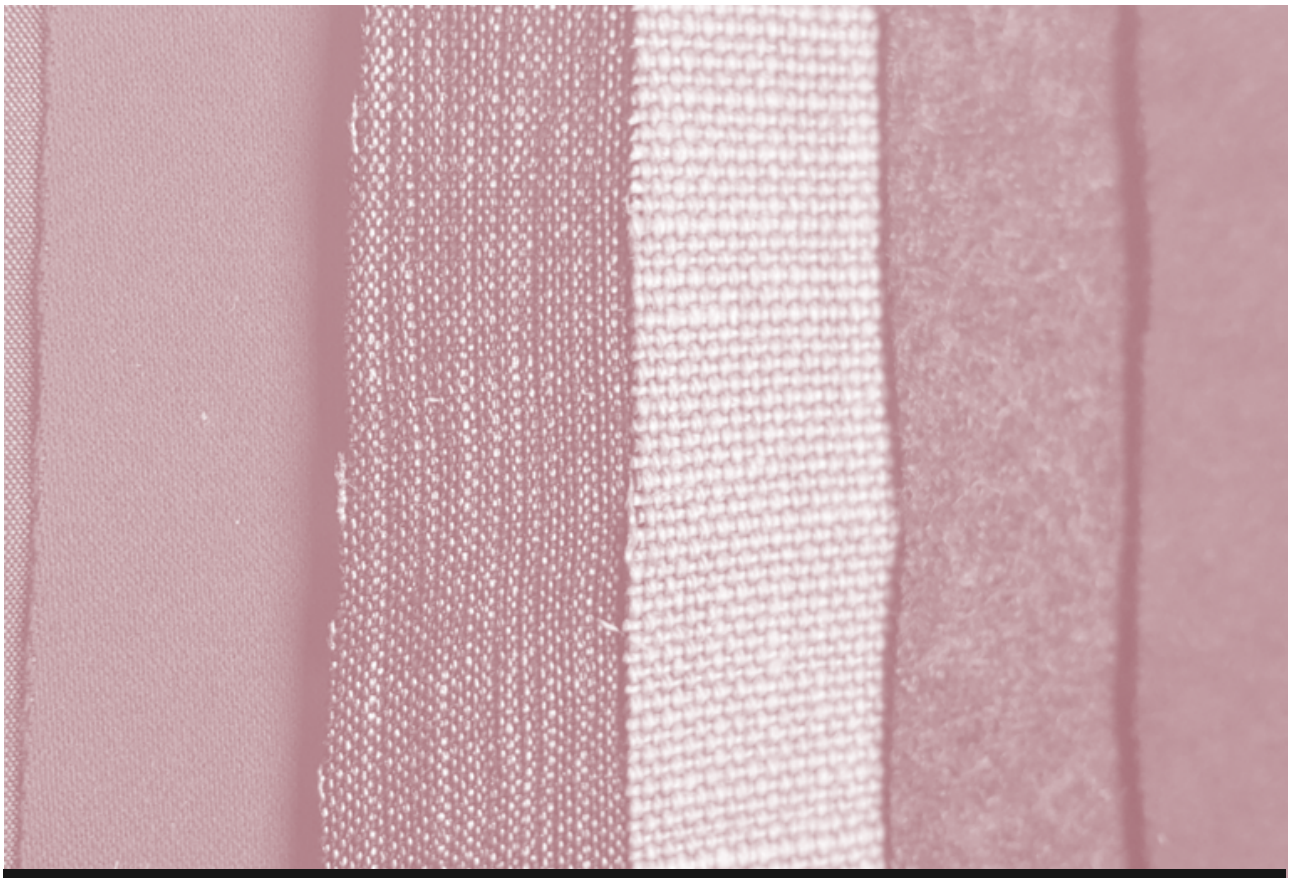
mistra
future
fashion



consumers' perceptions & acceptance of material and design choices.

by
Siv Lindberg
& Maria Rådsten Ekman

report developed by:

Title: consumers' perceptions & acceptance of material and design choices.
The user perspective.
Author: Siv Lindberg & Maria Rådsten Ekman
Mistra Future Fashion deliverable: D3.1.3
Edition: Only available as PDF for individual printing
ISBN: 978-91-89049-57-4

Mistra Future Fashion report number: 2019:23

Images: Siv Lindberg
Layout: Malin Viola Wennberg

A Mistra Future Fashion Report

Mistra Future Fashion is a cross-disciplinary research program, initiated and primarily funded by Mistra. It holds a total budget of SEK 110 millions and stretches over 8 years, from 2011 to 2019. It is hosted by RISE in collaboration with 15 research partners and involves more than 50 industry partners.

www.mistrafuturefashion.com

For additional questions about the research, please contact corresponding author:

Siv Lindberg
Researcher, RISE AB
Siv.lindberg@ri.se

summary

The present paper investigates consumers', perceptions of renewable and disposable nonwoven textilelike material, produced from pulp and PLA on a paper machine for the MISTRA Future Fashion Program (MFF samples). The main purpose was to see if such a material can accepted by consumers as a clothing material. Twenty-one female consumers participated in the study which consisted of tactile exploration, a semi-structured interview on materials and a web-based survey on their knowledge and behavior about fashion consumption as well as their personality traits with respect to being Style or Fashion oriented as described by Gwozdz, Gupta and Gentry (2015). From tactile exploration only (no vision), some of the MFF samples with different treatments were difficult to distinguish from woven fabrics. Wool, cashmere and one of the MFF samples (micro creped #53) were rated highest in preference and accepted as wearable by >80% of the respondents.

Results were further analyzed with respect to consumers psychological orientation towards Fashion or Style. Due to small sample size results are somewhat scattered although we see some tendencies of e.g. more Style oriented consumers among those acting and using sustainable consumption options such as choosing brands with no child or sweat shop labor, locally produced, eco-labelled textiles, etc.

When evaluating a picture of a T-shirt concept produced by one of the MMF materials, they emphasized the environmental and sustainability aspects of the garment, but they also had hesitations about the design (too big, too stiff) and the functionality of the material (too warm, too delicate). It was pointed out by respondents that the design and the marketing of such disposable fashion would be critical for its success in the marketplace.

table of content

1. background

During the first decade of the new millennium, Sweden's consumption of textiles increased by approximately 40 net percent(Carlsson, Hemström, Edborg, Stenmarck, & Sörme, 2011). Globally, according to a McKinsey report, the average consumer increased the number of garment purchased yearly with 60 % between 2000 and 2014 (Remy, Speelman, & Swartz, 2016) The business model this is based on is called fast fashion and is characterized by continuous change and short led times. Zara for example, can design, produce, and deliver a new garment in two weeks; Forever 21 in six weeks, and H&M in eight weeks (Cline 2012; 99 in (Linden, 2016). Furthermore, these designs are expected to be worn less than 10 times (Morgan & Britwistle, 2009) and it is estimated that consumers keep clothing items about half as long as they did 15 years ago. Some estimates suggest that consumers treat the lowest-priced garments as nearly disposable, discarding them after just seven or eight wears (Remy et al., 2016).

The fast fashion model creates challenges along the supply chain related to the environmental impact of production in the developing countries and the textile waste created at the consumption sites. Negative impacts are, for example, water use, toxic chemicals, poor labor conditions and increased textile waste.

Recovery of clothes - the creation of a circular economy - is one of the measures that many clothing companies now highlight as a solution to how we can continue to use clothes at the fast pace we do. H&M and Levi's have each partnered with I:CO to collect clothing and footwear for reuse and recycling. The garment is returned to the store for recycling and the customer receives a value check. In Europe, 15-20% of disposed textiles are collected, whereof approximately 50 % is reused and 50 % is recycled, the vast majority through mechanical shredding and tearing which in practice means a downcycling of the material (e.g. to industrial rags, low-grade blankets, insulation materials and upholstery)(Sandin & Peters, 2018). The technology to chemically separate fiber blends such as e.g. cotton and polyester, and recycle fiber to fiber, up-cyckling to make new material is currently being developed as a part of the Mistra Future Fashion program, and more information can be found in the report by Hanna de la Motte and Anna Palme (de la Motte & Palme, 2018)

However, as the need for affordable fashion garments is ever growing and all solutions cannot lie in longer-life products alone, an alternate route to fast fashion could be a completely disposable material, such as cellulose, which is an inexpensive, bio-based "recoverable" material with sustainable credentials. The idea being that by connecting existing industries such as pulp and paper, textile and waste recovery, we could curb the damage caused by fast fashion by using more appropriate material for "disposable fashion" while still acknowledge consumers drive to express their personal lifestyle through fashion consumption.

1.1. purpose of the study

The purpose of our study was to investigate consumers', perceptions and acceptance of renewable and disposable nonwoven paper-composite textiles in the context of fast fashion.

Studies were undertaken on the developed materials prior to final prototypes being made to establish consumers' 'perception' of the developed materials. This study aims at answering the following questions:

- Perception: Can a tactile feeling of textile be recreated in nonwoven paper composites; i.e. can the material be perceived as textile-like?
- Acceptance: Can a paper-composite material produced on a paper machine be accepted by consumers as a clothing material
- Knowledge and beliefs about fashion consumption and environment: How do young female consume fashion, use and dispose of it, and how aware are they of environmental consequences?

1.2. consumer acceptance of renewable and disposable materials

The media coverage of environmental and social issues and corporate social responsibility is extensive and consumers all over the world are to some extent aware of the environmental impact from production and consumption. According to Nielsen, 66% of global consumers are willing to pay more for sustainable products, and this number has increased by 16% since 2013 (Nielsen, 2015). Yet, the whole ethical sector still represents only small share of total consumption (Cowe & Williams, 2000; EkoWeb, 2019; Wiederhold & Martinez, 2018) . For example, final market share for organic food, although growing, is a modest 5 % in large European markets such as Germany and France (EkoWeb, 2019). There is a gap between what consumers say about the importance of ethical and environmental issues and where they actually put their money (Auger & Devinney, 2007; Carrigan & Attalla, 2001; European Commission, 2013; Sudbury-Riley & Kohlbacher, 2016). Even the same green consumer will not use the same decision criteria or focus on the same industry actors when purchasing products in different sectors, e.g. when purchasing fast mowing consumer goods versus white goods (McDonald, Oates, Thyne, Alevizou, & McMorland, 2009). Although evidence overall suggest that consumers are willing to consider ethical and social aspects when purchasing products, weaknesses in survey methodologies may account for part of the gap. Using a choice based methodology, Auger and Devinney showed that traditional survey methodology that use simple rating scales might overestimate the importance of ethical issues in consumer purchase behaviour (Auger & Devinney, 2007).

Niinimäki (Niinimäki, 2010), showed the complexity of the attitude-behaviour gap in clothing consumption by segmenting respondents based upon their personal self-reported commitment in eco-clothing purchasing decisions. When consumers ethical commitment is high, they place more weight on issues such as eco-materials and less on brands or fashion following (Niinimäki, 2010). The different consumption patterns among clothing consumers may be rooted in different

psychological traits, i.e. the extent to which clothes reflects the inner self (style oriented) or is oriented towards the outer self and portrayed to others (fashion oriented) (Gwozdz, Nielsen, Gupta, & Gentry, 2017). Some of the key consumption characteristics of a style-oriented consumer are longevity, authenticity, and uniqueness, whereas fashion-oriented consumers report a higher shopping frequency than style-oriented consumers (Gwozdz, Gupta, & Gentry, 2015).Consumers with a higher style orientation were also more likely to engage in pro-environmental behavior than consumers with a higher fashion orientation (Gwozdz et al., 2017). Consequently, characterize consumers' orientation will add to the understanding of the acceptance of the new textilelike material.

Karana and her colleagues have proposed a method, Material Driven Design (MDD), to facilitate designing for material experiences (Karana, Barati, Rognoli, & Zeeuw van der Laan, 2015; Karana, Pedgley, & Rognoli, 2014). The method is organized around four main steps containing activities relating to understanding the material, vision creation, manifesting experience patterns and designing the material/product. The foundation of the experience part revolves around evoked *sensorial responses (e.g. soft) and interpretative meanings (e.g. strange) affective responses* (e.g. surprise) and *performative actions* (e.g. stroking, folding). Investigating the experiential characteristics of the new material will support the designer in seeing interrelationships between intended or observed experiences and the formal properties of the material (Karana et al., 2015).

1.3. delimitations

Only a specific gender and age group between 18 and 36-years-old is interviewed. The research is undertaken in the area of Stockholm, Sweden which perhaps limits the meaning of the results.

2. method

Within the Mistra Future Fashion program, a transition towards a circular and sustainable fashion industry was studied form the point of view of consumers' attitudes and behaviour towards sustainable fashion, how to design for circularity, how to promote circular and sustainable supply chains, and how to increase the recovery of textile fibers. One theme explored the effects of the 'speed' of the fashion cycles on design and material/process decisions, and one of the routes addressed the growing fast-fashion industry's increasing needs of large impact textiles in relation to Sweden's cellulose and paper making industries as a potentially eco-friendlier material producer. Renewable and disposable nonwoven paper-composite textiles for efficient recovery through the paper stream was developed and tested as a replacement for larger impact textiles in short-life fashion. The present study was performed as a part of the consumer research theme with the aim of investigating consumer responses to the new developed material in terms of material experience and attitudes, practices and knowledge towards sustainable fashion.

The study was conducted in three parts and were performed individually. Each participant performed the three tasks in the same order as indicated below:

1. A tactile examination whereby the subjects sort fabric samples for common characteristics based on the tactile feel of touching the material surfaces without seeing them.
2. A questionnaire in which test subjects were asked to answer questions regarding their shopping habits, fashion attitudes and their understanding of the environmental impact of the fashion industry.
3. A semi-structured interview probing areas of the materials' experiential qualities and the reaction to a T-shirt prototype from the developed material.

Data was collected via a convenience sample of female students that signed up on a web-based recruitment site for students. They were given a cinema ticket as incentive for their participation. Young females were chosen because women in general have better tactile acuity than men and furthermore, tactile acuity diminish with age for both genders (Abdouni, Moreau, Vargiolu, & Zahouani, 2018; Peters, Hackeman, & Goldreich, 2009). We also expected this age group to be more culturally homogeneous than any other age cohort and thus reduce the amount of random errors compared with a sample from the general public (Tybout, Calder, & Phillips, 1981). Furthermore, the consumers within this age cohort will be the next generation of ethical consumers (Mirza, 2004) cited in (Joergens, 2006). (Bertrandias & Goldsmith, 2006)

Given the small number of the developed prototype samples and their propensity to become damaged due to mechanical abrasions when touched, the number of participants were restricted in order to be able to exchange samples for fresh ones after 5-7 sessions. A total, 21 females participated. Age distribution is shown in table 1.

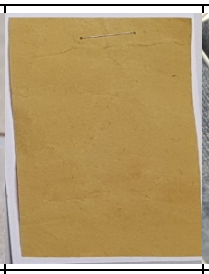
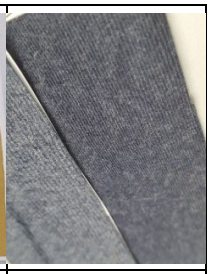
table 1 Distribution of age.

gender	age	n
female	18-24	14
female	25-29	5
female	30-34	2
Sum		21

2.1. materials

A non-woven material from cellulose and Polylactide acid (PLA) was developed within the MISTRA Future Fashion Program as a collaboration between RISE and University of Arts London. (Politowic, Goldsworthy, Granberg, MacLennan, & Telfer, 2017). PLA is a naturally degradable, thermoplastic polyester made from renewable resources. Maize starches or cane sugar are common ingredients. Different textile properties can be achieved through different cellulose and PLA blends and through different converting methods. To engage the consumers perception and final acceptance of the material, finishing and conversion processes should support a large span of possible visual and haptic expressions that are associated with textiles such as softness, good hand feel, flexibility, stretch, drape etc.

table 2 Samples manufactured for the MISTRA Future Fashion program.

					
names	BC LS BA	CD ML	DB CA	AA	52 53
production process	crimped & rolled		top-layer PLA, POLY spot welding	crimped & rolled	industrial crêping Micrex®
dye	cochineal dye	food colouring	no colouring	no colouring	Textile colouring of PLA
fiber content	3% CMF 40% pulp 57% PLA	3% CMF 40% pulp 57% PLA	3% CMF 40% pulp 57 PLA	0% CMF 95 % pulp 5% PLA	1)40% PLA 60% pulp 2)60% PLA 40% pulp

Ten different prototype materials were produced. They consisted of different cellulose pulp and PLA fiber blends that were produced on a paper machine. Finishing processes included, softening

of material by hand crumpling, dyeing using natural dyes and food coloring, patterning with laser techniques, utilizing the thermoplastic properties of the PLA and micro creeping using the Micrex® process. For details see (Granberg, Zachrisson, & Granlöf 2019; Politowic et al., 2017), and consult table 2. Six commercial textiles were also included as comparisons: cashmere, wool, linen, viscose and 2 silk samples with varying coarseness: red (smooth) and blue (coarser), see figure 1.

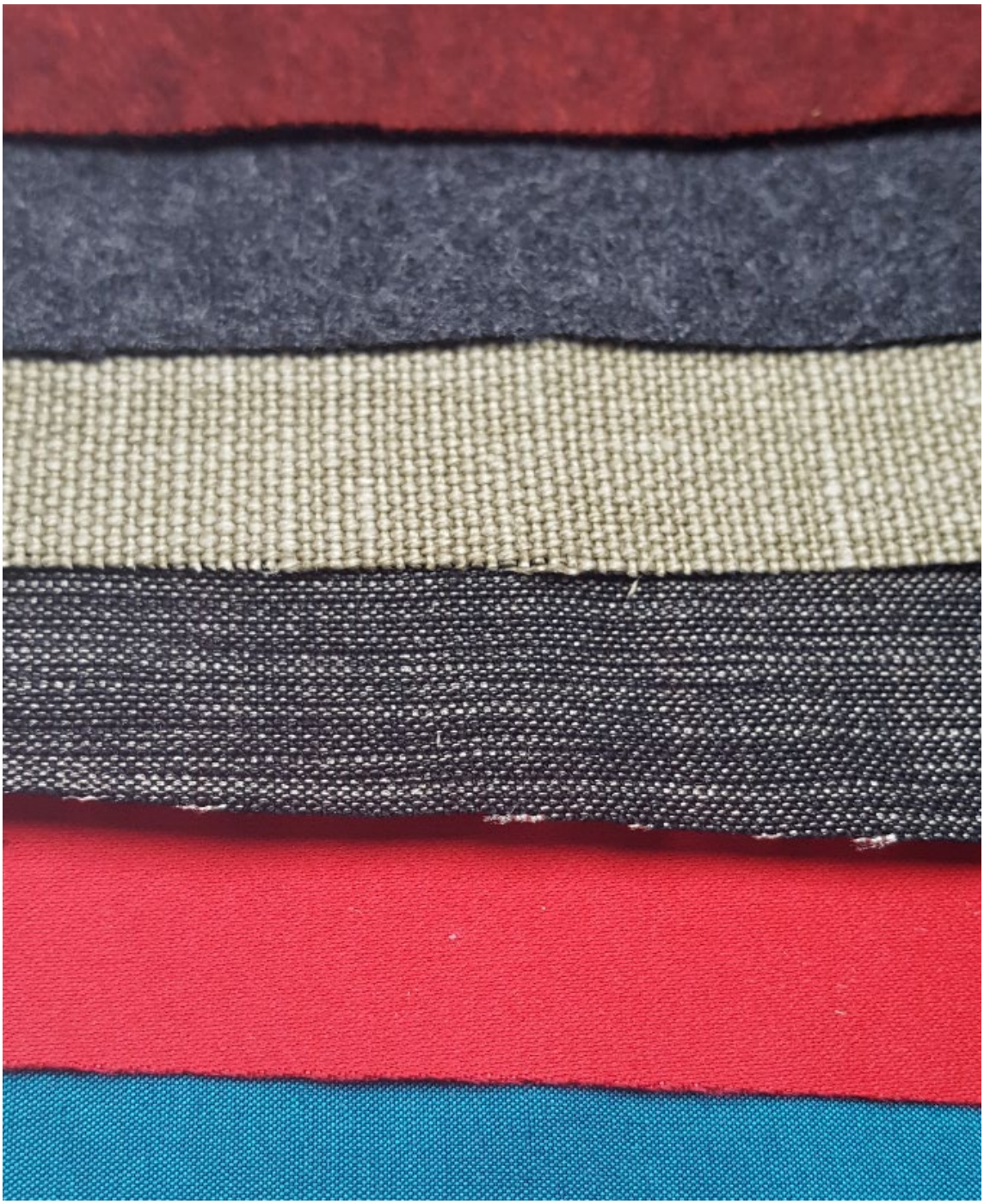


figure 1 Textile samples used in the tactile evaluation. From top to bottom: cashmere (MD), wool (CK), Belgian linen (AB), Viscose (KL), red silk (less coarse: LB) and blue silk (coarse: MM)

2.2. tactile exploration: similarity and acceptance

The experiments were performed on an individual basis. The laboratory was darkened with only a faint guidance light for the participant to be able to see the silhouette of the table and the stimuli but not be able to see any details like color or texture.

A free sorting technique was used. The textiles and the Mistra Future Fashion samples were spread out in a random order on the table and the participants were asked to sort them into groups based on their perceived similarity. Active touch was used, and participants were instructed to explore the surfaces only with the sample remaining flat on the table. There was no restriction regarding the number of groups except for the cases of all stimuli in one group or each stimulus in a separate group. After the sorting was completed, the lights were turned on the participants gave verbal descriptions of the groups based on the sorting criteria they used.

Preference ratings were than assigned to each group. The method of Magnitude Estimation was used, a scaling technique where respondents assign numbers that reflects the magnitudes of their preferences, i.e. a sample that is preferred twice as much receives a twice as large number (Stevens, 1975). Finally, participants were asked to choose which group(s) they found acceptable/suitable to use as garments.

2.3. questionnaire

To gain insights into the shopping behaviour of the participants, a small questionnaire was constructed to which the respondents answered individually. The purpose was to explore the fashion versus style-orientation proposed by Gwozds et al (2015) in relation to consumer acceptance of the new textile-like material.

1. The questionnaire comprised of 21 questions and took approximately 10 minutes (Appendix 2). The following areas were coveredClothing acquisition: Shopping habits, store types and frequency
2. The use phase: use and disposal
3. Understanding of sustainable clothing including materials, labels and information. Highly visible issues such as the use of child labour appear to increasingly affect consumers purchase decision (Auger, Burke, Devinney, & Louviere, 2003)
4. Fashion versus style. Items adopted from Gwozdz, Gupta and Gentry (Gwozdz, Nielsen, & Muller, 2017).

2.4. semi structured interview topics

The interview was divided into two main parts:

First part was based on the Material Experience (Karana et al., 2015) and included the following topics:

1. What are the unique sensorial qualities of the material?
2. What are the most and the least pleasing sensorial qualities of the material (according to users)?
3. Is the material associated with any other material due to its similar aesthetics?
4. How do people describe this material? What kind of meanings does it evoke?
5. Does it elicit any emotions such as surprise, love, hate, fear, relaxation, etc.?
6. Second part first red a short intro about fast fashion and the environmental challenges and introduced three main areas for contemporary research (reuse/share, recycle and new material) and introduced new materials as the current topic of discussion. A printed image of the concept designed by the UAL partners was shown to the respondents, figure 2.

figure 2 Concept illustration. Cochineal colored sample BC.

The following areas were explored:

- Spontaneous reactions
- Could you consider wearing something like this?
- In which context can you imagine wearing clothes like this?
- Perceived benefits and draw backs.

3. results

Consumer orientation towards fashion (5 items) or style (5 items) was investigated through survey items adopted from Gwozdz et. al. 2017. A 7-step scale from 1=does not describe me at all, to 7=describes me completely was used. In order to see if shopping patterns differed in relation to consumer orientation, items on shopping frequency and location was also included in the survey. Respondents could score minimum of 5 points and a maximum of 35 points summed over the 5 items belonging to each of fashion or style-oriented set of items. A cut of value of >20 was used to assign respondents to either Fashion oriented (4 respondents) or Style oriented consumers (10 respondents). A third group was defined by scores that indicated neither fashion items the style items did describe them properly (low scores on all items <20, i.e. showed low interest/involvement in clothing and clothing consumption and were labelled 'Indifferent'. For details see table 3.

table 3 Fashion and style orientation. Means and standard deviations.

items	all (n=21)		fashion oriented (n=4)		style oriented (n=10)		indifferent (n=7)	
Fashion orientation items	**mean**	***std***	**mean**	***std***	**mean**	***std***	**mean**	**std**
Fashionable, attractive clothing is very important to me.	4,86	*1,68*	5,50	*0,58*			3,43	*1,90*
Keeping up with the latest fashion is important to me.	2,86	*1,31*	4,25	*0,50*			1,86	*0,69*
I spend considerable time and effort to learn about the latest fashion.	2,43	*1,21*	4,00	*0,00*			1,43	*0,79*
I keep my wardrobe up-to-date with the changing fashions.	2,67	*1,49*	4,50	*0,58*			2,00	*1,53*
I usually have one or more outfits of the very new fashion.	4,14	*2,13*	5,50	*1,29*			3,43	*2,37*
Style orientation items	**mean**	***std***	**mean**	***std***	**mean**	***std***	**mean**	**std**
What I wear reflects my inner self	4,67	*1,46*			5,45	*1,21*	3,71	*0,95*
Who I am is clear in my clothing style	4,38	*1,69*			5,27	*1,62*	3,29	*0,95*
I typically purchase clothing I know will fit my personal style for a long time	5,57	*1,75*			6,45	*0,82*	4,00	*2,00*
I prefer clothes that are unique/rare	3,24	*2,00*			4,36	*1,75*	1,86	*1,46*
I prefer clothes that have a distinctive mode of tailoring	3,81	*2,18*			5,00	*2,00*	2,29	*2,14*
Fashion items bought	mean	std	mean	*std*	mean	*std*	mean	std
	10,24	*8,23*	13,6	*9,91*	8,3	*7,57*	11	*8,72*

During the last three months, respondents bought on average 10,24 garments. Fashion oriented consumers (n=4) bought more than average; 13,6 garments, whereas Style oriented respondents

bought less than average; 8,3 garments. This difference in shopping frequency is in accordance with the findings of Gwozdz et.al. 2015, although cautions must be taken with respect to the small sample size here. The "Indifferent" group (n=7), had a shopping frequency close to the average for the whole group; 11 garments bought during the last three months.

The majority shop at the large chains and are mainly fast fashion consumers. Only one respondent report to have bought at a swap market and 7 bought second hand 1-3 times last 3 months. Determinants of their last purchase were price (91%), quality (76%) and design (62%), multiple choices could be checked.

figure 3 Clothes acquisition. More than one option could be selected.

Exploratory factor analysis (extraction: principal component, rotation: varimax) was carried out for the fashion and style related items. The factor structure obtained is similar to that of Gwozdz et al. (Gwozdz et al., 2015), and can be seen as an indication that the present sample of young females is not deviant or extreme in relation to the general European population surveyed by Gwozdz and colleagues. However, due to the small sample size, the results are more scattered and of course may be seen only as indicative. The factor structure is shown in table 4.

table 4 2-D factor solutions for consumer orientation items. Factor loadings Rotation: Varimax raw Extraction: Principal components.

item	Factor 1	Factor 2
Fashion related items		
Fashionable, attractive clothing is very important to me.	0,512	0,665
Keeping up with the latest fashion is important to me.	0,852	0,301
I spend considerable time and effort to learn about the latest fashion.	0,802	0,114
I keep my wardrobe up-to-date with the changing fashions.	0,889	-0,119
I usually have one or more outfits of the very new fashion.	0,788	0,030
Style related items		
What I wear reflects my inner self	0,167	0,736
Who I am is clear in my clothing style	0,011	0,757
I typically purchase clothing I know will fit my personal style for a long time	0,157	0,758
I prefer clothes that are unique/rare	-0,162	0,734
I prefer clothes that have a distinctive mode of tailoring	0,106	0,485
Expl.Var	3,131	3,025
Prp.Totl	0,313	0,302

3.1. shopping behavior and understanding of sustainable fashion.

When shopping for clothes, 71% state that they *never or rarely* think about sustainability and ethical issues, and 29% think about it *often or always*. The meaning of sustainable fashion is said to be longevity (garments that last for a long time; 38%), and timeless fashion (33%). 14% think of second-hand as a form of sustainable fashion and only 2 respondents (9,5%) consider the sustainability of the material itself. One person claim sustainable fashion does not interest her (figure 4). We see no pattern related to consumer orientation here, options are about equally distributed within groups.

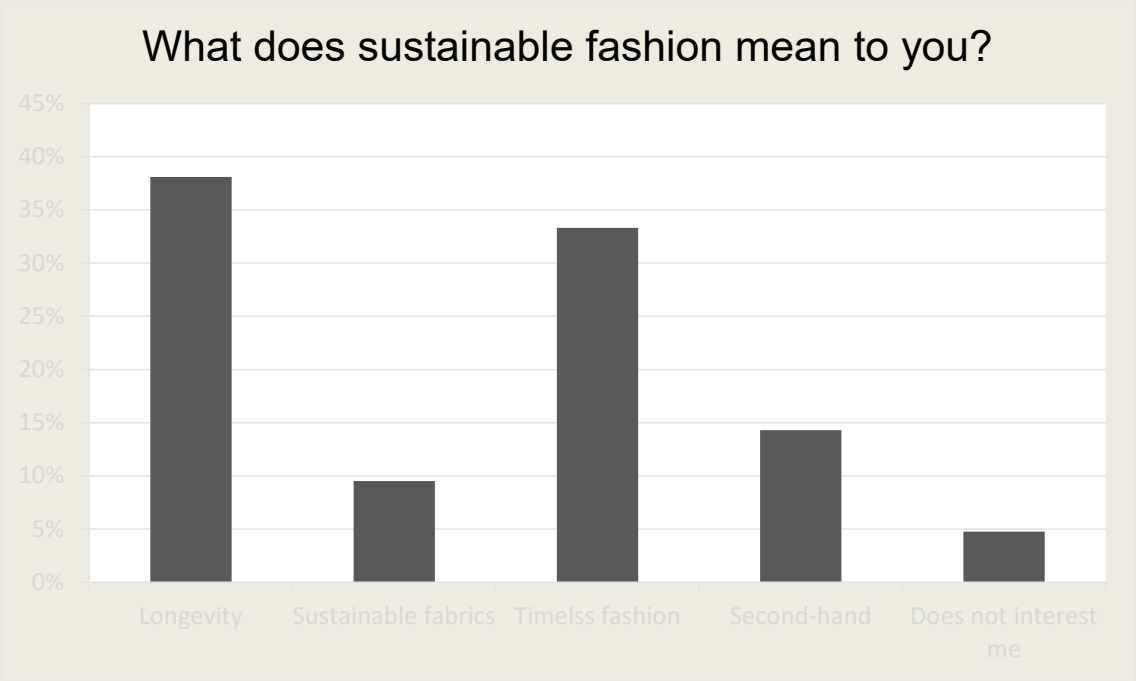


figure 4 Perceived meaning of sustainability in a fashion context.

Who is responsible for making fashion sustainable? In a multiple-choice question 90 % says the fashion industry is but 67 % think it is also the ordinary people i.e. consumers. International organizations such as UN or EU are chosen as responsible in 52 % of the cases. However, respondents report lacking information and knowledge about sustainability issues and they take very few actions. figure 6 shows the most frequently reported activities; take the old clothes to a recycling facility before buying new clothes is reported by 48% of the respondents, and 43% opt for highest possible quality in the purchase situation. Only 24% report actively choosing social sustainable brands ('no sweatshop brand') whereas 76% do this never or rarely. Locally produced garments, in Scandinavia is chosen never or rarely by 76% of the respondents and 24% choose this option often or always.

This reported lack of using sustainable consumption options may be related to their reported feeling of lacking information about *sustainable brands* (95%), *sustainable fabric* (86%), and eco labels (91 %). To be compared to that only 10% of the respondents felt they were lacking information about *recycling facilities* for clothes (see figure 5).

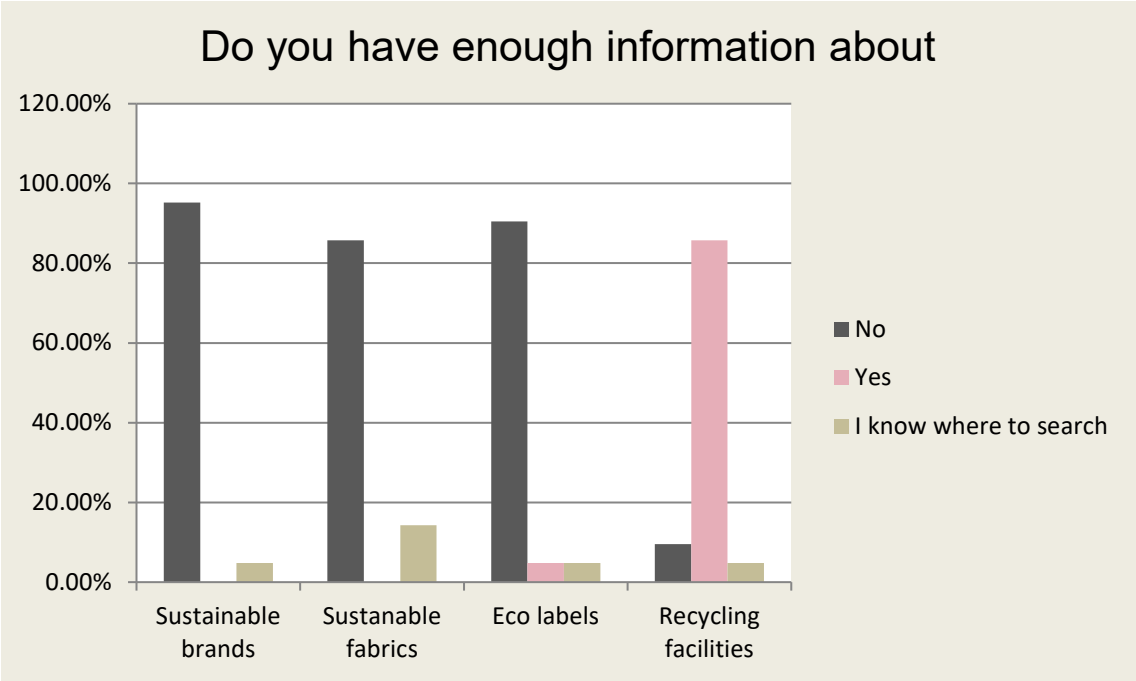


figure 5 Knowledge on sustainable options.

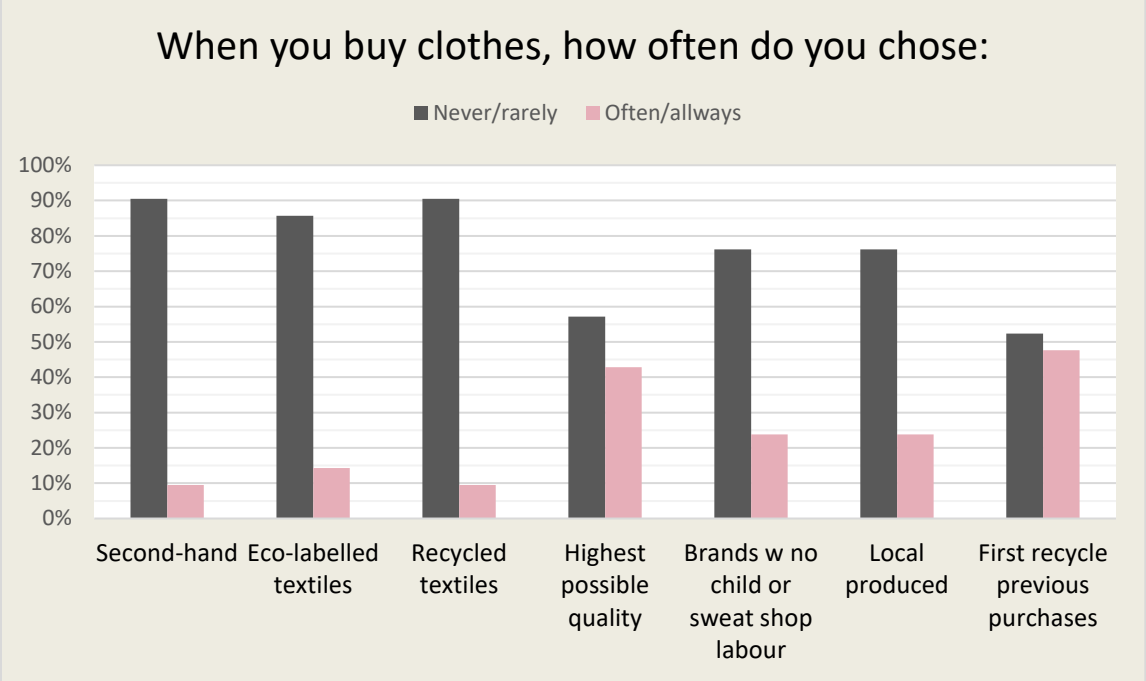


figure 6 Use of sustainable consumption options.

3.2. disposal

They report using their clothes frequently, once a week (48%) or at least once a month (48%) and the large majority (57%) keep their clothes 3-4 years before throwing away. The most frequent reported reason *for throwing away clothes was change of body shape – does not fit well any more* (71%). This may be an age bias as the majority of the test group is between 18-23 years and have thus most probably experienced growing out of clothes not too long ago. Other reported reasons were related to appearance (wear) or broken, see figure 7 (scale from 1 "very rarely" to 5 "very often".

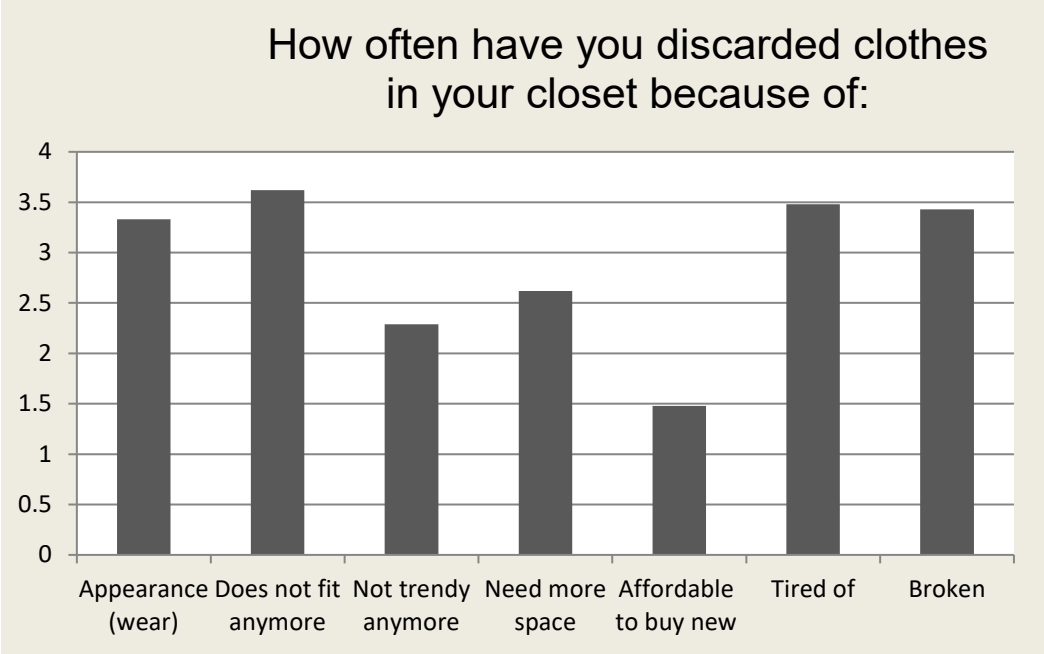


figure 7 *Reasons for discarding clothes.*

The method of disposal varies, the most reported method of disposal was recycling station, 38% and second hand organizations such as Human Bridge, Myrorna is common, 33% (see figure 8).

figure 8 Methods of disposing clothes.

3.3. tactile perception of fabrics and textilelike papers

In the blind-folded tactile only material perception experiment, samples were on average sorted into 6 groups (range: 4-11 groups) based on their tactile similarity. Furthermore, 1-3 descriptors were collected for each group. The verbal descriptors were analyzed together with the preference and acceptance ratings. The results for preference and acceptance ratings are seen in table 5. The most preferred materials are cashmere and wool, acceptance >80%, are described as *soft, thick, fluffy warm and nice*. The two industrial creped pulp-PLA samples (52 and 53), acceptance >70% are described as *rough/medium rough, woven and textile like*. Sample BC is the reference sample used for designing the T-shirt concept (figure 2) and is found in position 6 and accepted as wearable 67% of the time. BC is described as rough, soft textilelike.

If a cut-off value for acceptance is set at 50% accepting the material as suitable for clothing, the material space would then include cashmere, wool, silk and four of the pulp-PLA blends; the industrial creped samples 52 and 53 and the red cochineal dyed samples BC and LS.

table 5 Preference ratings for all samples, percent accepted as wearable and the most frequently used descriptors.

sample	code	preference rating	% accepted	descriptors, most frequent first.
cashmere	MD	36,8	85,7	Soft, thick, fluffy, warm,
wool	CK	32,3	81,0	Soft, thick, rough, warm, nice
red silk	LB	31,4	76,2	Smooth, soft, cool, silky, thin, glossy
53*	53*	30,7	81,0	Rough/textured, textile, woven, soft, papery
52*	52*	25,4	71,4	Medium rough, thick, textilelike, soft
col-coch14*	BC*	25,2	66,7	Rough, soft, textilelike, papery, comfortable, not comfortable
col-coch4*	LS*	23,8	61,9	Soft, smooth, warm, suede, fury, paper
col-coch13*	BA*	22,1	47,6	Smooth, thick, warm, papery, thin,
blue silk	MM	20,9	57,1	Rough, thin, flat, silky, smooth, papery
viscose	KL	18,7	47,6	Rough, textilelike
col-ris1*	CD*	18,5	38,1	Papery, rough, rustle
mech-las11*	DB*	17,8	42,9	Smooth, thin, flat, silky, papery, nice textile
linen	AB	15,7	42,9	Rough, texture, thick, textile like, furniture cloth
col-fo1*	ML*	15,7	23,8	Papery, smooth, thin, cheap,
mech-las9*	CA*	14,8	23,8	Hard, papery, rough, dry,
col-ao8*	AA*	11,6	14,3	Hard, rough stiff, papery

The histogram in figure 9 shows the percentage of times each sample was evaluated as wearable in ascending order. As can be noted also two fabrics, linen and viscose fabric received rather low acceptance rate. The Belgian linen is rather coarse and more suitable for furniture cloth and the viscose/PES/silk blend is also rather textured.

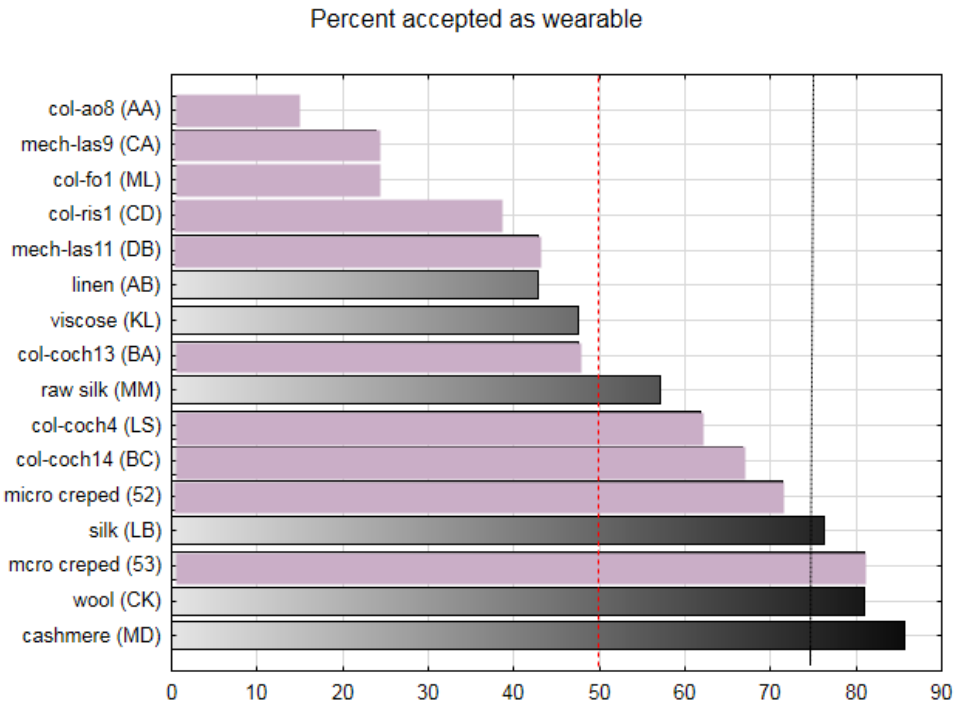


figure 9 Proportion of times each sample was accepted as wearable. The Mistra Future Fashion samples are marked in lavender colour.

3.4. multidimensional analysis of tactile similarity

The purpose of multidimensional scaling (MDS) is to provide a visual representation of the pattern of proximities (i.e., similarities or distances) among the set of fabrics and textilelike papers. Data was analyzed using Proscale multidimensional scaling routine and software (Donderi, 1988). The analyses are based on the distinctiveness of each sample and the dissimilarity between each pair of samples. Respondents groupings of samples were converted to dissimilarity scores based on the frequency two samples were grouped together, and to distinctiveness scores based on the co-occurrence of each sample with every other samples, i.e. the smaller the number of samples that are grouped together with a specific sample, the more distinct that sample is.

A three-dimensional solution explains 67% of the variation in the data. Given the relatively small sample size (21 respondents) the factor structure may be considered indicative only.

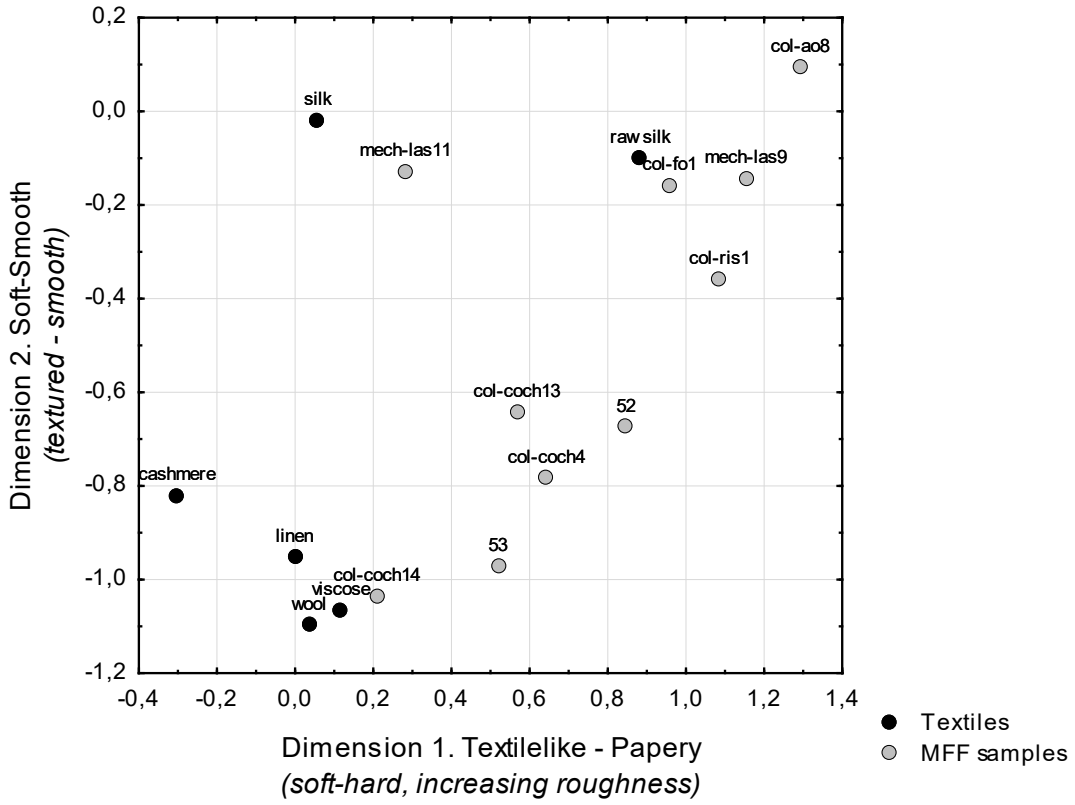


figure 10 3-Dimensional solution of respondent's similarity sorting.

The first 2 dimensions are plotted in figure 10. Samples that are close together are perceived similar by touch. By examine the samples with high absolute loadings on the different dimensions, an interpretation of the underlying meaning of the dimensions can be made. We can see in figure 10 that the mechanical laser treated sample (mech-las9) together with a raw silk fabric and the two food colored samples col-fo1 and col-ris1 define the far-right end of dimension 1 and the top of dimension 2 axis. In table 3 we see these samples being described as *hard, papery, flat, thin* and they also have rather low preference and acceptance ratings. To the far left on dimension 1 we find the fabric samples. These are however separated on dimension 2: samples with high negative factor loadings are described as *soft, textured, fluffy warm,* whereas samples closer to the top are described as *smooth, thin and flat* and *silky.*

We call dimension 1 "Textilelike – Papery" as mowing from left to right samples appear to elicit more and more papery feeling. Also, this dimension shows and overall negative correlation to preferences (correlation r=-0,64) as shown in figure 11. The silk samples and the laser treated pulp-PLA samples share some common characteristics related to smoothness (same level on dimension 2) but they differ in papery feel. One of the laser-treated samples (mech-las11) has a similar surface feeling as the silk sample (often grouped together), whereas the silk sample with a rougher surface (raw silk) is more often associated with the more paper-like samples. However, having a similar surface feel does not always render similar preferences which can be seen in figure 11 where mech-las 11 is rated lower in preference than the silk sample.

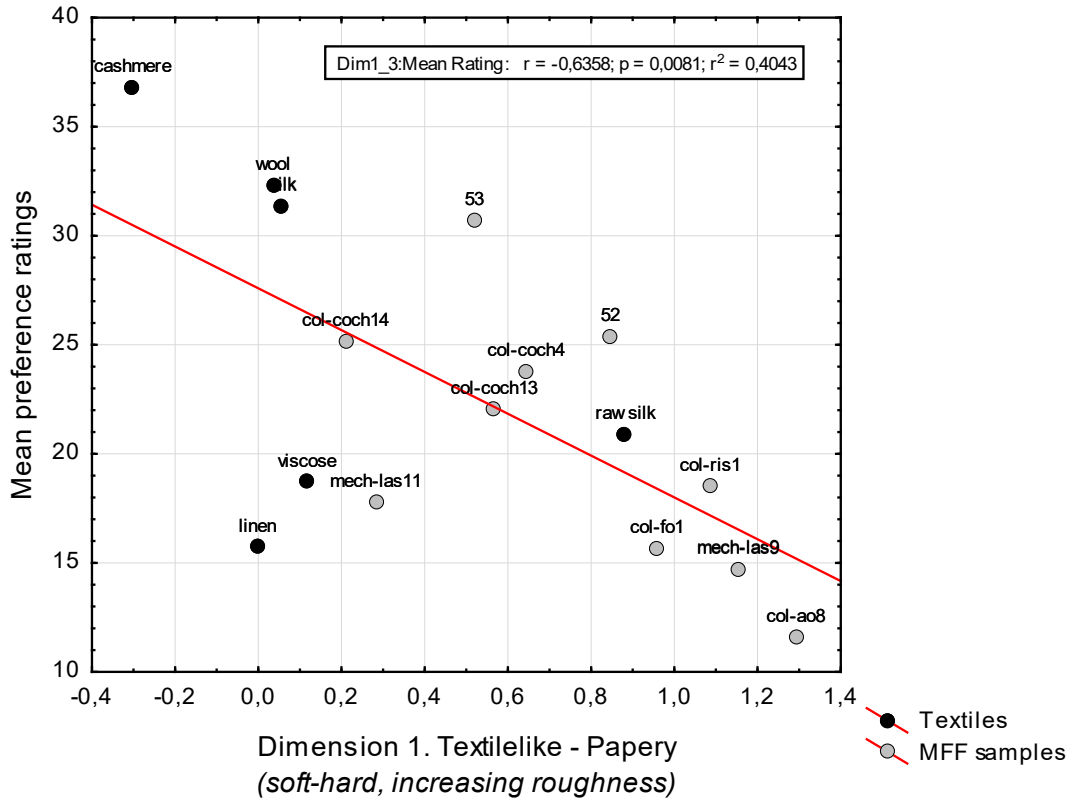


figure 11 Preference ratings plotted against Dimension 1: Soft – Hard

3.5. consumer style and tactile preferences

An analysis was performed to see if tactile preferences for different materials was related to consumer orientation with respect to Fashion- Style- or Indifferent orientation. For each consumer group the top-ranking samples were analysed. The Style-oriented consumers preferred cashmere which received the highest ratings in this group and was said to feel soft and thick. The MFF concept sample (T-shirt, i.e. BC) was often grouped together with wool and the micro creped sample 52, and these three received the second highest ratings. Preferences were diversified, all samples were represented at least once in the highest rated groups among these consumers.

The Fashion-oriented consumers, which constitute a much smaller group (n=4) did rate several of the MFF samples highest in preference: one micro creped sample (53) and one of the cochineal coloured samples (LS) as highest, followed by two other coloured samples (CD, BA).

The remaining respondents, "Indifferent", had the most pronounced tactile preferences, they preferred cashmere, wool and micro creped sample number 53. Seven of the MFF samples never occurred among the highest rated samples for this group.

3.6. material experience

Reflection on clothing consumption and material: In the semi-structured interview, the respondents talk about their earlier reflections on clothing consumption. Although they claim to lack knowledge/information on sustainable brands, materials and labels (figure 5), more than half (13 respondents) have reflected on clothing consumption in the past. Two major strategies on sustainable consumptions were 1) to buy less clothes and 2) to buy durable material, or better material e.g. eco cotton or non-animal-based materials.

'Yes, I chose based on material, do not want it (garment) to be destroyed in laundry, like wear it as long as I want without it to break. I mend and sew garments if they break'
Female 30-34, Style oriented.

'Saw the documentary The True Costs – agrees well with how the consumer sees it and this survey. Do not think very often on materials, more on consumption and to avoid fast fashion, to buy second hand but it is difficult to find something that fits me'
Female 30-34, Style orientation.

'Last years has been focusing on this. Bloggers have travelled to textile production sites, e.g. H&M plant, got me to stop shopping at H&M for a year, now just buy base garments. Would like to think more about what I purchase but when you are a student, you are ego and buy the (convenient) alternative. Do not think very much about garment and environmental impact, guess that has to do with parents and where you are from'
Female 18-24, Fashion oriented

Description of the materials: Respondents were shown the pulp-PLA samples and could look and touch them freely. They were asked about the sensory qualities of these samples. The materials were generally described in terms of being either papery, having a feeling and look of paper, or being described as soft and like textiles. Some materials were more often perceived as hard and papery, e.g. sample AA, whereas others were more often perceived as textiles, e.g. samples BC, 52 and 53. Refer to table 2. for sample images and descriptions.

'Some are soft and could be worn" pointing to BC (reference for the t-shirt concept), 52 and 53. Others feel like paper and are harder against the skin'
Female 18-24, Style oriented

'I like most of them, impressed that they are so like fabric. Not very strong colors, nice! BC CD LS looks papery (the cochineal colored samples)'
Female 18-24 years, Style oriented

'BC works for a top or a dress'
Female 18-24, Indifferent

'If it was available and somehow announced that this is much better, then I think it would work...common colours, would be possible to wear something like this if the design is modern. People like to feel they do something good'
Female 18-24 years, Fashion orientation

Most and least pleasing sensorial experience: Softness and being textilelike was mentioned for some of the materials and consequently, hardness, paper like and stiffness (e.g. lack of drape) as negative sensorial experiences for other materials. Other pleasing aspects that were mentioned were quality, aesthetical aspect, environmentally friendliness and the fact that it is visible that it is not conventional fabric which makes the material more exciting. The least pleasing sensorial experiences had to do with the hardness and stiffness of some of the material samples. Also was mentioned that bio looks cheaper than regular material. Here there was rather good agreement among respondents and no clear patterns related to consumer orientation.

3.7. reactions to the concept.

The respondents were shown an image of the T-shirt concept (figure 2). The spontaneous reactions to the concept garment was divided; half of the respondents thought the T-shirt was cool, nice, unique, good design, innovative and modern, whilst the other half thought the opposite i.e. ugly, doesn't fit well, uncomfortable etc. It was noticed from the image that the Tee appeared to be somewhat stiff (e.g. lacking in drape). Several comments concerned that it was wrinkled, some thought that it was cool others that it had to be ironed.

'Looks surprisingly nice for being in that material. Looks stiff. Nicer than I thought, looks like a real T-shirt'
Female 18-24, Fashion orientation

The material of the garment also raised questions about the materials potential to withstand rain or sweats. They were in general hesitant if they could consider using the garment. Apart from the design issues, some respondents also raised the question if fast disposable fashion is good for the environment and maybe it is better to produce garments that are durable and can be kept for a longer period of time.

Most of the participants emphasized the environmental and sustainability aspects of the garment:

'It´s made of paper bags or something similar, its positive to find things that is recycled and to find new products. More sustainable consumption, new things made of recycled material, new business than we have today.'
Female 18-24, Style orientation.

'No. Maybe to sleep in, not continue to buy more and more or to produce clothes that are less durable in order to throw in the compost next week'
Female 30-34, Style orientation.

'Possibly if it says 'coloured by beetroot' takes a lot of the design for me to choose, has to be stylish.'
Female 25-28 Style oriented.

'No, cannot see myself wearing it.'
Female 18-24, Fashion oriented.

‘I do not know, have to try it first’
Female 18-24, Fashion oriented

In general, they were rather hesitant regarding comfort and fit and this hesitation was roughly equally divided among all respondents. Special occasion garment was mentioned but also every day like on the beach in the summer. They also expressed concerns that this could probably lead to higher costs.

Drawbacks: Drawbacks circulated around price, material comfort and durability in relation to stains and strain. Also, consumer behaviour and costs were lifted as potential drawbacks.

‘Would people recycle? Clothing libraries are good, but you want to own clothes yourself, same thing with single use garments’
Female 25-29 Style oriented

‘I believe more in producing less, but in good materials and that lasts longer. Need to rethink as consumers.’
Female 30-34, Style orientation

’You don’t change the behavior of people but (you) instead accept fast fashion, (we) do not want to change behavior pattern’
Female 18-24, Indifferent.

’Higher prices, it is more difficult to produce, more advanced processes if it is environmentally friendly…limitations as to what design and fit can be made’
Female 18-24, Fashion oriented

4. concluding discussion

A group of 21 young females participated in material testing and interviews. Young females were chosen as being the major target group in the fast fashion context. Using the fashion versus style orientation questions from Gwozdz et al. (Gwozdz et al., 2015) we can see also in our small sample a tendency to a similar grouping in Fashion and Style orientation. However, a third group of respondents did not feel that either fashion or style related questions could describe them appropriately (low average scores on both dimensions. This group was called 'Indifferent' as they do not adhere to the fashion vs style dimension. The Fashion oriented consumers reported having the highest shopping frequency (~14 items the last 3 months) and Style oriented consumers having the lowest (~8 items the last 3 months), which is in accordance with earlier research by Gwozdz et. al. (2015). Furthermore, Gwozdz and colleagues found that consumers with higher environmental concerns and higher skepticism towards sustainable product claims tend to be more style oriented. In our data we can see a tendency towards more style oriented consumers among those taking action and using the sustainable consumption options described in figure 6, although caution should be taken as our data set is small, and results are rather scattered.

The Indifferent group had an average shopping frequency in between 8~11 items the last 3 months).

Knowledge and information play a vital role for consumers sustainable behavior. Although the public domain contains much information in relation to ethical and sustainable consumption, e.g. several respondents in our interviews reported on having read blogs or seen movies on production conditions or having reflected on materials, yet they seem to block this information out after a while. A majority (71%) responded they rarely or never think about sustainability issues in relation to fashion. Bray, Johns and Kilburn were investigating factors that intervene between consumers' attitudes, behavioral intentions and actual behavior. The authors found that price, loyalty, convenience, cynicism and lack of information are the main factors that contribute to the green gap. For example was mentioned that bad press could result in avoiding unethical products or companies but without prominent communication about these issues, lack of knowledge would continue to limit ethical communication (Bray, Johns, & Kilburn, 2011). In our study 95% of our survey respondents reported lacking information about *sustainable brands*, 86% lack information about *sustainable fabric*, and 91% say they lack information about eco labels. This clearly points towards the complexity of understanding sustainability in the fashion context. Bly, Gwozdz & Reisch (Bly, Gwozdz, & L.A., 2015) interviewed fashion sustainability pioneers and argues that consumers may have a hard time caring about what cannot see or feel, something that could be attributed to the modern global production systems' opacity, distance and speed.

From the tactile exploration of textiles and the MFF non-woven experimental pulp-PLA material, some of the MFF materials were difficult to distinguish from woven fabrics. When participants assessed tactile similarities between materials, we find one underlying dimension moving from textile-like to paper-like. Several other MFF samples give rise to a more paper-like experience. Despite having a smooth surface, the tactile feeling was too papery and hard.

Cashmere, wool and one of the MFF micro creped samples (#53) were accepted as wearable among >80 percent of the interviewees. The MFF sample labelled col-coch14, (accepted as

wearable among 67 percent) was perceived as rather similar to wool and viscose in the tactile test and has also been used to design a concept prototype, a T-shirt. When the respondents were introduced to a picture of the "3D concept" their responses were divided. On the one hand, they emphasized the environmental and sustainability aspects of the garment, on the other, they had hesitations about the design (too big, too stiff) and the functionality of the material (too warm, too delicate). It was pointed out by respondents that the design and the marketing of such disposable fashion would be critical for the success in the marketplace. This aesthetic dilemma is also pointed out by Markkula and Moisander as one of the factors contributing to the green gap (Markkula & Moisander, 2012). Two respondents expressed concern that disposable fashion might not be the answer to the environmental burden of fast fashion and that maybe consumers will have to rethink their way of consuming.

4.1. limitations of the study

This study was characterized by several limitations that restrict the reliability to generalize the findings. First, the study was restricted to small number of participants due to limited availability of test material for tactile exploration. Although some results points towards the validity of Style and Fashion orientated consumers, it may be possible to obtain different results in the case of conducting the study with other types of participants using random or stratified sampling techniques to represent the total population. Furthermore, future researches could investigate the impact of consumer decision making styles in considering also the participants here labelled "Indifferent", i.e. not adhering to either Style or Fashion oriented consumers in order to obtain a better understanding of the ways in which consumers engage in struggle trying to make sense of their roles in sustainable fashion consumption.

references

Abdouni, A., Moreau, G., Vargiolu, R., & Zahouani, H. (2018). Static and active tactile perception and touch anisotropy: aging and gender effect. Scientific Reports, 8(1), 14240. doi:10.1038/s41598-018-32724-4

Auger, P., Burke, P., Devinney, T. M., & Louviere, J. J. (2003). What Will Consumers Pay for Social Product Features? Journal of Business Ethics, 42(3), 281-304. doi:10.1023/a:1022212816261

Auger, P., & Devinney, T. M. (2007). Do What Consumers Say Matter? The Misalignment of Preferences with Unconstrained Ethical Intentions. Journal of Business Ethics, 76(4), 361-383. doi:10.1007/s10551-006-9287-y

Bertrandias, L., & Goldsmith, R. E. (2006). Some psychological motivations for fashion opinion leadership and fashion opinion seeking. Journal of Fashion Marketing and Management: An International Journal, 10(1), 25-40. doi:doi:10.1108/13612020610651105

Bly, S., Gwozdz, W., & L.A., R. (2015). Exit from the high street: an exploratory study of sustainable fashion consumption pioneers. International Journal of Consumer Studies 1-11. doi:10.1111/ijcs.12159

Bray, J., Johns, N., & Kilburn, D. (2011). An Exploratory Study into the Factors Impeding Ethical Consumption. Journal of Business Ethics, 98(4), 597-608.

Carlsson, A., Hemström, K., Edborg, P., Stenmarck, Å., & Sörme, L. (2011) Kartläggning av mängder och flöden av textilavfall. Report for the Swedish EPA, SMED Report: Vol. 46.

Carrigan, M., & Attalla, A. (2001). The myth of the ethical consumer – do ethics matter in purchase behaviour? Journal of Consumer Marketing, 18(7), 560-578. doi:doi:10.1108/07363760110410263

Cowe, R., & Williams, S. (2000). Who Are the Ethical Consumers? Ethical Consumerism Report, Cooperative Bank. . Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.458.5207&rep=rep1&type=pdf

de la Motte, H., & Palme, A. (2018). The development of the Blend Re:wind process. Retrieved from www.mistrafuturefashion.com:
Donderi, D. C. (1988). Information measurement of distinctivness and similarity. Perception & Psychophysics, 44(6), 576-584.

EkoWeb. (2019). Marknadsrapport 2019. Retrieved from http://www.ekoweb.nu/attachments/67/45.pdf

European Commission. (2013). TNS Political&Social: Attitudes of Europeans towards building the single market for green products. Brussels Retrieved from http://ec.europa.eu/public_opinion/flash/fl_367_en.pdf.

Granberg, H., Zachrisson, A.-M., & Granlöf , L. (2019). Crimping and welding of textile-like papers. Mistra Future Fashion report number 2019:18 . Retrieved from www.mistrafuturefashion.com

Gwozdz, W., Nielsen, K. S., Gupta, S., & Gentry, J. (2017). The relationship between fashion and style orientation and well-being. Retrieved from www.mistrafuturefashion.com

Gwozdz, W., Gupta, S., & Gentry, J. (2015). The role of fashion vs. style orientation on sustainable apparel consumption. Paper presented at the 39th Annual Macromarketing Conference.

Gwozdz, W., Nielsen, K. S., & Muller, T. (2017). Environmentally friendly clothing consumption across Western countries: Consumer segments and their behavior. Sustainability, 9(5), 762.

Joergens, C. (2006). Ethical fashion: myth or future trend? Journal of Fashion Marketing and Management: An International Journal, 10(3), 360-371. doi:doi:10.1108/13612020610679321

Karana, E., Barati, B., Rognoli, V., & Zeeuw van der Laan, A. (2015). Material Driven Design (MDD): A Method to Design for Material Experiences 2015, International Journal of Design [Online].

Karana, E., Pedgley, O., & Rognoli, V. (2014). Materials Experience: Fundamentals of Materials and Design UK: Elsevier.

Linden, A. R. (2016). An Analysis of the Fast Fashion Industry
Senior Projects Fall 2016. 30. http://digitalcommons.bard.edu/senproj_f2016/30.

Markkula, A., & Moisander, J. (2012). Discursive Confusion over Sustainable Consumption: A Discursive Perspective on the Perplexity of Marketplace Knowledge. Journal of Consumer Policy, 35(1), 105-125.

McDonald, S., Oates, C., Thyne, M., Alevizou, P., & McMorland, L.-A. (2009). Comparing sustainable consumption patterns across product sectors. International Journal of Consumer Studies, 33(2), 137-145. doi:doi:10.1111/j.1470-6431.2009.00755.x

Mirza, K. (2004). Is green this season's color? Drapers, 21-.23.

Morgan, R. L., & Britwistle, G. (2009). An investigation of young consumers disposable habbits. International Journal of Consumer Studies, 33(2), 190-198.

Nielsen. (2015). The sustainable imperative. New insights on consumer expectations The Nielsen Company (US), LLC.

Niinimäki, K. (2010). Eco-clothing, consumer identity and ideology. Sustainable Development, 18(3), 150-162. doi:doi:10.1002/sd.455

Peters, R. M., Hackeman, E., & Goldreich, D. (2009). Diminutive Digits Discern Delicate Details: Fingertip Size and the Sex Difference in Tactile Spatial Acuity. The Journal of Neuroscience, 29(50), 15756-15761. doi:10.1523/jneurosci.3684-09.2009

Politowic, K., Goldsworthy, K., Granberg, H., MacLennan, S., & Telfer, D. (2017). A.S.A.P. (Paper Cloth). Textile Toolbox.

Remy, N., Speelman, E., & Swartz, S. (2016). Style that's sustainable: A new fast-fashion formula https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/style-thats-sustainable-a-new-fast-fashion-formula?cid=sustainability-eml-alt-mip-mck-oth-1610.

Sandin, G., & Peters, G. M. (2018). Environmental impact of textile reuse and recycling – A review. Journal of Cleaner Production, 184, 353-365. doi:https://doi.org/10.1016/j.jclepro.2018.02.266

Stevens, S. S. (1975). Psychophysics: Introduction to its Perceptual, Neural and Social Prospects. New York: Wiley.

Sudbury-Riley, L., & Kohlbacher, F. (2016). Ethically minded consumer behavior: Scale review, development, and validation. Journal of Business Research, 69(8), 2697-2710. doi:https://doi.org/10.1016/j.jbusres.2015.11.005

Tybout, A. M., Calder, B. J., & Phillips, L. W. (1981). Designing Research for Application. Journal of Consumer Research, 8(2), 197-207. doi:10.1086/208856

Wiederhold, M., & Martinez, L. F. (2018). Ethical consumer behaviour in Germany: The attitude-behaviour gap in the green apparel industry. International Journal of Consumer Studies, 42(4), 419-429. doi:doi:10.1111/ijcs.12435

Appendix 1

Concept	Item	source
Background	• Gender • age	Own
Clothing consumption/acquisition	How many items of clothing have you purchased during the last three months? • None • 1-4 • 5-9 • 10-15 • 15-20 • 21-25 • 26 or more At which stores do you typically acquire your clothes? Please indicate the most common for: • Physical stores • online Of which materials are the clothing you typically purchase made of? • Conventional material • Ecological material • Recycled material In the last 3 months, how often did you approximately acquire clothes from: *(Rated from 1=never to 7=always)* • High street • Shopping mall • Online shopping • Mail order • Small boutiques • Second hand • Supermarkets • Swapping markets • Other: (text box)	Gwozdz, W., Nielsen, K. S. & Müller, T. (2017). An environmental perspective on clothing consumption: Consumer segments and their behavioral patterns. Sustainability, 9(5), 762.
	Which factors were decisive for your last purchase? *(multiple choices possible)* • Price	Own

Concept	Item	source
	• Quality • Brand • Eco material or Eco label • Design • Newness • Other	
Fashion orientation	Please indicate how well the following statements describe you. *(Likert scale: 1=does not describe me at all, 7 describes me completely)* • Fashionable and attractive clothing is important to me • Keeping up with the latest fashion is important to me • *I spend considerable time and effort to learn about the latest fashion* • *I usually have one or more outfits of the very new fashion*	Gwozdz, W., Nielsen, K. S., Gupta, S., & Gentry, J. (2017). *The relationship between fashion and style orientation and well-being*. Retrieved from www.mistrafuturefashion.com: Selected items
Style orientation	Please indicate how well the following statements describe you. *(Likert scale: 1=does not describe me at all, 7 describes me completely)* • What I wear reflects my inner self • Who I am is clear in my clothing style • I typically purchase clothing I know will fit my personal style for a long time • I prefer clothes that are unique/rare • I prefer clothes that have a distinctive mode of tailoring	Gwodz, W., Nielsen, K. S., Gupta, S., & Gentry, J. (2017). *The relationship between fashion and style orientation and well-being*. Retrieved from www.mistrafuturefashion.com: Selected items from the latent variables uniqueness, longevity and authenticity.

Concept	Item	source
Understanding of sustainable fashion	When shopping for clothes, how often do you consider sustainability and ethical aspects: *(Labelled 4 category scale: Never, Rarely, Often, Always)* What does sustainable fashion mean to you: *(Choose one)* • Garments that last a long time • Ecological materials • Timeless fashion garments • Second hand • Does not interest me • Other (text)	
	What does sustainable fashion consumption mean to you: *(Choose one)* • Long durability of garment • To buy environmentally friendly garments • Wash using low temperatures and not too often. • Not buy new clothes that often.	
Information	Do you feel you have sufficient information about: (*Yes, No, and "Not now, but I know where to find information)* • Which brands has a sustainable/ethical clothing production? • Which materials are sustainable /least environmental impact? • Which environmental labels that exists for clothes? • Where I can dispose my old clothes for recycling?	Own

Concept	Item	source
Information	Where do you search information about sustainability of clothes? *(Multiple choices possible)* • In store • Read labels • Brand homepage • Social media • Organisational website, e.g. Sveriges Konsumenter • Do not search for such information • Other (text)	Own
Use phase	How many times do you usually wear a pair of jeans or a T-shirt from your closet? (*Choose one)* • Utterly rarely (once a year or less) • Rarely (less than every 3rd month) • Sometimes (at least once every other month) • Often (at least once a month) • Very often (at least once a week) How long do you usually keep a garment before discarding it? (*Choose one)* • Less than 6 months • Less than a year • 1-2 years • 3-4 years • 5 years or more	Gwozdz, W., Steensen Nielsen, K., & Muller, T. (2017). An environmental perspective on clothing consumption: Consumer segments and their behavioural patterns. Sustainability 9, 762, pp.1-27.

Concept	Item	source
End of life	How often have you discarded clothes in your closet because of? *(5-point scale: 1= Utterly rarely, 5=Very often)* • Material looks worn out (e.g. colour is fading) • Change of body shape, does not fit anymore • Does not feel new/trendy anymore • Need more space in wardrobe and drawers • It is cheap to buy new • Tired of/does not use anymore • Garment is broken, holes, seams etc. • Other (text) How do you discard unwanted garment? *(Choose one)* • Throw away • Second hand (e.g. Myrorna, Human Bridge etc.) • Clothes collection/recycling in store (e.g. KappAhl, HM, Hemtex etc.) • Recycling station • Other (text)	Own
Responsibility	Who do you consider responsible for making fashion industry more sustainable? *(Multiple choices)* • Fashion companies • The government/state • Local authorities • The individual consumer • NGOs • International authorities (UN, EU etc)	Innventia, & Kairos Future. (2016). Innventia International Consumer Survey, Consumer perceptions, Current Trends and the Role of Materials in a Bio-based Economy.

Mistra Future Fashion is a research program that focuses on how to turn today's fashion industry and consumer habits toward sustainable fashion and behavior. Guided by the principles of the circular economy model, the program operates cross disciplinary and involves 60+ partners from the fashion ecosystem. Its unique system perspective combines new methods for design, production, use and recycling with relevant aspects such as new business models, policies, consumer science, life-cycle-assessments, system analysis, chemistry, engineering etc.

MISTRA is the initiator and primary funder covering the years 2011-2019. It is hosted by RISE Research Institutes of Sweden in collaboration with 15 research partners.

FUNDED BY
MISTRA
The Swedish Foundation for Strategic Environmental Research

RI.SE