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**DOI**

[10.1080/00140139.2020.1853248](https://doi.org/10.1080/00140139.2020.1853248)

**Publication date**

2020

**Document Version**

Final published version

**Published in**

Ergonomics

**Citation (APA)**

Vink, P., Anjani, S., Udomboonyanupap, S., Torkashvand, G., Albin, T., Miguez, S., Li, W., Reuter, C., & Vanacore, A. (2020). Differences and similarities in comfort and discomfort experience in nine countries in Asia, the Americas and Europe. *Ergonomics*, *64*(5), 553-570.  
<https://doi.org/10.1080/00140139.2020.1853248>

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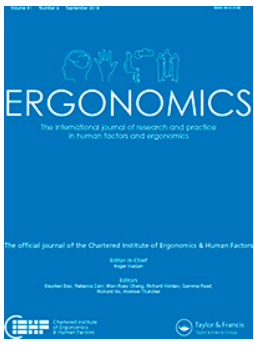
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To cite this article: Peter Vink , Shabila Anjani , Sumalee Udomboonyanupap , Golnoosh Torkashvand , Thomas Albin , Symone Miguez , Wenhua Li , Christian Reuter & Amalia Vanacore (2020): Differences and similarities in comfort and discomfort experience in nine countries in Asia, the Americas and Europe, Ergonomics, DOI: [10.1080/00140139.2020.1853248](https://doi.org/10.1080/00140139.2020.1853248)

To link to this article: <https://doi.org/10.1080/00140139.2020.1853248>



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## Differences and similarities in comfort and discomfort experience in nine countries in Asia, the Americas and Europe

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### ABSTRACT

In order to investigate differences in comfort and discomfort experiences amongst different regions of the world (America, Asia and Europe), a cross cultural study was performed. A questionnaire was sent to participants out in nine countries (Brazil, Canada, the USA, China, Indonesia, Thailand, Germany, Italy and the Netherlands). In total 795 participants completed the questionnaires. All countries score the comfort of a luxurious bed higher than a simple bed, first-class seats higher than economy class and all countries rate the comfort lower when the duration of sitting increases. The study suggests that in the USA and Canada softer beds, hammocks, more luxurious seats and softer pillows are scored as more comfortable compared with the other countries. There are indications that China and Germany prefer a harder mattress than in the other countries. For pillows, the differences between countries are large, which might show that much is influenced by habitude or hesitation to use something new. The Asian countries score the comfort of a brace neck pillow higher, which might be because these participants better realise the benefits better or feel less concerned to wear something that might give the appearance of an orthotic device. Further studies are needed to confirm these suggestions. The study shows that obvious differences are seen in all countries, which makes the construct of comfort internationally comparable.

**Practitioner summary:** In designing and manufacturing globally, it is important to know how different parts of the world experience (dis)comfort. This study did not show large cultural differences amongst nine countries. Some differences emerge regarding pillows, perhaps as differences in sleeping habits play a role.

**Abbreviations:** MANOVA: multivariate analysis of variance; VDA: Vargha and Delaney's A statistic; USA: United States of America

### ARTICLE HISTORY

Received 17 January 2020  
Accepted 14 November 2020

### KEYWORDS

Comfort; discomfort; cross cultural; different countries; sitting; sleeping

## 1. Introduction

Comfort is daily in our lives. Humans experience comfort in wearing clothes, lying in bed, using hand tools, kitchen appliances, computers and in their workstations as well as seats in cars, trains, buses and aeroplanes. Discomfort can be experienced as well in daily life and it has a relationship to having musculoskeletal complaints (Hamberg-van Reenen et al. 2008). Many comfort products or interiors are developed for international markets. However, in selling, marketing and developing these comfort-related products or interiors for international markets there is not much knowledge

whether there are differences between countries in experiencing comfort or discomfort. The aim of this study is to do a first attempt to gather more knowledge on this theme. In the scientific domain discomfort is often studied: Vink and Hallbeck (2012) found 104,794 papers mentioning discomfort in 30 years' time; Bazley (2015) studied 318 scientific papers with discomfort in the title in a period of 10 years and these papers concern mostly studies on physical human body interaction. These studies often use discomfort recordings to check the effect of an intervention. For instance, Groenesteijn et al. (2009) studied

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the postural discomfort experience to determine the differences between two chairs.

There are several visions on the meaning comfort and discomfort. Some state that discomfort and comfort are two opposites on the same line. Ahmadpour et al. (2014) found no differences between the underlying themes of comfort and discomfort. She states that this implies that both could be described using the same set of themes. On the other hand, Looze, Kuijt-Evers, and Van Dieën (2003) state that comfort is more related to psychological and emotional terms, while discomfort is more connected to physical aspects. There are some aspects of comfort and discomfort that are generally accepted (Looze, Kuijt-Evers, and Van Dieën 2003), like the fact that comfort and discomfort are of a subjectively defined personal nature and that it is experienced in an interaction with a product or an environment.

Looze, Kuijt-Evers, and Van Dieën (2003) developed a theoretical model of sitting comfort and discomfort. This model is divided into a part concerning the discomfort and a part concerning the comfort. The comfort is related to expectation, emotions or the aesthetic design. Sitting might evoke a cascade of mechanical, biomechanical or physiological responses, influenced by merely physical aspects. Vink and Hallbeck (2012) developed a comfort model inspired by the model of Looze, Kuijt-Evers, and Van Dieën (2003) but also other models, like the comfort model of Moes (2005). The process leading to the (dis)comfort experience is described in this model. It starts with the interaction between human and object in its environment, which result in internal human body effects, followed by weighing of input and experience and leading to the (dis)comfort perception. Visual input, input from other sensors and expectation influence this (dis)comfort perception as well. Naddeo et al. (2014) refined this model by adding more links between the elements of the model. Mansfield et al. (2020) used a 'cake model' as a metaphor, in which a product has a cosmetic coating, designed to produce an outstanding first-impression, and where vision plays a role. Behind the coating there are multiple layers comprising a multitude of design priorities. Each of the layers could need optimisation in a different way. For example, there could be differing requirements for thermal properties, lateral support, vibration damping, breathability and adjustability. These models have in common that a division between comfort and discomfort is shown and that discomfort is more related to the physical aspects. Additionally, these

models show that visual perception or cosmetic coating plays a role and influences the (dis)comfort experience, which means that not only visual aspects should be studied. In all of the 318 scientific papers studied by Bazley (2015) the differences between regions in the world were not taken into account, while it might be possible that the comfort or discomfort experience is different between regions. Bouwens (2018) described in her study that the importance of elements contributing to seat comfort are sometimes different per region. The Asian passengers attributed a bit more importance to a footrest compared with the USA and European passengers, but all regions prefer a good bottom cushion. Ikea (Thompson 2011) studied the comfort in seat cushions for sofa and stated that generally, people in the UK like softer cushions more than in Sweden and people from the USA prefer even softer cushions. Americans like to 'sink in their seats'. So, regional differences can be reasonably hypothesised.

As comfort and discomfort are subjective, giving values to products on expected comfort or discomfort differs. There are intra-individual and inter-individual differences. People differ regarding sensitivity and in different situations comfort can be rated differently (Vink 2014). Most scientific studies therefore use within subject designs in conditioned environments to check differences between products. For instance, in the study of Groenesteijn et al. (2009) different seats were used in the same environment with the same participants.

In studying comfort and discomfort in different regions of the world, it might be good to check for differences in perceived comfort/discomfort also between different versions of the same product, therefore two research hypotheses are investigated in this paper:

**Hypothesis 1.** People from different regions of the world rate products and environments related to comfort or discomfort differently

**Hypothesis 2.** Different versions of a product are perceived differently in various regions of the world.

In order to investigate the above hypotheses, a cross cultural study was conducted over nine countries (Brazil, the USA, Canada, China, Thailand, Indonesia, Italy, Germany and the Netherlands) belonging to 3 regions of the world (America, Asia and Europe). The study was done online, which has been done before. Ayachi, Dorey, and Guastavino (2015) studied factors contributing to bicycle comfort and discomfort using an online questionnaire with 244 respondents. Broega, Righetto, and Ribeiro (2017) conducted an online survey on 574 women to study comfort when using high-heel shoes. The study was conducted involving

one researcher for each country. A common questionnaire was made up, translated in the native language of each country. Each researcher got the instruction to recruit at least 40 participants taking care to get an even number of female and male participants in the age 18–65 years old. Participants completed the questionnaire online.

It is important to study environments and products that are related to comfort. The products and environments related to comfort and discomfort that are often mentioned in the scientific literature (Bazley 2015) are temperature or climate, patient comfort and seats or chairs. However, it is unknown what people link to comfort in daily life. Therefore, a small pilot study was done.

The paper is structured as follows: Section 2 is a pilot study to determine what people link to comfort in daily life. Section 3.1 describes how the questionnaire was built and the strategy adopted for statistical data analysis; Section 3.2.4 reports the results obtained from the analysis of the data and Section 4 discusses these with respect to findings available in the specialised literature.

## 2. Pilot study

### 2.1. Methods

To get a better understanding on which environments and products humans have in their mind in daily life, a pilot-study involving 155 students (65% Dutch, 35% other countries of which 13% were Chinese) was conducted. Students were asked to describe what they had in mind in thinking of comfort.

### 2.2. Results

The answers to the question of what the students had in mind thinking of comfort are shown in Figure 1. The bed and chair are most often mentioned, but also pillow and footwear are in the mind of people thinking of comfort. Environments were not so often mentioned. Two times the warm shower and a living with a heated floor were reported and one time sunbathing, calming music and being around the fireplace. These were included in the category 'other' in Figure 1.

## 3. Cross-cultural survey study

### 3.1. Methods

#### 3.1.1. The questionnaire

The topics that are mentioned mostly in the pilot study were placed in the questionnaire. A first version

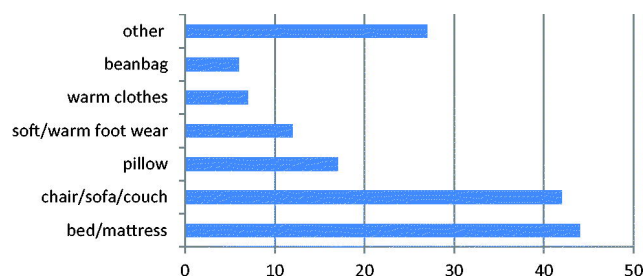


Figure 1. Products people have in mind thinking of comfort ( $n = 155$ ).

of the questionnaire was written in English and sent out for comments to the nine researchers (the authors) involved in the study. The questionnaire was adapted based on the researchers' comments and then translated into the native language of each country. Each researcher carried out a reading comprehension test of the translated questionnaire and based on the comments of the test, the questionnaires were adapted again. Finally, a link to the online version of each questionnaire was sent out by email to the potential participants in each country. The questionnaire was structured in three sections: (1) informed consent; (2) demographic information (i.e. age, gender, nationality); (3) comfort/discomfort questions (see Appendix 2). The products included in the questionnaire are the ones that the pilot study identified as often mentioned by students in relationship with their daily life experience of comfort/discomfort (see Figure 1). Participants were provided with photos of the products (see figures) under study as well as with text descriptions; they were asked to use a 7-point scale to answer comfort questions (1 = no comfort; 7 = extreme comfort) and a reverse scale to answer discomfort questions (1 = extreme discomfort; 7 = no discomfort). Moving from the premise that humans are better in scoring relative comfort and discomfort than absolute values (Vink 2014), questionnaire items generally refer to 2 or 3 versions of a product.

#### 3.1.2. Statistical data analysis

In order to determine whether comfort/discomfort scores differ significantly amongst countries (Hypothesis 1), a multivariate analysis of variance (MANOVA) using a fully nonparametric version of Wilks' Lambda,  $\Lambda$  (Liu, Bathke, and Harrar 2011) was applied. The MANOVA analysis was followed by a univariate analysis (i.e. Kruskal–Wallis test; Kruskal and Wallis 1952) to test, for each product version, if the distribution of comfort/discomfort scores in some

countries could be assumed superior (i.e. stochastically dominant) compared with the others.

The Vargha and Delaney's A statistic (VDA; Vargha and Delaney 2000) was included in the analysis to estimate the effect size of the Kruskal–Wallis test so as to complement information provided by  $p$  values. VDA provides the degree to which some countries have data with higher ranks than others. VDA ranges from 0 to 1, with 0.5 indicating stochastic equality between countries (i.e. overlapping distributions of comfort/discomfort scores) and 1 indicating stochastic dominance of some countries over the others (i.e. not-overlapping distributions of comfort/discomfort scores). Interpretations for VDA values, provided in Vargha and Delaney (2000), are reported in Table 1.

In order to identify the countries with significantly different comfort/discomfort scores, post-hoc testing was conducted via the Dunn (1964) test.

The differences in comfort/discomfort scores for comparable products (Hypothesis 2) were analysed through pairwise comparison via Wilcoxon test and compared amongst countries.

For each product version, differences in comfort/discomfort scores were analysed graphically via quantiles

**Table 1.** Interpretations used for Vargha and Delaney's A.

	Small	Medium	Large
Vargha and Delaney's A	0.56–<0.64 >0.34–0.44	0.64–<0.71 >0.29–0.34	≥0.71 ≤0.29

of the empirical distributions of comfort/discomfort scores across the nine countries. The median of the comfort/discomfort score was calculated for each level of the interaction of two factors of interest: country of residence (with 9 levels) and product version (with 1, 2, or 3 levels); the first and third quartiles (i.e. 25th and 75th percentiles) were used to indicate the spread of data about each median.

## 3.2. Results

### 3.2.1. The questionnaire

As the bed, chair, pillow and foot wear were mentioned most, these products are included in the questionnaire. They are related to comfort or discomfort experience in daily human activities like lying down for sleeping (i.e. simple bed versus soft bed, normal pillow versus latex pillow (see Figure 2) or for resting (i.e. hammock, see Figure 5); sitting during travelling (i.e. first versus second class train seats, economy versus business aircraft seats (see Figure 3), three configurations of travel pillows (see Figure 11)); sitting for working (i.e. wooden office seat versus soft foam office seats, no figure was shown only a description)); standing up in a row (see Figure 3 right picture); walking (i.e. military boots versus sneakers (no figure was shown only a description)).

The strategy adopted to build and try out the questionnaire in each country was valuable to improve the



**Figure 2.** The simple and soft bed (left two pictures) and normal pillow (middle two pictures) and latex pillow (right two pictures) shown in the questionnaire.



**Figure 3.** The 1st class and 2nd class train interior (left two pictures) and 1st and 2nd aircraft interior (middle two pictures) and waiting row (most right picture) shown in the questionnaire.

questionnaire. In some countries the number of participants having another place of birth than place of living is large (e.g. Canada and Indonesia), which made us decide to have two questions on the nationality: in which country do you live and in which country are born. In Thailand sometimes also office seats without a backrest are used, which made us add a question on the comfort in office seats without a backrest. Comfort of a latex bed pillows gets attention in Brazil, which made us decide to add a question on that as well. Discomfort is not an often used word in Germany, which made us decide to translate it into 'Unbehagen', which is a kind of 'unease'. In some countries trains are not often used by citizens (e.g. Brazil), which made us change the question 'how would you rate the comfort' into 'imagine you would travel on a train on this seat, how would you rate the

**Table 2.** Number of participants, gender and age (average and standard deviation) per country.

Country	# Participants	Male	Female	Avg age	Std age
Brazil	242	81	161	41.9	10.70
Canada	40	24	16	36.9	7.31
China	46	23	23	36.09	10.76
Germany	48	19	29	30.17	14.0
Indonesia	92	42	51	38.11	14.45
Italy	169	85	84	37.9	13.2
The Netherlands	43	22	20	36.95	14.56
Thailand	57	17	40	32.49	9.00
USA	58	19	39	50.5	12.16
Total	795	332	463	39.1	12.98

comfort'. The pre-study showed the importance of having a 'native' researcher and doing a pilot test.

### 3.2.2. Statistical results

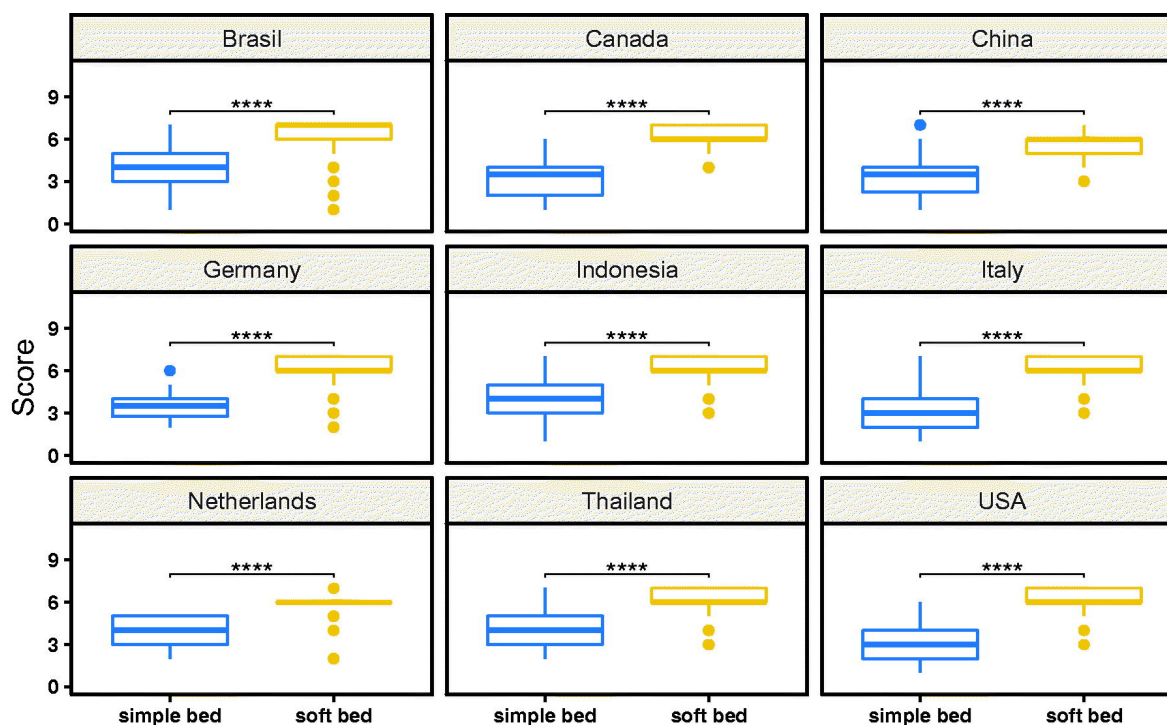
In total 795 participants answered all the questions on the questionnaires. The characteristics of the study population are reported in Table 2.

MANOVA results (nonparametric Wilks' Lambda = 5.725,  $p < 0.01$ ) show that comfort/discomfort scores significantly differ across countries. Statistically significant MANOVA was followed up by conducting a series of rank-based univariate comparisons via Kruskal–Wallis tests. The results are reported in Table 2. With the only exception for seat belt travel pillow: Kruskal–Wallis test results were always significant. The estimates of the maximum effect size (VDA.m) range from 0.67 (medium) to 0.81 (large). In Appendix 1, the significant pairwise comparisons obtained via Dunn test are also reported.

In the following, the results are discussed in detail for products grouped according to human daily activities.

### 3.2.3. For sleeping

In the first questions, a picture of a rather simple hard looking bed and a good looking soft bed were shown. It is interesting to see that in all countries the comfort was rated significantly different for the two beds (see



**Figure 4.** Distribution of the comfort score for a simple and soft bed (shown in Figure 2) in different countries on a 7 point scale (1 = not at all; 7 = extreme high); \*\*\*\*  $P \leq 0.0001$ .

Figure 4). The impression is here that Italy and North America (Canada and the USA) perceived the highest difference in comfort between the rather simple bed and the soft nice comfortable bed. In Brazil, the simple bed had the highest score; whereas in Italy and the USA, it had the lowest score.

Another way of relaxing than laying in the bed is using the hammock (Figure 5). The impression is that there was not much difference in expected comfort in a hammock between different countries, indeed the size effect of Kruskal Wallis test is medium (Table 3). It looks like that China and Germany appreciated the comfort of relaxing in a hammock less than citizens of other countries. However, the results of the Dunn test (see Appendix 1) highlight that differences are significant between Brazil and Germany, China and the USA and Germany and the USA and this latter comparison is the one with the maximum VDA value.

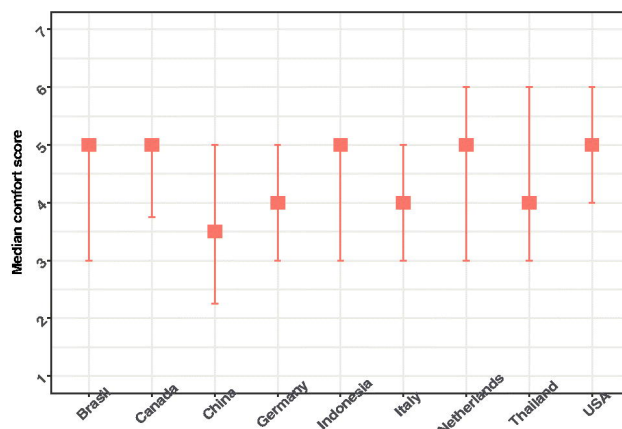


Figure 5. Interaction plot for the median comfort score in different countries on a scale (1 = not at all; 7 = extreme high) for lying in a hammock.

### 3.2.4. For sitting

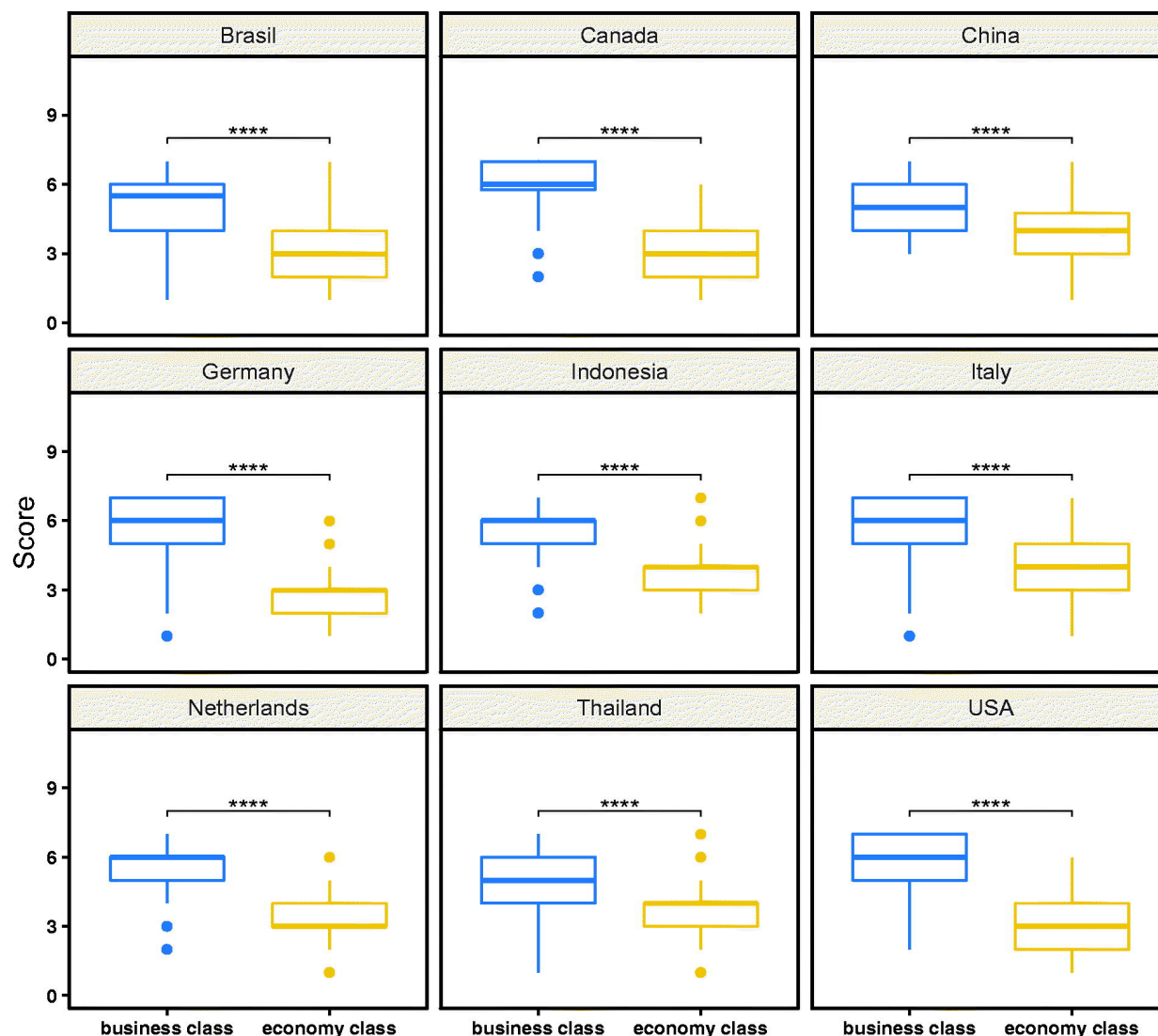
The comfort scores for flying first class and economy class were asked as well by showing pictures of the seats. Though for all nine countries, the comfort perceptions for the two aircraft seats resulted significantly different, it looks like that in countries like Germany, Canada and the USA the difference in comfort between economy class and business class was perceived to be larger than in other countries. Thailand, Italy, Indonesia and China provided higher comfort scores for an economy class seat. The results of Dunn test highlight that differences are significant between all these countries and Germany (see Appendix 1). This could be explained by differences in the average size of people (Figures 6–8).

One could expect comfort scores for 1st and 2nd class train seats would have similarities with the scores provided for business and economy aircraft seats, but a different pattern was shown: the median

Table 3.  $p$  Values and effect sizes for the Kruskal–Wallis test for each product version.

Product	Version	Adjusted $H$	$p$ Value	VDA.m	Interpretation VDA.m
Bed	Simple	37.43	<0.001	0.71	Large
	Soft	45.21	<0.001	0.74	Large
Hammock	Hammock	19.32	0.01	0.70	Medium
Aircraft seat	Business	28.37	<0.001	0.71	Large
	Economic	32.88	<0.001	0.71	Large
Train seat	1st class	26.32	0.00	0.68	Medium
	2nd class	32.40	<0.001	0.73	Large
Seating duration	3 h train ride	24.10	0.00	0.74	Large
Office seat	Wooden without backrest	52.93	<0.001	0.68	Medium
	Soft foam with backrest	51.16	<0.001	0.81	Large
	Standing in a row	73.82	<0.001	0.73	Large
Travel pillow	Seat belt pillow	12.04	0.15		
	Neck pillow	44.09	<0.001	0.80	Large
	Neck brace pillow	37.72	<0.001	0.74	Large
Bed pillow	Normal	23.54	0.00	0.72	Large
	Latex	24.10	0.00	0.67	Medium
Shoes	Combat boot	48.77	<0.001	0.71	Medium
	Sneakers	44.34	<0.001	0.67	Medium





**Figure 6.** Distribution of the comfort score for aircraft seats in different countries on a 7 point scale (1 = not at all; 7 = extreme high); \*\*\*\* $p \leq 0.0001$ .

comfort scores for the first-class train seat were between 4 and 5, whereas they were between 5 and 6 for business aircraft seat; differences in median comfort scores between train seats were larger than differences in median comfort scores between aircraft seats. A 3-h train ride was rated with highest discomfort in Germany that was significantly different from all other countries.

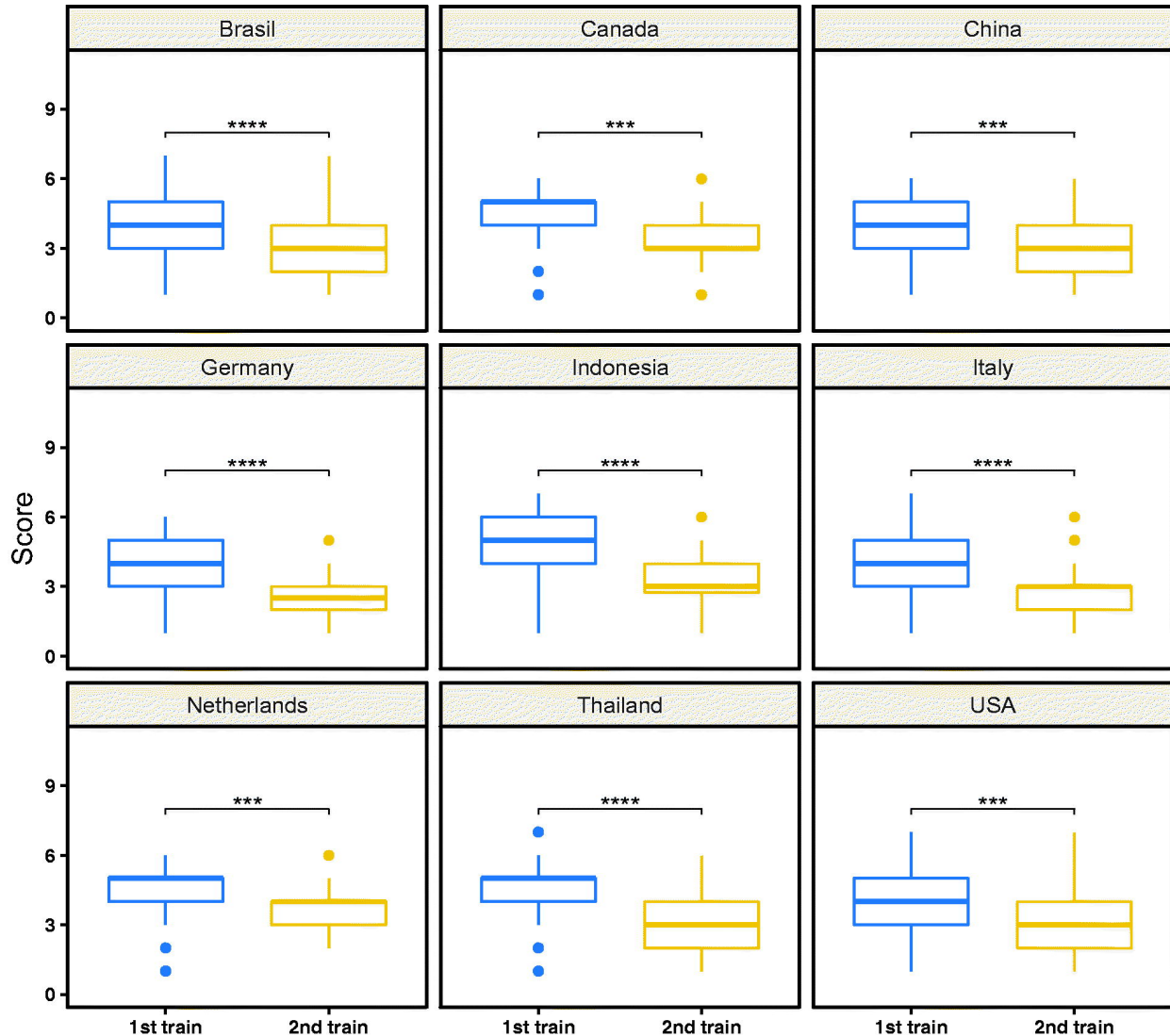
Sitting in a train and an aeroplane showed differences, but in all countries the differences were larger regarding discomfort sitting on the two office seats under comparison: a wooden flat seat with no backrest and a soft seat pan with a backrest. For the evaluation of office seats discomfort, Brazil showed significant differences with almost all other countries (see Appendix 1) (Figure 9).

### 3.2.5. Standing in line

For the comfort score related to standing in a line or queue there were large differences between countries. It seems that the Brazilians and Chinese experience standing in line with much less comfort than citizens from other countries. The maximum size effect is related to the difference between the USA and Brazil (Figure 10).

### 3.2.6. Pillows

There was a clear difference in expected comfort for the three pillows that could be used during travelling (see Figure 11). The seat belt pillow is the only product for which no significant difference was found in our study. The neck pillow scored overall highest and the neck brace pillow lowest. Similar results were in



**Figure 7.** Distribution of the comfort score for train seats in different countries on a 7 point scale (1 = not at all; 7 = extreme high); \*\*\* $p \leq 0.001$ , \*\*\*\* $p \leq 0.0001$ .

the study of Bouwens, Schultheis, et al. (2018). The Asian countries rated the neck brace pillow higher than the rest of the world. The distribution of comfort scores for neck pillow and neck brace pillow comfort is significantly higher in Indonesia. The Netherlands is the only country that rated the seat belt pillow higher than the other two product versions. (see Figure 11).

Regarding the bed pillows, generally the median comfort scores coincide for the two product versions (normal and latex) with exceptions for Brazil, Indonesia and the Netherlands (with the only significant differences between the two versions). It is worthwhile to note that Germany is the only country with a median comfort score for the latex pillow higher than for the normal pillow. The normal pillow obtained the highest comfort scores from Indonesians and the lowest scores

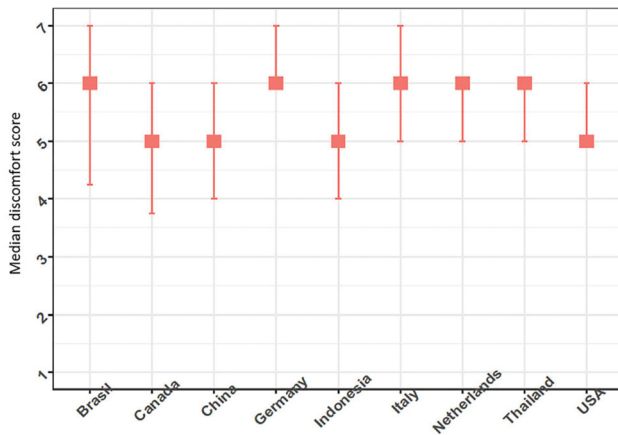
from Chinese. The latex pillow obtained the highest comfort scores from Germans and the lowest scores from Dutch (Figure 12).

### 3.2.7. Shoes

The difference in comfort between wearing combat boots or sneakers is more evident than for other between version comparisons. Though, differences resulted significant for all nine countries, the largest differences were obtained for Brazil and Indonesia; whereas the lowest ones were obtained for the USA and the Netherlands (Figure 13).

## 4. Discussion

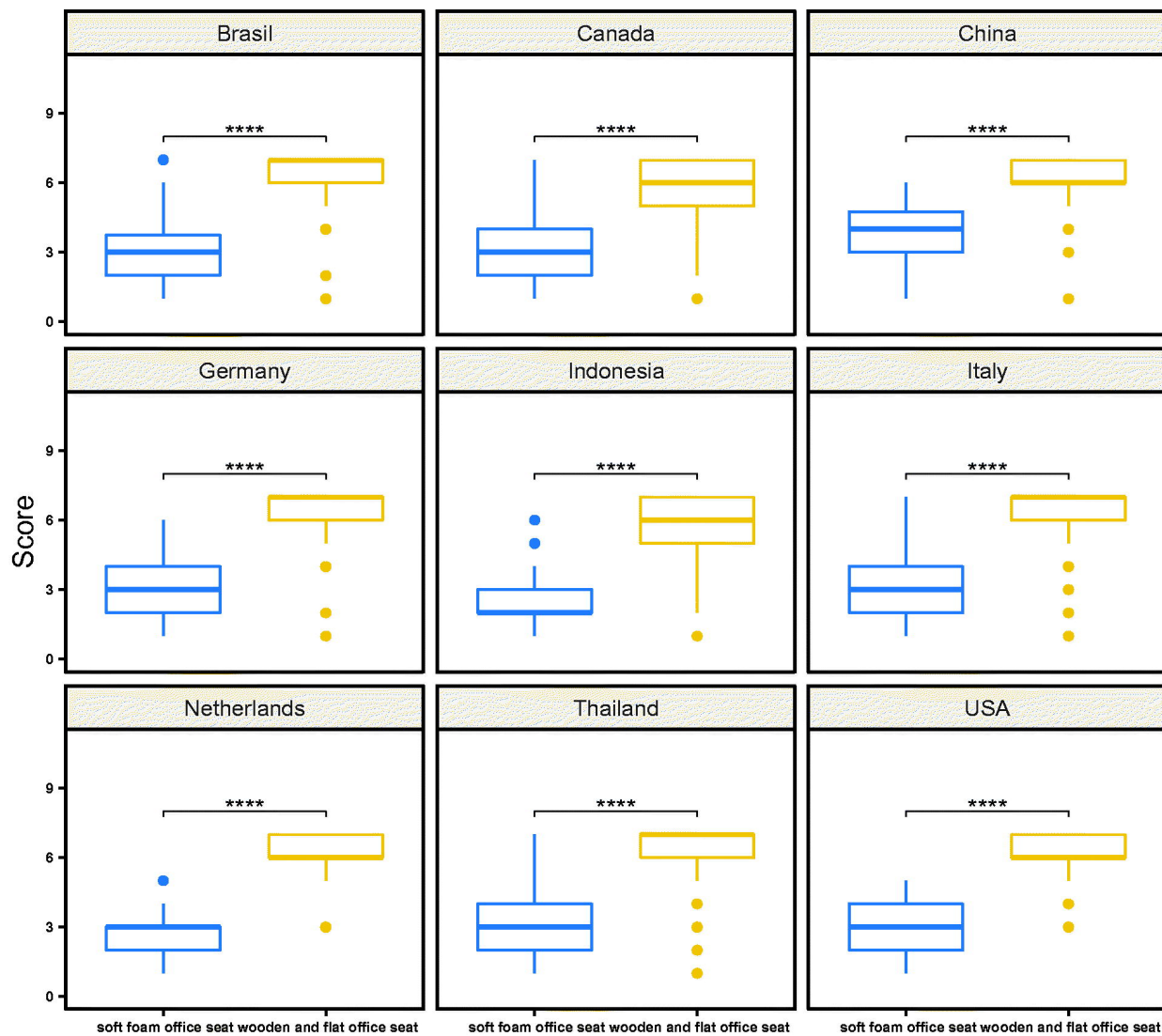
The results of our study provide interesting insights on the two research hypotheses investigated in this paper.



**Figure 8.** Interaction plot for the median discomfort score for a 3 h train ride in different countries on a scale (1 = no discomfort; 7 = extreme discomfort).

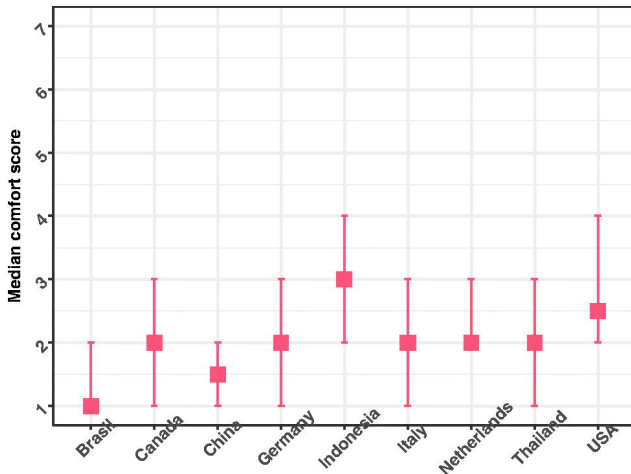
With respect to the hypothesis that *people from different regions of the world rate differently products and environments related to comfort or discomfort* (Hypothesis 1), some interesting differences were found: soft beds, hammocks, luxurious seats and soft pillows are rated as more comfortable by people from the USA and Canada; hard beds and hard seats seem to be more preferred in China and in Germany; the benefits of a neck brace seem to be more appreciated by Asians.

With respect to the hypothesis that *different versions of a product are perceived differently in various regions of the world* (Hypothesis 2), our findings seem to suggest that there are not large cultural differences amongst countries regarding comfort and discomfort for different versions of products like beds, seats and footwear: all countries rated a soft bed higher than a simple bed, first-class seats higher than economy,



**Figure 9.** Distribution of the discomfort score for office seats in different countries on a scale (1 = not at all; 7 = extreme high); \*\*\*,  $p \leq 0.001$ , \*\*\*\*,  $p \leq 0.0001$ .

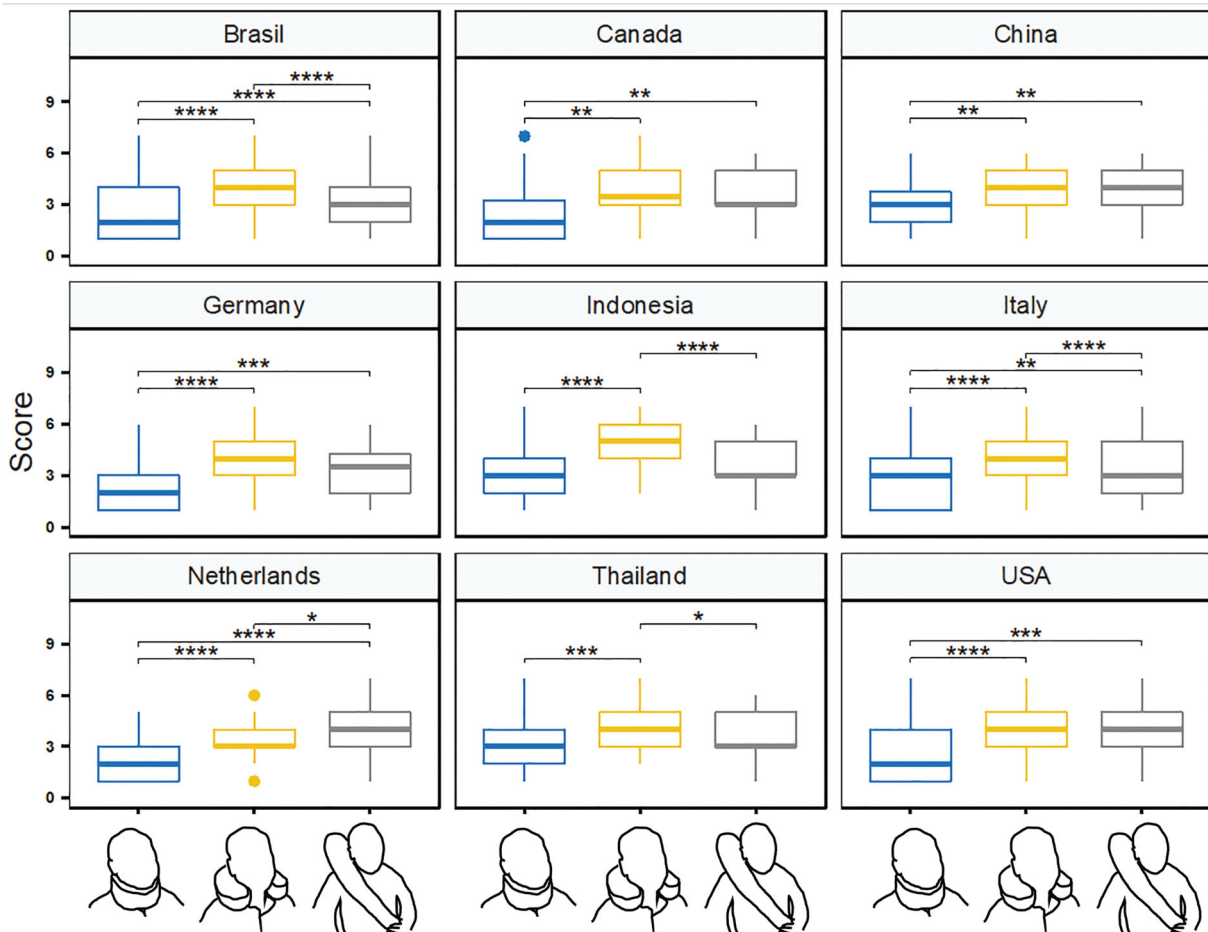
sneakers higher than combat boots and all countries rated the comfort lower when the duration of sitting increases. Instead, the differences amongst pillows are



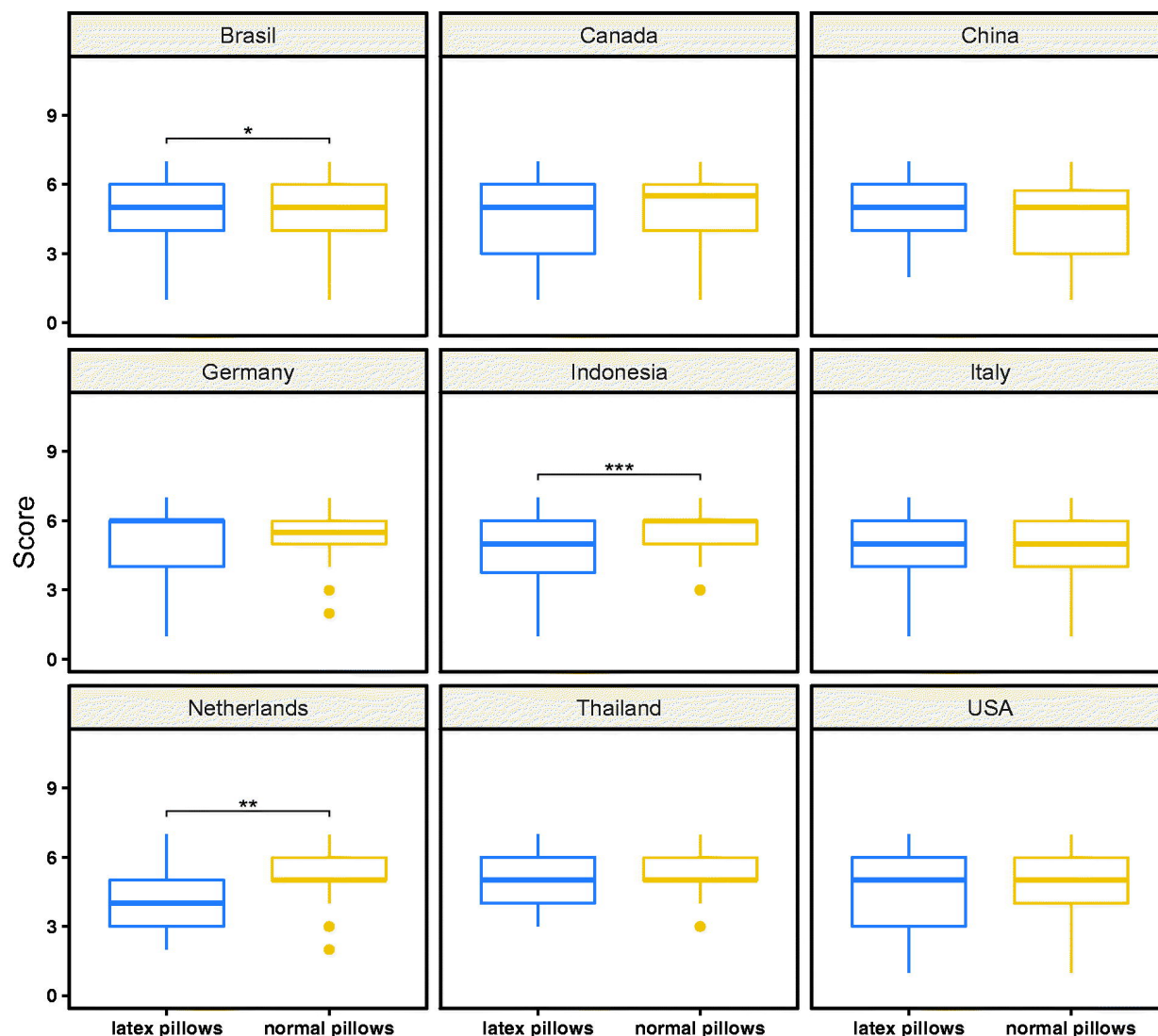
**Figure 10.** Interaction plot for the median comfort score for standing in a row in different countries on a scale (1 = not at all; 7 = extreme high).

large, which might show that much is influenced by habitude or hesitation to use something new like a latex pillow or a new kind of travel pillow.

Differences between countries are dependent on the product. Therefore, bed/mattress, seat, pillow and footwear are separately discussed in this section. Bed and mattress were the most mentioned products thinking about comfort. In all countries, the difference between a simple and a softer bed was valued in terms of more comfort for the softer bed, especially in the USA and Canada, where the difference between both beds was large. China and Thailand showed less difference between beds. Shen et al. (2012) stated there is an impression that Chinese like to sleep on a harder bed, not a soft mattress, however, in their study they proved that sleeping quality is dependent on many factors and high sleeping quality could be achieved with a softer mattress. China and Germany appreciated the hammock less. It is interesting that the scores for the soft bed were also among the lowest in these countries, and this could probably be interpreted as a preference for harder beds.



**Figure 11.** Distribution of the comfort score for three travel pillows (shown under the figure) in different countries on a scale (1 = not at all; 7 = extreme high); \* $p \leq 0.05$ , \*\* $p \leq 0.01$ , \*\*\* $p \leq 0.001$ , \*\*\*\* $p \leq 0.0001$ .



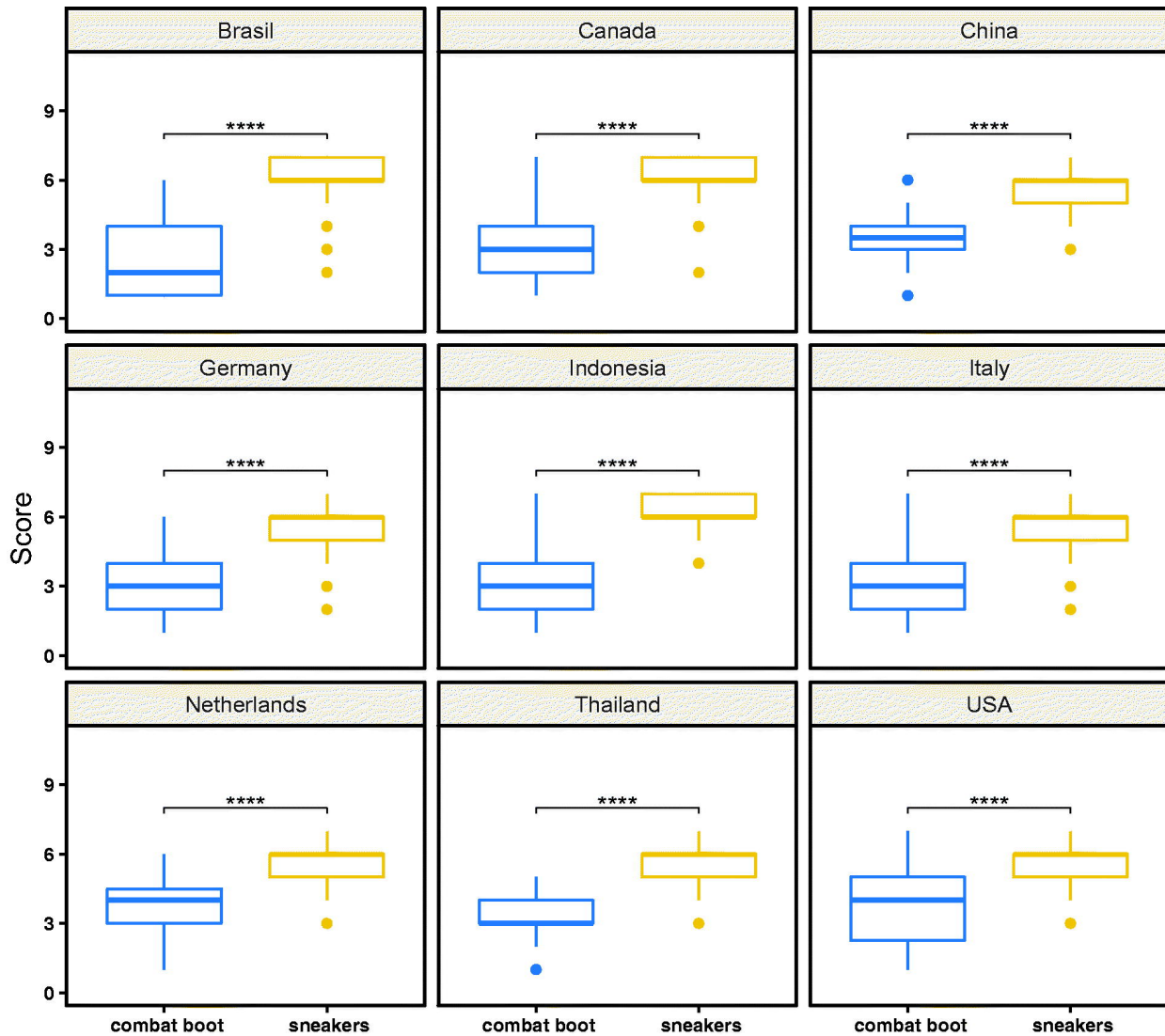
**Figure 12.** Distribution of the comfort score for two bed pillows (shown in Figure 2) in different countries on a scale (1 = not at all; 7 = extreme high); \* $p \leq 0.05$ , \*\* $p \leq 0.01$ , \*\*\* $p \leq 0.001$ .

Thompson (2011) describes a comparison between the USA, UK and German preference for chairs and the Americans resulted to prefer soft seats (they like to “almost reach the floor” sitting on a couch) more than people from other countries do. On the other hand, a study by Vercaygne-Bat (2008) showed that German drivers prefer a hard seat. Perhaps for beds, it could be likewise that Americans prefer a softer bed whereas Germans prefer a harder one.

The seat was the second product among those most mentioned when thinking about comfort. All countries provided higher comfort scores for business class aircraft seats and first-class train seats compared with the economy aircraft seat and the second class train seat. The largest differences between the business class and economy class aircraft seats were in Germany, the USA and Canada. For trains, this

difference was not so clear. Germans provided the highest discomfort scores for a 3-h train ride in a simple train seat. It is interesting to note that the picture related to this item in the questionnaire displayed a German train seat and probably Germans know that the specific seat in the picture has no foam or spring and thus it is rather hard.

The third most mentioned product thinking about comfort is the pillow. The pillows are the only products in which countries did not agree with their preferences for one pillow over the other ones. Probably the way people are used to a product or the openness to innovation plays a role here. The seat belt pillow scored highest only in the Netherlands and the latex pillow scored highest only in Italy. It seems that the three Asian countries rated the neck brace pillow higher than the rest of the world. It could be that



**Figure 13.** Distribution of the comfort score for wearing sneakers and combat boots in different countries on a scale (1 = not at all; 7 = extreme high); \*\*\*\* $p \leq 0.0001$ .

they see the benefits (more support) better or that they are less concerned with potentially negative perceptions to wear the neck brace pillow. According to Hofstede and Minkov (2010) the Uncertainty Avoidance Index scores tend to be higher in East and Central European countries, in Latin countries, in Japan and in German speaking countries, lower in English speaking, Nordic and Chinese culture countries. The USA, Italy, Thailand, China and Indonesia could more risk taking. On the other hand, this difference was not shown regarding the new latex pillow. Showing a latex pillow with a large edge compared with the more common soft pillow resulted in various reactions. Again, the participants from the USA and Canada preferred the traditional soft pillow, but the Dutch and Indonesians rated comfort likewise. Italians even preferred the latex and the Thais and Germans rated the comfort not so different.

The fourth most mentioned product thinking about comfort concerns footwear. All countries preferred sneakers above combat boots.

Of course, this study also has its limitations. It is the question whether the participants of each country are representative for the whole country. Online questionnaires are not accessible to everyone, which means that a specific selection is made. It is also the question whether the participants completing the survey had experience with the products of environments. In the pre-test in the different countries, it was already shown that in Brazil there was not much experience using trains. That is why the sentence was added to the question: 'Imagine you travel in this train seat.' The use of photos certainly influences the rating as the first impression influences comfort (e.g. the cosmetic coating in the cake model mentioned in the introduction). Bouwens, Schultheis,

et al. (2018) showed that looking at pictures of the travel pillows generate a different comfort score than after wearing the travel pillows for more than an hour. Ideally, in future research participants should be asked to their comfort when experiencing the product or environment, which is a suggestion for future research on cultural differences. Also, for comfort and discomfort, it is known that memory can disturb the results. Mansfield et al. (2020) state that ideally, a questionnaire is completed while seated, as memory errors may creep in once a subject has left their seat. Mellert et al. (2008) showed for instance that after being in a noisy aeroplane crew complained about their swollen feet and not about the noise. The goal of the project was to have the same ranges of age in the different countries. However, in the end, this appeared to be not completely equal, which also might have had some influence on the results.

An important finding in this study is that there are not big differences between countries regarding comfort and discomfort experiences. Also, the comfort differences between first and second-class travelling and the difference in comfort between combat shoes and sneakers are found in every country. This means that comfort studies done in one country might be relevant for other countries as well. The study also shows that differences for products related to sleeping are larger between countries, probably because sleeping habits differ. Also, seat softness might be more country-specific, which is also described by Thompson (2011). These kinds of products might need to be tested in different countries. Also, shown from this study is the importance of having a 'native' researcher and doing a pilot test.

Though this study provides interesting suggestions, further investigations are needed in order to really affirm the suggested hypotheses. In fact, the authors are aware that this study suffers from two main limitations: only nine countries were studied; the questions were not asked while using the products and this could induce a different evaluation of comfort or discomfort, indeed in a recent study Bouwens, Hiemstra-van Mastrigt, et al. (2018) showed some differences in comfort experiences during the flight and those reported after the flight.

### Disclosure statement

No potential conflict of interest was reported by the author(s).

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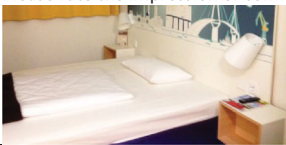
**Appendix 1. List of pairwise comparisons via Dunn test (Benjamini–Hochberg adjusted *p*-value)**


Simple BED	Thailand–Brazil (0.005)	Thailand–USA (0.001)	Thailand–Canada (0.006)	Thailand–China (0.0219)	Thailand–Germany (0.0125)	Thailand–Italy (0.000)	Indonesia–USA (0.0353)	Italy–Indonesia (0.0061)	Italy–the Netherl. (0.0232)	Italy–Brazil (0.0206)		
Soft BED	<b>Brazil–China (0.000)</b>	Brazil–Germany (0.0416)	Brazil–Italy (0.0109)	Brazil–the Netherl. (0.0281)	Brazil–Thailand (0.0118)	Canada–China (0.0119)	Germany–China (0.0363)	Indonesia–China (0.0001)	Italy–Thailand (0.0320)	Thailand–China (0.0495)	USA–China (0.0026)	
Hammock	Brazil–Germany (0.0479)	USA–China (0.0632)	<b>USA–Germany (0.0227)</b>	Canada–Thailand (0.0226)	Germany–China (0.0267)	Italy–China (0.0231)	USA–China (0.0175)	Germany–Thailand (0.0450)	Italy–Thailand (0.0320)	USA–Thailand (0.0362)		
Business AIRCRAFT SEAT	Canada–Brazil (0.0448)	Italy–Brazil (0.0461)	<b>Canada–China (0.0284)</b>	Italy–Germany (0.0008)	Thailand–Germany (0.0076)	Thailand–Germany (0.0008)						
Economic AIRCRAFT SEAT	Brazil–Italy (0.0219)	China–Germany (0.0046)	<b>Indonesia–Germany (0.0012)</b>	Indonesia–Italy (0.0056)	Indonesia–USA (0.0055)	Indonesia–USA (0.0012)						
1st class TRAIN SEAT	Indonesia–Brazil (0.0007)	<b>Indonesia–China (0.0071)</b>	Indonesia–Germany (0.0063)	Germany–the Netherl. (0.0057)	Italy–Indonesia (0.0020)	Italy–the Netherl. (0.0013)						
2nd class TRAIN SEAT	Brazil–Indonesia (0.0316)	Netherl. (0.0192)	Germany–Indonesia (0.0105)	<b>Germany–the Netherl. (0.0057)</b>	Italy–Indonesia (0.0020)	USA–Germany (0.0183)						
3 h seating in TRAIN RIDE	Canada–Brazil (0.0424)	<b>Canada–Germany (0.0025)</b>	China–Germany (0.0115)	Indonesia–Germany (0.0066)	Italy–Germany (0.0425)	USA–Brazil (0.0038)						
Wooden without backrest	Canada–Brazil (0.0015)	China–Brazil (0.0103)	<b>Indonesia–Brazil (0.000)</b>	Italy–Brazil (0.0294)	Thailand–Brazil (0.0106)	Indonesia–Italy (0.0040)		Canada–Germany (0.0153)	Indonesia–Germany (0.0017)			
OFFICE SEAT	Indonesia–Brazil (0.0034)	Indonesia–Canada (0.0021)	Indonesia–USA (0.0408)	Indonesia–Germany (0.0101)	Indonesia–Italy (0.0113)	<b>Indonesia–China (0.0000)</b>		China–USA (0.0007)	China–Brazil (0.0000)	China–Germany (0.0067)	China–Italy (0.000)	
Standing in a ROW	Canada–Brazil (0.0143)	Indonesia–Brazil (0.000)	The Netherl.–Brazil (0.0055)	Thailand–Brazil (0.0127)	Italy–Brazil (0.0002)	Indonesia–China (0.0004)	Indonesia–Germany (0.0014)	Indonesia–Italy (0.0054)	Indonesia–Thailand (0.0340)	Indonesia–Thailand USA–China (0.0012)	USA–Germany (0.0033)	USA–Brazil (0.000)
Neck TRAVEL PILLOW	Brazil–Canada (0.0206)	Brazil–the Netherl. (0.0004)	Brazil–USA (0.0440)	Indonesia–Canada (0.0008)	Indonesia–China (0.0116)	Indonesia–Germany (0.0059)	Indonesia–USA (0.0010)	Indonesia–Italy (0.0166)	<b>Indonesia–the Netherl. (0.000)</b>	Italy–the Netherl. (0.0022)	Thailand–the Netherl. (0.0051)	
Neck brace	Indonesia–Brazil (0.0001)	Indonesia–Canada (0.0048)	Indonesia–Germany (0.0003)	Indonesia–Italy (0.0016)	<b>Indonesia–the Netherl. (0.0003)</b>	USA–Indonesia (0.0048)	Thailand–the Netherl. (0.0198)	Thailand–Brazil (0.0397)	Thailand–Germany (0.0199)			
TRAVEL PILLOW	Brazil–China (0.0299)	Germany–China (0.0352)	<b>Indonesia–China (0.0012)</b>	Thailand–China (0.0384)	Indonesia–Italy (0.0099)							
Goose-BED PILLOW	Italy–the Netherl. (0.0470)	Italy–USA (0.0388)										
Latex-BED PILLOW	Netherl. (0.0470)	USA–Germany (0.0217)	USA–Italy (0.0137)	USA–Brazil (0.000)	Italy–Brazil (0.0353)	China–Brazil (0.0005)	China–Indonesia (0.0238)	China–Italy (0.0181)	China–Italy (0.0403)	The Netherl.–Italy (0.0181)	The Netherl.–Brazil (0.0001)	
Military BOOT	USA–Germany (0.0217)	USA–Indonesia (0.0085)										
Netherl.–Germany. The (0.0241)	Netherl.–Indonesia (0.0118)											
SNEAKERS	Brazil–China (0.0012)	Brazil–Germany (0.0450)	Brazil–Italy (0.0005)	<b>Brazil–the Netherl. (0.0015)</b>	Brazil–Thailand (0.0003)	Brazil–USA (0.0224)	Indonesia–China (0.0441)	Indonesia–the Netherl. (0.0442)	Indonesia–Thailand (0.0234)			


In bold, the pairwise comparison with maximum value of VDA.


**Appendix 2. Comfort/discomfort questions (translations in different languages are provided in supplementary material)**

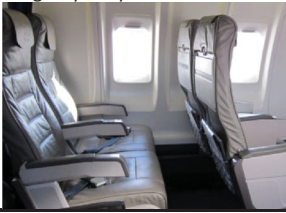
1. Please rate the impression of comfort of this bed on a scale 1-7.  
How comfortable is it?

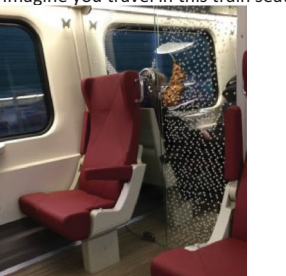
1.	Please rate the impression of comfort of this bed on a scale 1-7. How comfortable is it?					
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7

2.	Please rate the impression of comfort of this bed on a scale 1-7. How comfortable is it?					
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7





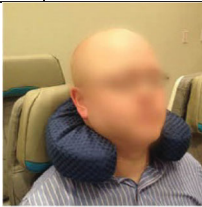
3.	Please rate the comfort of this way of relaxing on a scale 1-7. How comfortable is it?					
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7

4.	Imagine you fly in this aircraft seat. How comfortable is it on a scale 1-7:					
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7

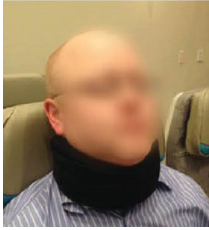




5.	Imagine you fly in this aircraft seat. How comfortable is it on a scale 1-7:					
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7

6.	Imagine you travel in this train seat. How comfortable is it on a scale 1-7:					
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7

(continued)

7. Imagine you travel in this train seat. How comfortable is it on a scale 1-7:						
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7
8. If you would sit three hours on this train seat. How would you rate the discomfort?						
						
<i>Extreme discomfort</i> <span style="float: right;"><i>No discomfort</i></span>						
1	2	3	4	5	6	7
9. How would you rate the discomfort of an office chair seat pan with a <b>flat wooden surface and no backrest?</b>						
<i>Extreme discomfort</i> <span style="float: right;"><i>No discomfort</i></span>						
1	2	3	4	5	6	7
10. How would you rate the discomfort of an office chair seat pan with a <b>soft foam cushion and a back rest ?</b>						
<i>Extreme discomfort</i> <span style="float: right;"><i>No discomfort</i></span>						
1	2	3	4	5	6	7
11. How would you rate the comfort standing in this row. How comfortable is it on a scale 1-7:						
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7
12. Please rate the comfort of this travel pillow on a scale 1-7:						
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7
13. Please rate the comfort of this travel pillow on a scale 1-7:						
						
<i>not at all</i> <span style="float: right;"><i>extremely high</i></span>						
1	2	3	4	5	6	7

(continued)

																											
14. Please rate the comfort of this travel pillow on a scale 1-7:																											
<i>not at all</i>														<i>extremely high</i>													
1		2		3		4		5		6		7															
15. Please rate the comfort impression using two pillows of this goose model on a scale of 1 to 7:																											
																											
<i>not at all</i>														<i>extremely high</i>													
1		2		3		4		5		6		7															
16. Please rate the comfort impression using one pillow of this latex model on a scale of 1 to 7:																											
																											
<i>not at all</i>														<i>extremely high</i>													
1		2		3		4		5		6		7															
17. what is your opinion about wearing combat boots you see in the military? How would you rate the comfort?																											
<i>not at all</i>														<i>extremely high</i>													
1		2		3		4		5		6		7															
18. what is your opinion about wearing sneakers? How would you rate the comfort?																											
<i>not at all</i>														<i>extremely high</i>													
1		2		3		4		5		6		7															