IDENTIFICATION OF PREPONDERANT FACTORS FOR WORK-WEAR DESIGN

Sara Bragança[1], Miguel Carvalho[1], Pedro Arezes[1], Susan Ashdown[2]; Liliana Fontes[1]

[1] *University of Minho, Guimarães, Portugal*

[2] *Cornell University, Ithaca, NY, USA*

(Presenting and Corresponding author E-mail: saraabraganca@gmail.com)

ABSTRACT

The work garments' fit is one factor that highly impacts on workers' productivity and on their feeling of comfort. Work-wear may have some limitation, e.g. mobility, protection, temperature, aesthetics, comfort and fit. Moreover, as the variation of the human size and shape is so large it is extremely difficult to design clothes that can accommodate a large variety of people. The purpose of this paper is to present some important aspects that should be taken in consideration when designing clothes to be used at work. All information was gathered using a questionnaire, to understand how the participants feel about the clothes they usually wear at work and to identify what changes should be made to make it more comfortable – e.g. increase in the leg length. The results obtained show that there is more dissatisfaction towards the lower part of the garment. There are some issues that prompt discomfort such as the excessive leg length or the tightness of the garment.

Keywords: work-wear; fit; opinions

INTRODUCTION

Clothes are designed to fit people within a range of dimensions and general body types. But, clothing size and fit are concepts very difficult to quantify and analyze because the relationship between the human body and the clothing is complex and often ambiguous (Parkinson & Reed, 2010; Loker, Ashdown, & Schoenfelder, 2005). As such, to understand the relationship between garments and the human body there is a need to analyze many complex factors. Every person has a specific apparel fit preference based upon aesthetic and functional expectations and regardless of what is imposed by the designer, ultimately the decision of what constitutes good fit is made by each individual (Ashdown & Delong, 1995).

Currently, different brands use different base measurements and provide different size numbers, with different steps between sizes. Moreover, individual firms, which use identical base sizes to define their models, interpret the standards that define garment sizing as they wish, causing the same size to be different in every store (Gupta et al., 2014; Loker et al., 2005). Ashdown, Loker, Rucker and Davis (2007) make some comments on the fact that the lack of a good fit is the main reason why many consumers do not purchase clothing at ready-to-wear stores and the cause of many returns in purchases via catalogs. In some extreme cases, garment fit is of the outmost importance, determining even the safety and performance at work, whether it is regarding loose clothes that can get caught in machinery and cause accidents

or regarding tight or smaller clothes that can restrict the range of movements and the blood circulation. Ideally clothing must have sufficient ease or enough elasticity, not being too loose or too tight, allowing the worker to move uninhibited and to be comfortable (Dorman & Havenith, 2007). In any of those cases the wearer's mobility and the level of protection provided by the garment can be adversely affected (Rintamaki, 2005; Huck, Maganga, & Kim, 1997). The clothes worn must allow users to perform their tasks without any impedance or restriction (Bragança et al., 2015). According to Man and Swan (2007), in order to make the design process easier, designers should have a modeling tool that can evaluate different designs and quantify the impact that they have on human performance.

This paper aims at understanding the opinions of workers from different types of environments about the clothes they wear during the labor time. Additionally, they were also questioned about what they think that should be changed to proportionate more satisfaction and comfort.

MATERIALS AND EXPERIMENTAL METHODS

This study was based on the opinions of fifty participants, that were divided in two groups. Group 1 (G1) was composed by 30 participants, 12 females and 18 males, with ages ranging from 20 to 62 years old. These participants worked in three different companies/institutions – one research centre, one software development company and one university. They were grouped together since they had very similar work characteristics and worked 8 hour in a sitting position, with some occasional standing. This group of workers are free to wear clothes of their choosing as long as they followed the appropriate dress code instituted at the institutions/company. Group 2 (G2) was composed by 20 participants (all males) with ages ranging from 24 to 59 years old. These participants worked in an industrial company. All these participants work in the day shift for 8h with a standing posture with some movement. This group wear the company's uniform that consists of a cotton t-shirt, a pair of loose pants and a jacket.

The data for the evaluation of the workers' satisfaction with their work-clothes and the identification of garments' characteristics was done using a questionnaire. The first stage of the questionnaire was based on Likert-type scale questions regarding five different aspects: (i) fit; (ii) mobility; (iii) comfort; (iv) protection; and (v) donning/doffing. The second stage included an open-ended style questionnaire where the participants were able to freely describe their suggestions and opinions, without being limited to standardized categories.

The analysis of the questionnaire was performed for its five parts individually. In all of the parts it was made a comparison between the two groups of participants analysed. In the analysis of all the questionnaire parts, except part I regarding the garments' fit, the data was divided in four categories – the upper and lower parts of the garments for G1 and for G2. The analysis contained information about the characteristics that have been ranked the best and the worst, on average, for both participants' groups. Additionally, the percentage of people dissatisfied with all the characteristics presented in the questionnaire was also quantified.

RESULTS

Stage One – Part I – Fit

The results of the questionnaire showed that, in general, people feel more dissatisfied with the fit of garments for the lower body rather than the fit of garments for the upper body. The best and worst classifications for each group and each part are presented in Table 1 (the mean of the classifications attributed by the participants is in parenthesis). The classification is based on the obtained score by using a scale from 1 (worst fit) to 9 (best fit).

Table 1. Body parts with the best and worst classification in terms of fit.

Body part group	G1 Better	G1 Worst	G2 Better	G2 Worst
Lower part	Ankle (7.2)	Leg length (5.2)	Ankle (6.7)	Leg length (5.5)
Upper part	Arm length (7.2)	Chest (6.6)	Arm + Forearm (7.1)	Abdomen (6.5)

The best and worst classifications for the lower part were attributed to the same body parts by both groups – ankle and leg length, respectively. As for the upper part, the opinions between the groups are divergent. In terms of dissatisfaction, Figure 1 shows the percentage of people dissatisfied for each body part, divided in the two groups under analysis.

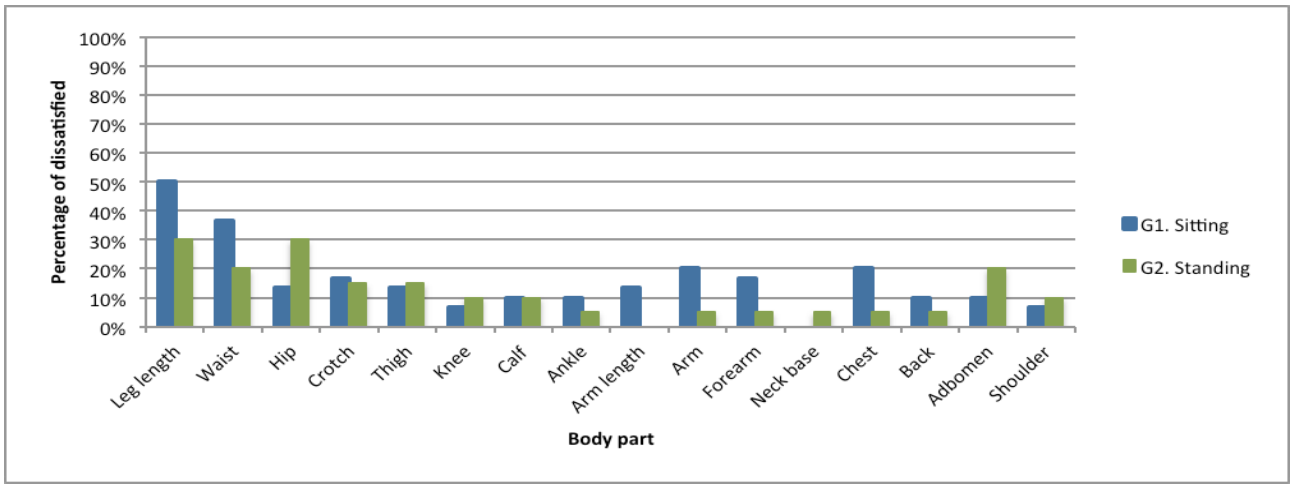

Figure 1. Percentage of dissatisfaction with the garment's fit.

It is clear that for both groups the leg length is a big problem, with 50% and 30% of people dissatisfied for G1 and G2 respectively. The fit in the waist is not very good for 36.67% of the G1 population whilst for 30% of G2, the fit in the hip is not pleasing. On the other hand, for G1, the body parts with a smaller percentage of dissatisfied are the knee, with 6,67% of people displeased, the calf and ankle, both with 10% of people dissatisfied. For G2, the ankle is the body part with fewest people dissatisfied (5%). In the garments for the upper body, the regions more problematic are the arm and chest for G1 (with 20% of people dissatisfied) and the abdomen for G2 (also with 20% of people dissatisfied). The neck base and arm length are the only body parts that do not have any people dissatisfied with, for G1 and G2 respectively.

Stage One – Part II – Mobility

In terms of mobility, the dissatisfaction is also more accentuated in the garments for the lower body. The best and worst classifications for each group and each part are

presented in Table 2 (the mean of the classifications attributed by the participants is in parenthesis). The classification is based on the obtained score by using a scale from 1 (worst sensation of mobility) to 9 (best sensation of mobility).

Table 2. Best and worst classification in terms of sensation of mobility.

Body part group	G1 Better	G1 Worst	G2 Better	G2 Worst
Lower part	Toughness (6.3)	Tightness (5.4)	Discomfort (5.6)	Toughness (5.2)
Upper part	Discomfort (7.2)	Tightness (6.2)	Limitation of movements (6.9)	Discomfort (6.3)

Surprisingly, the characteristic better ranked for group 1 was the one with the worst score for group 2 – rigidity. As observed in part I, the opinions between the two groups are a little bit different. Regarding dissatisfaction, Figure 2 depicts the percentage of users dissatisfied for each body part, divided in the two groups under analysis.

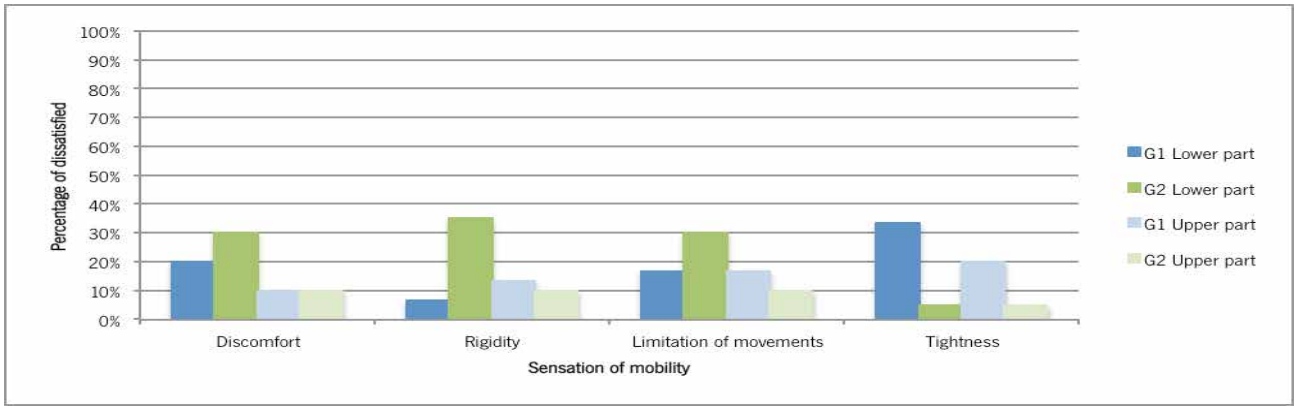

Figure 2. Percentage of dissatisfaction with the garment's sensation of mobility.

Tightness of the garments for the lower body is the main characteristic that causes dissatisfaction for G1 (with 33.33% of people dissatisfied), whilst for G2 the most troublesome characteristic of the garments for the lower body is the rigidity (35%). On the other hand, the rigidity of the garments for the lower body is the characteristic that has the lowest percentage of dissatisfied in G1 (with 6.67% of people dissatisfied) and the tightness of the garments for the lower body is the characteristic that has the lowest percentage of dissatisfied in G2 (with 5% of people dissatisfied). Regarding the garments for the upper body, the feeling of dissatisfaction is more balanced. 5% of G2 feel discontent with the tightness of the garments for the upper body. All other characteristics elicited only 10% of dissatisfaction. In G1, the worst result was found for the limitation of movements caused by the garment.

Stage One – Part III – Comfort

In general, the great majority of people showed some dissatisfaction towards their garments, both for the lower and upper parts of the body, in situation of cool or warmth.

The best and worst classifications for each group and each part are presented in Table 3 (in parenthesis is the mean of the classifications attributed by the participants). The classification is based on the obtained score by using a scale from 1 (worst sensation of comfort) to 5 (best sensation of comfort).

Table 3. Best and worst classification in terms of sensation of comfort.

Body part group	G1 Better	G1 Worst	G2 Better	G2 Worst
Lower part	Itchy sensation (1.6)	Cool sensation + Skin irritation/ redness (2.7)	Skin dryness (2)	Warmth sensation (3)
Upper part	Itchy sensation + Skin dryness (1.5)	Cool sensation + Warmth sensation (2.5)	Itchy sensation (2.1)	Warmth sensation + Skin dryness (2.7)

Controversially, G1 indicates the cool sensation as the worst characteristic in terms of comfort, both in the lower and upper parts of the garment, whilst G2 specifies the warmth sensation as the worst characteristic. Regarding the dissatisfaction, Figure 3 depicts the percentage of users dissatisfied for each body part, divided in the two groups under analysis.

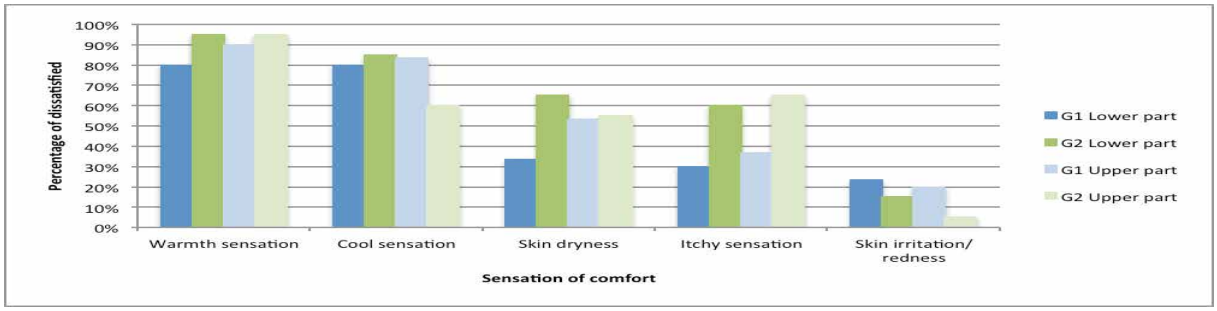

Figure 3. Percentage of dissatisfaction with the garment's sensation of comfort.

Warmth and cool sensations were identified as the main causes of dissatisfaction in both groups and in both parts of the garment, with about 90% of people dissatisfied. The remaining characteristics have less people dissatisfied in the upper and lower parts. Skin irritation and redness was the characteristic with less people dissatisfied in both groups and in both parts of the garment, with only about 15% of people dissatisfied.

Stage One – Part IV – Protection

In terms of protection, in contrast to what happens in the other parts, people are more dissatisfied with the garments for the upper body, especially when it comes to ruptures caused by objects. Figure 4 depicts the percentage of users dissatisfied for each body part, divided in the two groups under analysis.

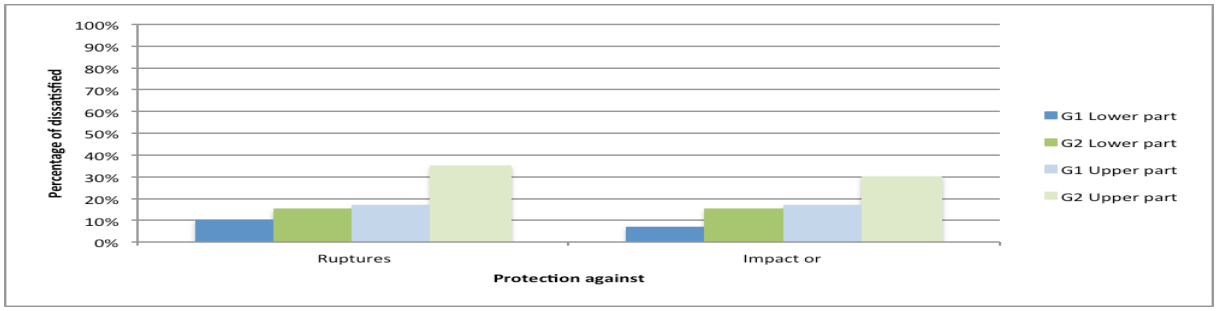

Figure 4. Percentage of dissatisfaction with the garment's ability of protection.

The protection category is the one in the entire questionnaire with the fewest dissatisfied people. The largest percentage of dissatisfaction was registered for the inability of the garment to protect against ruptures in the upper part, especially for G2, with 35% of people dissatisfied.

Stage One – Part V – Donning/Doffing

As observed in part IV, regarding protection, this part was also one where better satisfaction was registered. In general, people feel more dissatisfied with the donning, rather than the doffing of the garments. In both situations the garments made for the upper body are more favorably.

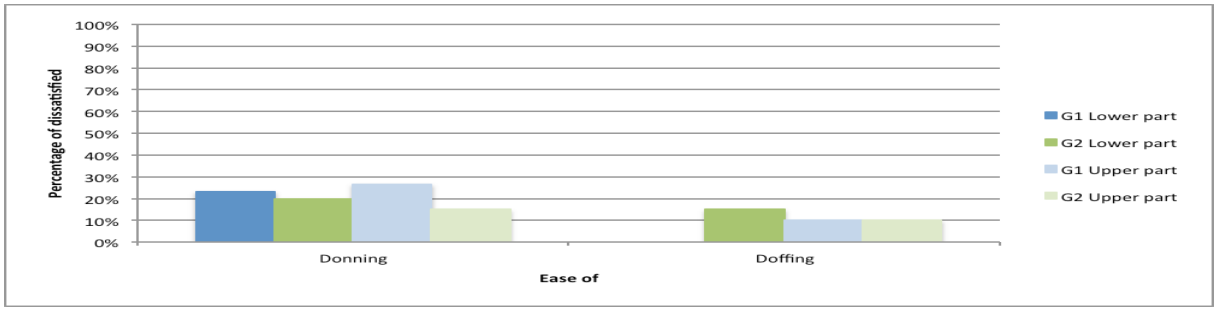

Figure 5. Percentage of dissatisfaction with the garment's ease of donning and doffing.

Figure 5 depicts the percentage of users dissatisfied for each body part, divided in the two groups under analysis. Here it is possible to see that the highest value of dissatisfied people was 26.67% for the donning of garments for the lower body in G1. On the other hand, the doffing had a small percentage of dissatisfaction, even 0% for garments for the lower body in G1.

Stage Two – Open-end questions

The open-end questions revealed that both groups have similar opinions in many aspects concerning their work outfits. Table 35 shows a summary of the several answers given by the participants for the most relevant questions.

Table 4. Results of the open-end questions.

Questions regarding	General participants' answers
Alterations on fit	Collar; Waist; Hip; Thighs; Knees; Crotch; Legs; Leg length Flexibility
Alterations on comfort	Waist; Hip Rigidity; Roominess Fabric
Areas causing limitations	Sleeves; Armholes; Shoulders; Chest; Back; Waist; Hip; Thighs; Calf; Knees; Crotch; Legs
Better protection against	Cool; Heat; Cuts
Best features	Aesthetics; Comfort; Donning; Flexibility; Maintenance; Practicality; Quality
Worst features	Comfort; Donning; Durability; Modeling; Quality; Thickness; Rigidity

It should be noted that the protection against cold and heat were the answers more constantly given by the majority of the participants, regardless of their group. Participants from G1 tended to point out areas of dissatisfaction more related to garments for the upper body, whilst participants from G2 point out more areas from garments for the lower body. However, for both groups there were displeasing aspects in both garments, for the upper and for the lower body. As can be seen, the areas that were pointed out as in need for alterations of fit are also the ones presented as causes of limitations. In terms of fit and comfort, the participants demonstrated that the pants were the garments that need more changes. For G2, the explanation for

this is obvious, since they wear a loose cotton t-shirt in the upper part of the body, that does not cause any limitations of movements or any discomfort due to tightness. As in G1, the participants are free to choose their clothes, thus it is normal that they select the ones that fit them better. Nevertheless, sometimes this choice compromises the range of movements, reason why the sleeves, shoulders, chest and back areas were presented as causes of some limitations.

Some of the best features reported by the participants were the aesthetics, flexibility ease of maintenance, and practicality. As opinions vary from person to person, there are some features that were registered good and bad, such as the comfort or the lack of it; the process of donning, that can be easy or not; and the quality of the products or the lack of it. All of these features are subject to a subjective perspective of the wearer, which is based on his/her preferences and lifestyle. The other features that participants tended to dislike more were the low durability of the clothes or some areas of it; the poor fit of some designs; and the thickness and rigidity of some fabrics and seams.

CONCLUSIONS

Clothing design for mass consumption is done in order to accommodate a large variety of people in the same size. This may lead to problems in terms of fit for some users, since two persons with distinct body types and sizes can wear the exact same size. In this study, the leg length was pointed out as the most problematic area regarding fit. As the garments that both groups analyzed are ready to wear, and not customized, it is normal that to fit a particular user well some changes need to be made. However, most people do not want to take the time or the effort to make alterations to their clothes. Nevertheless, in some cases these alterations are crucial for comfort and safety, as the case of leg length, which if very long can cause accidents and discomfort.

The questionnaire showed that G1 feels, in general, more dissatisfied with their garments. The fact that people in G2 have no other option rather than to accept the garments they are provided with, may also contribute to the higher classifications. In the moment of decision of whether to buy the garments or not, people in G1 are able to select models that fit them better and are aesthetically pleasing at the same time. Obviously, G1 tends to choose a more fashionable and close-fitting type of clothes, while the garments worn by G2 are looser and not very fashionable. This is the reason why the tightness of the clothes is not pinpointed as troublesome for G2 as for G1, where the tightness of both the upper and lower parts of the garment are poorly classified.

Additionally, the G2's garments are exactly the same that the rest of the workers wear in other parts of the world where the company is based. This fact may lead to many problems in fit since the design is not population-specific, but meant to a population that is considerably larger than the one studied here, as the cloth was originally designed for the German population. As reported, the fact that the clothes of G2 are fairly loose and very tough causes a lot of discomfort and limitation of movements. Opposing of what might be though to limit the range of motion, i.e., tight clothes, it is clear here that the combination of loose and tough garments is the cause of much dissatisfaction and discomfort amongst workers.

In the modern society people tend to care more about the appearance, where clothes play an important role. People from G1 seem to represent well this paradigm; it is clear that they sometimes compromise comfort over fit and aesthetics. Fashion trends and the dress codes imposed in many workplaces make people wear garments that are sometimes limitative, whether it is of movement (caused by the tightness of the clothes) or of acclimatization (caused by wearing clothes more pleasing than functional). The materials of which the garments are made of also play a very important role in the sense of satisfaction of its users. As previously mentioned, the greatest advantage that G1 has over G2 is the possibility to choose the clothes to wear during the working period, allowing the selection to be based on several aspects crucial to the users' satisfaction. The inability to choose what makes them satisfied is the main reason why most of the garments' characteristics regarding the sensation of comfort have more people dissatisfied in G2 than in G1.

It is clear that the two work environments represented in this study are very different and that what one group values the most is not necessarily the same as the other group. Taking the example of the garments' protection against ruptures or impact, it is obvious that this is much more of a concern to G2 (causing an increased dissatisfaction) than to G1, where people do not have many problems of this nature in their everyday activities. For the users of G2 the garments capacity of protection is of extreme importance, putting at risk their safety when poorly designed.

The last characteristic analyzed in the questionnaire, regarding the donning and doffing of the garments is sometimes neglected by designers, which create clothes aesthetically pleasing but not very practical to put on and to take off. However, for people who have to change from their regular clothes to the work clothes, it is important that the process of donning and doffing is simple, quick and efficient. Having this is mind it is possible to say that aspects like good fit, good modeling and high flexibility, combined with fabrics that protect users against adverse temperatures, should be better thought out and not forgotten when designing clothes that are meant to the workplace.

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