Metadata of the chapter that will be visualized in SpringerLink

Book Title	Advances in Design for Inclusion	
Series Title		
Chapter Title	Sports-Wear in Wheelchair Rugby: Establishing Design Needs	
Copyright Year	2018	
Copyright HolderName	Springer International Publishing AG	
Corresponding Author	Family Name	**Braganca**
	Particle	
	Given Name	**Sara**
	Prefix	
	Suffix	
	Division	
	Organization	Southampton Solent University
	Address	Southampton, UK
	Email	sara.braganca@solent.ac.uk
Author	Family Name	**Steele**
	Particle	
	Given Name	**James**
	Prefix	
	Suffix	
	Division	
	Organization	Southampton Solent University
	Address	Southampton, UK
	Email	james.steele@solent.ac.uk
Author	Family Name	**Gill**
	Particle	
	Given Name	**Simeon**
	Prefix	
	Suffix	
	Division	
	Organization	University of Manchester
	Address	Manchester, UK
	Email	simeon.gill@manchester.ac.uk
Author	Family Name	**Carvalho**
	Particle	
	Given Name	**Miguel**
	Prefix	
	Suffix	
	Division	
	Organization	University of Minho
	Address	Guimaraes, Portugal

	Email	migcar@det.uminho.pt
Author	Family Name	**Arezes**
	Particle	
	Given Name	**Pedro**
	Prefix	
	Suffix	
	Division	
	Organization	University of Minho
	Address	Guimaraes, Portugal
	Email	parezes@dps.uminho.pt

Abstract	This paper reports the findings of a preliminary study that intended to understand how wheelchair rugby athletes feel about the clothing they wear while playing the sport and how the available clothes make them feel. 61 non-professional wheelchair rugby players from 21 different teams/clubs in the United Kingdom participated in this study. To understand the players' opinions, this study consisted of a mixed-method approach, with data collected through a focus group and a questionnaire. The results show that, on top of the lack of availability of sports-wear for this specific sport, which compromises the athletes' satisfaction, comfort and performance, there is also a need on the part of the athletes for this type of specialized equipment. This study showed that there is a need for this type of sports-wear, hence the importance to act and develop more specialized garments to satisfy this population not just in terms of safety, comfort and performance but also in terms of inclusivity.

Keywords (separated by '-')	Sports-wear - Wheelchair rugby - Inclusivity - Inclusive design

Sports-Wear in Wheelchair Rugby: Establishing Design Needs

Sara Braganca[1(✉)], James Steele[1], Simeon Gill[2], Miguel Carvalho[3], and Pedro Arezes[3]

[1] Southampton Solent University, Southampton, UK
{sara.braganca,james.steele}@solent.ac.uk
[2] University of Manchester, Manchester, UK
simeon.gill@manchester.ac.uk
[3] University of Minho, Guimaraes, Portugal
migcar@det.uminho.pt, parezes@dps.uminho.pt

Abstract. This paper reports the findings of a preliminary study that intended to understand how wheelchair rugby athletes feel about the clothing they wear while playing the sport and how the available clothes make them feel. 61 non-professional wheelchair rugby players from 21 different teams/clubs in the United Kingdom participated in this study. To understand the players' opinions, this study consisted of a mixed-method approach, with data collected through a focus group and a questionnaire. The results show that, on top of the lack of availability of sports-wear for this specific sport, which compromises the athletes' satisfaction, comfort and performance, there is also a need on the part of the athletes for this type of specialized equipment. This study showed that there is a need for this type of sports-wear, hence the importance to act and develop more specialized garments to satisfy this population not just in terms of safety, comfort and performance but also in terms of inclusivity.

Keywords: Sports-wear · Wheelchair rugby · Inclusivity · Inclusive design

1 Introduction

To achieve optimum performance, clothes should be designed and adapted with clear consideration of the wearers' functional and performance needs. However, this can only happen if the specific body characteristics and the several dynamic postures adopted during the day are considered [1]. Moreover, the process of designing clothes should imply the use of population-specific anthropometric data and respond to users' requirements and needs. However, there are many cases where this does not occur.

Wheelchair users are one of these populations that are neglected due to a lack of specific data. Consequently, the clothes they use are often designed using measurement of the able-bodied in the sitting position which, according to [2], are significantly different. There are even worst cases where the clothes are designed using measurements obtained from the standing position. As a result, many clothes do not to fit these specific users properly, as they do not fit into the existing size systems due to the differences in

G. Di Bucchianico and P.F. Kercher (eds.), *Advances in Design for Inclusion*,
Advances in Intelligent Systems and Computing 587, DOI 10.1007/978-3-319-60597-5_36

their body shape and size [3]. As such, many wheelchair users consider that obtaining suitable clothing is a very difficult task [4].

This mismatch is especially problematic for this population compared to others due to the psychological effects of clothing. Some studies show that wheelchair users do not want to wear a garment that highlights their condition – a reason why most of them prefer to adapt common clothing pieces rather that purchase purpose-specific ones [5].

Wheelchair users have special requirements that common clothing does not satisfy (e.g. pressure points, temperature and humidity control). Nonetheless, the clothing items for this population should also be aesthetically pleasing, comfortable to wear (in all its variables), practical, and easy to put on and take off [6]. It is very important that clothes do not cause pain or discomfort by being too loose or too tight or by not correctly fitting some parts of the body. To design clothing that fits the users' specific requirements there are many variables that should be considered, such as fabric, function, sensorial comfort, performance expectations and ease determination [7].

These principles should be applied not only to everyday clothing, they are also crucial in sports-wear, as safety and performance are key issues that might be affected with inappropriate designs.

This paper reports the findings of a preliminary study that intended to understand how wheelchair rugby athletes feel about the clothing they wear while playing the sport. This study is part of an ongoing larger project focused on inclusive fashion. For this study, a questionnaire was completed by a sample of 61 non-professional wheelchair rugby players from 21 different teams/clubs in the United Kingdom. The responses were used to assess the satisfaction of the players towards the items of sports-wear they currently use during training and competition of wheelchair rugby as well as to identify current problems with the sports-wear and possible solutions that would satisfy the users' needs.

2 Methodology

61 non-professional wheelchair rugby athletes (which represents approximately 27% of the entire population [8], from 21 different teams/clubs in the United Kingdom, participated in this study. The participants had different types of impairments that conditioned

Table 1. Characterization of the sample.

Variable	Categories	N	%
Frequency in each age group	18–30	23	37.7%
	31–40	12	19.7%
	41–50	17	27.9%
	51–60	7	11.5%
	60+	2	3.3%
Gender	Male	54	88.5%
	Female	7	11.5%
Time since start of playing wheelchair rugby	Minimum	2 months	–
	Maximum	33 years	–

them to use a wheelchair, such as amputation, brain injury, multiple sclerosis and spinal cord injury. Table 1 shows some characteristics of this sample, such as the distribution of age, gender and years playing the sport.

This study consisted of a mixed-method approach, where the data was collected by a focus group and a questionnaire. The focus group was a preliminary study that served not only as a first source of valuable information, but also as a basis to later develop the questionnaire. Both these data collection methodologies were used to assess the satisfaction of the players towards the items of sports-wear they use during training and competition of wheelchair rugby.

The focus group took place prior to the questionnaire to provide an overview of the current situation regarding clothing faced by sports-wear wheelchair rugby players'. It was conducted at the host university, where one of the researchers involved in the project moderated the session. The session was recorded on video, to which the participants agree upon by signing a consent form for video recording. Additionally, all the participants also signed a consent form that stated they agreed to participate in the study.

The questionnaire followed the focus group, which was specifically designed for this project. The questions were developed on the basis of the focus group but also based on topics identified in the literature (based on questionnaires employed in past relevant studies – [9–13] and on discussions between the partners of this project. This questionnaire was answered anonymously and included diverse types of questions – demographic, dichotomous, multiple choice, and open-ended questions – that intended to represent, in the best way possible, the opinions of the players regarding the items of sports-wear they usually use.

Many questions used subjective rating scales so that the players could manifest their satisfaction/dissatisfaction with the sports-wear. However, and most importantly, there were many open-ended questions, to leave space for the players to freely describe the specific items of sports-wear, or their characteristics, they are (di)satisfied with and the issues they would like to change.

The results were analyzed in terms of frequency and distribution of the answers between the different categories. Additionally, some statistical tests were performed using the SPSS software. To verify if the levels of satisfaction with the sports-wear were related to aspects such as age, gender and the number of years playing the sport, the nonparametric Spearman correlation was used. Prior to using this correlation test, a normality test was conducted using the Kolmogorov-Smirnov test.

3 Results and Discussion

The results of the questionnaire showed that most athletes are fairly satisfied with the sports-wear they are currently using. However, 10% of the athletes revealed that they are not very satisfied or even very unsatisfied with their current sports-wear. Figure 1 shows the distribution of the results regarding the users' satisfaction.

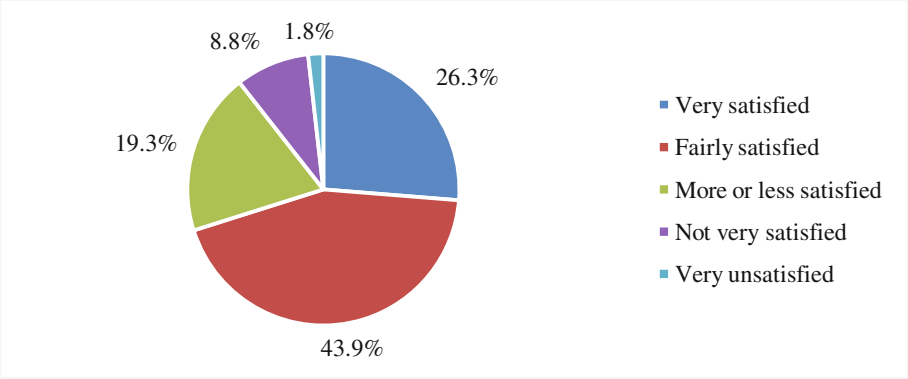

Fig. 1. Athletes' satisfaction with sports-wear while playing.

At a first glance, this 10% might seem a very small percentage of dissatisfied people. This first question was in conflict with later responses, where participants gave more nuanced details of areas of dissatisfaction. The subsequent questions showed that most athletes find problems with the sports-wear and areas that need significant improvements, especially considering fit experiences that may have wider implications. It is possible that the dissatisfaction was not a consideration, as the athletes did not see an immediate remedy to the problem. Possibly, if asked again the same question at the end of the questionnaire the answers would be different.

According to the Kolmogorov-Smirnov test, all variables are abnormal (Table 2), so the correlation test to be used in order to evaluate the correlation between the level of satisfaction and the other variables (age, gender and the number of years playing the sport) is the nonparametric Spearman's correlation coefficient.

Table 2. Results of the Kolmogorov-Smirnov test.

	Statistic	df	Sig.
Age	0.229	61	0.000
Gender	0.525	61	0.000
Years playing	0.258	60	0.000
Level of satisfaction	0.266	57	0.000

When correlated with age, gender and year playing the sport, the level of satisfaction had no significant correlation (Table 3). This indicates that there are other factors, such as personal feelings, that affect how people generally feel about their sports-wear.

Table 3. Results of the Spearman correlation.

		Age	Gender	Years playing
Level of satisfaction	Correlation coefficient	0.018	0.217	-0.137
	Sig. (2-tailed)	0.894	0.105	0.315
	N	57	57	56

In more detail, the athletes that stated they were not very satisfied with their sports-wear revealed what are their main causes of dissatisfaction (Fig. 2). Accordingly, the most common cause of dissatisfaction was the fit of the clothes, followed by the ability to maintain a good temperature and the comfort felt.

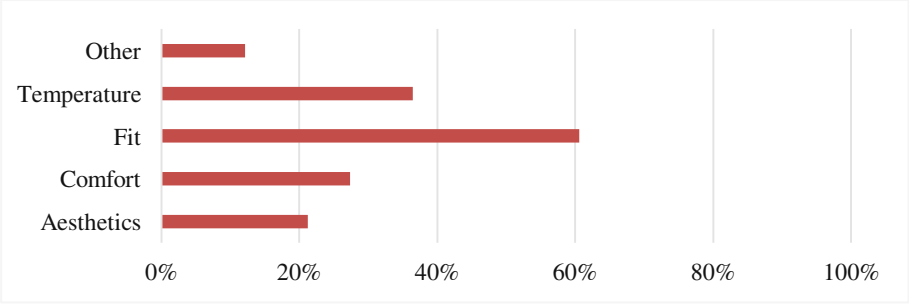

Fig. 2. Main causes of dissatisfaction with sports-wear while playing.

As discussed by many authors, it is very difficult for clothes designed for able-bodied people to fit wheelchair users properly. This thesis is proven here once again as the issue that most dissatisfies users is the fit. This poor fit also affects the comfort felt by the athletes as well as the aesthetics.

Wheelchair users have more difficulties in maintaining the core and skin temperature than able-bodied people. Hence, if they wear clothes that are not designed taking this in consideration (by using special fabrics or pattern designs) the task of maintaining the body's temperature is more troublesome.

Apart from these pre-identified causes of dissatisfaction some athletes also mentioned other causes that make them feel unsatisfied, such as:

- the availability of clothes for the sport;
- the ease of putting on and taking off the clothes;
- the materials that constitute the clothes;
- the impact the clothes have on performance.

Regarding the specific items of sports-wear athletes usually use, this questionnaire showed that what causes the most dissatisfaction are the gloves. This was followed by the trousers and sleeveless tops and vests. Figure 3 shows the distribution of these results.

In the focus group conducted prior to the questionnaire the problems with the gloves were also much highlighted. There are no specific gloves for this sport, so the athletes must use alternatives that are not purpose-specific. Some players even mentioned they use gardening or industrial gloves. As they are not appropriate for the sport, athletes must alter the gloves to make them more suitable – they add adhesive tape to ensure the gloves do not come off while moving the wheelchair or while catching the ball; they add a type of resin to enhance the grip.

The trousers were also pointed out multiple times as a problem during the focus group, especially for two main reasons: (i) they tend to get caught on the wheels of the

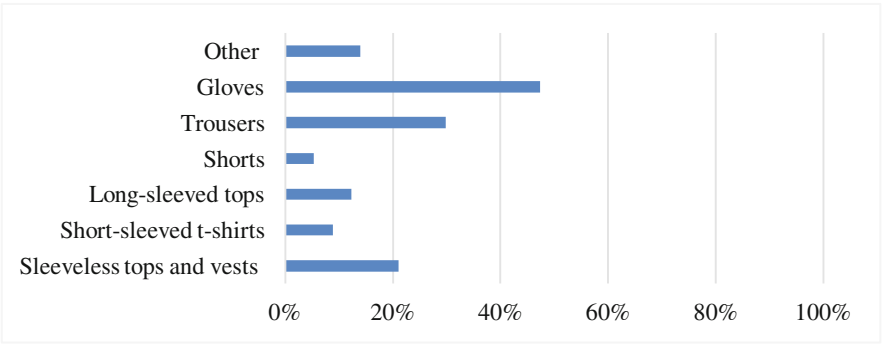

Fig. 3. Items of sports-wear that cause the most dissatisfaction and need the most improvements.

chair, compromising safety and performance; (ii) they do not fit the users properly, exposing their lower back area and compromising comfort.

When questioned about the acts of choosing and buying sports-wear for playing wheelchair rugby, the athletes demonstrated that they value different characteristics for each part of the garment. Figure 4 shows the distribution of these results.

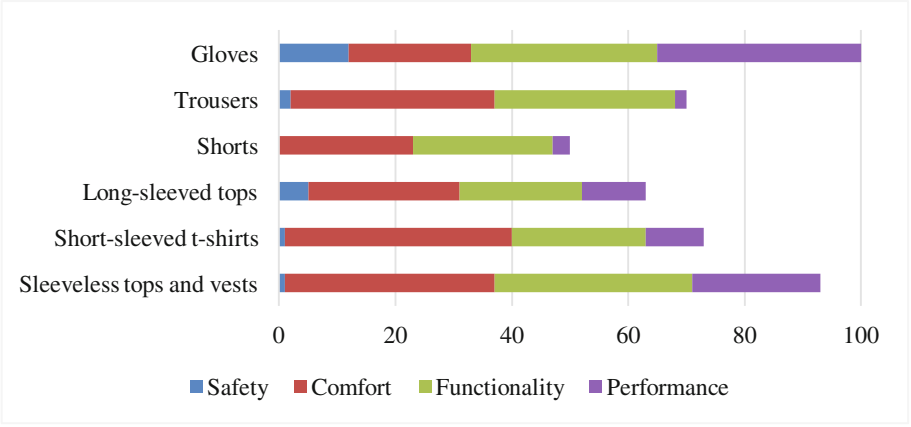

Fig. 4. Aspects considered when buying sports-wear for each garment.

Comfort is the most important aspect of all for every part of the garment. Opposite to that is safety, which apparently is the least important feature athletes look for in clothing. Hand in hand with comfort comes the functionality, which is a characteristic also regarded as very important when making the decision to purchase a garment. Performance has been ranked as somewhat important for the majority of the garments. However, when looking for gloves the athletes prefer options that ensure performance above all the rest. The findings withdrawn from this question are aligned with the results of previous questions, which showed that the gloves, sleeveless tops and vest, and trousers are the most critical parts of the sports-wear.

This questionnaire served also to confirm that the sports-wear stores do not offer a wide variety of garments specific for wheelchair users. When asked about their feelings towards this situation, most athletes stated that it has a negative impact on them. Examples of some expressions used by the athletes are presented in Table 4.

Table 4. Expressions used by the athletes to demonstrate how they feel on the lack of available sports-wear for wheelchair users.

Words	Sentences
"Annoyed" "Disappointed" "Frustrated" "Inconvenient" "Marginalized" "Segregated" "Unhappy"	"It makes me feel sad because you could be stopped for doing sport because you cannot get the equipment you need from sports-wear shops" "Like I am being penalized for not fitting the normal clothing style" "Under appreciated as an athlete"

When looking at this problem in more detail, it was possible to find the negative issues athletes encounter in the available ready-to-wear sports-wear (Fig. 5).

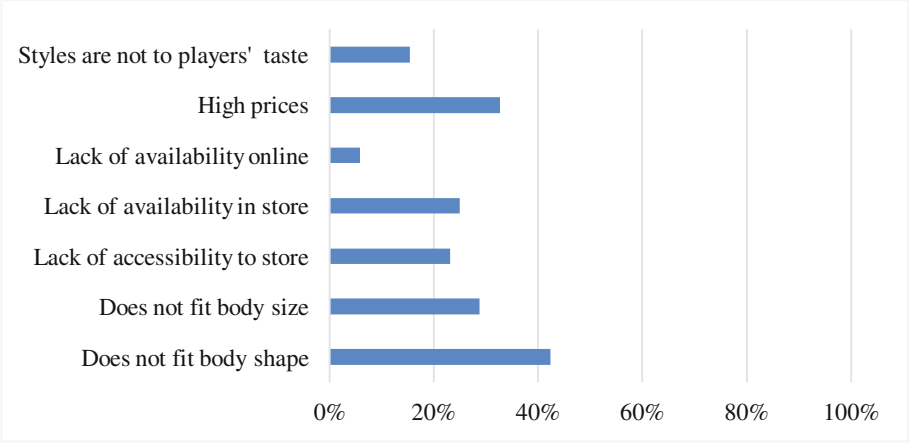

Fig. 5. Problems encountered with ready-to-wear sports-wear.

The most commonly encountered problem is that the ready-to-wear sports-wear does not fit the athletes' body shape. The inability of the garments to fit the body size was also pointed as problematic. Even if the garments are specifically designed for wheelchair users, the variety of different conditions make it almost impossible to fit everyone properly both in shape as in size. The high prices were also identified as a problem with the available options. As a niche market the prices of specialized sports-wear for wheelchair users tend to be higher than the products for the masses.

4 Conclusion

The information gathered in this study is very useful to view the world in the perspective of the people that are wheelchair-bound, to understand what they value the most in their sports-wear and what they would like to see improved.

The results of this preliminary study highlight the lack of availability of clothes designed specifically for wheelchair rugby. This situation not only compromises the athletes' satisfaction and comfort but also makes them feel neglected and not very included in the society.

The part of the garment that causes the most dissatisfaction are the gloves. The trousers and sleeveless tops and vest were also pointed out as being problematic but for different reasons. Hence, it became clear that there is a need to act to improving the athletes' performance and satisfaction.

As part of a larger ongoing project, this preliminary study gave a good overview on the aspects that need to be explored when designing sports-wear for wheelchair users. This information can be very relevant to foster a better inclusivity of wheelchair users in the society, by prompting performance, safety, and comfort.

Acknowledgments. The authors wish to acknowledge the commitment of the participants of this study. This study had the financial support of FCT - Fundação para a Ciência e a Tecnologia of Portugal under the projects UID/CEC/00319/2013 and UID/CTM/000264; and FEDER funds through the Competitive Factors Operational Program (COMPETE) POCI-01-0145-FEDER-007136

References

1. Bragança, S., Carvalho, M., Arezes, P., Ashdown, S.P.: Work-wear pattern design to accommodate different working postures. Int. J. Cloth. Sci. Technol. **29** (2017)
2. Kozey, J.W., Das, B.: Determination of the normal and maximum reach measures of adult wheelchair users. Int. J. Ind. Ergon. **33**, 205–213 (2004)
3. Thorén, M.: Systems approach to clothing for disabled users. Why is it difficult for disabled users to find suitable clothing. Appl. Ergon. **27**, 389–396 (1996)
4. Chang, W.-M., Zhao, Y.-X., Guo, R.-P., Wang, Q., Gu, X.-D.: Design and study of clothing structure for people with limb disabilities. J. Fiber Bioeng. Inform. **2**, 62–67 (2009)
5. Carvalho, M., Duarte, F., Heinrich, D., Woltz, S.: WeAdapt: inclusive clothing design proposal for product development. In: Include 2009 (2009)
6. Clulow, E.E.: Clothes for the handicapped. J. R. Coll. Gen. Pract. **24**, 362–366 (1974)
7. Gill, S., Prendergast, J.: garment fit and consumer perception of sportswear. In: Materials and Technology for Sportswear and Performance Apparel, pp. 245–260 (2015)
8. GBWR: Report & Consolidated Financial Statements 2015 – 2016 for the year ended 31 March 2016 Great Britain Wheelchair Rugby Limited (2016)
9. Wang, Y., Wu, D., Zhao, M., Li, J.: Evaluation on an ergonomic design of functional clothing for wheelchair users. Appl. Ergon. **45**, 550–555 (2014)
10. Howe, I.: Fashioning Identity: Inclusive Clothing Design and Spinal Cord Injury. University of Sydney (2012)

11. Wu, D.W., Wang, Y.Y., Li, J.: Design of functional daily wear for wheelchair users. Adv. Mater. Res. **332–334**, 458–461 (2011)
12. Çivitci, Ş.: An ergonomic garment design for elderly Turkish men. Appl. Ergon. **35**, 243–251 (2004)
13. Wu, S.K., Williams, T.: Factors influencing sport participation among athletes with spinal cord injury. Med. Sci. Sport. Exerc. **33**, 177–182 (2001)

MARKED PROOF

Please correct and return this set

Please use the proof correction marks shown below for all alterations and corrections. If you wish to return your proof by fax you should ensure that all amendments are written clearly in dark ink and are made well within the page margins.

Instruction to printer	*Textual mark*	*Marginal mark*
Leave unchanged	··· under matter to remain	New matter followed by ⌐ or ⌐(x2)
Insert in text the matter indicated in the margin	⌐	
Delete	/ through single character, rule or underline or ⊢⊣ through all characters to be deleted	⌐/ or ⌐/(x2)
Substitute character or substitute part of one or more word(s)	/ through letter or ⊢⊣ through characters	new character / or new characters /
Change to italics	— under matter to be changed	⌐
Change to capitals	≡ under matter to be changed	≡
Change to small capitals	= under matter to be changed	=
Change to bold type	~ under matter to be changed	~
Change to bold italic	≈ under matter to be changed	≈
Change to lower case	Encircle matter to be changed	≠
Change italic to upright type	(As above)	⌐
Change bold to non-bold type	(As above)	⌐
Insert 'superior' character	/ through character or ⌐ where required	⌐ or ⌐ under character e.g. ³⌐ or ³⌐
Insert 'inferior' character	(As above)	⌐ over character e.g. ⌐₂
Insert full stop	(As above)	⊙
Insert comma	(As above)	,
Insert single quotation marks	(As above)	⌐ or ⌐ and/or ⌐ or ⌐
Insert double quotation marks	(As above)	⌐ or ⌐ and/or ⌐ or ⌐
Insert hyphen	(As above)	⊢
Start new paragraph	⌐	⌐
No new paragraph	⌐	⌐
Transpose	⌐	⌐
Close up	linking ⌒ characters	⌒
Insert or substitute space between characters or words	/ through character or ⌐ where required	⌐
Reduce space between characters or words	⌐ between characters or words affected	⌐