Applied Acoustics 103 (2016) 64–70

Contents lists available at ScienceDirect

Applied Acoustics

journal homepage: www.elsevier.com/locate/apacoust

Approach for combining physical properties and sensibility for pleasant beverage can-opening sound

Toshihiko Komatsuzaki [a,*], Jing Han [b], Hiroaki Uchida [b]

[a] Kanazawa University, Institute of Science and Engineering, Kakuma-machi, Kanazawa, Ishikawa 920-1192, Japan
[b] Universal Can Corporation, 1500 Suganuma, Oyama-cho, Sunto-gun, Shizuoka 410-1392, Japan

ARTICLE INFO

Article history:
Received 28 May 2015
Received in revised form 1 September 2015
Accepted 15 October 2015
Available online 28 October 2015

Keywords:
Sound design
Beverage can
Semantic differential method
Frequency analysis

ABSTRACT

The sound quality of consumer products has recently become an important feature, receiving much attention in the fields of engineering and manufacturing. The sound could add value to the product in the way that it meets the interests and preferences of consumers in a wide range of fields. The present study deals with the sound emitted from beverage cans when lifting the tab of the can end to open it before drinking. With a view toward finding the characteristics of sound that have a sense of ease and certainty for the consumer when opening a beverage can, we introduce the semantic differential method for the subjective assessment of sounds of various cans. We then perform waveform analyses in both time and frequency domains to determine the physical properties of the desirable sounds. Finally, we successfully correlate the texture factor with the duration of the tearing sound, which may be a new way to design cans with pleasant sounds.

1. Introduction

A product's intrinsic sound is considered to be a significant factor in the characterization of its image and quality, and it may provide satisfaction to the consumer [1]. For example, the sound heard when opening a beer can could give consumers a pleasant feeling so that they might be disposed to drink the beverage. The sound heard when closing an automobile's door is designed to project a sense of luxury [2,3]. We subconsciously realize that a photograph was taken when we hear the "snapshot" sound of a digital camera, even though the sound is not necessary for the camera to function [4]. These examples show that a characteristic sound has the ability to add special meaning to a product. Past studies of sound control technology focused mainly on the mitigation of unwanted noises in products, such as those of vacuum cleaners and air conditioners [5]. Recently, attempts have been made to design pleasant and more appealing sounds to give a sense of luxury and quality to a product to meet the preferences of each individual [6–8]. The designed sounds could enhance the value and attractiveness of a product.

The unique sound emitted when opening a beverage can could affect consumer sentiment. There have been several studies on the ergonomic design of easy-to-open, easy-to-grasp, easy-to-drink, and scented aluminum beverage cans and bottles [9–12], but literatures on the design of the can-opening sound are not found.

The aim of the present study was to develop a design procedure to realize an expected can-opening sound, by which the semantic space obtained by evaluation of the sensibility for the can-opening sound correlates with the physical properties of the sound. First, we defined the goal of the design of the can-opening sound as "a sound that brings to the user an easy-to-open, comfortable feeling with sureness." To evaluate sensibility, we introduced a semantic differential (SD) scale method, a technique that uses a rating scale to measure the meaning of objects and concepts. At the same time, we evaluated the physical properties by using time series analysis, frequency analysis, and loudness and sharpness assessments. These investigations were followed by a correlation analysis that studied the relationship between the psychological factors and the physical parameters. Finally, based on the correlation analysis, we determined the design parameters of the beverage can, such as its geometrical and acoustical features, that can be physically altered to achieve the goal of a pleasant sound.

2. Materials and methods

2.1. Sensibility evaluation using the SD method

The SD method is a psychological measurement technique that identifies the connotative meaning of objects and concepts. The method has drawn attention for use in sensibility analysis of objects since it was first developed by Osgood in the 1950s [13].

* Corresponding author. Tel.: +81 76 234 4673; fax: +81 76 234 4676.
E-mail address: toshi@se.kanazawa-u.ac.jp (T. Komatsuzaki).

http://dx.doi.org/10.1016/j.apacoust.2015.10.016
0003-682X/

The SD method measures an individual's impression or the perceived meaning of an object by using a series of adjective scales. The adjective scale is a bipolar rating scale that typically has seven choices between a bipolar adjective pair, the components of which have opposite meanings. The obtained scores undergo factor analysis to extract the dimension of semantic space for the object. The general workflow of the SD method is shown in Fig. 1.

We selected 14 adjective pairs suitable for sound evaluation to form the survey's scales. The adjective scales were then used within the SD evaluation framework to rate the can-opening sounds. In addition, three factor axes were extracted from the obtained scores via factor analysis to form a semantic space that explains the connotative meaning of the sound.

2.2. Selection of adjective pairs for sound evaluation

The selection of appropriate adjective pairs is the important first step in successful factor analysis in the SD method. The components of an adjective pair are at the ends of the rating scale and have opposite meanings (e.g., strong–weak and long–short). In the present study, we started with 25 adjective pairs that we obtained by referring to past work on sound evaluation [14]. We then reduced the number of adjective pairs to 12 by merging similar pairs that overlapped in their meanings, thereby avoiding fatigue and boredom of the respondents. The 12 pairs were chosen as follows: First, we selected four can-opening sounds, two for carbonated and two for noncarbonated beverages. Second, after listening to the four can-opening sounds that were presented in sequence, 14 male university students, ranging in age from 22 to 24 years, chose 12 out of the 25 adjective pairs that they thought were suitable for evaluating the can-opening sound. The respondents could listen to the sounds as many times as necessary.

The 25 adjective pairs presented to the respondents are listed in Fig. 2, along with their scores shown as bar graphs. In addition to the top 12 adjective pairs, an additional two pairs were introduced to evaluate the sensibility of sounds that could express the objective sound features Wiggling–Bursty and Secure–Insecure. The 14 pairs used for the following analysis are listed in Table 1.

2.3. Sensibility evaluation using the SD technique

Next, the sensibility for can-opening sounds was evaluated by the respondents using the 14 adjective pairs determined in the previous subsection. Evaluations were made as follows: Eleven male university students, between the ages of 22 and 24 years, listened to the sound of eight noncarbonated (cans A–H) and eight carbonated (cans I–P) 350 ml stay-on-tab-type beverage cans as they opened each can. The evaluations were made in an ordinary meeting room without sound proofing treatment, where the background noise level was approximately 40 dB. Each time the respondents opened a can, the can-opening sound was recorded using an IC recorder (SONY PCM-D50) placed 30 cm apart from the can. The respondents were asked to open the can within approximately 2 s. After a respondent opened a can, he provided scores for the 14 adjective pairs, each of which was divided into a five-step scale.

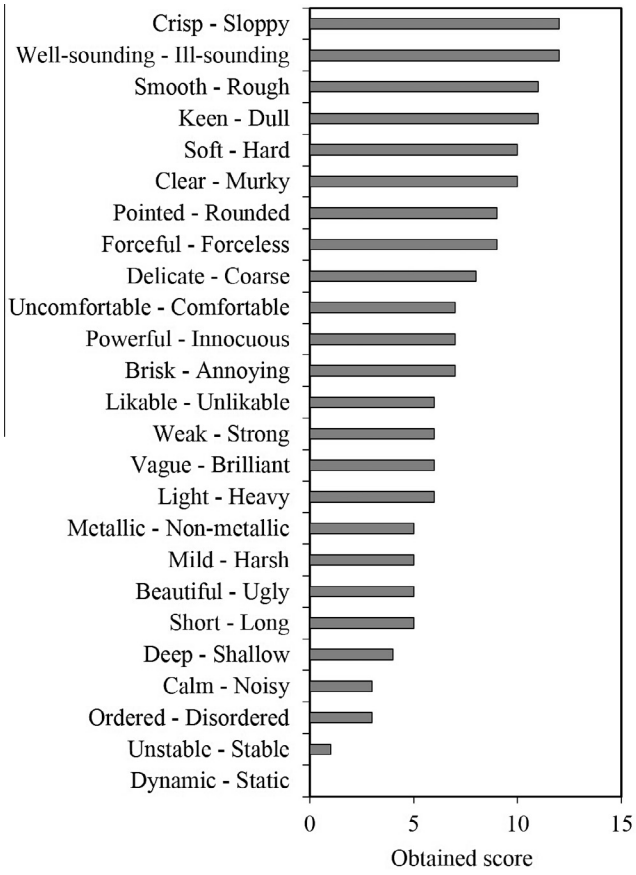

Fig. 2. Rating of adjective pairs in the preliminary test.

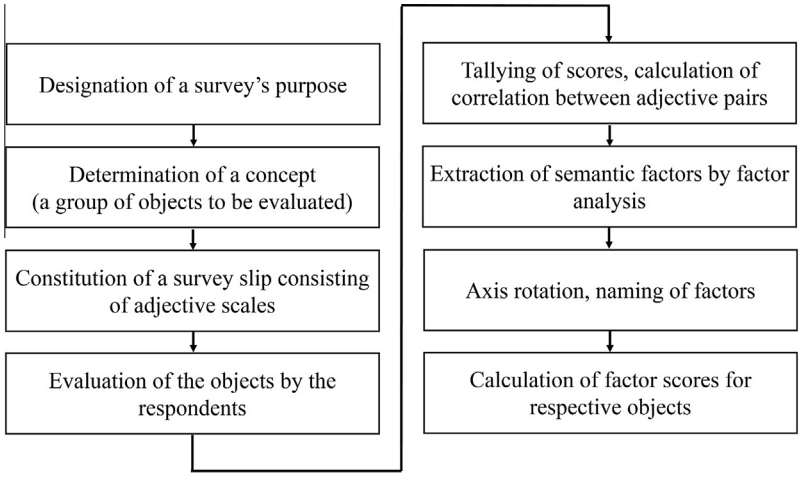

Fig. 1. General workflow used in the SD method.