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A taxonomy of sound sources in restaurants

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ABSTRACT

Restaurants are complex environments engaging all our senses. More or less designable sound sources, such as background music, voices, and kitchen noises, influence the overall perception of the soundscape. Previous research suggested typologies of sounds in some environmental contexts, such as urban parks and offices, but there is no detailed account that is relevant to restaurants. We collected on-site data in 40 restaurants (n = 393), including perceptual ratings, free-form annotations of characteristic sounds and whether they were liked or not, and free-form descriptive words for the environment as a whole. The annotations were subjected to cladistic analysis, yielding a multi-level taxonomy of perceived sound sources in restaurants (SSR) with good construct validity and external robustness. Further analysis revealed that voice-related characteristic sounds including a 'people' specifier were more liked than those without it (d = 0.14 SD), possibly due to an emotional crossmodal association mechanism. Liking of characteristic sounds differed between the first and last annotations that respondents made (d = 0.21 SD), which might be due to an initially positive bias being countered by exposure to a task inducing a mode of critical listening. Comparing the SSR taxonomy with previous classifications, we believe it will prove useful for field research, simulation design, and sound perception theory.

1. Introduction

The acoustical richness of restaurants provides ample opportunities to study sound perception in context. Restaurants, being one kind of servicescape i.e. the "manmade, physical surroundings, as opposed to the natural or social environment", are characterised by "elaborate physical complexity" and "interpersonal services" [10, p. 58]. The complexity is evident in that ambient environmental conditions affect the senses through physical factors such as temperature, lighting, noise, music, and scent, as well as through psychological factors such as memory, appraisal, and "imagery" ([18, p. 172]; see also [48]). Restaurants are interpersonal in that actions are performed both by customers and employees in face-to-face interaction. Bitner [10, p. 66] suggested that sensorial effects are mainly holistic, and that they might only become problematic when either extreme (e.g. high ambient noise levels), persistent (e.g. faint yet annoying sounds), or in open conflict with people's expectations (e.g. 'wrong' music genre). While overall aspects are important, we believe it is necessary to identify and classify the physical and interpersonal design elements in as much detail as possible, if we want to identify how the servicescape can be improved.

The present study extends our recent work [5] and attempts to answer the call for contextual specificity in soundscape research ([25]; see also [18]). We focussed on perceived sound sources in restaurants and chose an empirically grounded approach.

Two related forms of systematic classification of phenomena are typology, concerned with universals and constructed top-down, and taxonomy, built bottom-up from empirical observations. [51,52]. Schafer [49, p. 137–148, 268–270, p. 26] classified the sonic realm by referential aspects ('natural sounds', 'human sounds', 'sounds and society' and so forth) and by significance ('keynote', 'signal', and 'soundmark'). The first typology refers to physical sources in the world and the second to their purpose as understood by humans. Schafer's work influenced numerous operational classifications of sounds in outdoor urban soundscapes (e.g. [59,39,22,9,7,8,25,12,13]). However, indoor soundscapes have received comparatively less attention. Sound sources in restaurants were discussed by Aletta and co-authors [1, p. 1549], and in Migneron and Migneron [31]. In our previous work, we have proposed a typology of acoustic design elements in restaurants [5]. Some but not all of the proposed classification schemes retained Schafer's distinction between the attributed source and

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interpreted purpose of perceived sounds (further discussed in Section 4.3).

Restaurant sonic environments are constituted by designable acoustic elements. Models of restaurant soundscapes might be validated against ecologically strong measures such as profit [32,38] and 'priciness' [5]. Through crossmodal correspondences, sound is known to affect people's perception of the taste and flavour of food [53,38]. Cognitive assessment of sound sources is conditioned on perceiving certain sounds as foreground events [11]. The strength of the emotional reaction to a foreground event depends on whether the physical source is recognisable or if the sound is abstract [2]. Indeed, source identification might be a stronger predictor of perceived quality than sound level [35]. The recent ISO definition states that soundscape is a perceptual construct originating in sound sources that are distributed in space and time in a physical environment [14]; see also e.g. [50]. Studies of the urban soundscape have shown that most people prefer natural over technological sounds [49,41]; see also [21,40,57,35,9]. Bosch and Andringa [11] combined appraisal and event annotations of sound sources in an urban soundscape and found "attractors" towards 'calm' and 'chaotic', indicating a tendency for dichotomisation. Some sounds appear to be almost universally undesirable, yet might still be wanted in particular settings [18, p. 174]. Perceptual experiments have shown that soundscape evaluation depends on the activities that the listener observes or imagines taking place [34]. Perhaps due to innate ecological listening principles, people spontaneously attribute auditory phenomena to causal actions [54]. Individual differences such as age [58], personality factors [4], and noise sensitivity [60], have also been shown to influence the perception of sound. As emphasised in the ISO definition, context matters. However, it is easier to define what is annoying than what is pleasing [18, p. 169].

Among the various designable acoustic elements in restaurants, music is the most obvious. It is something that managers have at their immediate disposal and it is an effective way in which they can communicate information about the venue. On the other hand, how restaurant customers perceive background music is less well understood. Researchers have focussed on how behaviour and appraisal are influenced by music style and sound level [56,36,37]. Manipulation of such factors have typically shown that moderately arousing music is preferred ([32,38]; see also field studies by [15,17]). The effect of other aspects of background music design, such as loudspeaker sound diffusion design and interactive personalisation, remain to be systematically investigated.

Another prominent acoustic element in restaurants is constituted by voices, commonly identified as a major source of annoyance. For example, "conversation of others" was found to be the most predominant noise source in restaurants and a factor that limited, not promoted, social interaction [17, p. 11]; see also [61]. While speech is essential for restaurants as social places, voice sounds become problematic mainly due to room acoustic factors that are largely designable [45]. Different kinds of restaurants may have different design priorities. Interior design materials, which clearly affect room acoustics, are associated with food style, design style, and priciness [5]. For a vocal communication to be intelligible it needs to be 7 dB or more above the background level [29, p. 362]. With multiple simultaneous conversations inside an enclosure, each speaker tends to raise the voice in order to be heard, thereby contributing to the background din for listeners that are outside the communication perimeter. This produces a feedback loop of increased ambient noise known as the Lombard effect (see [55]). A survey of 112 restaurants documented a median level of 70 dBA [5], significantly higher than the "optimum level... for dining pleasure", 64 dBA, suggested by Novak and collaborators [38]. In social situations, listeners tend to direct their attention towards one speaker at a time, while the voices of others perceptually fuse into the background (a.k.a. the cocktail party effect, described by Cherry [16]). As background levels soar, the soundscape becomes saturated and the cocktail party effect is overpowered; individual conversation breaks down and is replaced by crowd din. Music that is not loud enough to be listened to and understood as communication becomes part of the background noise. Contemporary practices in interior design, such as a proclivity for large, open spaces with few partitions, and hard, easily maintained surfaces, create generous reverberation that further compounds to the effect.

Beyond music and voices, other sound sources might influence the experience more subtly. Navarro and Pimentin [33] investigated vocal comfort in food courts and concluded that improving the design of incidental sources, via "fix-mounted chairs, improving dish tray handling, and avoiding game stations", might have a larger and more immediate impact on the perceived quality than controlling crowd noise with acoustic panels. There is a vast array of 'other noises' in restaurants, as diverse as coffee bean grinders, cutlery, and cash register bells. From common experience and anecdotes (e.g. the vivid account in [47]) it is clear that the perception of such sounds goes from extremely negative to extremely positive. Yet, the prevalence of all the 'other noises' in restaurants has not been systematically investigated in the reviewed literature; the influence that individual sound sources have on the overall soundscape quality is unknown. Addressing this lacuna of knowledge, the aim of the present work was to create a taxonomy of perceived sound sources in restaurants. Our hypothesis was that the appraisal of sound sources would correlate with the perceived quality of the soundscape as a whole.

2. Methods

2.1. Questionnaire

We developed a questionnaire aiming to capture restaurant customer behaviour and their perception of the environment. One part was designed to identify perceived sound sources via free-form annotations, and the other part adopted the Swedish Soundscape Quality Protocol (SSQP; version of March 2011, [8]. Three questionnaire items are relevant to the present study.

First, respondent were asked to "Describe 3 characteristic sounds of this restaurant". They answered by writing free-form text (a single word or a short phrase) on three numbered lines. At the end of each line, they were asked: "Do you like this sound? Yes/No (Please circle)". The appraisal was registered in a variable called Liking, encoded numerically with 'yes' = 1, 'no' = −1, and blank (no response) = 0. Annotation order was also coded.

Second, respondents had to "Give 5 words that you would use to describe this restaurant to a friend". They answered by writing free-form text (a single word or a short phrase) on five numbered lines.

The third item was adopted from the SSQP: "To what extent do you agree with the statements below on how you experience the present surrounding sound environment?". Responses were made on 5-point Likert scales labelled "pleasant", "chaotic", "exciting", "calm", "annoying", and "monotonous" and anchored by "Agree completely" and "Disagree completely". According to the circumplex model that the authors had developed, a score for Pleasantness can be derived from the six ratings on unidimensional scales by calculating:

$$Pleasantness = pleasant - annoying + 0.71 * (exciting - monotonous + calm - chaotic). \quad (1)$$

Note that the scales are taken pairwise, each pair representing a bipolar perceptual dimension. The first pair is aligned with the Pleasantness construct, while the latter two dimensions are offset by ±45° (i.e. $\cos(45°) \approx 0.71$).