in the questionnaire. Finally the test persons were asked about their average daily coffee consumption and the type of their own coffee machine. The last question was: 'What is particularly important to you concerning a coffee machine?'

Results

The results from both test groups were analysed first by means of a two-tailed t-test ($\alpha = .05$). Figure 1 exemplarily shows the mean initial ratings of the coffee machines carried out during the product test with 95% confidence intervals. The school grades have been transformed, so a high value corresponds to a good rating. There is no significant difference in means between both test groups for none of the devices. So the sound modification of device 2 in the treatment group did not affect its initial overall evaluation.

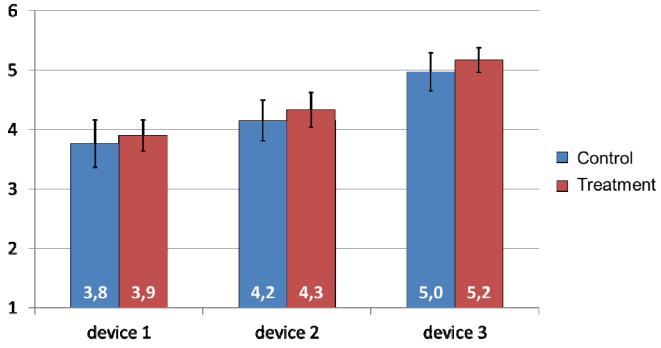

Figure 1: initial ratings of the coffee machines (arithm. means with 95%-CI)

The results for the initial ratings of the different coffees did not show any significant differences as well and therefore are skipped in this contribution.

However, the mean ratings of the operating noise in the questionnaire (Figure 2) reveal different results. First of all it is noticeable that the operating noise of device 1, a very impulsive and thus salient sound, was distinctly devaluated in both groups compared with the initial ratings.

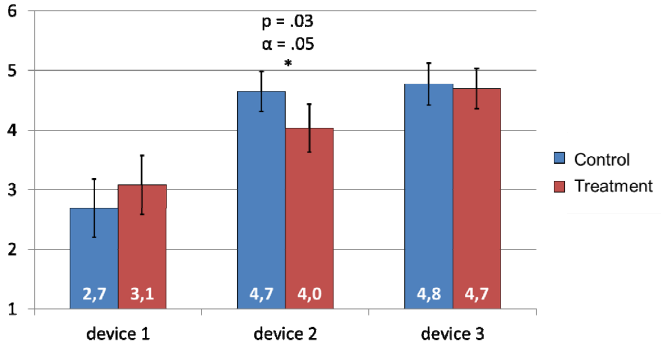

Figure 1: operating noise mean ratings (arithm. means with 95%-CI)

Beyond that, the t-test indicates a significant difference in means of 0.7 scale points for the evaluation of device 2 ($p = .03$). Obviously the sound modification was perceived by the test participants although they were not focused on the operating noise of the coffee machines during the product test. This finding is quite interesting, also due to another fact: the question about the operating noise was raised in the questionnaire subsequent to the test. Hence a certain amount of time passed since the devices had been operated and it should be difficult to remember the devices' acoustical behaviour. So if the test participants were able to evaluate the operating noise based on their memory contents, some kind of inattentional sound processing must have occurred in the test, to create these memory contents.

Although the evaluation of device 2 was different in both groups, when the test persons were asked directly about the operating noise, this did not affect the final overall evaluation of the coffee machines (Figure 3). The mean values in both groups are almost identical for each of the three devices.

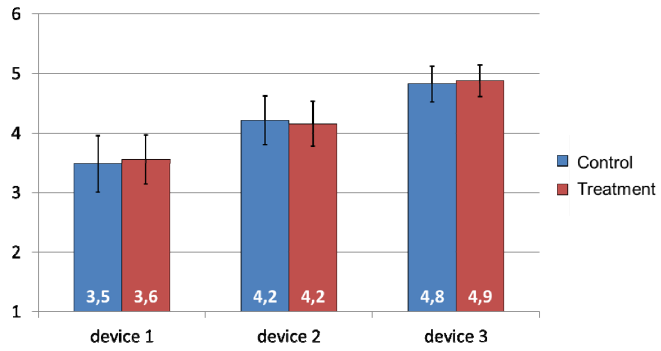

Figure 3: final overall ratings of the coffee machines (arithm. means with 95%-CI)

Moreover, the worst rated operating sound of device 1 does not influence the final overall evaluation as much as expected. Obviously other factors than the operating noise are decisive for the overall evaluation of capsule coffee machines. Regarding device 3 a halo effect, caused by the design of the coffee machine, can explain the good ratings. This is confirmed by a linear regression analysis which reveals the factor design to be the most dominant predictor of the overall evaluation in this case. Concerning the other devices the linear regression analysis revealed different predictors. However, in none of the cases the operating noise contributed to the variance explanation. This is also in line with the answers the test persons gave at the end of the questionnaire with regard to important factors concerning a coffee machine. The most frequently mentioned factors were the coffee flavour, the usability and the design of the device. Only 10.4% of the test persons mentioned the operating noise as important factor.

A correlation analysis of the mean values of both test groups concerning all rated items and devices results in r = .92 (p = .00). Therefore the evaluation behaviour in both groups can be considered as very similar. This confirms the finding that the sound modification does not have a fundamental effect in this experiment.

Initial and final ratings

In order to investigate the relation between spontaneous and more analytical judgements the initial overall ratings for each device were compared with the final overall ratings in the questionnaire by means of a correlation analysis. This brought up very similar positive correlation coefficients for all three coffee machines which are highly significant as well (**p < .01):

- Device 1: r = .68**;
- Device 2: r = .62**;
- Device 3: r = .65**.

So the spontaneous initial ratings carried out without comparisons between the devices can be regarded as consistent with the final overall evaluations in the questionnaire. Nevertheless, the correlation is not very high. One reason might be the small variance between the devices affecting the correlation.

Conclusions

The results from this study bring about empirical evidence that there is no significant effect of the operating noise respectively its modification on the overall evaluation of capsule coffee machines when test participants are not focused on sound in the course of a product test. Other factors like design, coffee taste and usability of the device affect the overall evaluation of this product category to a greater extent. Nevertheless, a significant difference between the evaluation of an original and a modified operating noise was found, when test persons were asked to judge product sounds retrospectively. Since the memory contents people refer to must have been created before, there is evidence to suggest an inattentional processing of product sounds during the experiment. Based on these results the threshold of attentional sound processing when product sounds become influential should be the topic of further research. This means, for example, to what extent the operating noise of a product has to be modified to have a significant influence on the overall evaluation. Notwithstanding, the results from this study are valid for capsule coffee machines and have to be verified with other product types. As a consequence the question arises, which product categories are actually relevant for product sound design.

References

[1] Kahneman, D.: Attention and Effort.
Prentice-Hall, New Jersey, 1973

[2] Schneider, W., Shiffrin, R.: Controlled and Automatic Human Information Processing: I. Detection, Search, and Attention.
Psychological Review **Vol. 84 No.1** (1977), 1-66

[3] Kahneman, D.: A Perspective on Judgement and Choice.
American Psychologist **Vol. 58 No. 9** (2003), 697-720

[4] Steffens, J.: Realism and Ecological Validity of Sound Quality Experiments on Household Appliances.
Fortschritte der Akustik – DAGA 2013, CD-ROM.

[5] Knöferle, K.: Acoustic Influences on Consumer Behavior: Empirical Studies on the Effects of In-Store Music and Product Sound.
PhD thesis, University of St. Gallen, 2012