EXPLORING THE POSSIBILITIES OF INCREASING THE CONTACT COMFORT BY WOODEN MATERIALS – TACTILE INTERACTION OF MAN AND WOOD

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ABSTRACT

The paper deals with the problematic of contact comfort as a part of a user-centred design. Contact comfort consist of a combination of balanced surface temperature, heat transmission, surface roughness, surface elasticity/hardness, sorption activity of the surface in terms of vapor absorbance. All these parameters are measurable and it is possible to optimize them with the aim to achieve solutions that are providing higher contact comfort.

Different wood based materials and wood species with different types of surface finishing were investigated by using a test chair. The current paper presents the methodology and results of this study. It could be shown that wooden surfaces are assessed more positive by the probands than aluminium and polypropylene.

Key words: contact comfort, tactile wood properties, wood surface impression

INTRODUCTION

The human being its environment – which is nowadays mostly built environment – is strongly influenced by materials and forms/proportions of the built elements. Even when our culture is more visually oriented, we „feel“ the space with all our senses. The tactile perception is sometimes underestimated and the designers do not pay enough attention to it when designing our artificial environment. Many examples of neglecting tactile perception can be seen in public space such airports, train stations, public gardens, entrance lobbies, universities and school rooms etc.

According to Hall (1989) the pleasure of touching a surface and enjoying the smoothness and balanced temperature is connected to tenderness and caress. The intimate touch of the human skin with textiles has already been studied thoroughly and in many fields a haptic design of technical components (e.g. interior design in cars) is a must. Meyer (1999) provides a profound survey on the measurement, the design and the impression of haptic effects. Only a few studies have been performed on the haptic perception of wood material based interior components and furniture surfaces, such as the haptic perception of various wood flooring surfaces, performed by Berger et al. (2006).

Obata et al. (2005) have done research on the quantitative evaluation of good tactile warmth of wood, where they have stated good tactile warmth of wood as one of its advantages. Further Haviarová et al. (1996) were investigating the temperature sense of a person and thermal properties of the materials chosen and wood species used at the complex interior formation. They measured the surface temperature and the thermal conductance of different materials including wood and then compared it with the subjective feeling of a target group.

In our previous research we investigated the hand perception of different surfaces of beech wood without finishing, oiled, lacquered and a laminate with wood décor. The result was that the surface most preferred was the solid beech wood sanded and polished without finishing (Kotradyová, 2010).

1. STUDY OBJECTIVES

The target of this paper is to analyze the tactile characteristics by direct and intensive contact of the human body by sitting or lying on some plane or molded material, which is a different „experience“ to the usual hand or feet tactile contact. This „sitting contact“ is a more common, frequent and intensive way of interaction of the human body and a specific material. We defined this situation as “contact comfort“ which is a complex perception of different parameters such as contact temperature, heat transmission, surface hardness/softness, stiffness of the material, slip resistance etc.

It is one of the most usual types of contact by using of any kind of interior elements and by a long term interaction, such a sitting. Many other factors are important, too, including sorption activity etc. All these parameters are interwoven and with general ergonomic principles and the individual mental setting of a user; they create a complex contact comfort by sitting or lying on some surface.

Contact/tactile comfort is strongly influenced by its duration. For the short time interaction a cold and hard surface with very little springing/flexibility can be refreshing for a user, but an interaction of more than 10 minutes can cause pain caused by hurting overlapping bones of our skeleton and also tiring of muscles (Kraus 2011)..

2. MATERIAL AND METHOD

In order to assess the sitting comfort we have developed a test chair which shows the following features (fig. 1): exchangeable seat, backrest and armrest made of different materials with different types of finishing that are usually used in the production of chairs.

Fig. 1. Testing chair with exchangeable sets of seat boards, arm rests and backrests, arm rest are also usable for testing the edge radius preferences.

The skeleton of the chair is designed according to contemporary ergonomic standards in order to offer a usual somatic comfort so as to allow the respondent to concentrate on the contact comfort.

The following materials were used:

1. polypropylene

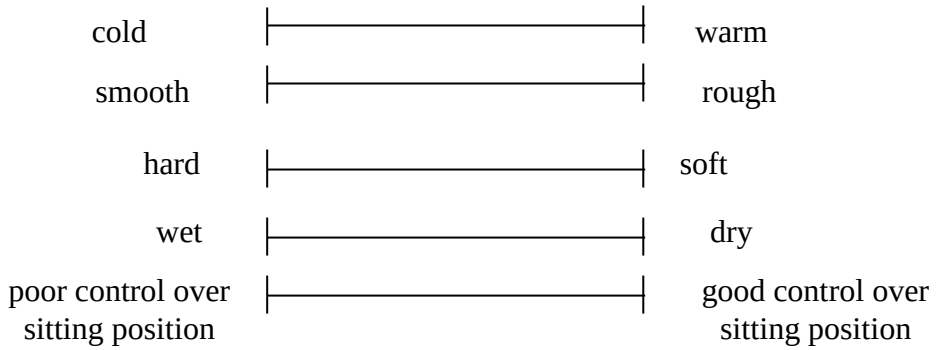
2. aluminium
3. thin plywood board set with PUR-lacquer finishing – high glance spruce glued board set without finishing
4. beech glued board set with PUR-lacquer finishing – high glance
5. beech glued board set with flax oil finishing
6. beech glued board set without finishing
7. spruce glued board set with PUR-lacquer finishing – high glance (focus to „sliding effect“)
8. spruce glued board set with flax oil finishing
9. spruce glued board set with flax oil finishing

We tested the impression of the various materials by short-term interaction (after a 2 minute contact) and long-term interaction (after a 10 minute contact) in a typical office environment at a room temperature of about 22°C. After each cycle of 2 minutes and 10 minutes the chair was equipped with another material.

Due to the explanatory approach of the study only 10 test persons were asked to participate in the study. There was no further statistical and gender related approach in the current investigation. The following questionnaire was used for the response of the probands.

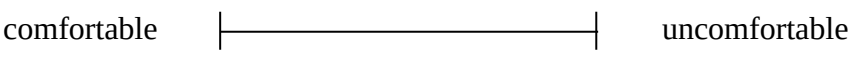
2.1 STRUCTURE OF THE QUESTIONNAIRE

The questionnaire had the following structure and the probands could rate their intuitive impressing by putting their score within the range of a pair of antipodes, e.g. cold – warm. In the later analysis a scale from 0 to 10 was put into this range.



Control over sitting position means that a material supports a good contact to the human body and prevents a sliding across the sitting shell.

The last question is about comfort/discomfort and should mirror an overall impression.



3. RESULTS

Table 1 summarizes the results of the various tests. By assessing the *thermal comfort* of the material (*characteristic cold/warm)*, the highest rating of all sets is „spruce raw“ (7.6/7.5) and the lowest rating is aluminum (1.0/1.6). Independently from the material, the thermal comfort increased with the running time. At other impressions, such as smooth/rough, hard/soft, wet/dry etc. there was no distinct difference over the time of contact.

Tab. 1. Evaluation of all criteria considered for contact comfort of all tested materials. Mean value of 10 probands. Milestone I rating after a 2 minute contact, milestone II rating after a 10 minute contact.

Material	cold / warm		smooth / rough		poor/good control oversitting		hard / soft		wet / dry		discomfort/ comfort	
Milestones	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.	I.	II.
polypropylen	3,1	4,0	1,3	1,4	3,3	4,0	2,3	2,3	6,3	6,4	3,3	2,7
aluminum	1,0	1,6	1,7	1,8	4,0	4,2	1,5	2,6	6,6	6,6	2,0	2,8
beech plywood (5mm thick) lacquered	4,8	5,8	2,9	2,8	4,7	4,8	3,7	3,5	7,0	6,6	4,1	4,1
solid beech glued board (25mm thick) lacquered	4,8	6,0	2,1	2,2	4,6	4,6	3,6	3,6	7,3	6,7	5,0	5,2
solid beech glued board (25mm thick) oiled	6,3	6,7	5,6	5,7	6,8	5,8	4,8	4,7	8,0	7,7	5,9	5,6
solid beech glued board (25mm thick) raw	5,9	6,5	5,6	5,6	6,0	5,8	4,4	4,1	7,5	7,7	5,3	5,3
solid spruce glued board (18 mm thick) lacquered	6,2	7,5	2,3	2,6	4,2	4,7	4,4	4,6	6,6	6,7	5,2	5,4
solid spruce glued board (18 mm thick) oiled	6,8	7,4	4,7	4,6	6,3	6,2	5,9	5,5	7,9	7,8	5,1	5,7
solid spruce glued board (18 mm thick) raw	7,6	7,5	6,7	6,5	7,7	7,2	6,0	6,1	8,2	8,0	5,9	5,4

By testing the impression of the surface characteristics *(characteristic smooth/ rough)* the polypropylene, aluminium and lacquered wood surfaces were assessed as smooth (1,2–2,6) whereas raw and oiled wooden surfaces were seen as somehow between smooth and rough (scores around 5).

Analyzing the characteristics *control over sitting position* one can see that raw wooden surfaces provide the best control over the sitting position, followed by lacquered wooden surfaces. Aluminium and propylene show a significantly poorer control of the sitting position.

By evaluating *sorption activity*, (tested by the characteristics *soft/dry)* no difference between the materials and the two milestones can be seen.

The general parameter *discomfort/comfort* is seen as an expression of the overall comfort regarding mental setting, too. It can be seen that the rating was quite similar to the other parameters and in general, wooden surfaces have a higher rating than aluminium and polypropylene. There are only small differences between the various wooden surfaces. Basically every element of the test seat (seat, backrest, armrest) could be assessed separately, but in the current pilot study only the element „seat“ was assessed by our probands.

4. DISCUSSION AND CONCLUSION

According to literature and field research we have synthesized the following parameters that are playing an important role in creating contact comfort, and these are:

- surface temperature – thermal comfort
- roughness of surface

- hardness of surface
- sorption activity of surface in term to absorb the external moisture (e.g. sweat or humidity of air/its condensates)
- having control over sitting position
- possibilities of maintenance – cultural influence
- individual mental and physical settings that create an overall feeling of comfort

In our pilot study we have explored those parameter and created a methodology how to get a proper feedback from users. According to our hypotheses, there should be a difference in the assessment of sitting comfort after an immediate impression (e.g. 1 minute contact time) and a longer time (e.g. 10 minute contact time). As there was no significant difference at most parameters, one can assume, that also the contact time of 10 minutes might have been too short and in future studies, this time should be elongated. In our hypotheses we assume a significant difference between the materials after a longer contact time especially for parameters such as wet and dry and a more pronounced differences between short-term and long-term sitting contact concerning comfort and discomfort.

Concerning „positive“ and „negative“ impressions, it could be shown that wood surfaces exhibit predominantly positive impressions compared to polypropylene and aluminium.

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