Applied Acoustics 211 (2023) 109472

Contents lists available at ScienceDirect

Applied Acoustics

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

A European and Brazilian cross-national investigation into the Portuguese translation of soundscape perceptual attributes within the SATP project

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ARTICLE INFO

Article history:
Received 10 March 2023
Received in revised form 4 May 2023
Accepted 31 May 2023
Available online 10 June 2023

Keywords:
Soundscape attributes
Translation
Cross-national
ISO/TS 12913-2:2018
Portuguese translation

ABSTRACT

This paper presents a cross-national investigation into the soundscape perceptual attributes translation from English into European and Brazilian Portuguese. It is a study within the scope of a larger project – the Soundscape Attributes Translation Project (SATP) – that involves the translation of the same eight Perceived Affective Qualities (PAQs) into different languages through standard procedures. The structure of the paper reflects two separate moments of data collection and analysis. In the first part, the work done outlines the translation process and the resulting Portuguese-language expressions for the eight PAQs. The translation used a mixed-method approach that involved expert panels and online questionnaires. The second part of the paper outlines the impact of cultural and linguistic factors on soundscape perception and evaluation. This assessment analyzed how Portuguese speakers perceive the eight PAQs of the SATP project and compared it with the results of the English speakers. Additionally, investigations occurred on the differences between the perception of European Portuguese and Brazilian Portuguese speakers. The study found differences in how individuals from Portuguese-speaking countries describe sounds compared to the original English circumplex soundscape model. The Vibrant, Monotonous, Annoying, and Chaotic PAQs did not correlate as in the original English model, indicating the need for further investigation. However, the Pleasant and Calm PAQs had no issues in all analyses and shall remain with their initial translations. These findings have important implications for soundscape developments related to standardization tools, research methods, and test design in Portuguese-speaking contexts, as well as contributions to the growing body of knowledge on the role of culture and language in soundscape perception and evaluation.

1. Introduction

Soundscapes studies gained attention in recent years as a complementary approach to managing environmental noise [1] and urban planning policies [2]. To expand the subject worldwide, the "Soundscape Attribute Translation Project" (SATP) [3] encourages the diffusion of soundscape assessments through the translation and validation to different languages of the eight Perceived Affective Qualities (PAQs) known as Eventful, Vibrant, Pleasant, Calm, Uneventful, Monotonous, Annoying, and Chaotic [4]. Many challenges exist in the cross-cultural translation of terms, such as vocabulary, idiomatic, grammatical-syntactic, experimental, and conceptual equivalents [5].

Derived from a study measuring different soundscape audios on 116 attribute scales [6], the eight PAQs of the ISO/TS 12913-2 [4] spread over a two-main dimensional model of Pleasantness on the horizontal axis and Eventfulness on the vertical axis. The first dimension relates to how Pleasant or Annoying soundscapes can be, while the second dimension represents the number of activities in the acoustic environment, Eventful or Uneventful scale [7]. Furthermore, two axes are formed by a mixture of the two main dimensions when rotated at 45°. For instance, when rotating clockwise, the Eventful scale becomes the Vibrant and Monotonous

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https://doi.org/10.1016/j.apacoust.2023.109472
0003-682X/

dimension, while the Pleasant scale turns to the Calm and Chaotic dimension [7].

So far, translations into different languages of the soundscape PAQs encountered many obstacles at different levels [8–16]. Difficulties were observed not only in the lexical translation words [8–13,15] but also in the lack of balance between main (Pleasant versus Eventful) and derived (Vibrant and Calm) dimensions [10,16] of the ISO 12913 circumplex model [4]. For instance, there were inconsistencies identified in the attributes for Eventful [8,9,14,15], Vibrant [10,15], Uneventful [8,11–13,15], Monotonous [10,11–13,15], Uneventful [11–13,15], Annoying [10,16], and Chaotic [8–10] attributes. The exception lies in the Pleasant and Calm terms, where most studies report no significant differences between soundscape appraisal with translated and original English PAQs [10,15,16]. One possible explanation that current authors imagine is that people have more facility to identify positive feelings related to the sonic environment as pleasant and calm soundscapes. Nevertheless, the evidence that six out of the eight PAQs have discrepancies when translated into other languages demonstrates that translations demand further investigation.

From a cross-national perspective, a study between Greece, the UK, Italy, Germany, and Switzerland [1] observed divergence in the subjective evaluation of the sonic environment, which the authors attribute to cultural and climate differences. The researcher claims comparisons among different cities/countries may not be convenient because of other factors like lifestyle and individual differences that may influence human preferences [1]. For instance, people living in cities with different population sizes, economic conditions, and cultural values reveal different paces of life that contribute to the city's personality [17]. Additionally, Lam and colleagues of the STAP project [16] observed differences in the PAQs translation among two countries that share the same language, which authors consider related to the differences in language proficiency among countries. Other reasons for these disagreements may be due to biases by the translation teams, methods used and forms of the translation validations, cultural differences among countries, the individuality of participants, and further underlying confounders that may appear between different parts of the world.

Moreover, another influential factor in soundscape assessments is age range. In Sheffield field surveys [18], young people demonstrated more tolerance to mechanical sounds, while older people preferred natural and cultural sounds, only agreeing across ages when classifying surrounding speech sounds as neutral. Yang and Kang [18] suggested that older individuals have shaped their preferences by previous experiences and emotions, resulting in an appreciation of natural and cultural sounds. Meanwhile, the younger ones, beginning their social life, prefer vibrant soundscapes in public areas [18].

In addition, Bockstael and colleagues [19] observed that younger participants perceived a quiet site as more monotonous than older people. Also, in a nosier location, their participants assessed the site as less Calm and more Chaotic with increasing age [19]. Authors considered that if age range reflects on the appraisal of restorative sonic areas, differences could connect to everyday sound intolerances in older individuals as hyperacusis, a decrease of background sounds suppression with age increment, search for quieter places in senior persons, and inclination among younger individuals to group gatherings and social engagement [19]. In contrast, another investigation of perceived soundscape restorativeness in Chinese parks [20] indicated that interviewed visitors below 40 years old demonstrated more benefits with pleasant soundscapes, while eventful soundscapes promoted more positive restoration in those individuals over 40 years old. They [20] believed older people have higher soundscape demands due to their life experiences. Altogether, the age factor was observed to impact the assessment of soundscapes evaluation [18–20], especially regarding how restorative natural and quiet soundscapes can be.

In the present paper, the authors include results observing two influencing aspects on soundscape assessments: participants from different-sized cities (São Paulo and Lisbon) and age ranges between countries (Brazil and Portugal). São Paulo is the most populated and wealthiest Brazilian city, ranked as the fourth largest city in the world with around 12 million people [21]. Meanwhile, Lisbon is the capital of Portugal and the biggest city in the nation containing approximately 2.7 million inhabitants [22]. It is interesting to notice that in 2021 the number of residents over 40 years old in Portugal was around 80% [23], while Brazil counted 40% [24], which indicates that Portugal has an older population than Brazil.

The objective of this paper resides in the investigation if Portuguese speakers perceive the PAQs of the SATP project in the same way as English speakers, along with observing whether there are any perceptual differences between the groups from Portugal and Brazil. The first stage consisted in doing the "best possible translation" of the eight PAQs from English to Portuguese to obtain the essence rather than a literal translation. The second stage consisted of listening tests with native speakers using the translated terms from the previous stage [11], the same set of sound stimuli, equipment, and calibration procedure to validate the translations [3]. Nevertheless, including our experience and results from other SATP groups, the Portuguese team aims to review, improve translations by doing in situ experiments, and expand to other Portuguese-speaking communities to assist in disseminating the soundscape attributes and potentially enhancing sound planning towards the quality of life.

2. Materials and methods

2.1. Stage 1: Preliminary translations of soundscape attributes into Portuguese

2.1.1. Data collection method

As there were no standard protocols for the attributes' translation from English into Portuguese, the Portuguese research group, represented by two Portuguese and two Brazilian researchers, decided to proceed with a two-step approach. First, a qualitative analysis examined a provisional translation of the PAQs based on bibliographic research and panel expert. Then, as a second, quantitative analysis occurred with an online questionnaire application [11]. The first step studied the available translations from previous soundscape works into Portuguese. Then, several working meetings discussed all the proposed translations before arriving at the final three expressions for each attribute. During the qualitative data collection and selection process, the proposed expressions aimed to be closer to the original meaning rather than force a literal translation of the word. At the end of this stage, three Portuguese expressions for each PAQ attribute were proposed.

The second step of Stage 1 consisted of a designed online questionnaire with a subsequent data analysis that led to the proposal of one or two expressions for each affective attribute. This questionnaire included two sections: the first related to the soundscape PAQs in Portuguese, and the second with the respondents' general information [9]. The first section of the online questionnaire included a header section with eight pictures related to different sonic environments, and it asked the participants to look at them for a few moments. Afterwards, respondents imagined themselves immersed in the sound environment described in the text (corresponding to the verbal description of one of the eight photos in the header section) and chose the affective attribute more adequate to the sound environment described. The possible answers

to the questions included the three possible PAQ attributes determined in the first step and an open section called "others" that allowed the respondents to propose a word or expression. The second section of the online questionnaire consisted of respondents' general information, including gender, age group, native country, professional activity as students, acousticians or non-acousticians, and educational level. In addition, the two questions were incorporated at the end: "*How do you rate your sensitivity to noise?*" and "*Would you like to send any comments regarding this questionnaire?*".

The questionnaire was available online between the 2nd and 28th of June 2021, and its dissemination had the support of both national acoustic societies: SPA – *Sociedade Portuguesa de Acústica*, in Portugal, and SOBRAC – *Sociedade Brasileira de Acústica*, in Brazil.

2.1.2. Participants

A total of 245 people answered the questionnaire. Of them, 175 respondents (71%) were Brazilians, and 70 (29%) were Portuguese. These results are available in [11,12]. The Brazilian respondents were mainly female (67%), and the group aged from 18 to 29 years old represented 59% of the respondents. Regarding educational level and professional activity, most participants were students in undergraduate courses (51%), and professionals from acoustics and vibration represented 22%. Most respondents reported being very (42%) to moderately (46%) noise sensitive.

For the Portuguese respondents, there was a balance in gender between females and males, 50% for each group. The age category was older than the Brazilians (50% were between 30 and 49 years old, followed by 37% for 50 years old and above, and 13% from 18 to 29 years old). Regarding professional activity, 64% of the respondents came from other working areas, followed by 36% of acoustic professionals. As for the educational level, 46% had completed graduate studies, 40% had undergraduate studies, and 14% had other levels of education. Most respondents reported being very sensitive to noise, most were not students, and there was a balance between undergraduate and graduate students that reported being moderate to very sensitive to noise.

2.1.3. Data analysis

Through a simple frequency analysis, the percentage values led to the selection of two words for each PAQ. Results were tabulated for Portuguese and Brazilians individually and for all samples (Portuguese and Brazilians). For more details, see reference [11].

2.2. Stage 2: Soundscape listening tests using SATP database – Preliminary translations validation

2.2.1. Data collection method

In the second stage, listening sessions occurred with the material from the University of London: audio files with representative recordings of everyday acoustic environments experienced in an urban context [25]. Additionally, the authors classified the sound stimuli from the SATP dataset into the following classes: human, nature, traffic, and equipment. The description of the audio files made by the authors is in Appendix 1. Important to notice that this categorization comes from the authors' perceptions (2 authors from Portugal and 2 from Brazil) and does not represent an official description from the SATP group. As the audio material is common to all SATP project participants, the voices heard from the human stimuli are in spoken English.

For both countries, ethics committees of the universities involved in the listening tests approved the protocols used in this research according to the presented methodology. In Brazil, it was approved by the University of São Paulo Committee of Ethics in Research with Human Beings, according to the attributions defined by the National Health Council (CAAE 46694121.0.0000.5561). In Portugal, the Lusófona Research and Development Institute published a research authorized minute (number 7 of 2022).

The listening sessions in Brazil took place at the Laboratory of Environmental Comfort and Energy Efficiency (LABAUT) of the Faculty of Architecture and Urbanism of the University of São Paulo (FAU USP) located at São Paulo City, and in Portugal, at the National Laboratory of Civil Engineering (LNEC) and the Lusófona University, both placed in Lisbon. Before the beginning of the sessions, a calibration process occurred with the sound card, amplifiers, and headphones according to the protocol established by the SATP project. In short, the procedure was the following: the headphones were plugged into the headphones output of the sound card when the calibration sine signal of 94 SPL and a 1 kHz were played (also provided by the SAPT project). All the experimental setup was adjusted until the measured voltage at the headphone jack was equivalent to a 94 dB voltage, considering the headphone sensibility. The achieved gain settings were maintained until the completion of the SATP tests.

This procedure consisted of presenting a normalized sound level for the sound stimuli. These sessions took place in rooms where the ambient noise levels were low. For example, in Brazil, the A-weighted sound pressure levels were below 40 dB, whereas at LNEC they were below 28 dB.

Before starting the session, each participant (a Portuguese native speaker) was given the information sheet for the listening session. Also, they signed the informed consent form and confirmed their hearing impairment (self-assessment). Given a higher age group of the participants from LNEC, audiometric tests were performed for each participant. Fig. 1 shows the equipment set up for the listening tests.

Participants listened to the 27 audio excerpts and responded to the attribute's online questionnaire. Each audio had a duration of 30 s and session duration varying between 45 and 60 min. Important to notice that the 27 audio excerpts were distributed randomly over five playlists. For each audio, the participant answered eight questions, indicating their agreement or disagreement about the sound environment heard on a continuous slider scale from 0 (zero) to 100, with the labels: "Absolutamente nada" for the beginning of the scale associated with 0 (not at all) and "Extremamente" for the opposite end of the scale with 100 (extremely). Questions for each sound environment were as follows: "*Em que medida concorda que o som que acabou de ouvir foi...*" (To what extent do you agree that the sound you just heard was...) followed by the eight translated PAQs. Finally, a question was asked about the sound intensity of the sound heard, with the same scale as before (from 0 to 100, labeled in this study as perceived loudness). Additionally, participants reported their gender and age.

2.2.2. Participants

A total of 70 people answered the questionnaire. From them, 40 respondents (57%) were Brazilians (native speakers), and 30 (43%) were Portuguese (native speakers). The Brazilian participant's average age was 32 years old, with a standard deviation of 11 years, a minimum value of 18 years, and a maximum value of 61 years. The median value was 29 years old. Regarding gender, exactly half were female, and half were male (although other options were available for gender, such as "I prefer to describe myself" or "I prefer not to say"). As for the Portuguese participants, the average age was 47 years old, standard deviation of 13 years, a minimum value of 20 years, and a maximum value of 69 years. The median value was 51 years old. Regarding gender, 60% were female, 37% were male, and 3% expressed as non-binary.

About the UK data from Zenodo [26], the total was 32 participants with an average age of 30 (standard deviation of 7 years), a minimum value of 21 years, and a maximum of 47 years. The

Fig. 1. Equipment setup for the listening tests used in Brazil (São Paulo University).

median value was also 30 years old. Regarding gender, 41% were male, and 59 % were female.

2.2.3. Data analysis

The values obtained for the 8 PAQs in the Portuguese language for the two countries (Portugal and Brazil) were correlated using the Spearman correlation coefficient [7,27,28]. In addition, an analysis of differences in ratings was conducted between the Portuguese, Brazilian, and English results using the Kruskal-Wallis signed rank test and post-hoc-related tests. The Kruskal-Wallis test is a generic form of the Mann-Whitney method that permits two or more groups (in this case, countries). These data analyses were processed using the SPSS software, version 27 [27].

To discuss the stimuli' multi-dimensional aspects, the 27 audio responses for each country were plotted on a two-dimensional plane with the ISO Pleasant and the ISO Eventful scales in the coordinates of x and y. This procedure was used instead of calculating the median response for each PAQ before applying it to the circumplex coordinates for each location (as described in ISO/TS 12913-3 [7]). The obtained vectors for the ISO Pleasant and the ISO Eventful scales are in a continuous variable from −1 to + 1 and can be statistically analyzed [29]. For this analysis and data visualization, the Python package used was *Soundscapy*, available for download from *Github* [30]. This treatment of the 8 PAQs assumes that Vibrant soundscapes are both Pleasant and Eventful, Chaotic soundscapes are both Eventful and Annoying, Monotonous soundscapes are both Annoying and Uneventful, and finally, Calm soundscapes are both Uneventful and Pleasant [7]. For further investigation into the 2D circumplex model, a segmentation of the data set occurred using two different aspects: age and participants' perceived Loudness. For this, a categorization of participants' age into three classes (up to 25 years, between 25 and 45 years, and more than 45 years) and participants' perceived Loudness (corresponding to the last question about the intensity of the sound heard) into 3 classes (lower Loudness, when the intensity was lower than 30; medium Loudness when the intensity was greater than 30 and lower or equal 70; and higher Loudness when the intensity was greater than 70 - all units related to the 0 "not at all" to 100 "extremely" scale) were divided. Furthermore, a final data segmentation split participants' perceived Loudness according to the type of sound source classified by the authors (see Table 1).

3. Results

3.1. Stage 1: Preliminary translations of soundscape attributes into Portuguese

3.1.1. Preliminary translations

The main challenge was the possibility of translating each of the eight PAQs of the ISO document into a single word. Therefore, the authors agreed that if a single word was not enough to translate the original meaning, a set of two or three words would be allowed to translate as closely as possible to the same perceptual construction.

For the Pleasant, Annoying, Calm, Vibrant, and Uneventful PAQs, both countries agreed about the first and second most chosen words and a significative percentage concerning the other possibilities. Regarding these cases, the chosen translated words for each attribute were the two highest frequencies. For the Monotonous PAQ, the first word was the same for both countries, and the difference between the first and second choices was the largest in frequency. Since the number of Brazilian participants was superior, the second word selected was the Brazilian second choice. For the Eventful PAQ, the two chosen words for each country were the first and second options. An exception happened for Chaotic for two reasons: the translated word *Caótico* stood out significantly from the others with a frequency above 79%, clearly representing the coherent translation for most respondents, and the second choice was different for Portugal and Brazil. The compilation of results is reported in [11] with the frequencies of responses for the terms translated by Portuguese and Brazilian respondents and for both countries. Table 2 resumes the proposed translations into Portuguese for each of the 8 PAQs from Stage 1.

3.2. Stage 2: Preliminary translations validation through the soundscape listening tests using the SATP database

3.2.1. Correlation coefficients between the 8 PAQs for Portugal

A Spearman's rank correlation coefficient determined the relationship between the PAQ axes for the Portuguese results (Portugal). Table 3 presents the values obtained, where * means a significant correlation with $p < 0.05$, and ** means a significant correlation with $p < 0.01$. When there is no statistically significant

Table 1
List of SATP sound stimuli categorized by current authors.

#	Audio	Category	#	Audio	Category	#	Audio	Category
1	OS01d	Human	10	W16	Traffic	19	E11b	Traffic
2	CG01	Human	11	E02	Nature	20	OS01c	Human + Traffic
3	LS06	Human	12	E01b	Traffic	21	E10	Human
4	E05	Human	13	KT01	Equipment	22	E09	Human
5	RPJ01	Human	14	W09	Equipment	23	CG07	Human
6	N1	Traffic	15	W01	Equipment	24	W11a	Human
7	W22	Human	16	CT301	Equipment	25	CG04	Human
8	W06	Nature	17	E12b	Equipment	26	W15	Traffic
9	VP01b	Nature	18	HR01	Equipment	27	W23a	Human

Table 2
Reference English words and proposed translations into Portuguese.

English	Pleasant	Chaotic	Annoying	Monotonous	Calm	Vibrant	Uneventful	Eventful
Portuguese	*Agradável* *Prazeroso*	*Caótico*	*Irritante* *Desagradável*	*Monótono* *Entediante*	*Tranquilo* *Calmo*	*Animado* *Vibrante*	*Sem acontecimentos* *Estático*	*Agitado* *Movimentado*

relation, the *p-value* appears. For each PAQ, the blue cells mean the opposite attribute has a strong negative statistically significant correlation, and the green and yellow cells represent the adjacent attributes. The green ones illustrate a positive statistically significant correlation, and the yellow ones demonstrate no statistically significant correlation. The two words of the Portuguese translations are also present in the first column of the tables. Values in bold mean a significantly strong correlation between PAQs not expected when compared to the two-dimensional model for soundscape perception [7].

Considering the results in Table 3, the authors observed:

- A stronger negative correlation between Eventful and Calm PAQs ($r(28) = -0.552$, $p < 0.01$) instead of Eventful and Uneventful PAQs ($r(28) = -0.381$, $p < 0.05$);
- No significant association between Vibrant and Pleasant PAQs;
- The values in the range 0.2 – 0.4, in modulus, suggest a weaker correlation for the Uneventful and Monotonous PAQs compared to the remaining PAQs, making it difficult to relate the chosen words with the heard sounds. This weak correlation with adjacent attributes does not occur in the English model, which may indicate a possible cultural difference in terminology, given that both countries ranked the same words in the translation.
- A strong negative correlation between Annoying and Calm PAQs with $r(28) = -0.677$, $p < 0.01$, suggesting that the opposite PA for Annoying could be related to both Calm or Pleasant PAQs ($r(28) = -0.657$, $p < 0.01$). In addition to the negative correlation to the Annoying PA, the Calm PA has a strong negative correlation with Eventful ($r(28) = -0.552$, $p < 0.01$) and Chaotic ($r(28) = -0.566$, $p < 0.01$) PAQs; and
- A stronger positive correlation between Annoying and Eventful PAQs ($r(28) = 0.519$, $p < 0.01$) instead of Annoying and Monotonous PAQs ($r(28) = 0.291$, $p < 0.01$).

3.2.2. Correlation coefficients between the 8 PAQs for Brazil

Table 4 presents Spearman's rank correlation coefficient results for Portuguese (Brazil), following similar formatting and p-values interpretation.

Regarding the results in Table 4, the authors noticed:

Table 3
Spearman correlation coefficients for the Portuguese (Portugal) perceptual attributes.

Spearman's Correlation *rs*(28)	Eventful	Vibrant	Pleasant	Calm	Uneventful	Monotonous	Annoying	Chaotic
Eventful *Agitado* and *Movimentado*	---------	.445**	-.376**	**-.552****	-.381**	-.142**	**.519****	.704**
Vibrant *Animado* and *Vibrante*	.445**	----------	0.063 *p* = 0.074	-.165**	-.284**	-.335**	.161**	.289**
Pleasant *Agradável* and *Prazeroso*	-.376**	0.063 *p*=0.074	----------	.771**	.115**	-.208**	-.657**	-.456**
Calm *Tranquilo* and *Calmo*	-.552**	-.165**	.771**	---------	.265**	-.072*	**-.677****	-.566**
Uneventful *Sem acontecimentos* and *Estático*	-.381**	-.284**	.115**	.265**	---------	.401**	-.072*	-.252**
Monotonous *Monótono* and *Entediante*	-.142**	-.335**	-.208**	-.072*	.401**	---------	.291**	0.045 *p*=0.197
Annoying *Irritante* and *Desagradável*	**.519****	.161**	-.657**	**-.677****	-.072*	.291**	----------	.671**
Chaotic *Caótico*	.704**	.289**	-.456**	-.566**	-.252**	0.045 *p* = 0.197	.671**	---------

*Significant correlation, $p < 0.05$.
**Significant correlation $p < 0.01$.

Table 4
Spearman correlation coefficients for the Portuguese (Brazil) perceptual attributes.

Spearman's Correlation rs (38)	Eventful	Vibrant	Pleasant	Calm	Uneventful	Monotonous	Annoying	Chaotic
Eventful *Agitado* and *Movimentado*	----------	,466**	-,460**	**-,683****	-,513**	**-,382****	**,573****	,772**
Vibrant *Animado* and *Vibrante*	,466**	----------	0,023 p = 0,457	-,285**	-,308**	-,340**	,117**	,348**
Pleasant *Agradável* and *Prazeroso*	-,460**	0,023 p = 0,457	----------	,767**	,203**	-0,034	-,811**	-,612**
Calm *Tranquilo* and *Calmo*	-,683**	-,285**	,767**	---------	,469**	,252**	**-,737****	-,734**
Uneventful *Sem acontecimentos* and *Estático*	-,513**	-,308**	,203**	,469**	----------	,600**	-,195**	-,386**
Monotonous *Monótono* and *Entediante*	**-,382****	-,340**	-0,034 p = 0,264	,252**	,600**	----------	0,012 p = 0,699	-,213**
Annoying *Irritante* and *Desagradável*	**,573****	,117**	-,811**	**-,737****	-,195**	0,012 p = 0,699	----------	,721**
Chaotic *Caótico*	,772**	,466**	-,460**	-,683**	-,513**	-,382**	,573**	----------

*Significant correlation, $p < 0.05$.
**Significant correlation $p < 0.01$.

- There was no significant association between Vibrant and Pleasant PAQs in addition to Annoying and Monotonous PAQs.
- A negative correlation between Monotonous and Eventful PAQs ($r(38) = -0.382$, $p < 0.01$), suggesting that the opposite word for Monotonous PA could be related to Eventful or Vibrant PAQs ($r(38) = -0.340$, $p < 0.01$);
- A strong negative correlation between Annoying and Calm PAQs ($r(38) = -0.737$, $p < 0.01$), suggesting that the opposite PA for Annoying could be related to both Calm or Pleasant PAQs ($r(38) = -0.811$, $p < 0.01$). Besides the correlation to the Annoying PA, the Calm PA also has a strong negative correlation with the Eventful PA ($r(38) = -0.683$, $p < 0.01$) and the expected Chaotic PA ($r(38) = -0.734$, $p < 0.01$);
- A strong positive correlation between Annoying versus Eventful ($r(38) = 0.573$, $p < 0.01$) and Chaotic PAQs ($r(38) = 0.721$, $p < 0.01$). However, there was no significant correlation with Monotonous PAQ.

3.2.3. Perceptual attributes rating differences between Portuguese (PT), Brazilian (BR), and English (UK)

The non-parametric Kruskal-Wallis test (H-test) evaluated the soundscape PAQs rating differences among the three countries. The null hypothesis of the Kruskal-Wallis test is that the mean ranks of the groups are the same. Where significant differences at a 5% significance level led to a pairwise post hoc comparison-adjusted with the Bonferroni correction [27,28] was conducted. For the post hoc pairwise comparisons, the null hypothesis was rejected at a 5% significance level.

The results are presented in Table 5. The PAQs with significant differences among countries are in the first column, the Kruskal-Wallis H-test in the second column, the p-values in the third column, and the p-values adjusted for the pairwise comparisons are in the last three columns.

These results show that the Vibrant, Monotonous, Annoying, and Chaotic PAQs were differently rated between BR and PT participants, demanding further investigations to understand if differences are due to cultural or other issues. Furthermore, rating differences occurred for the Uneventful PAQ between PT and UK, and BR and UK; for the Pleasant PAQ between PT and UK; and the Chaotic PAQ between BR and UK. These differences brought to the Portuguese team's attention if the translation fully captured the meaning of the English word.

Comparing the first and the second stages of SATP for which the same words (first and second choices) were chosen in both countries (Pleasant, Annoying, Calm, Vibrant, and Uneventful), the distribution of responses between the two countries are different for Annoying and Vibrant translations. The same happened with Chaotic, which had only a one-word option for translation.

3.2.4. Two-dimensional circumplex models of soundscape PAQs

According to Oberman and colleagues [25], various plots of circumplex two-dimensional models of soundscape stimuli aided in the analysis of similarities and differences between the perceptual responses of each country. Since translations came from English, the authors considered it relevant to include the United Kingdom data. Fig. 2 presents the distributions of the perceptual responses for the 27 sound stimuli across the ISO Pleasant and ISO Eventful

Table 5
Significant results of the Kruskal-Wallis H test for the PA ratings among the three countries.

PAQs	H(2)	p-values	p-values for the pairwise comparisons		
			PT and UK	BR and PT	BR and UK
Vibrant	22.931	**1.000 e-5**	**2.600 e-5**	**2.850 e-4**	1.000
Pleasant	7.727	0.021	**0.016**	0.325	0.540
Uneventful	31.528	**1.424 e-5**	**0.001**	0.129	**6.595 e-8**
Monotonous	9.361	**0.009**	1.000	**0.012**	0.081
Annoying	17.180	**1.860 e-4**	0.294	**1.300 e-4**	0.053
Chaotic	9.156	0.010	1.000	**0.032**	**0.030**

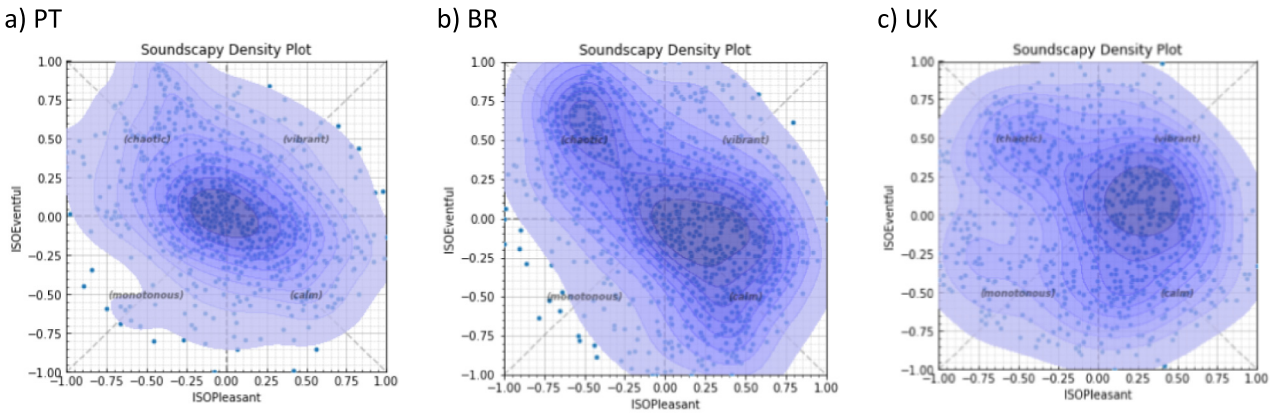

Fig. 2. Scatter plots of the perceptual responses for the 27 sound stimuli for each country: a) l*eft:* Portugal (PT), b) *middle:* Brazil (BR), and c) *right*: the United Kingdom (UK).

vectors for each country (Portugal – PT, Brazil – BR, and United Kingdom – UK), following the methodology proposed in [29]. A heatmap of the bivariate distribution and marginal distribution plots were superimposed for each scatter plot.

As demonstrated in the scatter plots, the general shape for each country is distributed within the two-dimensional PAQs space, with a form close as possible to a circle because all responses were mixed. Differences can be seen in Portugal's results as the grouping of plots in the centre of PAQ axes, while Brazilian plots demonstrated two distinct groups in opposite quadrants around the Chaotic and Calm PAQs. Meanwhile, the UK results have a group that covers mainly the Calm, Pleasant, and Vibrant PAQs.

To observe specific trends, Fig. 3 illustrates the overlaid 50th percentile contours for each country representing the medians as recommended by ISO 12913-3: 2019 [7]. The figure demonstrates that the Portuguese data is distributed around the centre of the axes with a focus on the Chaotic-Calm axis. Meanwhile, the Brazilian data follow a similar distribution to the UK data around the Chaotic-Calm axis, but not as much on the Vibrant scale. Additionally, the Brazilian data stretches in the Calm-Chaotic axis while the UK data goes more towards the Vibrant PA.

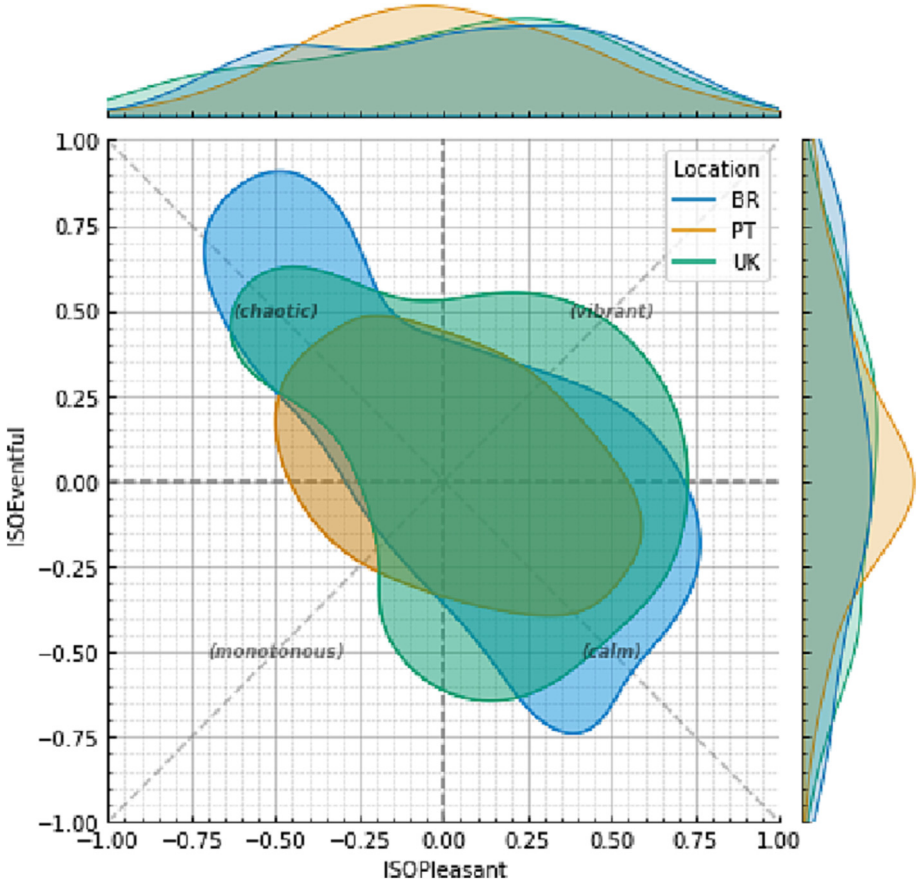

Fig. 3. Comparison between the 50th percentile contours for each country represented by blue for Brazil (BR), orange for Portugal (PT), and green for the United Kingdom (UK). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

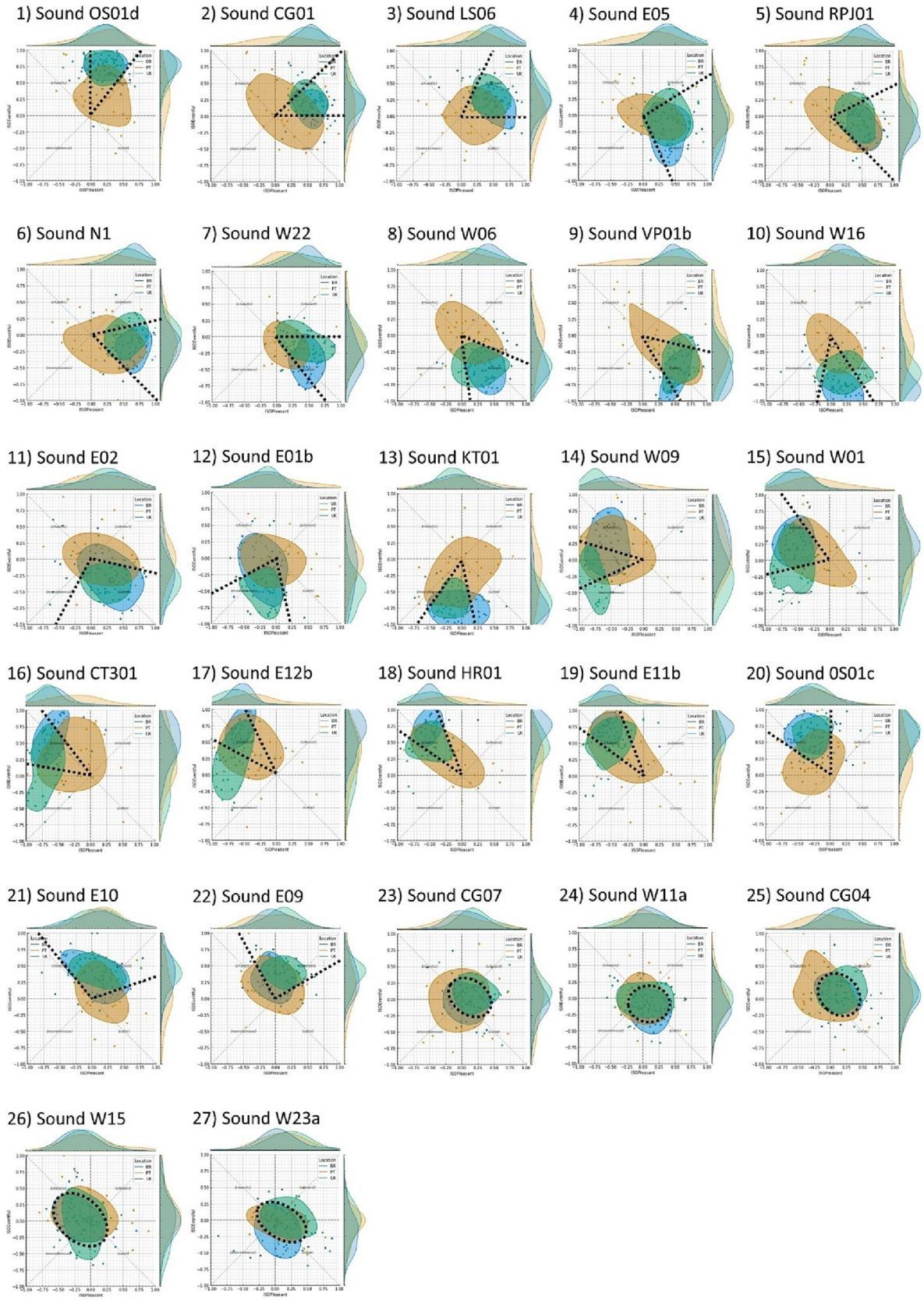

Fig. 4. Scatter plots and 50th percentile contours for BR in blue, PT in orange, and the UK in green for all audios listed in Table 1. Dashed lines represent intersections among all countries. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 4 presents the scatter plots for each audio listed in Table 1 (as they are named in the SATP [25]) for all participants and the overlaid of the 50th percentile contours for the three countries. Plots include dashed lines that delimit the contour intersection of countries.

For each sound in Fig. 4, the overlapping of the 50th percentile contours indicates a location in the soundscape circumplex quadrant where all countries have the same tendency response. For example, the projecting regions for the sounds OS01d (Fig. 4.1), CG01 (Fig. 4.2), and LS06 (Fig. 4.3) are distributed in the quadrant between the Eventful and Pleasant axes. Considering the Vibrant axis, the sound OS01d (Fig. 4.1) goes towards the Eventful scale, and the remaining sounds (CG01 in Fig. 5.2 and LS06 in Fig. 4.3) move towards the Pleasant axis. Consider observing that all Portuguese results are centred and spread around all PAQs. It is also present in plots for all countries for the sounds CG07 (Fig. 4.23), W11a (Fig. 4.24), CG04 (Fig. 4.25), W15 (Fig. 4.26), and W23a (Fig. 4.27). Except for W15 (Fig. 4.26), the other four sounds were classified as human activity, as observed in Table 1.

In the case of the quadrant between the Vibrant and Calm axes, there is an overlapping area of the 50th percentile contours for the sounds E05 (Fig. 4.4), RPJ01 (Fig. 4.5) and N1 (Fig. 4.6) towards the Pleasant scale. The first two sounds were related to human activity, whereas N1 (Fig. 4.6) was related to traffic sounds.

For the quadrant between the Pleasant and Uneventful axes, the covered area for all responses occurs for the sounds W22 (Fig. 4.7), W06 (Fig. 4.8), VP01b (Fig. 4.9), W16 (Fig. 4.10), and E02 (Fig. 4.11). As expected, sounds W06 (Fig. 4.8), VP01b (Fig. 4.9), and E02 (Fig. 4.11) were classified as nature sounds and located over the Calm axis. Meanwhile, sound W22 (Fig. 4.7), characterized as human sound, is located between the Pleasant and Calm axes. And sound W16 (Fig. 4.10), listed as traffic sound, stays between the Calm and Uneventful axes.

For the quadrant bounded by the Uneventful and Annoying axes, an overlapping area for the sounds E01b (Fig. 4.12) and KT01 (Fig. 4.13) covers the Uneventful axis, but the results for Portugal and Brazil unexpectedly spread towards the Chaotic PA in sound stimulus E01b (Fig. 4.12). The sound E01b (Fig. 4.12) was categorized as traffic and KT01 (Fig. 4.13) as equipment. The superposition area of all countries for the sound W09 (Fig. 4.14), related to equipment sound, shifted towards the Annoying axis. It is interesting to recognize that there is no overlapping area towards the Monotonous axis.

For the Annoying and Eventful quadrant, the sounds W01 (Fig. 4.15), CT301 (Fig. 4.16), E12b (Fig. 4.17), HR01 (Fig. 4.18), and E11b (Fig. 4.19) have overlapping areas towards the Chaotic axis. The sound W01 (Fig. 4.15) also covers the Annoying axis. It is curious to observe that the first four sounds are classified as equipment and the last one as traffic. In the same quadrant, the OS01c stimulus (Fig. 4.20) overlaps between the Eventful and Chaotic axes and relates both to human and traffic sounds. Meanwhile, the sounds E10 (Fig. 4.21) and E09 (Fig. 4.22) relate to human sounds and project over the Eventful axis.

For further investigation among the countries, the dataset was segmented as explained in 2.2.3. Fig. 5 shows the results grouped by age category and some trends observed. Persons up to 25 years tend to rate sounds in the regions of Calm and Chaotic among all countries and additionally in the Vibrant axis for UK participants. Meanwhile, people over 45 years old are likely to classify in the central region for all countries. Except for the Portuguese results, they are always in the centre region, independent of age. Furthermore, the Brazilian results have a shape that stretches out over the Chaotic-Calm axis present in most plots for individuals below 25 years and for participants between 25 and 45 years, an additional expansion towards the Pleasant axis. Further, given the centred similarity of the results for the elderly individuals in all countries, the authors question whether this behaviour also present in all Portuguese results could be related to the fact that Portugal has one of the oldest European populations.

Regarding the perceived Loudness (Fig. 6), sounds with lower Loudness were perceived within the quadrant between the Pleasant and Uneventful axes, while higher Loudness sounds were in the opposite quadrant between the Annoying and Eventful axes for the three countries. In the case of the UK results, the higher the sounds became, the closer they came to the Monotonous axis. For the medium Loudness, results across all countries centred within the PAQ axes.

Figs. 7, 8, 9, and 10 present the perceived Loudness combined with the type of sound source (traffic, equipment, human, or nature sounds). Fig. 8 for the traffic sounds demonstrates that, as the Loudness increased, classifications for all countries moved from the Pleasant and Uneventful quadrant to the Annoying and Eventful quadrant.

Fig. 8 presents the results for equipment sounds combined with the intensity perceived. When the intensity increases, the sound classifications move from the Calm and Monotonous quadrant to the Annoying and Eventful quadrant turning clockwise from Calm to Chaotic poles. Overlaps among results for equipment sound versus Loudness were smaller than those for traffic sounds, with more similarities for the middle Loudness. In the lower Loudness, while UK and BR results concentrated along the Calm and Monotonous axes, PT results spread unexpectedly around all other axes. The authors did not find any valid explanation for the behaviour of the Portuguese participants other than that they classified the low-intensity sounds in different ways with no clear trend. Nevertheless, this tendency no longer appears for medium and high-intensity sounds among countries.

Fig. 9 presents the results for human activity sounds versus Loudness, where a similar trend was observed for the three countries for lower and medium Loudness. As the intensity increases, the sound classification moves from the Pleasant and Uneventful quadrant to the Chaotic and Vibrant quadrant. Differences among Portugal, Brazilian and English results indicated that the Portuguese participants tend to classify more in the region of the Chaotic axis in the higher Loudness. Meanwhile, Brazilian and English participants relate this type of sound with the Vibrant scale.

For nature sounds versus Loudness, Fig. 10 presents the results for the three countries, considering the perceived Loudness. In this case, the English participants did not perceive nature sounds with higher Loudness, so there is no plot for the UK, but plots for BR and PT are present. For lower and medium Loudness, there is a tendency for results to stay within the Uneventful and Pleasant axes. Furthermore, as the Loudness increased, the Portuguese and Brazilian respondents moved in opposite directions: one towards the Chaotic axis and the other in the direction of the Pleasant axis. The authors believe this distinct behaviour to be related to cultural differences.

4. Discussions

4.1. Remarks on PAQs

From the first stage of the SATP for the Portuguese language, the same words were selected for the preliminary Portuguese translations of the eight PAQs for Portugal and Brazil, Table 2. Nevertheless, in the second stage, results led to the conclusion that the distributions for four PAQs (Vibrant, Monotonous, Annoying, and Chaotic) were rated differently by the respondents of the two countries (Table 5). To outline the work carried out, we will present the main conclusions by PAQs.

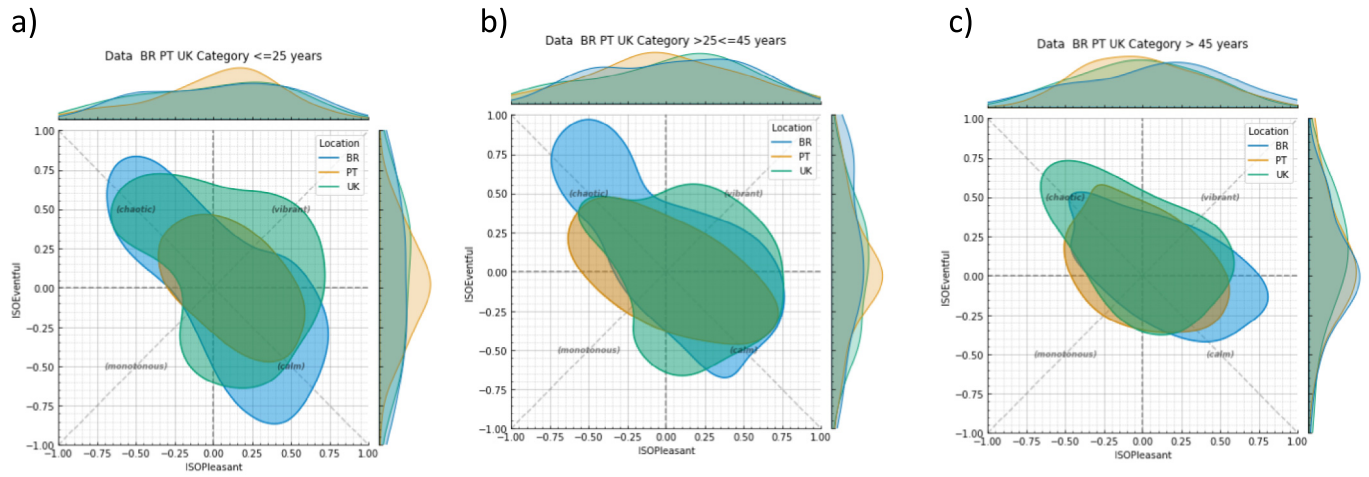

Fig. 5. 50th percentile contours for BR, PT, and UK results filtered by age for: a) *left*: participants up to 25 years, b) *middle*: participants between 25 and 45 years old, and c) *right*: participants over 45 years old.

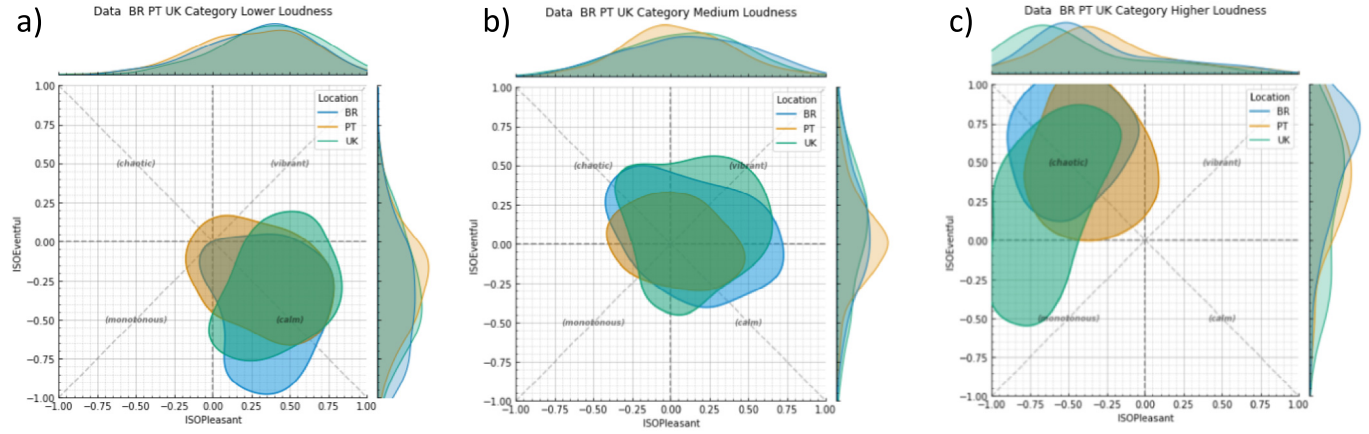

Fig. 6. 50th percentile contours for BR, PT, and UK results filtered by the perception of Loudness for all sounds for a) *left*: lower Loudness, b) *middle*: medium Loudness, and c) *right*: higher Loudness.

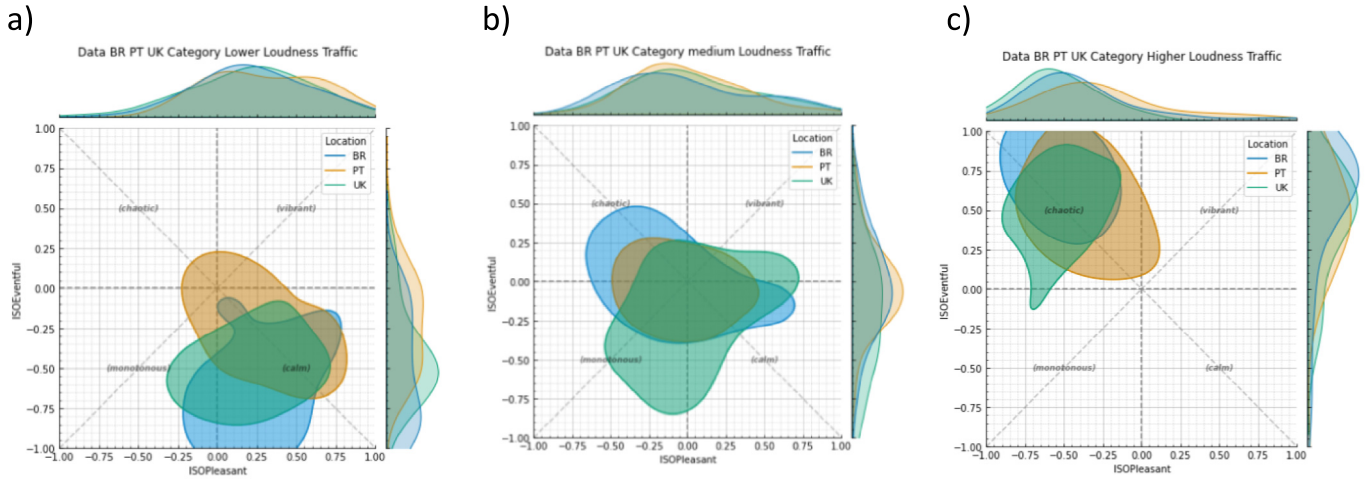

Fig. 7. 50th percentile contours for BR, PT, and UK results filtered by traffic sound source and perceived Loudness for: a) *left*: lower Loudness, b) *middle*: medium Loudness, and c) *right*: higher Loudness.

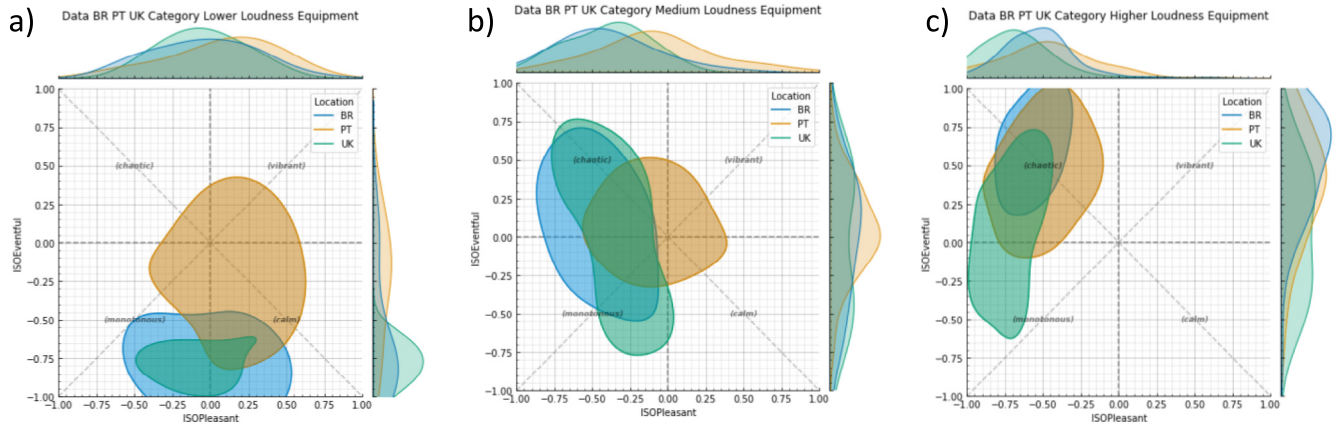

Fig. 8. 50th percentile contours for BR, PT, and UK results filtered by equipment sounds and perceived Loudness for a) *left*: lower Loudness, b) *middle*: medium Loudness, and c) *right*: higher Loudness.

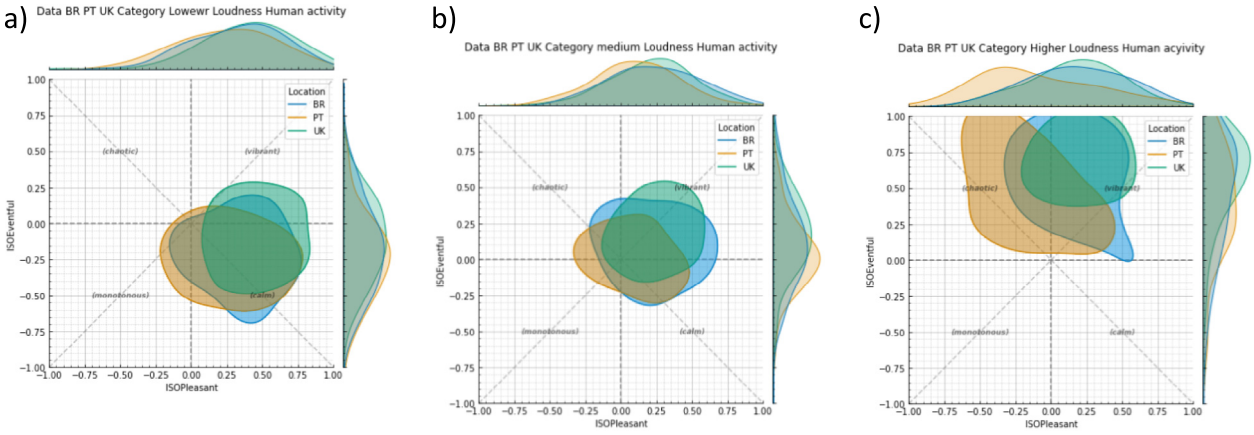

Fig. 9. 50th percentile contours for BR, PT, and UK results filtered by human activity sounds and perceived Loudness for: a) *left*: lower Loudness, b) *middle*: medium Loudness, and c) *right*: higher Loudness.

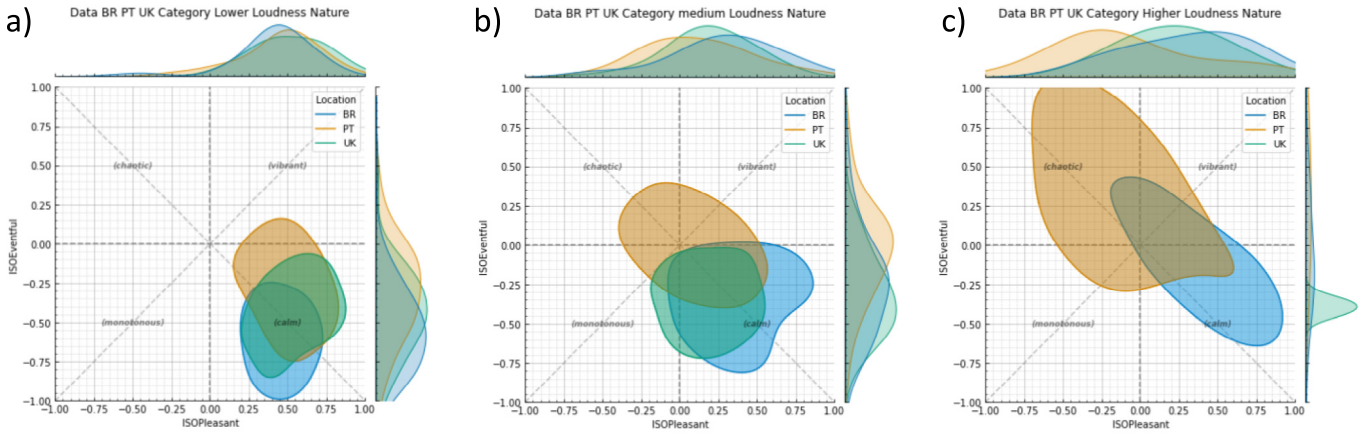

Fig. 10. 50th percentile contours for BR, PT, and UK results filtered by nature sounds and perceived Loudness for: a) *left*: lower Loudness, b) *middle*: medium Loudness, and c) *right*: higher Loudness.

4.1.1. Eventful

For the **Eventful** PAQ, an *Agitado/Movimentado* (**Eventful**) soundscape is for both countries a *Caótico* (**Chaotic**) and *Animado/Vibrante* (**Vibrant**) soundscape, but somehow also related to *Irritante/Desagradável* (**Annoying**). Considering that only *Animado* could represent a better translation for the Vibrant PA, this could improve the Portuguese circumplex model since no significant difference was found between how the Portuguese and Brazilians rated the distribution of Eventful.

4.1.2. Vibrant

For the **Vibrant** PA, the translation into Portuguese was *Animado* and *Vibrante*. As observed in Tables 3 and 4, for Portuguese and Brazilians, these soundscapes are more correlated to the *Agitado/Movimentado* (**Eventful**), and *Caótico* (**Chaotic**) PAQs instead of *Agitado/Movimentado* (**Eventful**) and *Agradável/Prazeroso* (**Pleasant**) PAQs as considered by the UK model. However, results in Table 5 show that Portuguese and Brazilians rated differently on the Vibrant scale. Thus, based on the data, the authors inferred that the Portuguese translation might not capture the positive meaning of the Vibrant scale even if the word *Animado* suggests a positive assessment. One possible way to overcome this issue may be using only the word *Animado* as the translation for the Vibrant, given that both countries relate this word to a more Pleasant assessment.

4.1.3. Pleasant

An *Agradável/Prazeroso* (**Pleasant**) soundscape for the Portuguese and Brazilian respondents represents a *Tranquilo/Calmo* (**Calm**) soundscape, not related to *Animado/Vibrante* as in the circumplex model for the UK (Tables 3 and 4). Table 5 shows no significant differences between how the Portuguese and Brazilians rated this PAQ. Also, both countries selected the same words in Stage 1, so the authors recommended keeping the translation. This finding corroborates with other studies that presented no significant differences between translated and original PAQ for pleasant [10,15,16].

The exception lies in the Pleasant and Calm terms, where most studies report no significant differences between soundscape appraisal with translated and original English PAQs words [10,15,16].

4.1.4. Calm

A *Tranquilo/Calmo* (**Calm**) soundscape is for both countries an *Agradável/Prazeroso* (**Pleasant**) and *Sem acontecimentos/Estático* (**Uneventful**) soundscape, as in the UK model. Also, there were no significant differences between how the Portuguese and Brazilians rated the distribution of Calm. So this translation is to be maintained in future projects. Again, other studies for the Calm PAQ translation [10,15,16] came up with similar conclusions with no significant differences between the English and translated PAQ.

4.1.5. Uneventful

The **Uneventful** PAQ was the only one rated differently between PT and UK, and BR and UK. This evidence suggests that the Portuguese translation could not capture the significance of the English meaning of the word, a divergence also stated among other SATP groups, such as Indonesian [8], Canadian French [9], and Greek [15]. Regarding the circumplex model, a *Sem Acontecimentos/Estático* (**Uneventful**) soundscape represents a *Monótono/Entediante* (**Monotonous**) and *Tranquilo/Calmo* (**Calm**) soundscape for both countries, as in the UK model. For this reason, the authors recommended the expression *Sem Acontecimentos* and *Estático* as the translations for Uneventful.

4.1.6. Monotonous

As seen in Table 4 for the participants from Portugal, a *Monótono/Entediante* (**Monotonous**) soundscape stands for a *Sem acontecimentos/Estático* (**Uneventful**) and *Irritante/Desagradável* (**Annoying**) soundscape following the UK model. However, for Brazilians (Table 5), the Monotonous scale represents a *Sem acontecimentos/Estático* (**Uneventful**) and *Tranquilo/Calmo* (**Calm**) soundscape. In addition, the two countries rated this PAQ differently (Table 5), suggesting differences in the interpretation, even though both countries selected the two chosen words in Stage 1. A further investigation shall proceed to identify the origin of this difference in ratings before recommending a translation for this PAQ into Portuguese.

4.1.7. Annoying

An *Irritante/Desagradável* (**Annoying**) soundscape represents both countries' responses as a *Caótico* (**Chaotic**) and *Agitado/Movimentado* (**Eventful**) PAQs, instead of *Caótico* (**Chaotic**) and *Monótono/Entendiante* (**Monotonous**) PAQs as in the UK model (see Tables 3 and 4). Furthermore, results in Table 5 also show that Portuguese and Brazilians rated the Annoying PAQ differently. These different assessments could be related to the age group differences (see Fig. 4) since older people from all countries tend to classify in the central region. Also, important to notice that the Portuguese results, regardless of age, are always near the central region, which could indicate a cultural trend. Additionally, Fig. 2 demonstrates that both countries had fewer ratings over the Monotonous axis which consequently limited the Annoying scale to be bounded by the Monotonous and Chaotic PAQs.

4.1.8. Chaotic

Despite differences among Brazilian and Portuguese ratings for the **Chaotic** PA (Table 5), both countries comply with the circumplex model considering this attribute located between the *Irritante/Desagradável* (**Annoying**) and *Agitado/Movimentado* (**Eventful**) PAQs (Tables 3 and 4). For this reason, the authors recommended keeping the actual translation (*Caótico*) for Chaotic PAQ.

4.1.9. Final remarks on PAQs

Finally, regarding the assessment of sound stimuli, participants declared that it would be different depending on the introduction of a context. For future listening tests, authors consider it pertinent to introduce a visual cue and, or other contextual factors considering that participants from both countries had the same suggestion.

In summary, after completing Stage 2 and analyzing the validation of the preliminary translation, the authors conclude that the translation of the PAQs into Portuguese, so far, shall be as shown in Table 6.

4.2. Remarks on the listening sessions

4.2.1. Listeners' perception of the listening sessions in Brazil

After the listening tests, participants could report comments or suggestions to improve the research. Some Brazilians declared they were confused by the Portuguese word *Vibrante* in the sense of being something that vibrates and, or some source of vibration, while *Animado* did not generate doubt. They also said that the terms for Monotonous, *Monótono* and *Entendiante*, could lead to different understandings, given that something *Monótono* is not necessarily *Entendiante.* Therefore, the authors considered the word *Monótono* could be the only representation in future questionnaires. The third comment was related to the translation of Uneventful PA as *Sem acontecimentos*, which means "without events" or denial of *acontecimentos* (events). This double negative generated doubts in some participants and created confusion when choosing the answer on a scale from 0 (totally nothing) to 100 (extremely), so they mistakenly selected closer to zero (0) instead of 100 when rating the Uneventful scale. In other words, they read and marked *Sem*

Table 6
Reference English words and translations into Portuguese proposed after Stage 2.

English	Pleasant	Chaotic	Annoying	Monotonous	Calm	Vibrant	Uneventful	Eventful
Portuguese	*Agradável* *Prazeroso*	*Caótico*	*Irritante* *Desagradável*	*Monótono* *Entediante**	*Tranquilo* *Calmo*	*Animado*	*Sem acontecimentos* *Estático*	*Agitado* *Movimentado*

* For Brazilians, consider using only *Monótono* as the translation for Monotonous.

acontecimentos as "zero events" instead of evaluating the absence of audio events in stimuli.

4.2.2. Listeners' perception of the listening sessions in Portugal

Portuguese participants could also report comments or suggestions after the listening tests. In this context, the same question about the double negative emerged when evaluating the *Sem acontecimentos/Estático* PA. Some said the evaluation as absolutely nothing at one extreme with a value of zero (0) is not intuitive. This double negative generated doubts in some participants. Another question was the existence of two very similar PA evaluations, always placed one after the other in the questionnaire: *Monótono* and *Sem acontecimentos* (Monotonous and Uneventful) which caused bias in the responses, given respondents declared both words to have a similar meaning. Other individuals mentioned the importance of defining the listening context. For one of the participants, she tried to visualize or imagine a scene whenever she heard the sound to respond afterwards. When she could not imagine it, she had doubts about classifying it. Another participant even said the assessment of sound would depend on the context. One participant mentioned that carrying out this test since childhood could prepare instincts and develop auditory perception. Finally, some people pointed out the need for an explanation before the beginning of the session about the intensity of 0 (zero – totally nothing) and 100 (extremely). This fact reinforces the importance of controlling the initial sound intensity to not influence evaluations.

4.2.3. Final remarks on listening sessions

Considering the comments during the listening tests, some changes come up: randomizing the order of the PAQ words in the questionnaire, reviewing the translations for the **Vibrant** and **Monotonous** PAQs, and introducing a context cue to the audio stimuli. For the **Uneventful** PAQ, some participants remarked that the double negative could be confusing. Thus, the recommendation is to change the labels of the rating scale from *Absolutamente nada* (Absolutely nothing) to *Discordo totalmente* (Totally disagree). Another possibility would be to label it *"Concordo Totalmente"* (Strongly Agree) instead of *"Extremamente"* (Extremely). Additionally, to avoid order bias in the responses, the authors suggest in future studies the random order presentation of the words for the PAQs in the questionnaire similar to what happened for the sound stimuli.

Furthermore, the confusion among Brazilians regarding the meaning of the word *Vibrante* (**Vibrant**) led them to consider using only the word *Animado* for this translation. Two reasons support this decision: first, *Animado* did not generate doubt among respondents, and second, given a previous analysis of the **Vibrant** PAQ (Tables 4 and 5), the referred word carries a more positive assessment in the Portuguese language. Also, some Brazilian participants in Stage 2 declared terms *Monótono and Entendiante* (**Monotonous**) could lead to different understandings since they considered something *Monótono* did not necessarily have the same meaning as something *Entendiante*. Therefore, only the word *Monótono* could be sufficient in the questionnaire for them.

5. Conclusions

The paper presented the results of a cross-national investigation of the translation (and its validation) of the eight soundscape PAQs from English to European and Brazilian Portuguese, within the scope of the Soundscape Attributes Translation Project (SATP), through the application of standard procedures. The results show that while there are some similarities in how individuals from both cultures describe sounds, there are also notable differences that may relate to cultural and linguistic factors. The Vibrant, Monotonous, Annoying, and Chaotic PAQs did not correlate as in the original English circumplex soundscape model, which indicates the need for further investigation. Additionally, the Uneventful term still has inconsistencies that may go beyond the Portuguese language, suggesting a possible revision of the original English term. Nevertheless, given that the Chaotic and Uneventful PAQs corroborated with the UK model, the current translations are to be maintained. Furthermore, the Pleasant and Calm PAQs had no issues in all analyses and shall remain with their initial translations.

These findings have important implications for soundscape developments related to standardization tools, research methods, and test design in Portuguese-speaking contexts. Additionally, they contribute to the growing body of knowledge on the role of culture and language in soundscape assessment.

Considering the remarks about the listening tests, the authors intend to apply the results of Table 6 in questionnaires on live situations, where the context is well defined, to verify whether the results obtained correlate better with the two-dimensional circumplex models of soundscape PAQs.

Also, future steps include comparisons with Spanish team results, a new round of listening tests in different parts of Brazil, and approaches to other Portuguese-speaking countries (e.g. Angola, Cabo Verde, Guinea-Bissau, Mozambique, São Tomé and Príncipe, and East Timor). In addition, issues with the Eventful PAQ must be resolved initially within the English model, given its Swedish origin and contradictions identified in different translations.

Furthermore, this research motivated, in Brazil, the translation of the three parts of the ISO 12913 standard. Therefore, after the new round of listening tests and validation of the translations, the authors intend to take the translated standard to the Brazilian Acoustics Committee from the Brazilian Association of Technical Standards (ABNT/CB-196), which is a mirror of ISO/TC 43 – Acoustics, to publish ABNT NBR ISO 12913 standard.

CRediT authorship contribution statement

Sónia Monteiro Antunes: Methodology, Formal analysis, Resources, Writing – original draft, Writing – review & editing, Visualization, Investigation. **Ranny Loureiro Xavier Nascimento Michalski:** Methodology, Resources, Writing – original draft, Investigation. **Maria Luiza de Ulhôa Carvalho:** Methodology, Writing – original draft, Writing – review & editing, Visualization. **Sónia Alves:** Methodology, Writing – original draft, Writing – review & editing. **Luís Cláudio Ribeiro:** Resources, Investigation.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors are grateful to all Soundscape Attributes Translation Project (SATP) researchers, especially its coordinators, for their comments and ongoing discussions in the research group. They also thank all the participants in Stages 1 and 2 for their voluntary collaboration in the research. This research did not receive grants from funding agencies in the public, commercial, or not-for-profit sectors. There are no potential competing interests to report by the authors.

Appendix 1

Table A1
Description of SATP sound stimuli descriptions (made by the authors).

#	Audio	Description	Intensity (perceived by the authors)	Category
1	OS01d	Music + people talking	Medium	Human
2	CG01	Music, people talking and laughing,	Medium	Human
3	LS06	Music, people talking and laughing	Low	Human
4	E05	People talking and laughing outdoors, and bird sounds	Low	Human
5	RPJ01	People talking and laughing, birds in the background	Low medium	Human
6	N1	Low road traffic, and birds in the background	Low	Traffic
7	W22	People talking and laughing, birds in the background	Low	Human
8	W06	Water sounds	Low	Nature
9	VP01b	Nature sounds, birds	Low	Nature
10	W16	Something ticking (like a clock) and road traffic in the background	Low	Traffic
11	E02	Water sound (waterfall or rain sound), a car passing by in the background	Medium	Nature
12	E01b	Sound of water and road traffic	Medium	Traffic
13	KT01	Background noise from something like a machine	Low	Equipment
14	W09	Constant machine sound	Medium	Equipment
15	W01	Machine sound (like a lawn mower)	Medium	Equipment
16	CT301	Machine sound (like a chainsaw)	High	Equipment
17	E12b	Hammer and a machine noise (like a jackhammer)	Medium-high	Equipment
18	HR01	Machines, sirens, hammers, construction site sound, metallic crashes, metallic objects falling,	Medium-high	Equipment
19	E11b	Rail traffic, sirens, engine exhaust	High	Traffic
20	OS01c	People talking on a street with traffic, a horn in the background, and a man shouting angrily in the background	Medium-high	Human + Traffic
21	E10	People talking, near a water source, children playing and crying	Medium	Human
22	E09	People talking, laughing, clapping, background music, a crying baby, birds	Low medium	Human
23	CG07	People talking, closed environment	Medium	Human
24	W11a	People talking, passing and traffic in the background, and someone walking nearby	Low medium	Human
25	CG04	People talking in an open space	Low	Human
26	W15	Road traffic, doors slamming	Low medium	Traffic
27	W23a	People talking and laughing	Low	Human

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