The Development of Standard Perceptual Attributes in Indonesian for Soundscape Evaluation: Result from Initial Study

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ISO 12913-1, 12913-2, and 12913-3 have standardized soundscape evaluation from different aspects such as definition and framework, data collection methods, and data analysis. Central to ISO 12913-2 is that an acoustic environment can be evaluated based on perceptual attributes standardized only in English. These perceptual attributes might be interpreted differently in a different country, resulting in incorrect soundscape evaluation. Thus, to overcome the problem, International collaboration was initiated to develop standard perceptual attributes for soundscape evaluation in 15 languages.

This study explains the development of soundscape perceptual attributes in Indonesian. A focus group discussion had been conducted to develop the attributes in Indonesian. Afterward, in-situ experiments were carried out to identify soundscape evaluation using two different perceptual attributes both in English and in Indonesian. The Wilkinson signed-rank test analysis shows that the rating score between English and Indonesian attributes is not significant on several attributes. Those attributes are pleasant, vibrant, calm, annoying, and monotonous. The other attributes (chaotic, uneventful, and eventful) are rated differently compared to the Indonesian version. It is interesting to note that using English attributes or using a straightforward translation might not be suitable for soundscape study in Indonesia.

1. Introduction

Soundscape studies have developed rapidly in the last ten years [1]. The soundscape approach also offers a comprehensive method to understand the urban environment rather than to use the traditional noise measurement approach [2]. Due to those reasons, many standards have been published as a foundation for further studies and applications of the soundscape [3]. So far, there are three standards related to soundscape published by International Organization for Standardization: ISO 12913-1:2014 [4], ISO 12913-2:2018 [5], and ISO 12913-3:2019 [6]. ISO 12913-1:2014 gives an explanation regarding soundscape definition and

the framework of soundscape. ISO 12913-1:2014 explains soundscape definition and the framework of the soundscape. ISO 12913-2 sets the method of data collection and the requirement for reporting aspects from the data collection. ISO 12913-2 gives detailed information about the methods for analyzing the data collection. This standard development is vital as a baseline to evaluate the quality of environment from human aspects.

The soundscape is defined as an "acoustic environment as perceived or experienced and/or understood by people, in context" while the acoustic environment is defined as "sound from all sound sources as modified by the en-

vironment" [1]. The soundscape definition implies the importance of understanding the subjective and objective aspects of the acoustic environment. Fig. 1 provides the framework of soundscape and how the soundscape approach tries to understand the acoustic environment with the consideration of both subjective and objective aspects.
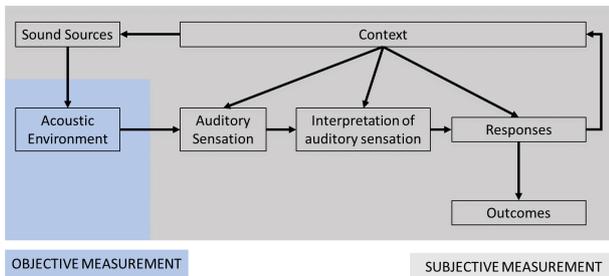
Fig. 1. Soundscape Framework. Adapted from ISO 12913-1 [4].

The objective measurement is usually taken based on several parameters such as noise parameters for environment noise [2, 3], psychoacoustic parameters [4], MFCC [5], and Music Likeness [6, 7]. Amongst those parameters, the noise parameters and psychoacoustic parameters have been adopted as the standard for objective measurement for soundscape study [8].

The subjective measurement was taken using several methods. The subjective measurement can be conducted in-situ [9], in a laboratory with acoustic environment reproduction [2], or in a laboratory with acoustic environment simulation [10]. The idea behind these methods is to represent the acoustic environment and to gather information about people's sensations, people's understanding of the environment, and people's response to the acoustic environment in a specific context. Some methods based on semantic analysis have been developed for subjective measurements, such as semantic differential analysis [11], semantic categorization [12], observation protocol [13], and interview [14]. Those methods rely heavily on how people explain the environment and feelings in their language.

ISO 12913-2:2018 standardizes the data collection methods for the soundscape. Several subjective gathered data covered the identification of the sound source, perceived acoustic quality, rating of the surrounding environment, assessment of the acoustic environment, experiment, etc. Although the standard has been accepted, some argument claims that some data gathering method is not applicable to be used due to the language used in the questionnaire [15]. The subjective measurement questionnaire develops in English, and some of the questionnaires can be translated directly without ambiguity. The problems emerged when

rating the assessment of perceived acoustic quality. The assessment was performed mainly based on the study's soundscape attributes identified by Axelsson et al. [16]. People with different languages might understand the attributes differently since people can use different terms to describe the environment [17]. Thus, to solve this problem, international collaboration is initiated to translate the soundscape attributes into 15 different languages, including Indonesian [18]. The project is called Soundscape Attributes Translation Project (SATP) and this study is also part of the project.

Indonesian translation of the soundscape attributes is important due to two main reasons. More than 190 million speak Indonesian as a first and second language representing roughly 2% of the world population [19]. Soundscape studies in Indonesia have increased steadily in the last five years. The studies varied in different space such as urban area [20, 21], hospital [22], passenger train [23], classroom [24], library [25], and mosque [26]. The development of standard attributes in Indonesian will significantly affect the further study and practical implementation in Indonesia.

2. Methods

There were two steps in this study: focus group discussion and in-situ soundwalk. The focus group discussion was conducted to determine the Indonesian version of the soundscape attributes, while the in situ soundwalk was conducted to compare the rating based on two different language versions of soundscape attributes.

2.1. Focus Group Discussion

The focus group discussion was done to determine the Indonesian version of soundscape attributes used for assessing the perceived acoustic quality. Five participants joined the discussion, and the details of the participants are:

- Researcher in acoustic for 14 years and in soundscape for three years, male, and a fluent speaker of English and Indonesian.

- Researcher in acoustic for eight years and in soundscape for six years, male, and a fluent speaker of English and Indonesian.

- Ph.D. student with the project of multimodal perception in the urban area, female, and a fluent speaker of English and Indonesian.

- A master student with the project of passenger's train soundscape, female, and a fluent speaker of English

and Indonesian.

- A master student with the project of hospital soundscape, female, and a fluent speaker of English and Indonesian.

The participant of the FGD selected based on the familiarity of soundscape study and has the experience of implementing the ISO 12913 in their study. All participants have the experience of designing a questionnaire for soundscape study and understanding the aspects of designing a proper questionnaire for soundscape study. They also have joined in-situ soundwalk at least once. These criteria are critical because not many people familiar with the soundscape study, and not many people have joined the soundscape study before. Therefore, we try to include peoples who have soundscape study experience as a researcher and participant. The other colleagues in the SATP project also conducted the FGD with people who experience soundscape study and do not include laypeople [18]. Furthermore, only the team from China includes the linguistic expert since they try to develop the attributes in Mandarin and Yue.

There were two steps of focus group discussion conducted in the research. In the first step, participants formulated several soundscape attributes representing the English term. In this step, they identified the terms which were suitable to represent the standard soundscape attributes. The Indonesian terms must be a formal term and indexed in the official Indonesian dictionary [27].

The standard soundscape attributes were initially developed from The Swedish Soundscape Quality Protocol [20]. The soundscape attributes once developed to explain the acoustic environment in two dimensions: Pleasantness and Eventfulness. The dimension of pleasantness is represented by the attributes of pleasant and annoying, while the attributes of eventful and uneventful represent the dimension of eventfulness. Apart from those attributes, there are also attributes that represent the interaction of the two dimensions. The attribute of Calm must represent the mixed feeling of Pleasant and Uneventful. The attribute of Monotonous is the attribute to represent the feeling of Uneventful and Annoying. The attribute of Chaotic tries to explain the mixed feeling of Annoying and Eventful. The attribute of Vibrant tries to explain the mixed feeling of Eventful and Pleasant.

The representation of mixed feelings in one attribute is one of the challenges in developing the Indonesian standard soundscape attributes. Another challenge is to identify the term which is easily understood in the Indonesian context. This is why the students, which have limited ex-

perience in soundscape study, were included in the focus group to give the opinion representing the general people.

In the second step, the participant selected one term representing each soundscape attributes. The selection of Indonesian attributes was carried out based on the word's context and how easily naive people understood the terms.

2.2. In-situ Soundwalk

The in situ soundwalk was conducted by one master student and four undergraduate students with a background in engineering physics. All of the respondents can speak English and Indonesian fluently. They are three females and males between the ages of 22-25 years old. The students joined the experiment voluntarily, and they are doing their final project in Urban Soundscape. All of the students have joined in situ soundwalk before. They are requested to rate 63 acoustic environments using the soundscape attributes in English and Indonesian. In addition to the soundscape attributes rating, there is also an open question asking about the respondent's feeling regarding the survey area's sound. The in-situ experiments were conducted in several areas in Institut Teknologi Bandung and Bandung city, as shown in Fig. 2. In this study, the focus is to find as many variations of space and determined the consistency of rating by different soundscape attributes. Due to those reasons, five participants were adequate as long as we use many spaces to be evaluated. There are a total of 315 data analyzed in this study. Also, since the study's focus is on comparing the rating of soundscape attributes, the sound sources and space description data were not taken.

The participants of the study were also selected to represent laypeople. The previous study conducted by Martokusumo et al. shows that the respondent who has a background in architecture or urban planner evaluate urban space differently than laypeople [28]. The evaluation of laypeople is similar to the respondent's evaluation with a background in science and engineering. Hence, the participant joined in our study can represent the general people.

Fig. 2 describes the questionnaire of the experiment. The questionnaire adopts ISO 12913-2:2018 [8] on the perceived acoustic quality evaluation with 5 points Likert scale. In this study, we use the translated version and the original attributes. The use of original English attributes is intentional to make the respondent write their translation of the attributes based on their understanding. An example of the online questionnaire is described in Fig. 3.

The rating from each place is analyzed based on the respondent's median value, as suggested in ISO 12913-3:2019. Later, the rating's median score is used to determine the rating of each location's pleasantness and eventfulness di-

mension. The pleasantness dimension rating is calculated based on Equation 1. The rating of the eventfulness dimension is calculated based on Equation 2.

$$Pleasantness = (pleasant - annoying) + cos\,45°(calm - chaotic) + cos\,45°(vibrant - monotonous) \qquad (1)$$

$$Eventfulness = (eventful - uneventful) + cos\,45°(chaotic - calm) + cos\,45°(vibrant - monotonous) \qquad (2)$$
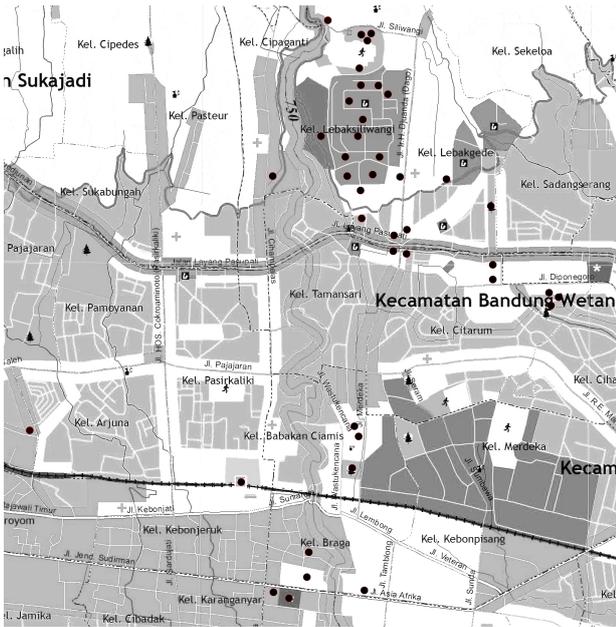

Fig. 2. The location of in situ experiment.
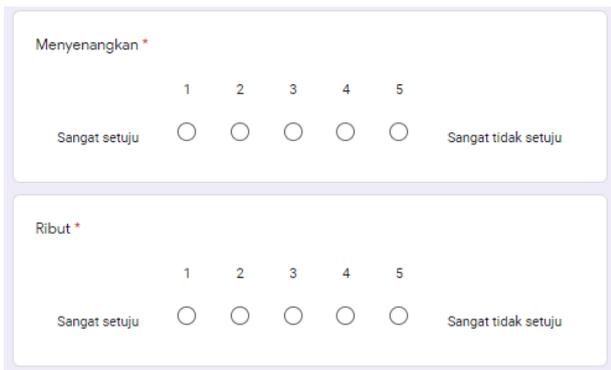

Fig. 3. Online questionnaire used in the experiment.

3. Results

3.1. Translation of Soundscape Attributes

The first step in Focus Group Discussion shows several terms that might be suitable as the Indonesian term of soundscape attributes. The proposed words and the direct translation of the attributes are presented in Table 1.

Table 1 points at some direct translations consistent with the proposed term such as Pleasant, Vibrant, Calm, Annoying, and Monotonous. Translated directly into Indonesian, three attributes, like Chaotic, Uneventful, and Eventful, would become misleading.

The direct translation of Soundscape attributes shows several terms that are uncommon in soundscape studies in Indonesia, for instance, Chaotic/"kisruh", Vibrant/"bersemangat", Eventful/"banyak kejadian", and uneventful/"tidak banyak kejadian". The term of attributes also does not appear in the description of the space from in situ experiment. Furthermore, those terms also do not appear in other studies with similar methods conducted by Mediastika et al. [29] and Martokusumo et al. [30]. This result indicates that several direct translations of standard soundscape attributes cannot describe the acoustic environment in Indonesian.

After identifying some possible attributes, the next step was to select the proposed soundscape attributes to be standardized. When choosing one term, several considerations are taken to avoid ambiguity. The deliberation covered the commonly used terms and word that has a proper meaning word. Table 2 provides the list of standard soundscape attributes in Indonesian.

Several Indonesian attributes can use direct translation. For instance, the word "menyenangkan" refers to pleasant, "tenang" for calm, and "mengganggu" for annoying. Those terms are used to describe the acoustic environment in Indonesia and are familiar with the Indonesian context. The word "bersemangat" points at vibrant. The Indonesian version is the direct translation of the English term, and it is easy to understand for Indonesian. Therefore the term "bersemangat" is suitable to be used. The term monotonous can be represented by the direct translation ("monoton"). However, the term "monoton" can be used in two ways. The term "monoton" can be described either as no variation or boring. The term "menjemukan" , which can be translated as boring, is selected to prevent ambiguity. The term is also suitable to represent the mixed feeling of uneventful

Table 1. Direct Translation and Possible Translation of Soundscape Attributes.

Soundscape Attribute in English	Direct translation	Possible translation
Pleasant	"menyenangkan"	"menyenangkan", "suka"
Chaotic	"kisruh"	"ribut", "berantakan", "kacau"
Vibrant	"bersemangat"	"bersemangat", "antusias", "menggairahkan", "sukacita"
Uneventful	"tidak banyak kejadian"	"sepi", "kosong", "senggang", "lowong"
Calm	"tenang"	"tenang", "tentram", "damai"
Annoying	"mengganggu"	"menganggu", "menjengkelkan"
Eventful	"banyak kejadian"	"ramai", "penuh", "aktif", "sibuk", "hidup"
Monotonous	"monoton"	"menjemukan", "membosankan", "menjenuhkan"

Table 2. Standard Soundscape Attributes in Indonesian.

Soundscape Attribute in English	Proposed Translation
Pleasant	"menyenangkan"
Chaotic	"ribut"
Vibrant	"bersemangat"
Uneventful	"sepi"
Calm	"tenang"
Annoying	"menganggu"
Eventful	"ramai"
Monotonous	"menjemukan"

and annoying.

The most challenging task is to identify the correct term to represent the attribute of Eventful and Uneventful. The term eventful has a similar meaning to the term lively, full of life, full of content, various, dynamic, full of contrast, and mobile [16]. The attributes eventful explain the event variation in the acoustic environment that comes from human activity or environment. The term "ramai" which has the meaning of having many events, is suitable for representing the eventful attribute. The term "ramai" can also be considered a neutral word in terms of pleasantness, so it is also suitable to represent eventful's attributes. The term "sepi" is used to represent the attribute of uneventful. The term uneventful is the antonym of the word eventful and does not represent a positive or negative feeling. Therefore it is suitable to be translated as "sepi".

### 3.2. Rating Difference between Indonesian and English Soundscape Attributes

The rating difference is analyzed by comparing the rating of Indonesian and English attributes. The comparison is made based on rating distribution, Wilkinson signed-rank test, and the soundscape dimensions score. Fig. 4 describes the rating distribution result. There is a similar histogram from the attribute of pleasant-"menyenangkan", vibrant-"bersemangat", calm-"tenang", annoying-"menganggu",

and monotonous-"tenang". Other pairs of attributes (chaotic-"ribut", uneventful-"sepi", and eventful-"ramai) shows different data distribution. The result indicates a distinctive assessment of the acoustic environment due to a different understanding of the attributes.

Further test using Wilkinson signed-rank test shows the consistent result with the histogram from the previous analysis. The Wilkinson signed-rank test indicates that the median score of pleasantness was not significantly different from the median score of "menyenangkan" $Z=1.337$, $p=0.181$. The result is consistent amongst several attributes such as vibrant-"bersemangat" ($Z= -0.800$, $p=0.424$), calm-"tenang" ($Z=-1.794$, 0.073), annoying-"menganggu" ($Z=-0.354$, $p=0.724$), and monotonous-"menjemukan" ($Z= -1.479$, $p=0.139$). The significant difference is shown by the attributes of chaotic-"ribut" ($Z= -5.617$, $p= 0.000$), uneventful-"sepi" ($Z=-3.880$, $p=0.000$), and eventful-"ramai" ($Z=-2.939$, $p=0.003$). This result shows a different rating between the English and Indonesian soundscape attributes, especially in chaotic, eventful, and uneventful attributes.

The subsequent analysis was completed to understand the score of soundscape dimensions from the rating of soundscape attributes. The soundscape dimension score was calculated based on Eq. 1 and Eq. 2. The score of soundscape dimensions is shown in Fig. 5, and it illustrates clearly that the implementation of English attributes will give a different score of soundscape dimensions compared to using the attributes written in Indonesian.

Pairwise T-Test was used to identify a significant difference between soundscape dimensions calculated from soundscape attributes rating in Indonesian and English. The T-Test shows that there is a significant difference between the score of the Pleasantness dimension calculated from Indonesian attributes (M= -2.02, SD=2.30) and English attributes (M= -0.99, SD=3.44); t(62)=-3.09, p=0.003. The result was also consistent with the score of the Eventfulness dimension. The score calculated from Indone-
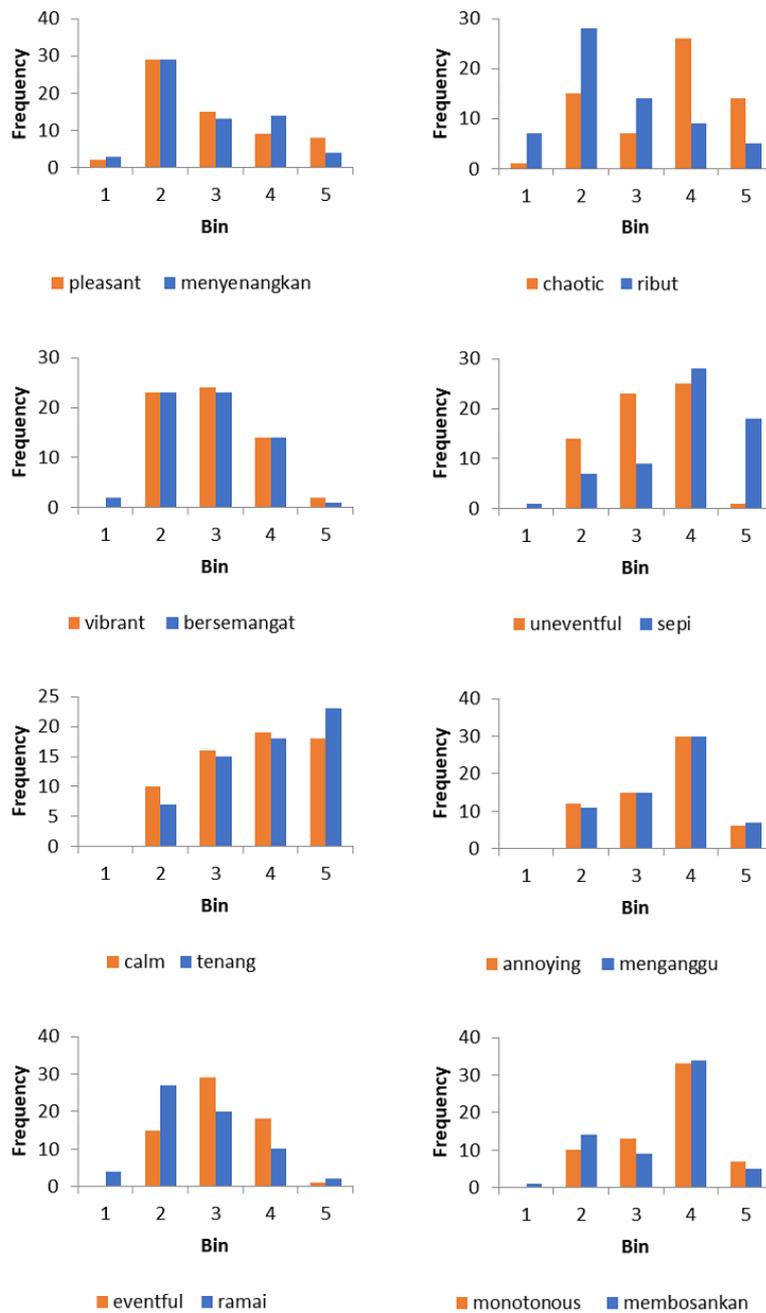
Fig. 4. Histogram of rating from in situ experiment using Indonesian and English attributes.

sian attributes (M=-2.51, SD=3.29) is significantly different from the score calculated from English attributes (M=0.74, SD=2.43); t(62)=-6.464, p=0.000. The t score from the test shows that the difference is higher on the dimension of eventfulness than the pleasantness. In general, the use of English attributes for soundscape study in Indonesia will give a different score of soundscape dimensions on both dimensions (Pleasantness, Eventfulness).

This study has confirmed that using English attributes or using a straightforward translation might not be suitable for soundscape study in Indonesia. This language issue was also found in the study done in Japan [17]. Further study needs to be done to validate the standard Indonesian soundscape attributes to be accepted internationally. The
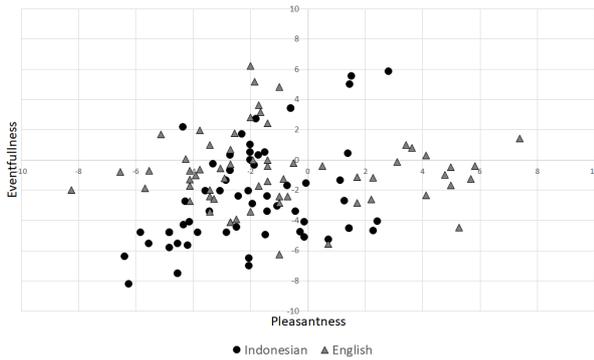
Fig. 5. Soundscape dimensions score from English and Indonesian attributes.

validation can be done through cross country studies with standard acoustic environment stimulus [18].

4. Conclusion

This study has developed standardized Indonesian soundscape attributes that are more suitable for studying Indonesia's soundscape. The eight soundscape attributes have been translated into Indonesian; pleasant-"menyenangkan", chaotic-"ribut", vibrant-"bersemangat", uneventful-"sepi", calm-"tenang", annoying-"menganggu", eventful-"ramai", and monotonous-"menjemukan". The Wilkinson signed-rank test shows that the rating score between English and Indonesian attributes is not significant on pleasant, vibrant, calm, annoying, and monotonous attributes. Other English attributes (chaotic, uneventful, and eventful) are rated differently compared to the Indonesian version. The use of English attributes or using a straightforward translation might not be suitable to be applied for soundscape study in Indonesia. Therefore, the Indonesian version of soundscape attributes must be used to study the soundscape in Indonesia.

5. Acknowledgments

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