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NOTES

Sitting Comfort of Ergonomic Office Chairs—Developed Versus Intuitive Evaluation

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The sitting comfort of office chairs with different ergonomic layouts (inferior, superior) was examined. Fifty participants were randomly assigned to a 2 × 5 factorial experimental design with 2 different conditions of ergonomic chair layout (inferior or superior) and 5 different conditions of instruction to explore the chair. Four conditions were created to differentiate between various levels of perceptual awareness and processing of chair-related information (guided exploration and developed evaluation). In a 5th condition, participants remained uninstructed (free exploration and intuitive exploration). Under guided exploration, the participants' perception of sitting comfort was in line with objective differences in the chair layout. Different conditions of guided exploration, however, did not influence the evaluations. Under free exploration, the participants' perceptions did not match the ergonomic chair layout. In contrast to participants under guided exploration, they even rated the ergonomically inferior office chair more favourably than the ergonomically superior chair.

sitting comfort   office chair   ergonomic chair layout   developed evaluation
intuitive evaluation   sensory awareness

1. INTRODUCTION

Sitting comfort is a subjective perception and sensory experience, which may not necessarily correspond with the objective layout of office chairs [1, 2, 3]. One reason can be limited awareness and cognitive processing of sensory stimulation provided by the ergonomic features of the chairs. Features of office chairs, such as the shape of the seat and back, the thickness and density of foam cushions, or type of cushion cover, provide a variety of sensory effects, which are mainly tactile and kinaesthetic in nature. Input from this sensory system, however, tends to create more diffuse and holistic perceptions than input from the visual or auditory sensory system.

In previous studies, Müller and Nachreiner [4, 5] and Müller [6, 7] showed that inexperienced as well as experienced users feel more comfortable when sitting in ergonomic office chairs compared to sitting in less ergonomic ones. However, they were unable to differentiate between these chairs on the basis of objective layout variations. In other words, the source of their comfort perceptions remained unclear: users just felt better. In the same vein, more recent studies confirmed that the spontaneous evaluation of naïve users may reflect an undifferentiated, schematic or heuristic way of processing information from the tactile and kinaesthetic sensory system [2, 8, 9, 10].

The present study explored the extent to which subjective perceptions of sitting comfort become

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more precise when supported in ways that foster sensory awareness and cognitive processing of tactile and kinaesthetic information. It is expected that users can be taught how to detect and recognize even subtle variations in objective features of ergonomic office chairs when prompted accordingly. This kind of developed evaluation is supposed to induce “bottom-up” information processing [11]. Bottom-up information processing (compared to “top-down” or intuitive information processing) requires the careful perception and screening of an object, subject or problem before an evaluation is made. In contrast, top-down information processing is characterized by the spontaneous, heuristic and often affect-driven evaluation of an object, issue or problem. Details are processed as an afterthought on a highly selective basis which unconsciously serves as a means of strengthening or justifying evaluations that have already been made [12].

One way to induce bottom-up processing of tactile and kinaesthetic information is sensory awareness instruction [13]. In the present study, sensory awareness instruction consisted of different strategies of how users should explore an office chair. Guided exploration was expected to raise the awareness of tactile and kinaesthetic sensations and by this make an evaluation more developed. Written and oral forms of guided exploration were used. It was hypothesized that increasing sensory awareness by guided exploration would lead to a more developed processing of tactile and kinaesthetic information. As a consequence, objective features of ergonomic office chairs should be recognized more precisely and the evaluation of sitting comfort should become more differentiated.

2. METHOD

2.1. Participants

Fifty individuals participated in the study (36 females, 14 males). Twenty participants were students of the University of Koblenz-Landau, Germany; the other 30 were employed by the same institution. Age ranged from 20 to 58 years ($M = 32.8$; $SD = 10.4$).

2.2. Experimental Conditions

The participants were randomly assigned to two experimental conditions: (a) ergonomic layout of the office chair, and (b) mode and extent of exploration.

The ergonomic layout of the office chair was varied on two levels. On level 1 (inferior layout), the office chair had three suboptimal features. First, the levers to raise the seat and activate dynamic sitting were not constructed and placed in a way that supports intuitively correct handling. Second, the seat and back were connected, which implies that the backrest could not be adjusted to the length of the upper part of the body. Third, during dynamic sitting the front part of the seat moved up and down, which impaired blood circulation at the back of the thighs in a relaxed sitting position. On level 2 (superior layout), the handling of levers to regulate height and dynamic functions of the chair was intuitively clear, the backrest could be adjusted separately, and the seat was divided into a fixed part right beneath the thighs and a larger dynamic back for relaxed sitting. Other features were similar in both chairs, including the shape of the armrest, seat, and back as well as cushioning and colouring.

The mode and extent of exploration was varied on five levels. On level 5 (extended oral instruction), the main features of the office chair (see section 2.3.) were pointed out for exploration. In addition, single attributes of these features were highlighted to enable exploration on a more specific basis. On level 4 (extended written instruction), a checklist was given, which provided the same information as the oral instruction in the first condition. However, participants had to work through the checklist by themselves and explore the chair without oral advice. On level 3 (restricted oral instruction), only the main features were pointed out without highlighting further attributes. On level 2 (restricted written instruction), the main features were written on a flipchart to remind the participants what and in what order to explore.

On level 1 (no instruction, control), neither oral nor written information about the features of the chair was given. Instead, the participants were allowed to explore the chair freely and to evaluate its sitting comfort according to their own experience and impressions.

The material for developed exploration (conditions 2–5) was developed on the bases of questionnaires used in various earlier studies [1, 5]. The items in these questionnaires were taken and reformulated to various degree to direct the participants' attention to specific features of the chair: (a) adjustment functions, (b) fit of seat and back, (c) dynamic sitting, (d) rotation and movement, (e) material of components, and (f) colour and shape. Objective differences between the two chairs referred to features (a) to (c), namely, adjustment functions, body fit and dynamic sitting.

2.3. Measures

Under developed exploration (all conditions but control, i.e., no instruction), single features as well as the overall sitting comfort of the chair had to be rated by the participants. In the condition of no instruction, only the overall sitting comfort had to be rated. Measures were on a 6-point scale of grades taken from the German school system. The grades were 1—*very good*, 2—*good*, 3—*satisfactory*, 4—*sufficient*, 5—*insufficient*, and 6—*failed*. Note that smaller numbers indicate more favourable perception of sitting comfort.

In addition, a short post-experimental questionnaire with four items was given which addressed the perceived usefulness of the exploration procedure itself (e.g., "The evaluation procedure has led to insights about the quality of chair features", "I discovered chair features which I might not have paid attention to otherwise"). The statements had to be rated on a 6-point scale from 0—*totally disagree* to 5—*completely agree*. Cronbach's α was .71.

3. RESULTS

The main question of the study referred to the general differences which guided versus unguided exploration may exert on the overall evaluation of sitting comfort. The analysis of overall sitting comfort was carried out by pooling different forms of guided exploration and subjecting measures of sitting comfort to a 2 × 2 factorial analysis of variance (ANOVA) with ergonomic layout (inferior versus superior) and type of exploration (guided versus free). Because of unequal cell frequencies the variances of measures were screened in cells with n = 5

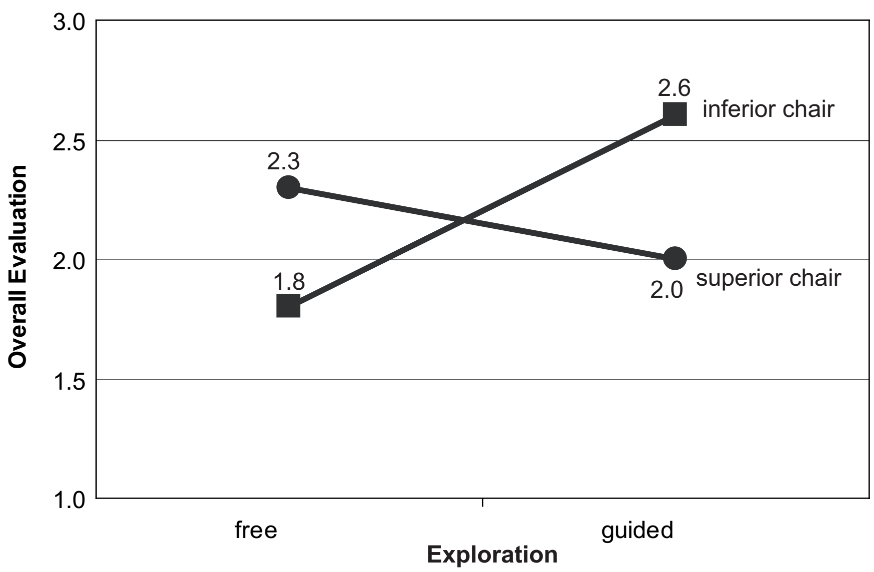

Figure 1. Chair × exploitation interaction effect. *Notes*. Lower scale values correspond with better evaluations.

and $n = 20$. It was found that mean variances in cells with $n = 20$ were greater than variances in cells with $n = 5$ (.48 and .39, respectively). Using ANOVA in cases like this leads to F tests of differences that tend to be more conservative and robust [14]. An analysis of overall sitting comfort provided a significant interaction effect, $F(1, 46) = 5.3$; $p < .03$. Figure 1 illustrates the means of the interaction effect.

The pattern of differences shows that under guided exploration the sitting comfort of the superior chair was perceived more favourably than that of the inferior chair, i.e., subjective evaluations tended to correspond to objective differences in chair layout. Under free exploration, however, the superior chair received less favourable evaluations than the inferior one, i.e., perceived sitting comfort and ergonomic chair layout were inversely related. The simple main effect of exploration for the inferior chair was significant, $t(23) = 2.2$; $p < .05$. Thus participants were misled by their intuitive impressions, since the inferior chair received better evaluations under free exploration than under guided exploration. Surprisingly, guided exploration, which in fact led to a more precise perception, was not rated as a more useful tool for reaching final evaluations of sitting comfort than free exploration, 3.4 and 3.1; $F(1, 46) = 0.76$.

Single feature evaluations (not available in the free exploration condition) were submitted to 2 × 4 factorial multivariate analyses of variance (MANOVA) with the ergonomic layout of the chair (inferior, superior) and four guided exploration conditions as independent variables. One MANOVA was carried out with three measures that referred to the objectively different features of the chairs (adjustment functions, body fit, and dynamic sitting). As expected, a significant multivariate main effect of ergonomic layout could be found, $p < .02$ for all criteria. The superior chair was more favourably evaluated with regard to adjustment functions, 2.2 versus 2.6, $F(1, 32) = 5.9$, $p < .05$; body fit of seat and back, 1.8 versus 2.8, $F(1, 32) = 8.5$, $p < .01$; and dynamic sitting, 1.9 versus 2.4, $F(1, 32) = 2.8$, $p < .10$, compared to the inferior chair. A MANOVA with evaluations of the objectively equal features of the chairs (rotation and movement, material, and colour and shape) revealed no significant effects. So, participants who were made aware of ergonomic features that differentiate between the two chairs perceived and evaluated these features accordingly. Indeed, under guided exploration, the multiple correlation between the evaluations of ergonomic features that differentiate between the chairs and the final evaluation of sitting comfort was $R = .82$, $F(3, 36) = 24.4$, $p < .001$, supporting this general notion.

With regard to various forms of guided exploration no significant effects were found. So, more extended oral or written instructions did not lead to a more adequate perception and evaluation of the superior or inferior chair layout.

4. DISCUSSION

Bringing ergonomic features of office chairs to the attention of participants and instructing them how to develop the sensory input provided by these features seemed to help participants recognize the objective ergonomic chair layout and evaluate it accordingly. This also led to perceptions of overall sitting comfort that were in line with the genuine ergonomic layout of the chairs. The obtained evidence lends support to the notion that under conditions of instructed sensory awareness, subjective evaluations of sitting comfort will be objectively accurate, at least more accurate than the results of previous studies have shown [7, 8, 10].

The different forms of guided exploration (oral, written, extensive, reduced) did not influence either the evaluation of ergonomic features or the perception and overall evaluation of sitting comfort. So, it seemed to be guided exploration per se which induced the more developed information processing and enabled the participants to evaluate ergonomic office chairs more objectively. Free exploration (no instruction), in contrast, provoked biased evaluations. Under free exploration, participants did not take more than 3–4 min before reaching an overall evaluation of the chair. Without guided exploration the perception of sitting comfort might have been based on only superficial impressions that misled participants in a way to evaluate the inferior chair as even better than the superior chair. This result is difficult to explain and needs further investigation. Possibly, a positive visual perception of the inferior chair may have superimposed perceptions of ergonomic features made later on. According to current research, even a short exposure to visual stimuli could lead to judgments of beauty and appealing appearance [15] which in turn influences the way products in total are evaluated [16].

Thus guided exploration per se is an effective device to ensure a more appropriate perception of ergonomic features, and ultimately, evaluation of sitting comfort. It remains an open question, which specific aspects of guided exploration may contribute to making the evaluation process more accurate. It is possible that the extended focus of experiencing body sensations elicited by guided exploration makes a difference, irrespective of the kind and number of instructions [17]. On the other hand, it is also possible that simple awareness of various features made them considerable criteria. Future studies are needed to clarify this explanation.

Despite the open questions, the results of this present study have valuable practical implications since their consideration may prevent people and organizations from buying or choosing office chairs with ergonomic deficiencies [18]. Obviously, objective ergonomic features are hard to experience by a naïve user, even though they are important for health and well-being. This study shows that even simple instructions may sensitize people to consider ergonomics when exploring, evaluating and—ultimately—acquiring products.

REFERENCES

1. Müller GF. Sitzkomfort—Die Messung subjektiver Urteile über ergonomisch gestaltete Büroarbeitsstühle [Sitting comfort—measuring subjective evaluations of ergonomical office chairs]. Zentralblatt für Arbeitsmedizin und Arbeitsschutz. 1994; 44:270–6.
2. Legg SJ, Mackie HW, Millicich W. Evaluation of a prototype multi-posture office chair. Ergonomics. 2002;45:153–63.
3. Looze de MP, Kuijt-Evers LFM, van Dieen J. Sitting comfort and discomfort and the relationships with objective measures. Ergonomics. 2003;46:985–97.
4. Müller GF, Nachreiner F. Ergonomie von Büroarbeitsstühlen im Urteil von Benutzern [Ergonomics of office chairs]. Zeitschrift für Arbeitswissenschaft. 1991;445:99–105.
5. Müller GF, Nachreiner F. Der Büroarbeitsstuhl im subjektiven Urteil [The office chair in a subjective perspective]. Zeitschrift für Arbeitswissenschaft. 1994; 448:113–8.
6. Müller GF. Sinnesdominanz bei der Beurteilung ergonomisch gestalteter Bürodrehsessel [Sensory dominance and evaluation of ergonomical office chairs]. Zeitschrift für Arbeits- und Organisationspsychologie. 1992;36:177–83.
7. Müller GF. Personenspezifische Entscheidungspräferenzen und subjektive Urteile über ergonomische Büroarbeitsstühle [Person-specific decision preferences and subjective evaluations of ergonomical office chairs]. ABOaktuell. 1996;3:7–11.
8. Corlett EN. Background to sitting at work: research-based requirements for the design of work seats. Ergonomics. 2006;14:1538–46.
9. Ebe K, Griffin MJ. Qualitative models of seat discomfort including static and dynamic factors. Ergonomics. 2000; 43: 771–90.
10. Ziefle M. Sitting posture, postural discomfort, and visual performance: a critical view on the interdependence of cognitive and anthropometric factors in the VDU workplace. International Journal of Occupational Safety and Ergonomics (JOSE). 2003;9:495–506.
11. Shiffrin RM, Schneider W. Automatic and controlled processing revisited. Psychol Rev. 1984;91:269–76.
12. Yeung CWM, Wyer RS Jr. Affect, appraisal and consumer judgment. J Consum Res. 2004;31:412–24.
13. Tophoff M. Mindfulness-training: exploring personal change through sensory

awareness. Constructivism in the Human Sciences. 2004;9:43–52.

14. Stevens J. Intermediate statistics. A modern approach. Mahvah, NJ, USA: Erlbaum; 1999.
15. Lindgaard G, Fernandes G, Dudek C, Brown J. Attention web designers: you have 50 milliseconds to make a good first impression. Behav Inf Technol. 2006; 25:115–26.
16. Hassenzahl M. Aesthetics in interactive products: Correlates and consequences of beauty. In: Schifferstein HNJ, Hekkert P, editors. Product experience. Amsterdam, The Netherlands: Elsevier; 2008. p. 287–302.
17. Lowe R, Laeng-Gilliat S. Reclaiming vitality and presence. Berkeley, CA, USA: North Atlantic Books; 2007.
18. Müller GF. CHECK-BS—Diagnose- und Bewertungsleitfaden für Büroarbeitsstühle [CKECK-BS—Manual for the diagnosis and evaluation of office chairs] [unpublished technical report]. Landau, Germany: University of Koblenz-Landau at Landau, Psychology of Social and Work Behavior Unit; 2008.