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FASHION AS THE NEXT SOCIAL MEDIUM?

A qualitative research into the considerations of fashion brands regarding offering smart interactive clothing

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Master thesis
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Abstract

Smart interactive clothing has the potential to constitute a new social medium as a communicative extension of the wearer. Research firms have been predicting its breakthrough for years, but penetration into the fashion industry is still awaited. Although many prototypes are ready for production, they are in need of investment from fashion brands to enter the market. To spark their interest, most research attention has focused on factors influencing consumer adoption, while the perspective of brands themselves has remained understudied. Insight into their deliberations could expose opportunities and barriers to anticipate on to facilitate market penetration. For this reason, qualitative research has been conducted to gain insight into the factors that play a role in the considerations of fashion brands regarding offering smart interactive clothing. Thirteen in-depth interviews with fashion brands and experts revealed that brands do expect to offer this innovation one day. However, most brands do not have a suitable infrastructure yet, combined with business models that are not aligned with the more demanding, human-centred and costly development of the innovation. For a successful and profitable introduction of this innovation, either large investments are needed or a change in mindset to rethink current business models and production processes.

Content

1. Introduction

Imagine yourself sitting behind your desk, working late to meet a deadline. You anticipated on this tough working day by putting on your favourite anti-stress shirt. Just when you think it is all getting too much, you feel the hands of your colleague pushing on your shoulder. No, this is not a form of unwanted intimacy, but an attentive colleague. Apparently, your shirt alerted that your stress-levels were getting too high and invited her to push on certain acupressure points, by lighting up those areas in the fabric. Slowly you feel the pressure drifting away from your body.

Sounds incredible right? But this is not as futuristic as it might yet seem. This shirt, the so-called 'e-Pressed Wearable' (see figure 1.1), and many other designs of smart interactive clothing, already exist, and are all set and waiting to break into the market (Toeters, 2019; Hertenberger, 2009). However, the large market demand of brands that is needed to get their production up and running is still awaited.

The creation of smart interactive clothing has come about by the miniaturisation of sensors, processors and communication technologies that can be integrated almost invisibly into all kinds of portable objects (Rawassizadeh, Price & Petre, 2015; Kimani, 2016). By now, such technologies can even be woven into fabrics, creating comfortable clothing with almost unimaginable possibilities to carry supportive and communicative functionalities with you every day. When those integrated technologies gain an interactive dimension, either towards the wearer, his environment or both, it is referred to as 'smart interactive clothing' (Lazaroiu, 2013; Lamontagne, 2017). Designer Ying Gao, for instance, integrated facial recognition technology in her dresses 'Can't' and 'Won't' (see figure 1.2), to enable the designs to read and react to facial expressions of passers-by and to only stop the movement of the fabric when emotions are detected at the on-lookers face (Acance, 2017; Gao, 2016). While reacting on the on-looker's emotions on the wearer's behalf, the clothing becomes a mediator in the wearer's social interactions (Lazaroiu et al., 2013). Smart interactive clothing is therefore no longer considered 'just' a tool, but becomes a communicative extension, acting as a mediator in the interactions of the wearer (Kimani, 2016; Van Dongen et al., 2019). Considering the expressive power clothing already has in itself as a communicator of the wearer's sociocultural status and individuality (Damhorst, 1990; Hwang, Chung & Sanders, 2016), the integrated functionalities add an extra communicative layer to the interactive clothing, turning it into a true communicative entity, worthy of communication-scientific attention.

With these social qualities, smart interactive clothing offers new opportunities for support in the effectiveness of our actions and social behaviour (Lazaroiu, 2013). These opportunities already go as far as being able to let clothes detect and communicate your emotional state to your environment through changes in patterns and colours, like Philips' Bubelle dress in figure 1.3 (VHM, 2006). Or monitoring the truthfulness of your conversational partner through the incorporation of speech recognition sensors and lie detectors, that give live feedback through electric shocks and on-board lights in the clothing, visible in figure 1.4 (Coleman, 2016). In addition, the ability to monitor social behaviour and physical functioning, provides opportunities to support mental and physical health care through faster detection and communication of abnormalities, such as an irregular heart rhythm (Dunne, 2010).

Figure 1: 1. E-pressed shirt. Retrieved from A. Hertenberger, 2009 (http://awarenesslab.nl/e-pressed/shirt.html);
2. Can't and Won't. Retrieved from Y. Gao, 2016 (http://yinggao.ca/interactifs/neutralite--cant-and-wont/);
3. Bubelle dress. Retrieved from VHM, 2006 (https://www.vhmdesignfutures.com/project/224/);
4. The Holy Dress. Retrieved from M. Coleman, 2016 (https://melissacoleman.nl/holydress).

The prospects for market penetration of smart interactive clothing seem positive. Research firm Juniper Research foresees the largest growth in the wearables industry for 'connected clothing' in the 2018-2022 period (Moar, 2018). A growth that the International Data Corporation predicts to reach nearly 76 percent (MarketWatch, 2019; IDC, 2018). According to Amanda Parkes, Chief Innovation Officer of Future Tech Lab, interactive clothing could even make the use of wearables redundant (Libbenga, 2018).

Nevertheless, smart interactive clothing is still nowhere to be seen in the streets and not because of the invisibility of the integrated technologies. An orientational conversation with fashion tech designer Marina Toeters (M. Toeters, personal communication, December 11, 2019) sheds light on this issue. According to Toeters, many prototypes and smart fabrics are ready for production and available on a small scale. For a real break into society however, the designs are in need of large investments that result from market demand. From Toeters' experience, the barrier lies with the brands. The clothing manufacturers behind the brands are

generally a lot more prosperous, have tested interactive features and fabrics and are waiting for fashion brands to demand production. A similar experience is shared by American top supplier Tri-Mountain, who has been developing smart garments for a few years already, but has yet to see one of these pieces being brought to market (Ruvo, 2017). The textile and clothing industries do not seem to be sufficiently engaged to make that happen (Lymberis & Paradiso, 2008).

This situation raises questions with regard to what factors could be holding fashion brands back from investing in smart interactive clothing. A Berkeley research report (Hanuska et al., 2016) discussed the issue related to the markets of athletics, the military industry and healthcare - the general fashion industry left aside - and found several technical and aesthetical barriers that the continuous development of the clothes will probably need to remove, except for the issue of data privacy. After all, the interactive side of the clothing mostly functions on the processing of personal data. Whether concerns regarding data privacy are also hindering the market penetration in the fashion industry is to be expected, since awareness of privacy issues and the (mis)use of data has increased considerably in recent years, awakened by events such as the Cambridge Analytica scandal and the establishment of the General Data Protection Regulation (Lamontagne, 2017; Schneble, Elger & Shaw, 2018; Utz et al., 2019). The countering of surveillance concerns might therefore require data management and security to become an important part of business operations (Amyx, 2017). Although the collection of data can be beneficial for companies to generate detailed consumer profiles (McAfee et al., 2012), one may wonder whether fashion brands are willing to defy the risks of data leakage and image damage, to reap the benefits of the data collected through smart interactive clothing (Amyx, 2017).

Companies might therefore have to weigh the benefits and risks of data-driven interactive clothing, while taking into account the demands of consumers who might be making a similar trade-off between benefits and risks of data disclosure, also referred to as the privacy calculus (Laufer & Wolfe, 1977). Regarding the adoption of healthcare related smart clothing, such as ECG-monitoring shirts, consumers indeed appear to make use of a privacy calculus (Li et al., 2016). The use of such a calculus by brands, however, has yet to be confirmed.

For this reason, a privacy-calculus perspective will be incorporated in this research to investigate if and to what extent privacy concerns are indeed being taken into consideration, by exploring what factors brands weigh against each other in the decision-making process regarding offering smart interactive clothing to their customers.

The study into the brand calculus will have societal relevance, as the results of the study will shed light on factors that must be overcome to successfully launch smart interactive clothing, even before penetration into society has taken place. This information will prepare investors, interested designers, brands and manufacturers to anticipate on possible opportunities and barriers before making their move.

Because of the newness of the innovation, scientific research into smart interactive clothing is still relatively scarce and - to the researcher's knowledge - no qualitative research has yet been done into factors influencing interactive clothing adoption from the brand-side. This is surprising, since the exploration of this emerging innovation requires qualitative research to expose the breath of influencing factors, whereas quantitative research can only test the effects of premediated factors. Furthermore, the research that has already been done into interactive clothing has mainly focused on factors - including privacy issues - that influence consumer acceptance (Kalantari, 2017; Li et al., 2016; Schaar & Ziefle, 2011). A meta-study concluded for instance that consumers are looking for meaningful functionalities that offer added value above the functionalities of their smartphones, which requires a "human-centred design process" (Kalantari, 2017, p. 300). Knowing what the consumer wants, brings us back to the fashion brands, since their investment is essential to bring the consumer into contact with smart interactive clothing at all. Considering the fact that these brands have the capacity to bring an innovation to the market with the potential to influence our communication as mediators in our interactions, calls for research from a communication-scientific perspective.

Although the perspective of potential consumers on smart interactive clothing is of interest for brands who consider offering such clothing, we focus in this study solely on the brands, as the perspective of brands compared to that of consumers has been understudied. A focus on the brand calculi is therefore needed to be able to complete the research into the consumer adoption and to create a complete understanding of the current situation and the factors influencing a successful launch of smart interactive clothing in the fashion industry.

The purpose of this study therefore reads as follows: *Gain qualitative insight into the factors that fashion brands include in their (privacy) calculus regarding offering smart interactive clothing, in order to get a better understanding of what factors are influencing the introduction of this innovation in the fashion industry.*

2. Theoretical Framework

Based on scientific literature, this chapter will first discuss what is known about smart interactive clothing and how it functions, to gain insight into factors that may play a role in the brand calculus regarding offering smart interactive clothing. Since privacy concerns are expected to be included, the risks and benefits of offering data-driven clothes will subsequently be discussed. Thereafter the possible added brand value of smart interactive clothing will be discussed and the financial and strategic investments that successful development and implementation may require. The chapter will be concluded with the problem definition and the related research questions.

2.1 What is smart interactive clothing?

The meaning of the term 'smart interactive clothing' can best be explained in comparison with the innovations 'wearables' and 'smart clothing', of which it can be considered an extension. Wearables, as derived from Mann's 'wearable computing' (1998), encompass a wide range of body-worn technological devices that create human-computer interaction (Gouge & Jones, 2016). When such technologies are integrated in clothing, many terms are used of which the best known is 'smart clothing', which one defines as "a "smart system" capable of sensing and communicating with environmental- and the wearer's conditions and stimuli" (Cho, Lee & Cho, 2010, p. 1). When the latter characteristic is the case - the integrated technology becomes communicative, which allows it to function as a mediator in the interactions of the wearer - one finally speaks of smart interactive clothing (Van Dongen et al., 2019; Suh, Carroll & Cassill, 2010). The clothes then become interactive, while functioning as a communicative extension of the person (Lazaroiu et al., 2013). According to Toussaint (2018) these garments "allow wearers to learn, show and express something about themselves, as well as to communicate and socially interact with others in unprecedented ways" (p. 192)

2.2 How does it function?

The technologies integrated in smart interactive clothing (hereafter indicated as SIC) streamline and process data, before they feed information back to the wearer via a visualisation interface and/or act on it to support the wearer in the actions on which the functionalities of the technologies are aimed (Lamontagne, 2017). There are two primary methods to implement 'intelligence' into the clothing to make it smart (Wei, 2018). The first uses smart textiles that have sensing and actuation properties, while the second makes use of microelectronics technology and information technology, "including the application of conductive material,

flexible sensors, unlimited communication technology and power supply." (Wei, 2018, p. 2). However, the possibilities are endless. "Technology is no longer 'just' electronics or mechatronics, but now bleeds into biology, chemistry, artificial intelligence, and rapid prototyping" (Lamontagne, 2017, p. 22). The development of nano-technologies enables increasingly unnoticeable integration of technologies, responsive textiles are able to change their properties and structure in response to small variations in the environment, energy harvesters can be integrated for years of power supply without requiring recharge or replacement, and even perfumes, vitamins and drugs can be incorporated in textiles for controlled release (Torah et al., 2018; Lamontagne, 2017; Lazaroiu et al., 2013).

The use of artificial intelligence (AI) has brought the interactivity of SIC to a next level. The possibility to integrate AI innovations such as speech recognition in the Holy dress (figure 1.4), and facial recognition in the designs Can't and Won't (figure 1.2), enables the measurement and communication of inner states, like emotions and attitudes, which are already difficult to detect for humans themselves. Machine learning enables computers to train themselves with algorithms, by which they become better at performing tasks and learn to communicate from their own initiative (Ketelaar et al., 2019). When applied to SIC, such 'intelligent' computers can extract meaning from an enormous amount of rich context information, such as conversations, sound, posture, and facial expressions, by learning the correlations between the actions of the wearers and the environment they are in (Billinghurst & Starner, 1999). Through this learning, the information offered increasingly meets the needs of the wearer (Van der Zwaag, 2019; Billinghurst & Starner, 1999). When these possibilities further develop, the insertion of AI in SIC might enhance our clothes "to become human's closest aides" (Wei, 2018, p. 2).

2.3 Data collection and privacy issues

The fact that SIC functions on the processing of data raises concerns regarding the ethical handling of the data. Although it is possible for some functionalities to make the clothing self-contained and thus without any connections to external data bases or computers, more complicated and personalised functions generally do need these external connections. This involves the tracking, sharing, quantifying and commodifying of all kinds of information measured on the wearer and the environment. Because the clothes are worn in close proximity to the body, very intimate and often biological data are exposed, which people normally prefer to keep to themselves (Toussaint, 2018; Dunne, 2010; Marx, 2006). This seems to conflict with article 11 of the Dutch constitution: the right to physical integrity, which means that all citizens

can decide for themselves what happens to their body, who touches it and which actions are performed on it (De Nederlandse Grondwet, n.d.). Although people can decide for themselves whether or not to put on SIC, it seems that control is lost over how the body is touched by the clothing, and what actions are being performed by it and with the obtained data. Others even get involved, as the garments can track information from the wearer's surroundings, including the geographical location and the behaviour of people standing in proximity to the wearer (Toussaint, 2018). The subject of surveillance thus extends from just the wearer to "settings and patterns of relationships" between people and objects (Marx, 2002, p. 12). Almost the perfect reflection of the surveillance being discussed in the tracking of the spread of Covid-19.

Knowing who has access to this personal and relational data is of great importance, since the clothes can "track people for the sake of health, safety, or protection while also – or even simultaneously – being used for the sake of governing, regulating, influencing, and managing their behaviour" (Toussaint, 2018, p. 178). Insurance companies, for instance, are already biomonitoring the data from users of wearable technologies to adjust healthcare costs accordingly (Parviainen, 2016). The amount of data being gathered from wearers throughout the day, paired with the evolving security needs of the technology and the ease with which data silently travel across borders, increase the difficulty to control the accessibility and surveillance by other parties at all times (Amyx, 2017; Surveillance Studies Network, n.d.). These risks can cause wearers to feel spied upon or even forced into specific exemplary behaviour, which evokes the fear of intrusion (Toussaint, 2018; Melenhorst et al., 2004). Although the physical obtrusiveness of SIC decreases due to the increasingly invisible integration of technologies (Paradiso & Pacelli, 2011), intrusiveness in the sense of privacy invasion and security risk may only increase when data-driven objects, like SIC, continue to gain popularity (Melenhorst et al., 2004).

2.3.1 A privacy-calculus perspective

Knowing that the data disclosure needed to exploit the full potential of SIC will be accompanied by privacy risks, consumers can be expected to constitute a risk-benefit privacy calculus when deciding whether or not to adopt the clothing (Laufer & Wolfe, 1977). Although this theory is originally conceived from consumer perspective, brands could be expected to make a similar trade-off when managing these personal data.

On the one hand, the all-day biomonitoring of SIC is beneficial to fashion brands, since it produces nearly real-time consumer information that can directly be translated into improved decision making and performances (McAfee et al., 2012). It allows brands to adopt a customer-centric orientation in designing their business strategies, which enables precision marketing,

facilitating personal targeting, new product development, and the realignment of business strategies to maintain a "sustainable competitive advantage" (Xie et al., 2016, p. 1037).

On the other hand, to reap the full benefits of the massive data collection, it has to be managed effectively and in a sufficiently secure manner to protect the customers and the companies' image (McAfee et al., 2012). Companies will therefore have to invest in professionals skilled at protecting, cleaning and organizing large data sets to be able to extract useful patterns, plus the required tools to handle the volume, variety and velocity of the data (McAfee et al., 2012). This comes down to a major strategic investment to ultimately benefit from the advantages of the data collection.

Thus, where the privacy calculus for consumers concerns the risk-benefit trade-off regarding the disclosure of personal data, the brand privacy calculus could concern the trade-off regarding the handling of these disclosed consumer data.

2.3.2 The privacy paradox

However, multiple researchers are doubting whether privacy decisions are made as rationally as is assumed by the privacy calculus theory (Acquisti & Grossklags, 2005; Compañó & Lusoli, 2010; Knijnenburg, Kobsa & Jin, 2013). We seem to trade our personal data easily for each new interesting functionality, a so-called "price of convenience" (Ketelaar & van Balen, 2018, p. 176). Studies even reveal an average price of £20 for respondents to willingly give away their location data (Cvrcek et al., 2006; Danezis et al., 2005). Our degree of concern, in fact, seems to be "inversely proportional to our level of comfort and familiarity with technology" (Hopkins, 2019, p. 5), also referred to as the 'privacy paradox' (Barnes, 2006). Several studies indeed confirm this paradox, showing that participants disclose a significantly greater amount of data than stated intentions and trust-perceptions indicate, and that the more we get familiar with data-driven technologies, the less we are concerned with our privacy (Norberg, Horne & Horne, 2007; Bergström, 2015). Despite the aforementioned privacy risks, the growing familiarity with data disclosure - especially for the emerging generation of 'digital natives' that has grown up in a completely digitalized world - might then be leading to privacy matters playing an increasingly smaller role in the (privacy) calculus of the consumer, and consequently in the brand calculus (Hamelmann & Drechsler, 2018).

2.4 Brand value

Regardless of whether or not SIC evokes privacy issues, it can be expected that the introduction of interactive clothes will express a vision about the strategy a brand pursues. Discussions about

the value of SIC will therefore most likely also include considerations about the image it portrays and the brand value it can deliver.

According to Campbell (2002) "strong brands start with differentiation, understanding and building how it is they are different from the competition" (p. 215). It is the driver on which consumers base their selection and creates associations that consumers link to the brand (Campbell, 2002). One way to achieve such a differentiated position is through branding with innovations. As a relatively unknown innovation, SIC could appeal to consumers due to its innovative, almost futuristic character, and the support it can offer as an enhancer of our natural capacities (Tamminen & Holmgren, 2016). This could influence the brand image with progressive associations, but also with caring associations, based on the fact that SIC can actually get to know the wearer and train itself to better assist the wearer in the daily activities and interactions (Dunne, 2018; Wei, 2018). Furthermore, the constant development of integrable functionalities ensures that brands who choose to differentiate with this innovation can continue to innovate to live up to their brand promise. This is important since branding creates a brand promise that must be nurtured to keep satisfying the customers attracted by the brand image the branding has created (Campbell, 2002; Holt, 2016).

2.5 Consumer acceptance

The associations that accompany SIC, however, will not match with every brand and consumer type. The social identification theory states that individuals have a need for group belonging, and therefore categorise others according to similarity of identity to the self, labelling those with more similarities as ingroup members and others as outgroup members (Hogg & Abrams, 1988). This categorisation extends to organisational settings, since individuals tend to select those brands that help them enhance their self-expression within their group identity, which further increases their brand loyalty (Ashforth & Mael, 1998; Kim, Han & Park, 2001). Changing course by offering SIC could therefore be considered a bold move, since individuals not only base their purchase decision on personal interest, but also on the evaluation of their social ingroup (Hogg & Abrams, 1988; Kalantari, 2017). The change of brand identity thus risks the loss of loyal customers who can no longer identify and express themselves with the brand image (Fernández-Caramés & Fraga-Lamas, 2018).

To increase the chances of successful consumer adoption, many studies have looked into factors that facilitate adoption, of which most are based on the classical Technology Acceptance Model (TAM) of Davis (1989). Interestingly, the TAM assumes that the attitude towards using an innovation is governed by its perceived usefulness and perceived ease of use,

which doesn't take the aforementioned role of ingroup identity into account. Since clothing in itself already carries an important expressive value of identity (Damhorst, 1990), the TAM might not be sufficient to study technological fashion innovations. Van Heek et al. (2014) therefore added several user-diversity factors to this model, which indeed appeared to play a crucial role in the acceptance of SIC. Brauner, Heek and Ziefle (2017) thereafter created the Smart Textiles TAM (STTAM), which confirmed social influence to be one of the key predictors of acceptance, next to habit, hedonic value and performance expectancy of the interactive textile. In addition, those effects were stronger for younger and male consumers, whose general attitude toward technology also appeared to be more positive (Brauner et al., 2017). Kalantari's meta study further concluded the need for a human-centred design process in which individual characteristics and social factors (e.g. personality traits and image regulation), technology characteristics (e.g. comfort, aesthetics and visibility of technology), and perceived benefits and risks (e.g. perceived usefulness and privacy risks), should be taken into account (Kalantari, 2017). Incorporation of the latter two factors confirms the influence of a (privacy) calculus (Laufer & Wolfe, 1977).

Knowing that privacy risks are taken into account, it can be expected that because of the need to disclose personal data, consumers will only select a few trusted brands as the protectors of their personal bio-signals (Fernández-Caramés & Fraga-Lamas, 2018). Loyalty and brand awareness might therefore play a role in deciding which brands are going to dominate the sector (Fernández-Caramés & Fraga-Lamas, 2018). Brands who aim to increase loyalty and brand awareness through branding with SIC, should therefore already possess these characteristics to some extent, investigate their target group's characteristics and needs, and pursue a vision in which they will keep experimenting with innovative garments to maintain the customer loyalty (Fernández-Caramés & Fraga-Lamas, 2018; Holt, 2016).

Moreover, the possibility of a novelty effect in the adoption of SIC should be noted, i.e., a discontinued use of SIC after the 'newness' of the innovation has faded, which has been found in longitudinal research regarding the adoption of the closely related activity trackers (Shin et al., 2019). In fact, the study showed that continued use after the novelty period did not have to do with the device or its features, but mostly with the social and personal context of the user, emphasizing the need for thorough consumer research (Shin et al., 2019).

Taking into account all these requirements, one could justify brands being cautious to adopt SIC. However, the extent to which brands are aware of all these factors and how this affects their attitude towards SIC, remains to be investigated.

2.6 Developing smart interactive clothing

To actually get SIC to the right target group, the previously discussed requirements facilitating consumer adoption should be aligned with those of the manufacturers, which turns the development of SIC into an intricate process (Cho, 2010). Compared to wearables, design choices also have a bigger impact for SIC, since carried devices only reflect a part of the identity as an external entity, while the intimately worn smart garments reflect the user's identity in a much bigger sense (Dunne, 2010). Considering the expressive value clothes already have as visualisers of a person's identity, this gets extended with the communicative value of the integrated functionalities (Damhorst, 1990; Lamb & Kallal, 1992; Lazaroiu et al., 2013). Brands therefore also need to consider how the visibility of the interactive functionalities converges "with the social and stylistic reading of the garment/design" (Tomico et al., 2017, p. 4). Additionally, a difference between impressive (for the self) and expressive (to show others) purchase intentions could affect the preference for visible or invisible integration of the functionalities, making design directions even more uncertain (Kapferer & Bastien, 2009).

Manufacturing SIC while integrating all the design needs is a complex process, since it requires the collaboration of two industries – the electronic industry and the clothing industry - which are not used to working together and unfamiliar with each other's processes and materials (Dunne, 2010). For this reason, "most commercial products in the area of wearable technology are creations of either fashion or technology companies, approaching the subjects with their traditional approaches" (Uhlig, 2012, p. 16-17). This insufficient convergence hinders the full integration of the design needs, which according to Ariyatum and Holland (2003) needs to be overcome before SIC can conquer mass markets.

2.7 Money matters

One can imagine that the development of SIC in the current situation becomes a relatively risky and costly endeavour. Electronic processes are precise and expensive, while the fashion industry is used to low-cost production with less accurate requirements (Cherenack & van Pieterson, 2012). Since the integration of electronics into clothing is still far from being automated, such low-cost manufacturing can only be achieved when large-area fabrication methods from both industries can be combined almost seamlessly, which is not yet the case (Cherenack & van Pieterson, 2012; Dunne, 2010). Market research firm Mordor Intelligence (2020) therefore foresees high manufacturing costs leading to costly end-user products, to be one of the main restraints to the growth of the market in the next five years. Adding up the costs associated with securing good data management, purchasing the needed tools, researching

consumer needs and changing business strategies, brands will have to carefully consider what benefits may outweigh these costs. Although it can be imagined that the elevated production costs will be translated into higher selling prices, it remains uncertain whether the brand's target group is willing to pay more for the functionalities integrated in the clothing (Cho, 2010). When establishing the prices for SIC, the question should thus be asked as to whether the prices reflect the value for the consumer (Dvorak, 2008).

2.8 Problem definition

Whether SIC can indeed offer such a value to consumers as well as to brands has yet to be confirmed. The ability of the innovation to extract information from data that wearers cannot easily extract themselves, enables faster identification of abnormalities and the enhancement of our social and physical capabilities (Toussaint, 2018; Lazaroiu, 2013). Thus, having the potential to improve wearers' lives, the optimistic predictions of the research firms can be explained. However, to be able to enjoy those advantages, a fairly high price must be paid by both the wearers and the brands. It remains uncertain what price the consumer is willing to pay for the clothing - in money as well as in the disclosure of personal data, which adds up to the risks concerning investment in proper data management, consumer research, clothing development and brand positioning.

Due to the lack of research into the considerations of brands regarding offering SIC, little is known about what benefits and risks assumed by the scientific literature brands are actually aware of, and thus which factors are truly included in their (privacy) calculus. In fact, the importance of privacy in this calculus has yet to be confirmed. Moreover, these considerations are contextually bound, and might therefore differ for each brand. It should therefore be noted that this research is not aimed at finding all the factors involved, but at gaining a better understanding of the relationships between factors that different brands include in their calculus, in order to gain a better understanding of reasons why fashion brands choose whether or not to add SIC to their collection at the present time.

In order to investigate this issue, the central question in this study reads as follows:

> *What factors play a role in the calculus of fashion brands regarding offering smart interactive clothing?*

In order to arrive at a balanced answer, the three following sub questions have been formulated:

1. *What potential benefits do fashion brands see in offering smart interactive clothing?*
2. *What concerns do fashion brands experience about offering smart interactive clothing?*
3. *How do the benefits and concerns of fashion brands regarding offering smart interactive clothing relate to each other?*

3. Methods

3.1 Qualitative research

Considering the fact that SIC has not broken into society yet, and the considerations of fashion brands regarding investment in it have barely been studied, the investigation of this subject is exploratory in nature. When this is the case, qualitative research is the preferred research method, since it allows for unanticipated responses and gives the flexibility to probe initial responses of the participant (Mack et al., 2005). Rather than forcing participants to choose from several fixed responses, as with quantitative methods, qualitative research makes use of open-ended questions, which can evoke rich and nuanced answers that reveal a diversity of perspectives (Braun & Clarke, 2013). In this way, a deeper understanding can be gained of how different compositions of brand calculi influence the introduction of the innovation by fashion brands.

According to Hijmans and Wester (2006), in-depth interviews are suitable for exploratory qualitative research, as it provides respondents the opportunity to share their own experiences, motives and concerns, through which they give meaning to the phenomenon, in their own words. A semi-structured interview design will therefore be used, which leaves scope for participants to raise issues that have not been anticipated, while overseeing that all premediated topics of the topic list are sufficiently discussed (Braun & Clarke, 2013).

3.2 Research design

Qualitative research is cyclical in nature and has a phased structure. The three main phases; observation, analysis and reflection, continuously alternate (Wester & Peters, 2009). Moreover, the researcher constitutes both the instrument of observation and of analysis (Braun & Clarke, 2013). To maintain a good overview and to ensure the imitability of the research, it is therefore important to maintain a structured research design (Braun & Clarke, 2013), which will be explained below.

3.2.1 Participants and recruitment

In total, 13 participants across the globe have participated in this study (see table 1). For the selection of participants, first purposive sampling was used, because this design allows for "the selection of information-rich cases" (Hutchinson et al., 2007, p. 102). Such cases were desirable, since having some knowledge on the subject can lead to a more in-depth discussion. For this reason, not only employees of fashion brands were selected, but also several experts in

the field of retail, (fashion) tech and trend forecasting. Consulting such experts offers the opportunity to zoom out from specific brands to the entire breadth of the fashion sector, and to sketch a general and explanatory picture of factors that play a role in the adoption of SIC in the fashion industry.

After a few interviews, theoretical sampling was used to find participants that could approach the subject from a different angle and help to "sharpen, confirm or correct the previous findings", in order to create a nuanced view of the brand calculi in the diversity of perspectives (Plochg & van Zwieten, 2007, p. 81). International respondents were included, for instance, to highlight market- and culture-specific influences on the composition of the brand calculi, and a healthcare innovation expert to compare findings with the perspective of an interested party from another sector. Fashion brands were selected primarily on the basis of a progressive and/or popular image, since it is expected that such companies actually have the capacity and attitude to experiment with SIC and possibly already do so, which could lead to more lively and insightful conversations. All brands operated in the premium and luxury market segments or identified themselves as mass-market leaders.

For the recruitment, the network of the researcher was used to spread messages to relevant connections on LinkedIn and via email. Participants were also asked to recommend acquaintances. This snowballing technique (Braun & Clarke, 2013) was added, because of the network-based structure of the fashion industry, in which introductions from other names in fashion substantially increase the willingness to cooperate (The Fashion Network, 2018). However, to ensure the information-richness of the respondents, every person was screened before contacting, to match with the theoretical sampling technique. In qualitative research, saturation is generally sought when determining the amount of research units (Braun & Clarke, 2013). However, due to the diversity of perspectives sought, ensuring full saturation would be nearly impossible. Nevertheless, the 13th respondent, an experienced interactive clothing designer, naturally discussed and expanded on almost all previously discussed factors, whereby a degree of saturation seems to have been reached nonetheless.

Table 1: Respondent characteristics

Resp. nr.	Brand (B) Expert (E)	Position	Company	Segment / *Sector*	Category	Country of residence	SIC Experience
R1	B	Content strategist	Tommy Hilfiger	Premium	Casual	Netherlands	Yes
R2	E	Futurist	-	-	-	Netherlands	No
R3	B	Supply Chain & Development	Nike	(mass) Market leader	Sports	Netherlands	Yes
R4	E + B	Inspirator and innovator *Previously:* Managing Director Buyer / Manager	InRetail (Sector-organisation in retail non-food) Clous Fashion Group Euretco	*Retail*	-	Netherlands	No
R5	E	Coordinator innovations team	Zozijn Zorglab (test lab for healthcare technology)	*Healthcare*	-	Netherlands	Yes
R6	E	Retail and F&B Acquisition Associate	City of Eindhoven Diamon Expert Network (Global advisor for retailers and brands)	*Retail & Fashion*	-	Netherlands Sweden	No
R7	E + B	Professor in entrepreneurship and retail marketing *Previously* Director	Fontys Triumph International, Hunkemöller, Mac & Maggie	*Fashion* (Mass) market leaders	 Lingerie Avant-garde	Netherlands Germany	Yes (Triumph)
R8	E	Co-Founder	MORGENFRISK (Advisor on optimisation of data-driven marketing)	*Marketing*	-	Netherlands	No
R9	B	Product manager	Baby and toddler brand[1]	(mass) Market leader	Baby & Toddler	Netherlands	No
R10	B	Senior handbag and accessories designer	Liebeskind	Premium	Accessories	Germany	No
R11	B	Co-founder / Designer	Rabôt *Previously:* Current/Elliot, Free People, Abercrombie & Fitch, Club Monaco, Ralph Lauren, Zac Posen	Luxury	Women's Evening	Los Angeles, USA	No
R12	B	Founder Creative Director	(Owner holds brand name) FOORIAT	Luxury Premium	Avant-garde	Poland	Yes
R13	E + B	Founder, designer & researcher in fashion tech Wearable technology consultant	SIC studio (Owner holds brand name) Holst Centre	*Fashion*	-	Netherlands	Yes

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[1] The respondent preferred the brand to remain anonymous

3.2.2 Procedure

Semi-structured interviews were conducted to collect the data, which entails the use of a topic list that served as a guide during the interviews. Because of the difference in focus on specific brands and the fashion sector in general, separate topic lists and interview guides were made for the two groups of respondents (see appendix 1-2.2)[2]. The main topics discussed in the theoretical framework of chapter 2 (e.g. brand value and product development), formed the basis for the structure of the topic lists, after which several sensitizing concepts were selected based on the theoretical findings regarding these topics, such as the match of SIC with the company vision. Such sensitizing concepts form "a starting point in thinking about the class of data of which the social researcher has no definite idea" (van den Hoonaard, 1997, p. 2), and thus help to structure and guide perception (Patton, 2015). Following Baarda and van der Hulst (2017), topics were structured in a sense that easier topics preceded more difficult topics. Constant reflection during data collection led to several adjustments to optimise the topic lists and interview guides. The interview guides consist of the basic structure of the topic lists, completed with example follow-up questions. Before each interview, some research was done to tailor follow-up questions to the respondent, in order to get most information out of topics matching the respondents' expertise. During the interviews, the topic lists were used to give the interviewer an easy manageable overview of topics to discuss and leave scope for unanticipated answers to guide follow-up questions.

Due to the outbreak of the coronavirus it was necessary to conduct interviews online through video and telephone calls, which on average lasted 50 minutes. Online interviews have the disadvantage that some forms of information, like visual and emotional cues, are lost, and the context in which the respondents find themselves can shape responses (Braun & Clarke, 2013). Due to technical problems, noise also caused some statements to not be fully understood. However, the possibility to join the conversation from home possibly created a more comfortable setting, which facilitates discussions of sensitive topics (Braun & Clarke, 2013), such as ethical deliberations. Also, the fact that geography was not a limitation, allowed for interviews with respondents located across the globe.

At the beginning of each interview, respondents gave informal consent for the recording of the interview. To guarantee the anonymity of the respondents, the transcripts were

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[2] For interviews with Dutch respondents, the interview guides and topic lists were translated in Dutch. The translated versions are available in the digital appendix.

anonymised, and both the recordings and transcripts were deleted after completion of the research.

3.2.3 Data analysis

After transcription of the recordings, the data was analysed through an inductive thematic content analysis with the use of the software MAXQDA. In a thematic analysis one searches for and identifies common threads that can be found throughout the entire set of interviews (Morse & Field, 1995). To find those common threads, the three coding phases of the spiral of analysis were followed (Boeije, 2010), starting with the open coding. In this phase, the transcripts were thoroughly read and each fragment relevant for the research question was assigned a specific code. During the axial coding, the researcher revised and reduced the set of codes, and organised them into main themes and subthemes. In the final phase, the selective coding, all themes were revised and structured into a clear scheme. As the 'spiral' in the name of this method already suggests, the different phases constantly alternated, as constant comparison led to revisions and adjustments (Boeije, 2010). When the final structure of the network of themes was established, it was visualised into a concept-indicator model (see figure 2). This model functioned as a guide throughout the writing phase that followed. To ensure theoretical sensitivity (Braun & Clarke, 2013), results from the analysis were frequently contextualised in relation to the theoretical framework.

3.3 Quality requirements

Qualitative research differs from quantitative research, among other things, in that procedures are not completely fixed. To optimally guarantee the reliability and validity, it is therefore crucial to work systematically. This increases the imitability of the research, which allows for intersubjective verification. The systematic measures that have been taken, will be explained hereafter.

3.3.1 Reliability

In qualitative research, the engagement of the researcher with participants, and the involvement in both observation and analysis, makes it hardly if at all possible, to recreate the same results. To guarantee the reliability one therefore strives for transferability, which "refers to the extent to which (aspects of) qualitative results can be 'transferred' to other groups of people and contexts" (Braun & Clarke, p. 282). To enhance this quality requirement, the participants, circumstances and all steps of the research method have been described in detail in this chapter. Furthermore, the topic lists and interview guides have been added in appendix 1-2.2 and the

transcripts and MAXQDA files are available upon request. By writing short memos throughout the research process (see appendix 4), the researcher kept track of unexpected findings and events that could have changed the course of the process.

3.3.2 Validity

In qualitative research, validity is about applying the research methods with integrity and accurately reflecting the data in the findings (Noble & Smith, 2015). To demonstrate the latter, the measure of thick description was taken, which requires the addition of illustrative quotes to support the findings in the results section (Braun & Clarke, 2013). Moreover, to ensure the correct interpretation of the statements of the interviewees, member checks were used throughout the interviews and by the end of each interview the main findings were briefly summarized, allowing the participant to correct or rephrase the interpretations (Kornbluh, 2015). As a third measure, triangulation was used to approach the topic from a different angle and try to find the fixed core in the answers (Wester & Peters, 2009). A different questioning technique was used for this, in which the brand respondents were shown four images of SIC designs (see appendix 3) that differed greatly in terms of (in)visible integration and types of functionalities, and asked to explain again what designs would best suit the brand and why. The pictures were not used for the experts, because they could not speak from the position of a specific brand, which could lead to mostly speculative answers. As a final measure, the interpretations of the data were reviewed by fellow master students as a measure of peer debriefing (Wester & Peters, 2009), to verify the integrity of the interpretations.

4. Results

This chapter discusses the results of the interviews with brand employees and owners, and a wide variety of industry experts (hereafter distinguished as 'brands' and 'experts'). As expected of a network-based industry, appeals and recommendations by acquaintances considerably increased the willingness to participate and even led to some experts reaching out themselves. The interview analysis reveals five main themes that fashion brands deliberate on when considering offering SIC. These themes are elaborated on below, followed by the discussion of two themes that are not a fixed part of the calculus, but do impact the interpretations of the themes, thereby influencing the composition of the calculus. Figure 2 presents a visualisation of the themes and their main relations in a concept-indicator model.

4.1 Economic deliberations

Fashion brands are commercial organisations, which accounts for the finding that most arguments of the respondents come down to the expected profitability of offering SIC. This often leads to a risk avoiding attitude in which a wait-and-see policy can be detected. This means that brands take a follower position in which they wait for others to initiate the innovation and depending on the consumer acceptance decide to come along. The brands that already experimented with SIC also identify themselves as risk takers who see more of a risk in missing the boat and losing their frontrunner position when not introducing SIC. However, they also admit this to be facilitated by their financial buffer, which allows them to take such a financial risk (see relation R1 in figure 2).

> R3: *Nike also has such deep pockets. [...] If it does not work as they expected, that is just a pity. But they can't risk missing the boat if it catches on and someone else develops it* (305). [3]

For other brands, however, the investments required to introduce the clothing do matter. Some also indicate they will only introduce SIC if the production becomes more cost-effective. This also relates to the fact that most fashion brands do not have a suitable company infrastructure yet to be able to produce the clothing, plus the fact that their business models are not aligned with the higher costs and the more personal design needs of clothing with an interactive element, as indicated by crossed line R2 in figure 2.

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[3] Quotes from Dutch interviews have been translated to English.
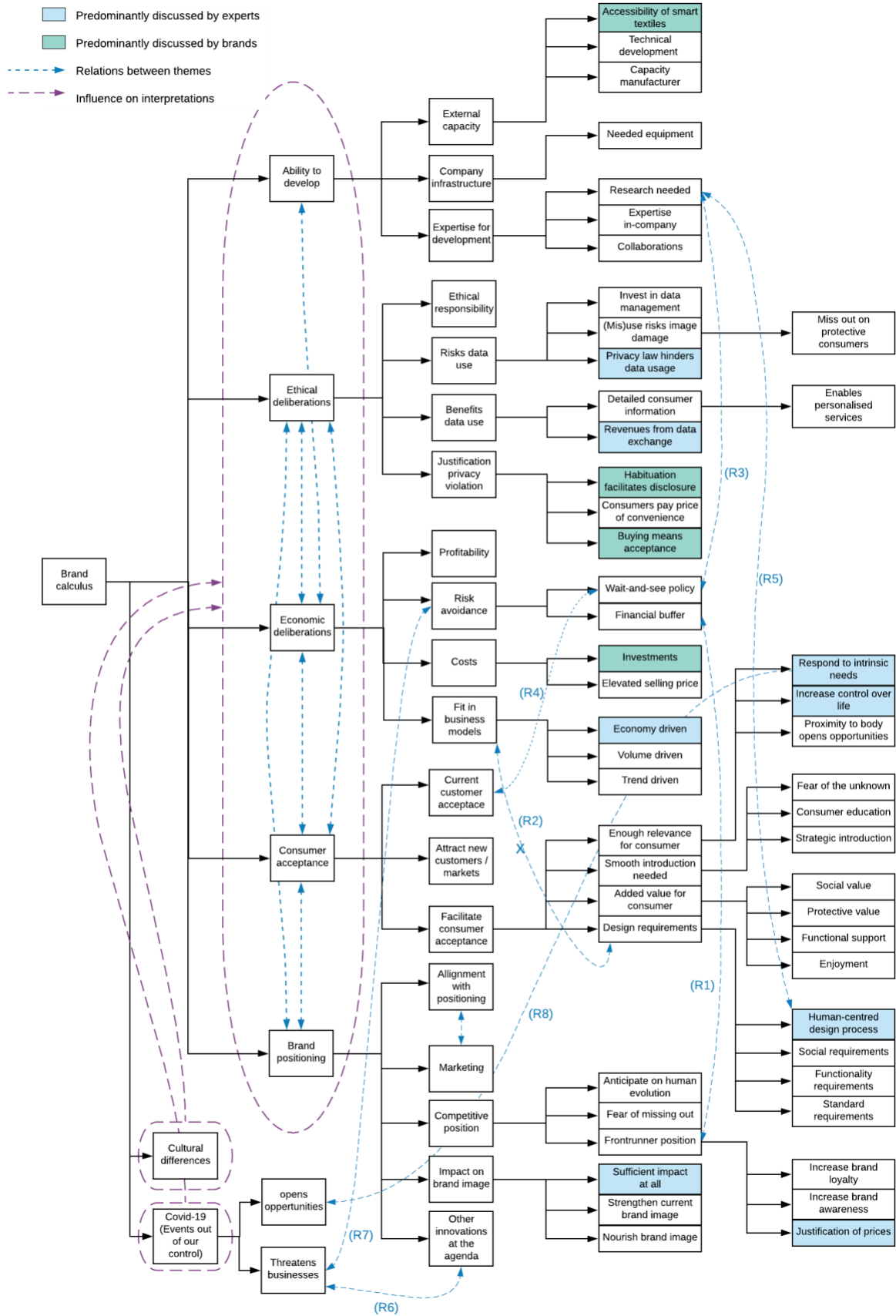
Figure 2: Concept-indicator model

With the general business models now being based on producing high volumes with small profit margins, produced as cheaply as possible across the globe, and in a fast design pace due to trend driven production, the production of SIC does not quite fit in these models. This barrier is acknowledged by a respondent who believes these models have to change before a breakthrough of SIC can happen.

> R13: *A fashion system that has been completely overhauled and where it is not about producing and selling as many products as possible. If that is the driver, if that economic growth it is based on, if it stays as it is, then there will not be a breakthrough there. Because that's not what interactive clothing is about* (369).

To cover the higher costs, the respondents believe that the selling prices will have to be raised. Although some fear that this will lower the sales and turn SIC into luxury products, others believe consumers to be willing to pay more for SIC with enough relevance. The latter is explained in section 4.2. Furthermore, some respondents believe an elevated selling price could create a more exclusive and therefore desirable image, which again could lift the sales.

4.2 Consumer acceptance[4]

The previous section already showed that the risk perception of the respondents is strongly related to the expectations of consumer acceptance. In fact, some brands admit to only take action when research or introduction successes of competitors prove that there is enough consumer interest (see R3 and R4 in figure 2). One respondent even identified uncertainty about consumer acceptance to be the biggest drawback for her brand.

> R9: *I think the target audience doesn't accept it [...] or at least they don't know if the target audience accepts it. For example, a company like [brand][5] simply cannot cope with that uncertainty* (225).

For brands to form their calculus, it is therefore important to identify whether - and which - consumers would be interested in SIC, and what actions could increase consumer acceptance. Initially, the brands thus consider whether their current customer base will be interested in SIC, and subsequently whether they assess it worthwhile to invest in attracting new target groups or markets they expect to be interested in SIC. The respondents roughly divide the interested consumers in three target groups: early adopters who are interested in innovations and

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[4] All the identified added values and design requirements of smart interactive clothing are visible in the extended consumer acceptance concept-indicator model in appendix 5.
[5] Respondent R9 preferred the brand to remain anonymous.

technology, persons in need of the functional support of the clothing (e.g. for health issues or work clothing), and 'ego trippers' who shape their identity by showing off the newest clothes. In general, respondents expect more interest from a younger millennial clientele that is more open to and familiar with technological innovations and/or a richer clientele that can better afford the clothes. A designer who worked for several large fashion brands for example expects the company with the most resources and younger clientele to be the best fit for SIC.

> R11: *They're a huge company. They would be able to incorporate something like that in our clothing. And I also think their customer base would be really interested in that. It's a little bit younger. And, you know, a younger clientele is more open to buying things […] I think they could make a little bit of a presence with smart clothing* (172).

To increase consumer acceptance, all respondents agree that SIC must have sufficient relevance for the consumer. The experts, in specific, agree that relevance is the highest when the functionalities respond to the intrinsic needs of the consumer. In line with such instinctive needs, they consider relevance to be high when clothes increase the wearer's control over life. Both brands and experts believe an advantage of SIC to be the fact that it is worn in close proximity to the body and thus can measure things other gadgets, such as smartphones cannot. Additional relevance therefore should be found in those functionalities that respond to this advantage, like sensory interactions and offer added value above the functionalities that other gadgets already offer.

> R13: *It should be much more about the sensory qualities of clothing and that you can make things tangible and that things can react by themselves. That it can indeed get some more personal, human aspects. I think that is where it (SIC) should go if you want people to eventually accept it and really experience some sort of added value to it* (377).

The respondents identify a large list of areas in which SIC could offer added value, which can roughly be classified into functional support, (health) protection, social value and enjoyment. However, most respondents expect SIC focused on functional support and mainly in sports to be accepted the fastest, because here the relevance and effects of the functionalities are more obvious and fabric innovations are constantly introduced, allowing for a smoother introduction. The respondents also recognise the need for strategic considerations to assure a smooth introduction, since the average consumer is not an early adopter and rather sticks to familiar products.

R1*: I think it would have to be presented and packaged in a way that doesn't, that still feels familiar to them. So, if we're talking about Tommy Jeans, it has to fit within their consumption world* (276).

Although enjoyment-focused SIC is expected to be least successful on the long run, which corresponds to the fact that it does not necessarily respond to human's intrinsic needs, respondents still consider it to be useful for a strategic introduction by means of a PR stunt using a gimmick. After the attention and brand awareness has been drawn, brands foresee a smoother introduction of the more relevant and complicated garments.

R3: *You'll have to keep in mind that it will always be a gimmick in the beginning, because it has to be developed and see if it catches on and whether it actually is something. But that it will always be developed with multiple versions, until it is really fully integrated* (189).

Respondents also recognise the need for consumer education to take away their fear of the unknown and to explain how interactive clothing could be valuable for them. However, when integrating an interactive element in clothing, the experience and the interpretation of the clothing can change. The uncertainty of the experience is recognized by the experts, who also emphasize that no matter how useful or pretty the clothes are conceived by the consumer, the experience could still be unpleasant when the interactivity is experienced as uncomfortable or invasive. According to them, a human-centred design process is required to increase the likelihood of consumer acceptance. This requires research (relation R5 in figure 2) into the social compatibility of the clothing with the target group and the level of invasiveness of the interactive element, above the standard clothing requirements such as aesthetics, and functionality-specific requirements such as ease of use and safety. When considering the visibility of the technology for instance, it is of importance to identify the target group one would like to attract with the functionalities and whether this target group would feel comfortable with others seeing them using these functionalities.

R8: *If it is a trend, then indeed you want to see the technology. Those are the trend runners. Early adapters just believe in technology and do it for that. And for those who find it really important for their health, you certainly do not have to see the technology. It should just be integrated invisibly* (33).

Although the brands do realise that acceptance is partly determined by the way the clothes match the identity of the wearer, the identity of the brand and the product identity, this awareness seems to be limited to the need for aesthetic compatibility in which the tech element should not be overpowering. Less attention seems to be paid to strategies or design methods to increase the chances of a pleasant experience of SIC. This could, however, have to do with the previously discussed fact that most fashion brands do not have a suitable infrastructure yet to carry out such a human-centred design process, and primarily consider the design requirements they are used to within their current infrastructure.

4.3 Ethical deliberations

The experience of invasiveness when wearing SIC is evoked by the fact that the clothes process personal data. The respondents therefore make a trade-off between developing self-contained clothing, which limits the possibilities of the functionalities and therefore also the relevance, and connected clothing, which transfers personal data that – when insufficiently protected – can become accessible to other (unwanted) parties. Deliberations concerning consumer acceptance thus are closely related with deliberations concerning the ethical responsibility of fashion brands towards consumers. Although all brands realise the importance of ethical handling of the data, some brands focus more on the risks of image damage and the financial risks that come with the investments needed to properly protect the data, while other brands feel uncomfortable when collecting data of consumers and therefore would prefer to make their clothing self-contained, and thus without connections to other computers.

> R12: *It's a huge responsibility to cover the things that are needed for this kind of stuff. […] I would prefer something that is more immediate. So it works in the moment you are wearing it. Not generating some data for the future that you have to analyse* (296).

The brands that already experimented with SIC, however, raised less of the ethical issues and focused more on the advantages of having detailed consumer information and the ability to offer more personalised services to their customers, while strengthening their frontrunner position.

> R3: *I don't know if they really… I think they do want to deal with it ethically, but now it's more like, they just want to have that data. One, because they can, because they can have it* (121).

A SIC designer also beliefs it not to be in the systems of fashion brands yet to consider the ethics of their clothing, and therefore advises to hire a data expert and an ethics expert to consult during the design process.

Responses of the experts and brands differed substantially regarding the ethics of SIC's data collection. While one of the main reasons of brands who prefer self-contained interactive clothing is that they are not okay with data being transferred to other parties, only the experts talk about the financial advantages of exchanging data for fashion brands. The experts also talk more about the barriers of the privacy law and the need for brands to invest in good data management by building a trust relationship with their consumers and making systems based on agreements on what data are being tracked and transferred to who exactly.

> R2: *I think systems will be created in the coming years in which you can measure it very well, in which you can very clearly agree 'I and this brand and this garment may give away so much data to those parties'. And that this interface may also become more important than the garment itself* (256).

Instead of thinking about solutions for ethically handling data-driven clothing, the brands either talk about strategies to introduce the innovation in small steps in order to prevent scaring off the consumer, or not offering connected clothing at all to prevent unethical data-exchange. This attitude even seems to result in brands justifying data tracking with the arguments that consumers are easily willing to disclose personal data for clothes with enough relevance, and that habituation to data disclosure makes it easier to disclose data again. Some brands even mentioned that consumers should just realise they give consent when buying such clothing.

> R9: *I do think that if you as a consumer purchase such items, you also assume and accept that you share so much personal data with a company, because otherwise your product just won't work. So yes it's a thing, but on the other hand I think if you buy it then you just know what to expect* (157).

4.4 Brand positioning

Both in the deliberations concerning the ethics of the clothing and the consumer acceptance, the importance to align with and protect the brand image already came up. The respondents clearly view the brand image as an important attribute to position themselves against competitors. In general, their first consideration when discussing offering SIC also has to do with the alignment of the innovation with the brand positioning and to what extent they believe

SIC can have enough impact to influence, change or strengthen their current brand image. Although some of the experts doubt whether offering SIC will impact the brand image, the brands do see possibilities to strengthen or nourish the current image with new associations, creating either a more tech, caring, exclusive, contemporary and most importantly a sustainable or innovative image.

> R7: *These kinds of innovations also play a role in the positioning of your brand as the absolute world leader in the field of new developments* (180).

It has to be noted however that just offering SIC will not suddenly upgrade a brand image to something completely different. Respondents also believe that some degree of alignment with the current image is necessary to be able to market the clothes and to become top of mind when a consumer is looking for such innovative clothes. Brands should be able to explain why they decide to offer SIC and why consumers should buy it from them in particular. In addition to the marketing investments required to successfully launch such new products, experts therefore indicate that more unknown brands will have to invest in marketing to increase their brand awareness and nourish their brand image – before the introduction of SIC could again strengthen this image and increase brand awareness in return. This reasoning makes it seem cumbersome for smaller and relatively unknown brands to invest in SIC.

> R4: *You need to be aware that you just have to put money and energy into it to get the publicity. If you suddenly fill your entire store with all kinds of technical tours de force, and you don't have an audience for it or your audience doesn't understand it because your employees can't explain, sell or propagate it, then you can write it all off* (92).

Surprisingly, all brands can foresee themselves offering SIC someday. This could be explained by the fact that most respondents do see technology as the future and expect our lives to become smarter and more connected in the coming years. Interactive clothing could therefore be seen as part of human evolution. As discussed before, the introduction timing of the brands differs in accordance to their more frontrunning or following position. One explanation is the differing perspective on risk avoidance, but another is the urge to stay ahead of the competition. While frontrunning brands indicate they wish to be the absolute first, the following brands indicate they will probably wait until a close competitor successfully introduces the clothing, to not fall behind on the competition.

R6: *There will probably be a dare devil who starts and it becomes a hit. And then something happens in the industry. Then it will be like; "but if we don't do it, what happens then?"* (304).

Frontrunning even has more advantages according to the respondents. It could for instance create a consumer base early on that would stick to the brand out of loyalty. For premium and luxury brands, SIC could not only strengthen their exclusive image, but also justify the elevated clothing prices with the added value this clothing offers to the consumer. Despite the advantages of a sooner introduction, a final factor could spoil the party. Respondents namely also acknowledge that SIC is not the only interesting innovation in the field of fashion and, given the current, financially threatening situation due to the outbreak of Covid-19, other innovations might be prioritized (relation R6 in figure 2).

4.5 Ability to develop

An indispensable factor in the calculus is whether or not a company has the ability to develop SIC in practical terms. Deliberations on this theme are closely related to the economic deliberations, since a lack of knowledge, expertise or equipment will result in companies needing to invest in these matters. The respondents realise that external factors play an important role in this, such as the degree to which the technology is developed to be integrated safely and comfortably in all garments, and the accessibility of smart textiles and skilled manufacturers that have the ability to meet both the technological and aesthetic requirements. Furthermore, fashion brands must be internally equipped to develop the clothing, and the company infrastructure should be suitable for a close collaboration between different departments, such as design and IT, that traditionally are not used to collaborating, to meet all the technical, social and aesthetic design requirements. A large premium brand indicated for instance that despite sufficient resources and expertise, the company is not yet sufficiently equipped for large production of SIC, because the expertise is not connected between all the involved departments.

R1: *I don't think the infrastructure is there yet. I mean, of course, we have IT and there's a massive infrastructure that goes into Hold PVH Corp. So, let's say the expertises are in-house, but they're not connected* (304).

In addition, all respondents agree that brands need to invest in research to properly launch this innovation. Not only do most brands – including those who already offer SIC – admit that they need to research the possibilities of SIC more, they also acknowledge the need for consumer

research to be able to meet the previously discussed design needs. Some experts also indicate that a disadvantage for fashion brands may be that they are not yet sufficiently engaged in R&D.

> R13: *A big obstacle I regularly encounter is that fashion companies aren't used to doing R&D. Many fashion companies aren't. Sports companies are still somewhat an exception. But R&D has been completely pushed to countries in Asia, for example* (169).

Finally, companies that do not yet have all the expertise in-house, also consider whether they want and can bring the expertise in-house by hiring experts, for example in the area of fashion tech, data or ethics, or whether they are willing to enter into collaborations with other experienced companies or manufacturers. According to the experts, an advantage of collaborating as opposed to outsourcing is the opportunity to share knowledge and risks, and possibly even enter new markets.

4.6 Cultural differences

A theme that impacts all previously discussed considerations, is the influence of cultural differences. Respondents believe them to influence consumer product preferences, aesthetic preferences, openness towards data tracking and spending patterns.

> R10: *I can imagine that in Asia, for example, or especially in a country like Japan, a backpack with LED lighting would work. I think it's still very much in the future for like our core customer that we have here in Germany* (114).

Furthermore, the respondents mention that some countries are already further involved in the development of smart products and SIC in specific, which might facilitate the introduction of such clothing. A country like China, for instance, in which data of all inhabitants are being tracked every day, might be less concerned with the ethics of SIC. In other countries the fashion industry is built up differently. A Polish designer, for instance, indicates that in her country producers often introduce their clothing innovations directly to the consumers instead of to the wholesalers as is the case in the Netherlands. This means that the interest of consumers could be sparked a lot earlier.

> R12: *Here in Poland where I'm based, there's a huge market of small producers that have their own trade shows directed to individual consumers, not buyers or wholesalers, but to regular people. And usually you can see a new approach there* (96).

4.7 Covid-19 (Events out of our control)

A final theme impacting the composition of the calculus, is the possibility of unexpected events out of our control to impact the fashion industry in unprecedented ways, such as the recent outbreak of the coronavirus. All respondents believe Covid-19 to have a major impact on the fashion industry, which on the one hand increases the urgency to explore the potential of SIC for social and medical support, but on the other hand decreases the relevance for companies to start investing in an innovation, leading to risk-avoidance (relations R7 and R8 in figure 2). According to a respondent, the financial impact of Covid-19 freezes product development at her brand to instead focus on saving money.

> R1: *Investing in something like interactive fashion is I think now so far removed from anything the company is trying to do at a time when they're trying to save money* (388).

Furthermore, the fact that the corona crisis impacts businesses everywhere also impacts the spending pattern of consumers who now might be shopping less and are less willing to spend more money on clothes. Moreover, given the negative reactions on the tracking-apps initiated by the government to combat Covid-19, companies might doubt the willingness of consumers to buy similar data-tracking clothes. Despite these concerns, most respondents do foresee the corona crisis to give a boost to the development of SIC. They believe the crisis to give more urgency to develop SIC for medical protection, but also for social support to facilitate social distancing and increase communication possibilities from distance. Since people are rethinking their lives and spending patterns, and revalue basic human needs like safety, health and wellbeing, respondents expect them to look for clothing that can respond to these intrinsic needs. This urgency might attract budgets and funding for SIC in the fashion companies.

> R13: *I think that now with such a concrete, urgent crisis, that perhaps extra budgets and extra capacity of people could be focused on it (SIC). Which may have been a bit more fragmented in different types of projects before and may not have received the full attention it needed to reach the next level of development, which it might be able to do now* (301).

When looking further ahead, respondents even believe that the crisis could affect the unsustainable volume-driven business models, since the closing of country borders could force companies to start producing more locally. Bringing the production closer to home would then facilitate the closer collaboration needed for the development of SIC, which takes away a first major barrier.

5. Conclusion and Discussion

This study aimed to gain insight into the (privacy) calculi of fashion brands regarding offering smart interactive clothing, in order to gain a better understanding of what factors are influencing the introduction of the innovation in the fashion industry. Qualitative interviews with fashion brands and experts shed light on what benefits and risks fashion brands perceive and how these factors relate to each other in the deliberations of the brands. The interviews revealed five main factors (e.g. economic deliberations, consumer acceptance, brand positioning, ethical deliberations and the ability to develop SIC) and two other factors (e.g. cultural differences and Covid-19), which influence all five aforementioned factors and therefore change the ratios between the factors in the calculi.

The overall attitude towards SIC is positive. The fact that all respondents see added value in the clothing and believe in a more tech-driven and connected future, accounts for the finding that all brand respondents foresee their brand offering SIC one day. Differing calculi therefore account for a different timing of launch. Frontrunners and followers however seem to both act from risk aversion in which different factors are valued most important. For frontrunners the biggest risk lies in missing the boat and damaging the innovative brand positioning, whilst followers fear introducing a product with insufficient consumer interest, leading to financial loss, due to the relatively high investments needed to introduce the clothing. These investments are of less concern to the frontrunners who either have a larger financial buffer such as the premium and luxury brands, or already possess a better suitable infrastructure with enough attention to R&D, such as the sports brands. Taking into account the expectation of Fernández-Caramés and Fraga-Lamas (2018) that consumers will select a few trusted brands as the protectors of their personal bio-signals, one could also expect such better-known and experienced brands to be a better fit to the consumers. The ability and affordability to develop SIC thus constitutes the backbone in the considerations of the brands.

Although brands do realise their ethical responsibility when offering data-driven clothes, The 'privacy' part of the privacy calculus of Laufer and Wolfe (1977) seems to be inferior to the other factors. Awareness of possible privacy concerns at the consumer side led to some brands thinking of ways to prevent unwanted data-exchange, mainly to protect the brand image, but most brands (including the frontrunners) seem well aware of the existence of a privacy paradox, following Barnes (2006), which some even use to justify the data collection. Awareness of a privacy paradox thus indeed seems to wipe out the privacy part from the brand privacy calculus. One could then even theorize the existence of a brand privacy paradox, in

which the awareness of careless consumer behaviour risking unwanted data exchange, increases the privacy risk perception, but does not lead to privacy protecting behaviour.

Respondents identify a greater barrier regarding the infrastructure of fashion companies and the fashion industry as a whole, corresponding to the findings of Cherenack & van Pieterson (2012). While the infrastructure of most fashion brands is not yet sufficiently organised with the right equipment, specialized personnel and cooperation between different departments, the current volume and trend-driven business models are not designed for the more expensive and demanding production of SIC. A profitable and successful launch therefore requires a change in mindset to adjust business models and strategies. In contrast to the brands, interviewed experts did discuss new strategies for ethical handling of data and new design processes that take into account the changing experience of clothing when incorporating interactive functionalities, as was pointed out by Tomico et al. (2017). The brands themselves, on the other hand, continued to think and search for solutions within their current business models and infrastructure, confirming the findings of Uhlig (2012), which makes sense given the current economy-driven business models, within which the high investments and risks of changing the models and ways of thinking do not fit. Despite the fact that the fashion brands believe in a future market penetration of SIC, in which early introduction of the clothing promises benefits concerning brand positioning, consumer loyalty and sales, those benefits get outweighed by economic risks in the calculus for those brands who stay in their bubble (i.e. hold on to their current business models and infrastructure) or lack a sufficient financial buffer.

However, a silver lining can be found in unexpected events, such as the outbreak of Covid-19. The financial impact and closure of borders pushes brands to rethink their current business models and production processes, while the event increases the urgency to explore the protective potential of SIC to meet the increased consumer demand. In other words, one major barrier gets attacked, while the promise of consumer acceptance and sales shakes up the benefit-risk ratio in the brand calculus.

Considering the cover question whether interactive fashion will become the next social medium, it can be concluded that although fashion brands do seem to believe in its market penetration, much still needs to change before brands will embrace the innovation *en masse*. Next up, to make consumers embrace the innovation and its social capacities, awareness needs to be raised about how the integration of true interactivity in clothing with already expressive value, influences the experience of the garments. Combining communication-scientific and industry-specific knowledge therefore proves to be important to understand the full complexity of an innovation located at the interface of fashion and communication.

5.1 Limitations and future research

A few limitations regarding the research methodology should be noted. Firstly, the participating brands all operated in the premium and luxury market segments or identified themselves as market leaders in the mass market segment. Therefore, they do not accurately reflect the full breadth of the fashion industry, which means that the composition of the calculus might differ for brands operating in the lower segments. In future research more attention could be paid to the deliberations of those brands. However, given the barriers already found for brands who have a greater capacity and likelihood of launching such innovative clothes, it is expected that brands with an even lower price point, producing for the masses, would find the same barriers of unsuitable volume- and trend driven business models with financial risks outweighing the benefits in the brand calculus.

Secondly, the brand respondents often indicated that – aside from considerations related to their own position - they possessed insufficient knowledge of other departments to provide well-founded answers to all interview topics. This shows that multidisciplinary knowledge is also needed to be able to show a full account of the considerations involved in the introduction of a multidisciplinary innovation. To fill the gaps in the knowledge of the respondents, diversity has been sought in the departments and positions in which they operate within the brands. However, it could be advised for follow-up research to conduct focus-group research within brands, to bring respondents with knowledge from all departments together at once and thereby create complete calculi per brand.

Thirdly, apart from some experts, most respondents indicated knowing little about the possibilities and functioning of SIC, including respondents working for brands that already experimented with SIC. The presentation of examples of SIC as a projective technique and the provision of additional information about the innovation, facilitated the discussion. However, it might have guided respondents in their perception and answers, which limits the authenticity of the responses and therefore the validity of the results. Nevertheless, this limitation provides important information about how the fashion industry is in need for education about SIC, before fashion brands are able to come to a well-considered and balanced calculus at all.

Despite these limitations, this research has given a first insight into factors influencing the introduction of SIC from the brand-side. Although the results reveal that brands indeed value insight into consumer acceptance – which accounts for the amount of consumer research that has already been done – they reveal several other barriers (e.g. unsuitable business models, company infrastructures and design processes) that should be overcome to facilitate a successful

launch of SIC in the first place. This research therefore confirms the need to focus more research on brand considerations, while looking for strategic solutions to break through these aforementioned barriers and support fashion companies in their transition towards more sustainable business strategies which allow for further development of SIC.

Brand research and consumer research, however, go hand in hand. This research has revealed predictions from brands and fashion experts regarding strategies and design requirements that could facilitate consumer acceptance. By testing these expectations and comparing results from follow-up consumer research, fashion brands can adjust their strategies accordingly. When looking at the summary of factors influencing consumer acceptance from Kalantari's meta study (2017), it actually appears that all factors are acknowledged by the respondents in this study, including the need for a human-centred design approach. This approach again confirms the need to keep researching the needs and experiences of consumers, especially given the uncertainty about how one will experience the interactivity of the clothing. To gain real insight into this experience however, longitudinal, qualitative research is needed in which the innovation is actually worn and used for a longer period of time, to understand how different types and degrees of interactivity are being interpreted by different types of consumers after the novelty effect has worn off and the adoption moves from early adopters to the mass. Only then, can we truly understand how users identify with interactive clothes, and thus in what cases they actually are understood and allowed to function as social media.

Finally, the findings of this study have led to the development of a theory regarding the existence of a brand privacy paradox. Whether this phenomenon indeed exists and can be applied to all brands, should be studied in follow-up research.

5.2 Practical implications

Based on the findings of this study, two main recommendations can be given to fashion companies interested in offering SIC. First of all, brands need to realise that the development of SIC demands multidisciplinary collaborations. Therefore, connections should be made internally between the different departments that all contribute to the development of the clothes and externally with experts and manufacturers that are able to meet both the technical and fashionable design requirements. Secondly, brands should realise that the design requirements of SIC differ greatly from those of regular clothes. In addition to the usual design requirements, requirements that accompany the integration of functionalities and social coherence to the target group also have to be taken into account, in order to arrive at balanced designs that consumers are willing to adopt for everyday use.

Literature

Acance, F. (2017, December 5). *Interactive clothing with fingerprint recognition technology by Ying Gao.* Retrieved from https://www.yellowtrace.com.au/possible-tomorrows-fashion-technology-ying-gao/

Acquisti, A., & Grossklags, J. (2005). Privacy and rationality in decision making. *IEEE Security and Privacy, 3*(1), 26-33. doi:10.1109/MSP.2005.22

Amyx, S. (2017). Privacy dangers of wearables and the internet of things. In A. Marrington, D. Kerr & J. Gammack, J. (Eds.), *Managing security issues and the hidden dangers of wearable technologies* (pp. 131-160). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-1016-1.ch006

Ariyatum, B., Holland, R., Harrison, D., & Kazi, T. (2005). The future design direction of smart clothing development. *Journal of the Textile Institute. 96*(4), 199-210. doi: 10.1533/joti.2004.0071

Ashforth, B. E., & Mael, F. (1989). Social identity theory and the organization. *The Academy of Management Review, 14*(1), 20-39. doi:10.5465/amr.1989.4278999

Baarda, B., & van der Hulst, M. (2017). *Basisboek interviewen*. Houten, Netherlands: Noordhoff.

Barnes, S. (2006). A privacy paradox: Social networking in the United States. *First Monday, 11*(9). doi:10.5210/fm.v11i9.1394

Bergström, A. (2015). Online privacy concerns: A broad approach to understanding the concerns of different groups for different uses. *Computers in Human Behavior, 53,* 419-426. doi:10.1016/j.chb.2015.07.025

Billinghurst, M., & Starner, T. (1999). Wearable devices: New ways to manage information. *Computer, 32*(1), 57-64. doi:10.1109/2.738305

Boeije, H. (2010). *Analysis in qualitative research*. London, England: Sage.

Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. London, England: Sage.

Brauner, P., van Heek, J., & Ziefle, M. (2017). Age, gender, and technology attitude as factors for acceptance of smart interactive textiles in home environments. *Proceedings of the 3rd International Conference on Information and Communication Technologies for Ageing Well and e-Health* (pp. 13-24). doi:10.5220/0006255600130024

Campbell, M. C. (2002). Building brand equity. *Journal of Medical Marketing, 2*(3), 208-218. doi:10.1057/palgrave.jmm.5040078

Cherenack, K., & van Pieterson, L. (2012). Smart textiles: Challenges and opportunities. *Journal of Applied Physics, 112*(9), 2-14. doi:10.1063/1.4742728

Cho, G (Ed.). (2010). *Smart clothing: Technology and applications.* Boca Raton, FL: Taylor and Francis Group and CRC Press.

Cho, G., Lee, S., & Cho, J. (2010). Review and reappraisal of smart clothing. In G. Cho (Ed.), *Smart clothing: Technology and applications* (pp. 1-35). Boca Raton, FL: Taylor and Francis Group and CRC Press.

Coleman, M. (2016). *The holy dress*. Retrieved from https://melissacoleman.nl/holydress

Compañó, R., & Lusoli, W. (2010). The policy maker's anguish: Regulating personal data behavior between paradoxes and dilemmas. In T. Moore, D. Pym & C. Ioannidis (Eds.), *Economics of Information Security and Privacy* (pp. 169-185). Boston, MA: Springer. doi:10.1007/978-1-4419-6967-5_9

Cvrcek, D., Kumpost, M., Matyas, V., & Danezis, G. (2006). A study on the value of location privacy. *Proceedings of the 5th ACM workshop on Privacy in electronic society* (pp. 109-118). New York, NY: Association for Computing Machinery. doi:10.1145/1179601

Dans, E. (2018, September 21). *Insurance, wearables and the future of healthcare*. Retrieved from https://www.forbes.com/sites/enriquedans/2018/09/21/insurance-wearables-and-the-future-of-healthcare/#472eff801782

Danezis, G., Lewis, S., & Anderson, R. J. (2005). How much is location privacy worth? *Proceedings of the Fourth Workshop on the Economics of Information Security*, Cambridge, MA: Harvard University. doi:10.1.1.335.5193

Damhorst, M. L. (1990). In search of a common thread: Classification of information communicated through dress. *Clothing and Textiles Research Journal, 8*, 1-12. doi: 10.1177/0887302X9000800201

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340. doi:10.2307/249008

De Nederlandse Grondwet. (n.d.). *Artikel 11: Onaantastbaarheid lichaam*. Retrieved from https://www.denederlandsegrondwet.nl/9353000/1/j9vvkl1oucfq6v2/vgrnblu821m2

Dunne, L. (2010). Smart clothing in practice: Key design barriers to commercialization. *Fashion Practice, 2*(1), 41-65. doi:10.2752/175693810X12640026716393

Dvorak, J. L. (2008). *Moving wearables into the mainstream: Taming the borg.* New York, NY: Springer.

Fernández-Caramés, T. M., & Fraga-Lamas, P. (2018). Towards the internet of smart clothing: A review on IoT wearables and garments for creating intelligent connected e-textiles. *Electronics 2018, 7*(12), 405. doi:10.3390/electronics7120405

Gao, Y. (2016). *Neutralité: Can't and Won't* [Online image]. Retrieved from http://yinggao.ca/interactifs/neutralite--cant-and-wont/

Gouge, C., & Jones, J. (2016). Wearables, wearing, and the rhetorics that attend to them. *Rhetoric Society Quarterly, 46*(3), 199-206. doi:10.1080/02773945.2016.1171689

Hamelmann, T., & Drechsler, A. (2018). Impacts of digital natives on technology acceptance: A conceptual analysis. *Proceedings of the Australasian Conference on Information systems 2018, 2*. doi:10.5130/acis2018.bd

Hanuska, A., Chandramohan, B., Bellamy, L., Burke, P., Ramanathan, R., & Balakrishnan, V. (2016). *Smart clothing market analysis report*. Retrieved from http://scet.berkeley.edu/wp-content/uploads/Smart-Clothing-Market-Analysis-Report.pdf

Hertenberger, A. (2009). *E-pressed* [Online image]. Retrieved from http://awarenesslab.nl/e-pressed/shirt.html

Hijmans, E., & Wester, F. (2006). De kwalitatieve interviewstudie. In F. Wester, K. Renckstorf & P. Scheepers (Eds.), *Onderzoekstypen in de communicatiewetenschap* (pp. 507-532). Alphen aan de Rijn, Netherlands: Kluwen.

Hogg, M. A., & Abrams, D. (1988). *Social identifications: A social psychology of intergroup relations and group processes.* London, England: Routledge.

Holt, D. (2016). Branding in the age of social media. *Harvard Business Review, 94*(3), 40-50.

Hopkins, G. (2019). Big Brother, erm data is watching and we don't seem to care. *Emerging Writers, 2*(2). Retrieved from https://digitalcommons.kennesaw.edu/emergingwriters/vol2/iss2019/2

Hutchinson, K., Alexander, N., Quinn, B., & Doherty, A. M. (2007). Internationalization motives and facilitating factors: Qualitative evidence from smaller specialist retailers. *Journal of International Marketing, 15*(3), 96-122. doi: 10.1509/jimk.15.3.96

Hwang, C., Chung, T. L., & Sanders, E. A. (2016). Attitudes and purchase intentions for smart clothing: Examining US consumers' functional, expressive, and aesthetic needs for solar-powered clothing. *Clothing and Textiles Research Journal, 34*(3), 207-222. doi:10.1177/0887302X16646447

International Data Corporation. (2018). *IDC forecasts slower growth for wearables in 2018 before ramping up again through 2022*. Retrieved from https://www.idc.com/getdoc.jsp?containerId=prUS44276818

Kalantari, M. (2017). Consumers' adoption of wearable technologies: Literature review, synthesis, and future research agenda. *International Journal of Technology Marketing, 12*(3), 274-307. doi:10.1504/IJTMKT.2017.089665

Kapferer, J. N., & Bastien, V. (2009). The specificity of luxury management: Turning marketing upside down. *Journal of Brand Management, 16*(5-6), 311-322. doi: 10.1057/bm.2008.51

Ketelaar, P. E., Aarts, J., & Demir, S. (2019). *23 innovations in digital communication: Move beyond speculations and master mediated communication*. Amsterdam, Netherlands: BIS.

Ketelaar, P. E., & van Balen, M. (2018). The smartphone as your follower: The role of smartphone literacy in the relation between privacy concerns, attitude and behaviour towards phone-embedded tracking. *Computers In Human Behavior, 78,* 174-182. doi:10.1016/j.chb.2017.09.034

Kim, C. K., Han, D., & Park, S. B. (2001). The effect of brand personality and brand identification on brand loyalty: Applying the theory of social identification. *Japanese Psychological Research, 43*(4), 195-206. doi:10.1111/1468-5884.00177

Kimani, N. (2016, September 16). *Interactive clothing: The future of fashion is all for connectivity.* Retrieved from https://tdsblog.com/interactive-clothing-future-fashion-connectivity/

Knijnenburg, B. P., Kobsa, A., & Jin, H. (2013). Counteracting the negative effect of form auto-completion on the privacy calculus. *Proceedings of the 34th International Conference on Information Systems (ICIS 2013).* Retrieved from https://aisel.aisnet.org/icis2013/proceedings/SecurityOfIS/2/

Kornbluh, M. (2015). Combatting challenges to establishing trustworthiness in qualitative research. *Qualitative Research in Psychology, 12*(4), 397-414. doi: 10.1080/14780887.2015.1021941

Lamontagne, V. (2017). *Performative wearables: Bodies, fashion and technology* (Doctoral dissertation, Concordia University, Montreal, Canada). Retrieved from https://spectrum.library.concordia.ca/982473/

Laufer, R. S., & Wolfe, M. (1977). Privacy as a concept and a social issue: a multidimensional developmental theory. *Social Issues, 33*, 22-42. doi:10.1111/j.1540-4560.1977.tb01880.x

Lazaroiu, G., Bratu, S., Serban, S., & Iordanescu, M. (2013). The semantics of communicative functions of smart interactive clothing. *Industria Textila, 64*, 260-265. Retrieved from http://revistaindustriatextila.ro/

Lamb, J. M., & Kallal, M. J. (1992). A conceptual framework for apparel design. *Clothing and Textiles Research Journal, 10*(2), 42-47. doi:10.1177/0887302X9201000207

Lee, J., Kim, D., Ryoo, H.-Y, & Shin, B.-S. (2016). Sustainable wearables: Wearable technology for enhancing the quality of human life. *Sustainability, 8*(5), 466. doi: 10.3390/su8050466

Li, H., Wu, J., Gao, Y., & Shi, Y. (2016). Examining individuals' adoption of healthcare wearable devices: An empirical study from privacy calculus perspective. *International Journal of Medical Informatics, 88*, 8-17. doi:10.1016/j.ijmedinf.2015.12.010

Libbenga, J. (2018, April 7). *Next: De toekomst is aan wearable tech*. Retrieved from https://www.emerce.nl/nieuws/next-toekomst-wearable-tech

Lymberis, A., & Paradiso, R. (2008). Smart fabrics and interactive textile enabling wearable personal applications: R&D state of the art and future challenges. *30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society* (pp. 5270-5273). Vancouver, Canada: IEEE. doi:10.1109/IEMBS.2008.4650403

Mack, N., Woodsong, C., MacQueen, K. M., Guest, G., & Namey, E. (2005). *Qualitative research methods: A data collector's field guide*. Research Triangle Park, NC: Family Health International.

Mann, S. (1998). Wearable computing as means for personal empowerment. *Proceedings of the 3rd International Conference on Wearable Computing (ICWC)* (pp. 51-59). Retrieved from http://wearcam.org/icwc/keynote.htm

MarketWatch. (2019, June 3). *Smart clothing market size to surge at 55% CAGR and hit USD 4 billion by 2024*. Retrieved from https://www.marketwatch.com/press-release/smart-clothing-market-size-to-surge-at-55-cagr-and-hit-usd-4-billion-by-2024-2019-06-03

Marx, G. T. (2002). What's new about the "new surveillance"? Classifying for change and continuity. *Surveillance & Society, 1*(1), 9-29. doi:10.24908/ss.v1i1.3391

Marx, G. T. (2006) Varieties of personal information as influences on attitudes towards surveillance. In K. D. Haggerty & R. V. Ericson (Eds.), *The new politics of surveillance and visibility* (pp. 79-110). Toronto, Canada: University of Toronto Press. doi:10.3138/9781442681880-005

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). Big data: The management revolution. *Harvard Business Review, 90*(10), 60-68.

Melenhorst, A. S., Fisk, A. D., Mynatt, E. D., & Rogers, W. A. (2004). Potential intrusiveness of aware home technology: Perceptions of older adults. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 48*(2), 266-270. doi:10.1177/154193120404800209

Moar, J. (2018). *Smart wearables: Competitor strategies, opportunities & forecasts 2018-2022*. Retrieved from Juniper Research website: https://www.juniperresearch.com/researchstore/smart-devices/consumer-wearables-market-survey-archive

Mordor Intelligence. (2020). *Smart fabrics market - growth, trends, and forecast (2020 - 2025).* Retrieved from https://www.mordorintelligence.com/industry-reports/global-smart-fabrics-market-industry

Morse, J. M., & Field, P. A. (1995). *Qualitative research methods for health professionals (Vol. 2)*. Thousand Oaks, CA: Sage.

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-Based Nursing, 18*(2), 34-35. doi:10.1136/eb-2015-102054

Norberg, P. A., Horne, D. R., & Horne, D. A. (2007). The privacy paradox: Personal information disclosure intentions versus behaviors. *Journal of Consumer Affairs, 41*(1), 100-126. doi:10.1111/j.1745-6606.2006.00070.x

Paradiso, R., & Pacelli, M. (2011). Textile electrodes and integrated smart textile for reliable biomonitoring. *2011 Annual International Conference of the IEEE Engineering in Medicine and Biology Society* (pp. 3274-3277). Boston, MA, IEEE. doi: 10.1109/IEMBS.2011.6090889

Parviainen, J. (2016). Quantified bodies in the checking loop: Analyzing the choreographies of biomonitoring and generating big data. *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments, 12*(1), 56-73. doi: http://dx.doi.org/10.17011/ht/urn.201605192620

Patton, M. Q. (2002). *Qualitative research and evaluation methods.* London, England: Sage.

Plochg, T., & Van Zwieten, M. C. B. (2007). Kwalitatief onderzoek. In T. Plochg, R. E. Juttmann, N. S. Klazinga, & J. P. Mackenbach (Eds.), *Handboek gezondheidszorgonderzoek* (pp. 77-93). Houten, Netherlands: Bohn Stafleu Van Loghum.

Rawassizadeh, R., Price, B., & Petre, M. (2014). Wearables has the age of smartwatches finally arrived? *Communications of the ACM, 58*(1), 45-47. doi:10.1145/2629633

Ruvo, C. (2017, July 5). *Smart clothing and the future of apparel*. Retrieved from https://www.asicentral.com/news/web-exclusive/july-2017/smart-clothing-and-the-future-of-apparel/

Schaar, A. K., & Ziefle, M. (2011). Smart clothing: Perceived benefits vs. perceived fears. *2011 5th International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth) and Workshops* (pp. 601-608). doi:10.4108/icst.pervasivehealth.2011.246031

Schneble, C. O., Elger, B. S., & Shaw, D. (2018). The Cambridge Analytica affair and internet-mediated research. *EMBO reports, 19*(8). doi:10.15252/embr.201846579

Shin, G., Feng, Y., Jarrahi, M. H., & Gafinowitz, N. (2019). Beyond novelty effect: A mixed-methods exploration into the motivation for long-term activity tracker use. *Jamia Open, 2*(1), 62-72. doi:10.1093/jamiaopen/ooy048

Suh, M., Carroll, K. E., & Cassill, N. L. (2010). Critical review on smart clothing product development. *Journal of Textile and Apparel, Technology and Management, 6*(4). Retrieved from https://ojs.cnr.ncsu.edu/index.php/JTATM/article/view/702

Surveillance Studies Network. (n.d.). *An introduction to the surveillance society.* Retrieved from http://www.surveillance-studies.net/?page_id=119

Tamminen, S., & Holmgren, E. (2016). The anthropology of wearables: The self, the social and the autobiographical. *Ethnographic Praxis in Industry, 1*, 154-174. doi: 10.1111/1559-8918.2016.01083

The Fashion Network. (2018, July 12). *Why you need networking to succeed in fashion*. Retrieved from: https://thefashionetwork.com/why-you-need-networking-to-succeed-in-fashion/

Toeters, M. (2019). *Unfolding fashion tech: Pioneers of bright futures*. Eindhoven, Netherlands: Onomatopee.

Torah, R., Lawrie-Ashton, J., Li, Y., Arumugam, S., Sodano, H. A., & Beeby, S. (2018). Energy-harvesting materials for smart fabrics and textiles. *MRS Bulletin, 43*(3), 214-219. doi:10.1557/mrs.2018.9

Toussaint, L. (2018). *Wearing technology: When fashion and technology Entwine* (Doctoral Dissertation, Radboud University, Nijmegen, Netherlands). Retrieved from https://repository.ubn.ru.nl/bitstream/handle/2066/195422/195422.pdf

Utz, C., Degeling, M., Fahl, S., Schaub, F., & Holz, T. (2019). (Un)informed Consent: Studying GDPR consent notices in the field. *Proceedings of the 2019 ACM SIGSAC Conference on Computer and Communications Security* (pp. 973-990). doi:10.1145/3319535.3354212

Van den Hoonaard, W. C. (1997). *Working with sensitizing concepts: Analytical field research*. Thousand Oaks, CA: Sage.

Van der Zwaag, G. (2019). Reflecting on wearables. In P.E. Ketelaar, J. Aarts & S. Demir (Eds.), *23 innovations in digital communication: Move beyond speculations and master mediated communication* (pp. 83-85). Amsterdam, Netherlands: BIS.

Van Dongen, P., Wakkary, R., Tomico, O., & Wensveen, S. (2019). Towards a postphenomenological approach to wearable technology through design journeys. *Proceeding of the 2019 Textile Intersections Conference.* doi:10.17028/rd.lboro.9724649

Van Heek, J., Schaar, A. K., Trevisan, B., Bosowski, P., & Ziefle, M. (2014). User requirements for wearable smart textiles: Does the usage context matter (medical vs. sports)? *Proceedings of the 8th International Conference on Pervasive Computing Technologies for Healthcare* (pp. 205-209). doi:10.4108/icst.pervasivehealth.2014.255179

VHM Design Futures. (2006). *Philips - Wearable electronics*. Retrieved from http://vhmdesignfutures.com/project/224/

Wei, X. (2018). The application and development of artificial intelligence in smart clothing. *IOP Conference Series: Materials Science and Engineering* (pp. 12-17). doi:10.1088/1757-899X/320/1/012017

Wester, F. P. J. , & Peters, V. A. M. (2009). *Kwalitatieve analyse: Uitgangspunten en procedures*. Bussum, Netherlands: Coutinho.

Xie, K., Wu, Y., Xiao, J., & Hu, Q. (2016). Value co-creation between firms and customers: The role of big data-based cooperative assets. *Information & Management,* 53(8), 1034-1048. doi:10.1016/j.im.2016.06.003