

# Augmented Reality Apparel: an Appraisal of Consumer Knowledge, Attitude and Behavioral Intentions

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## Abstract

*Growth in the interconnectivity of the internet and mobile technology has paved the way for augmented reality (AR) to be used in apparel, engaging consumers through extended garment features, such as promotion, entertainment and information delivery. However, for this to achieve social acceptance, consumers have to be informed of the emerging technology and persuaded of its benefits. Using a qualitative methodology and the Technology Acceptance Model, this research investigated consumers' perceptions of AR's usefulness and ease of use; their attitudes regarding AR; and their behavioral intentions towards AR enabled apparel. The findings demonstrated a lack of knowledge of AR, and its applications in the apparel sector. Furthermore, whilst initial reactions to the 3D graphics and text were positive, concerns were expressed about privacy and security. The paper concludes that to move into the mainstream requires further consumer education, to inform the potential market of the possibilities that AR technology presents.*

## 1. Introduction

Combining apparel and technological innovations was pioneered by researchers in the 1990s; and, in 1995, Starner *et al.* [1] (p.1) predicted that:

*Wearable computing will change the current paradigms of human-computer interactions. With heads-up displays, unobtrusive input devices, personal wireless local area networks and a host of other context sensing and communication tools, wearable computing can provide the user with a portable augmented reality where many aspects of everyday life can be electronically assisted.*

As developments in wearables continued, the idea that an item of apparel could be a communication device grew; with Marculescu *et al.* [2] suggesting that 'A T-shirt or backpack could display text and images, including video and advertising logos' (p.29). Manifestations of these technological wearables were subsequently designed with either the device being embedded in a garment, or connected via augmented reality using mobile software.

This interconnectivity between a physical item and internet enabled technology has been referred to as the 'internet of things' [3] (p.46). According to Spanier [3] whilst this concept 'has been talked about for years', it is finally going mainstream, '...as wireless technology connects everyday objects and appliances to the web' (p.46). Adding to this, Burn-Callander [4] suggested that '...the next big thing' in communication would be the emerging capabilities of AR. These predictions appeared to have been borne out when the two concepts combined, with the launch of AR enabled wearable Google Glass; until a lack of social acceptance, and concerns over privacy and safety, saw the product withdrawn for the market after less than a year [5].

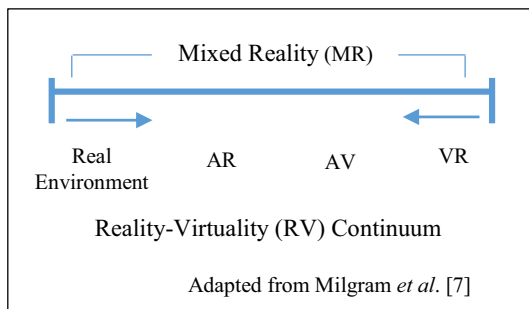
This would suggest that these multifarious advances in technology may have out-paced behavioral change and that AR, whilst exciting the technology and marketing communities, is still to make a significant impact on the consumer. Therefore, the paper gives consideration to the new AR enable opportunities that are being created in the apparel sector, how they are currently being perceived by the consumer and suggests a strategy for the future.

## 2. Literature review

### 2.1. AR technology

In the past decade, the pace of technological innovations has accelerated through a combination of increasing internet bandwidth and falling costs, which Spanier [3] predicts means ‘... we are on the cusp of a new mobile revolution’ (p.26). Part of this revolution has been the development and growth of AR, which Azuma *et al.* [6] defined as a system that ‘...supplements the real world with virtual (computer-generated) objects that appear to coexist in the same space as the real world’ (p.34).

To identify where AR sits in a range that spans from the completely real environment to completely virtual ones, involves the consideration of Reality-Virtuality (RV) Continuum [7]. This continuum starts with an individual’s actual, real and local world. It progresses through AR and a layering of Computer Generated Imagery (CGI) of electronically-stored information on to a view of the real world (an individual’s immediate surroundings). It continues on to augmented virtuality (AV) and concludes at virtual reality (VR), where the surrounding view of the real world is replaced by a virtual, fantasy or imaginary one [8] (Figure 1.).



**Figure 1. The reality-virtuality continuum**

Thus, whilst VR creates an illusion that the viewer is in a completely different place, AR adds information through text and graphics to the individual’s actual and immediate surroundings [9]. This allows AR to merge an individual’s real world with additional visual and audio material, which can be added by marketers. Thus, AR technology combines and aligns real and virtual objects, interactively with each other, in a real environment and in real time, through a variety of display technologies.

### 2.2. Advances in AR and mobile technology

Although the concept underpinning AR dates back to the 1960s, Azuma *et al.* [6] explained that it did not

become a research field until the 1990s (p.34). Initially, it was harnessed for a range of applications; from military training and flight simulators, to science-fiction films. However, a more recent, high-profile, application was Google Glass. Despite being withdrawn from the market, this innovation was described by Gibbs [10] as being ‘...one of the most interesting developments in wearable technology in the past four years’.

Advances in mobile computing systems, especially the inclusion of cameras in mobile telephone handsets [11], accelerated the development of innovative AR applications. The growth of mobile use in the United Kingdom (UK) has been reflected in figures from the Office of National Statistics (ONS) that show that, between 2010 and 2014, access to the Internet via a mobile device more than doubled, from 24% to 58%; and that 91% of households now had a broadband connection [12]. This has been further enhanced by the rollout of 4G connectivity and Wi-Fi hotspots [13]. Thus, as the consumer’s consumption of communication technology has grown, so have the marketing opportunities open to AR.

The combination of advances in AR and mobile technology led to, what Papagiannakis *et al.* [14] claimed, was the beginning of ‘...new breed of computing called ‘augmented ubiquitous computing’...[which encompassed]... the convergence of wearable computing, wireless networking, and mobile AR interfaces’ (p.3). This has facilitated AR’s growth in marketing communications, with technology companies exploiting the developing technology with the launch of apps (application) for iOS (iPhone Operating System), or Android devices [11]. This software is activated when a webcam is pointed at illustrations, in the form of a design, symbol, image or logo, to create a connection to the technology and enable the receipt of 3D text and graphics. Hence, this has recognizable applicability to items that have the capacity to display printed imagery.

### 2.3. Growth of AR through its use in print advertising

Over the past five years, a variety of businesses have used the AR technology in their print marketing campaigns. This has involved identifying enabled advertisements, by using an AR technology company branded marques in the layout (Figure. 2), with the optional accompanying phrase of ‘interactive advert’.



**Figure 2. Examples of AR brand marques (alphabetically ordered: Aurasma, Blippar, Onvert and Zapper)**

Examples of the diverse sectors that have used AR include charities, car manufacturers, financial services, the fragrance sector, and jewelry manufacturers. It has also been used by apparel and footwear brands Calvin Klein and Clarks; and retail brands Marks and Spencers, Debenhams and Tesco. In their campaign, Tesco used graphics the windows of their smaller stores to provide AR access to their F&F clothing range. Passers-by, with an Aurasma app on their smartphones, could view the ‘virtual showcase...then tap to purchase the item on display’ [15]. Thus, the AR technology was designed to provide information and then take the customer directly into Tesco’s website to complete the purchase.

Furthermore, the technology has been utilized by print magazines. This has resulted in special additions produced by UK publications Gracia, Hello!, Tatler and Heat, with the latter claiming that, over a period of four days, it helped to generate in excess of 180,000 interactions [16].

## 2.4. AR clothing application

Taking the concept into the physical clothing sector involves adding printed or embroidered design elements to enable garments to interact with AR. This results in fashionable wearables, which were defined by Seymour [17] as ‘...designed garments, accessories, or jewelry that combine aesthetics and style with functional technology’ (p.12). Such a combination can be used to engage consumers in extended garment features, such as promotion, entertainment and the delivery of information.

Realizing this potential in 2010, an interactive child’s T-shirt appeared on the market, which, through the use of technology, displayed the moving imagery of a sun, clouds and rainbows [18]. This was followed by technology company Aurasma who, in collaboration with UK based football club Tottenham Hotspur, tagged the club’s badge or logo with an AR connection; allowing fans to retrieve match highlights by scanning their own replica shirts [11]. This was similar to the collaboration between Moonpig and technology company Zapper, which brought AR to the greetings

card market [19]. Furthermore, Zapper had previously produced AR enabled T-shirts and worked on projects with Disney (*ibid*).

The idea of partnership through the use of AR was further promoted by Uniqlo and Sony, who created a collaboration by launching a T-shirt range created to coincide with the cinema release of The Amazing Spiderman film. These garments portrayed seven graphic and slogan designs, which enabled access to 3D augmented reality content [20]. Similarly, foam clog brand Crocs created a range of charms to be used in conjunction with their footwear that allowed wearers, both boys and girls, to use smartphones to access interactive characters, objects and games [21].

These methods of AR usage were plotted on a matrix, to identify patterns within campaigns and to suggest possible directions for future marketing strategy (Table 1.).

**Table 1. AR marketing focus matrix**

		AR enabled content	
Marketing Focus		Narrow	Broad
Beneficiary	Customer/ consumer	Enhancing product individuality to create a personal features - Moonpig’s personalised greeting card	Enhancing product utility to entertain or inform multiple audiences - Tottenham Hotspur’s AR enabled kit badge
	Marketer/ brand	Enhancing direct contact with the customer and limiting competitor selection - Tesco’s F&F virtual showcase and web-link	Enhancing collaborations with other brands - Uniqlo and Sony’s Spiderman T-shirt

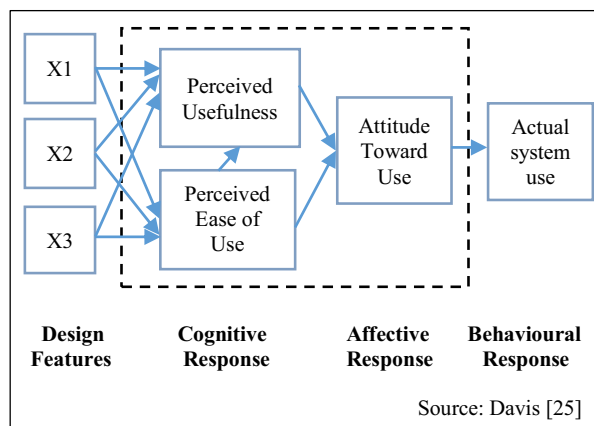
This analysis comes at an opportune juncture, because fashion embedded technology is set to become the norm within five years for most people, as the tangible merges with the intangible world [22]. This prediction was supported by Warman [23] who believed that, as technology fuses with fashion, incorporating innovations into clothing will move towards the mainstream. This would bring wider opportunities to ‘...bind those tablets to wearable technologies... [which would be] ...enabled by the global reach of the internet’ (*ibid*). Furthermore, van Krevelen and Poelman [8] declared that ‘We are on the verge of ubiquitously adopting Augmented Reality (AR) technologies to enhance our perception and help us see, hear, and feel our environments in new and enriched ways’ (p. 1).

However, whilst AR has been shown to be a highly engaging medium, which offers opportunities in

communications, there are concerns that ‘...consumer insight must remain at the heart of decision-making’ [23]. Additionally, van Krevelen and Poelman [8] identified limitations in the adoption of AR, one of which is social acceptance and the challenge of persuading people to use the technology. This is because, to participate in this revolution, the consumer has to engage with the innovative advances, which involves downloading the appropriate apps that enable AR, with each individual technology company having their own specification.

## 2.5. Technology acceptance model and AR

Setting out the process by which technology is introduced and diffuses through society to gain acceptance, Ryan and Jones [24] suggest that new technology emerges in the domain of technologists and those who are early adopters. Its potential starts to engage innovators who explore pioneering ways to connect to target audiences. This subsequently brings the technology into the mainstream, as it becomes adopted as standard. During this process, individuals have to be made aware, accept and learn how to use the new technology. To explain this process, Davis [25] developed the Technology Acceptance Model (TAM) (Figure 3).



**Figure 3. The Technology Acceptance Model (TAM)**

The previously mentioned AR enabled Google Glass ultimately suffered from what Gibbs [9] referred to as ‘...social rejection...[which]...many new gadgets have to overcome in their pursuit of mainstream adoption’. In this case, it not only involved the ‘attitude towards use’ [25] that the Google Glass consumer experienced, but also encompassed negative reactions, towards the early adopters, demonstrated by others in the wider society.

Therefore, whilst AR technology embedded in apparel and footwear is opening up new opportunities for collaborations between fashion and technology brands in the development of wearables, it also has the potential for creating risks.

This is especially the case regarding AR enabled garments targeting the childrenswear market. This is due to the controversy that can be caused by individuals aiming mobile phones in the direction of children [26] [27] and the interpretation of UK laws involved in data protection and human rights. These laws, on one hand, uphold an entitlement to respect in relation to privacy, whilst also promoting the right to free expression [28]. Consequently, the possibility of individuals (including strangers) using a mobile phone to engage in imagery worn by children has the potential to cause privacy and security concerns.

## 2.6. The next big thing

According to Dredge [29], ‘Mobile augmented reality is a relatively young technology’; and its emergence in the apparel sector being even more recent. Dredge continues by saying that its application has attracted hype and skepticism in equal measure and adds that whilst, ‘Overlaying digital information onto the real world, viewed through a camera phone, is technically impressive...the business models and usage patterns are still evolving’. Additionally, Clawson [30] adds a further note of caution, by claiming:

*AR designers are faced with the law of diminishing returns. The consumer who is captivated by, say, a cartoon image dancing on their hand today will surely be bored by something similar tomorrow. If simple spectacle is the selling point of AR, the novelty will surely wear thin, and quickly.*

For this reason, AR needs to prove that it can add more than just a short-term gimmick to the consumer-brand engagement, which is as much a reality for the fast-moving apparel sector as any other.

Therefore, this research considered the emerging use of AR as a technology applied to apparel and its capacity to impact on purchase behavior. Using the components of the TAM, it investigated the consumers’ knowledge and perceptions of the technology, their attitude towards its application and their propensity to consume AR enabled garment.

### 3. Methodology

This research was undertaken as a part of a larger study, which utilized a grounded theory strategy. The opinions of female fashion buying consumers were elicited through a qualitative methodology. This segment was chosen because nearly 80% of all consumer purchases are driven by women, who buy apparel for multiple markets, including womenswear, menswear and childrenswear [31]. The data collection involved five face-to-face focus groups, which were undertaken at UK based locations, with participants divided by age group (those in their 20s, 30s, 40s, 50s and 60plus). Non-probability snowball sampling was used to gain access to participants, by contacting five known individuals and requesting that they convene a group of between four and eight participants [32]. This led to 26 respondents in total, with five participants in each of the 20s, 30s, 40s and 50s groups, and six in 60plus category.

A semi-structured format was utilized, with the question schedule based on the elements of the TAM [25]. The discussion started with the consideration of design features to illustrate the practical application of the technology. This comprised of examples of AR enabled advertisements, including the image of an AR enabled advertisement, for fashion brand French Connection, and a video of garments with AR embedded designs [33]. This then led to an assessment of the participants' cognitive responses, which identified their perceptions of AR, including its usefulness and ease of application; their affective responses indicating their attitude towards the technology; and, finally, their behavioral responses to ascertain whether they would actually use the technology, or take it into consideration as a garment design feature, in their purchase behavior.

This data-collection strategy was aimed at evaluating both theoretical and practical applications of AR technology in the marketing and promotion of apparel. The discussions were audiotaped and transcribed, with the data examined through thematic analysis.

### 4. Results

The following focus group responses are divided into the elements identified by the TAM (cognitive, affective and behavioral responses); with the age group of the participant identified (20s, 30s, 40s, 50s, and 60plus). Where direct quotes are included, the participant's age group is included in brackets, if it had not been stated in the body of the sentence.

#### 4.1. Cognitive responses (knowledge and perceptions – including perceived usefulness and ease of use)

When the participants were asked if they had heard of AR, or seen a technology branded logo (similar to the examples in Figure 2), only two replied that they had. One answered 'Well I've heard of it, it's been round for a while' (30s); and the other replied 'We've got them on our business cards at work and it goes straight to our website' (60s). A participant (50s) believed she had seen something similar in advertising by a company called Moonpig, which makes personalized cards. She said:

*Moonpig were doing it with the...err... Forces [Armed Forces]...they had it with their Christmas card thing and...and...and birthday things...and it was somebody in Afghanistan or somewhere... opened their card and it was their...their children...erm... having a cake for them at home and it was all these messages ...and I was thinking 'Oh, how did they do that?'*

This participant further added that she liked the fact that the AR made her 'part of the greeting you send' (50s).

One respondent (40s) conceded that seeing the 3D imagery made her feel like 'such a techno-dinosaur'. Yet this was also the case in the 20s age group, with a participant stating that she felt 'really behind the times' and another in that category asking 'Why do we not know about any of this..this technology?'. This theme was taken up by others in the 30s group, one of whom asked '...how are they training people to know this...how does Mrs Britain know?'. Another (40s) asked 'So, do you have to download an App on your phone, for that to work?'; with a 60plus participant enquiring 'And is that just by actually holding that [mobile device] on top?'.

When asked how useful, and easy to use, they thought the technology would be, a respondent in the 20s group said that, although she had not heard of AR, if she had seen the logo 'I would know what to...what people would do with that [logo]', with another stating 'I would know that people would scan that [logo]' (20s). Those in the 30s were less sure, asking questions like 'What are you supposed to do with it?', but then adding 'All of those things, now you've mentioned it, they'll spring out to me on every magazine I buy'.



## 4.2. Affective responses (attitude towards the technology)

Initially, the reactions to the 3D imagery in the advertising and clothing illustrations were favorable. Comments of 'Oh wow' and 'That's so cool' were examples of those given by the 20s group. Participants in the 30s group referred to it as 'impressive'; whilst the 40s used terms like 'incredible', 'amazing' and 'phenomenal'. Similarly, participants from the 50s category referred to it as 'cool' and 'amazing', with a participant in the 60plus group saying 'it's clever, isn't it'.

However, as the different AR examples were demonstrated, there was also expressions of caution with the 3D effects. A lack of lasting enthusiasm for AR in advertising was evident in a response from a 60plus participant:

*I've got to admit, though I am impressed by them, but I don't think I would necessarily go on there to....if I see French Connection [the Blippar advert] there, advertising a dress...I see them advertising a dress...I don't think I'd necessarily go on to the [website]...*

Furthermore, others found it disconcerting and were unimpressed with the idea of it being incorporated into clothing. Participants from the 30s group said 'I wouldn't go near to that', 'I don't like that' and 'Dark art'; whilst it was described as 'really scary' and 'Too much info, maybe' by participants in their 40s. This was also reflected in the 50s age groups with 'That's just so scary' and 'It's like Blade Runner' (a science fiction film from 1982).

As there are AR clothing products targeted at children, concerns were expressed regarding the lack of jurisdiction the wearer would have; including over other individuals with mobile technology. Although it was acknowledged that fears maybe unfounded, one participant in the 30s category commented 'I hate myself for being ridiculous'.

## 4.3. Behavioral responses (likelihood of use and impact on purchase behavior)

Identifying their current use of mobile technology, a participant (50s) described studying apparel and footwear worn by others. She said she had seen a woman's trainers, which were 'just amazing'. Identifying the brand by its logo, she said '...and then we were like that, on our phones, looking for the specific pair of trainers and thankfully they were half-price on the site that we were looking at'. Therefore, the footwear

was purchased by using the brand, its logo, the footwear style and color, which was accessed via mobile technology. The application of AR in this context, to identify and facilitate a purchase through an AR enabled logo, was considered in the discussion.

Participants in their 20s indicated that AR would influence them in their choice and purchase of clothing with one saying 'I totally want that dress now, in that advert...I do want that dress now...I really do'. However, other age groups were less convinced, with examples of responses being 'Yeah, I think maybe I would', 'I probably would' and 'Yeah, in about ten years' time' (all 40s); and 'It's nice to have...it's a nice to have, I think' and 'You can live without it' (both 60s).

Concerns were expressed about the impact AR imagery may have on encouraging impulse buying, especially for consumers on a budget. However, one participant (20s) said:

*I don't know...errmm....probably because generally...erm...I donno, I might...I might look at it, just out of interest, but I don't think it would make me buy anything, because generally I don't buy things if I don't have any money, so it wouldn't really make any difference.....do you know what I mean?*

Furthermore, the issue of control was discussed, with concerns raised about being manipulated in the decision-making. An example '...I don't want things pushed at me...I want to control my process, I'll purchase it if I want it, but I definitely don't want to be responding to this 'Shop Now, Shop Now' [emphasized by shouting]' (30s). Other participants reported that they were not prepared to invest the time to download relevant apps, for example 'I could never use that technology...you know, you want an instant hit, don't you...you can't be bothered to download something like that' (30s).

Consideration was given to whether accessing AR imagery would have any lasting impact on behavior. A participant in the 40s encapsulated responses from her own and other groups when she said:

*I could see it as useful...yeah....and it would be like a novelty wouldn't it...and you would use it and then....it depends how useful it would actually be for you, cos there's an advert, so... I mean...I hate adverts on telly and you know...[I] flick over them if it was a magazine and so to actually spend time watching this advert, to bring it up, then I wouldn't think...I think it would be a novelty to hold it up and have it come to life...but then, after the novelty, I don't think I would find it particularly useful*

Therefore, the technology would hold limited appeal, unless it contained further functionality, especially if the participant had previously distanced themselves from advertising content.

## 5. Discussion and conclusion

The 'internet of things' focuses on connecting physical items to web-based technology and experts are predicting that this concept will herald considerable new opportunities for consumers. In juxtaposition, advances in mobile technology, due to the increasing internet bandwidth, falling costs [3] and the inclusion of cameras in handsets [10], have accelerated developments in AR. Combining innovations in these two areas has increased the potential for using AR in the apparel sector for communication, entertainment and information delivery. However, caution has been expressed, because, whilst AR is 'technically impressive' [29] strategies designed to minimize social rejection are still evolving.

The need for such strategies was highlighted by the research, with participants demonstrating an overall lack of knowledge of AR technology. There was a sense from the participants that they should know more, but were unaware of what the brands were doing to inform them of the benefits to be gained. Those in the 20s believed that they would be intuitive to what actions were needed if they had observed the technology brands' logos; with the 30s suggesting they would see interactivity options now it had been pointed out to them. However, they had, thus far, not been aware of the use of AR by a wide range of sectors and print magazines, which had been designed to engage them with the technology. Furthermore, only two participants gave examples of a commercially available products; greeting cards (50s) and business cards (60plus category); however, only the participant who identified the business cards knew that it involved an AR embedded product.

The research found that attitudes to AR technology in advertising and on clothing were mixed, from very positive and enthused; to appreciative, but relevantly ambivalent; and on to applying negative meanings and associations. Concerns over privacy and security, which had blighted the launch of Google Glass [5], were highlighted, but from an opposite perspective. Whereas objections to Google Glass had come from the wider society feeling monitored by the wearer, the application of an AR enabled designs or logos on apparel, which could attract the attention of mobile phone using strangers, highlighted privacy and security reservations for the wearer; especially in relation to childrenswear (30s).

Conversely, one of the participants (50s) recounted an experience of seeing someone in a public place wearing a pair of trainers and, having recognized the brand by its logo, searched the internet for the product. If the logo had been AR enabled, similarly to the collaboration between Aurasma and Tottenham Hotspur [10], she could have pointed her mobile telephone at the footwear and been directed straight to the relevant brand's website; without a search engine supplying her with a range of other selling options. Therefore, this would not only enhance the garment's utility to entertain or inform multiple audiences, it would also enrich the consumer's direct contact with the brand and limit competitor selection (as indicated in the matrix in Table 1). Thus, it would provide mutual benefit to both the consumer and the brand.

This holds a possible key to future social acceptance. If AR is simply used as a short-term novelty, the participants reported that they would soon lose interest (40s). However, if it could be employed to create benefits for the consumer, through a deeper, more personal or convenient, engagement, then interactions could rise.

Therefore, the current concentration of using AR to provide entertainment, with a focus on childrenswear products, could be limiting future potential and, in fact, creating unnecessary concerns. However, the communication of relevant information to engage and support the buying process of female consumers, who purchase nearly 80% of apparel from multiple markets [31], is proposed as a potential engagement strategy for the future.

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