The Application of Ethics to AI in Fashion – Mapping a Research Terrain

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**Summary**

This paper critically examines the ethical implications of current and predicted adoption of Artificial Intelligence (AI) in the fashion industry and presents a mapping of academic literature and industry practice in three key areas: personalisation, customer interaction and AI-enhanced digital technologies. AI has the potential to revolutionise fashion marketing and retail through greater precision, accuracy and effectiveness in decision-making, resulting in the creation of better products and more compelling shopping experiences. However, there exist widespread and justifiable concerns associated with its use (Davenport et al, 2020). AI causes its own environmental footprint in terms of energy requirements and there are social implications for consumer well-being, jobs and the workplace. By unpacking the ethical implications obtaining within the application of AI in fashion, we seek to map a research terrain which can begin the development of a research agenda needed in times of great technological change and uncertainty.

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**Introduction**

Challenges of great social import increase day by day, including extreme environmental change, pandemics, escalating levels of human migration and dramatic advances in technological power. Rapid technological, socio-political and environmental changes present significant challenges to the ethical pursuit of ‘the good life’ in the 21st century age of smart machines (Vallor, 2016; Danaher, 2018). Technological progress can bring great benefits to business and society, but the negative effects and incidental costs of emerging technologies such as AI, automation and robots must also be recognised (Ley, 2020). Companies and developers need to consider both the unintended effects of innovations and the ethics of the important question of ‘should we?’, not only ‘can we?’ Technology is innovating at a speed greater than can be regulated and legislation cannot keep up with the current pace of technological change. Therefore, there is a need to steer the growing power of technology with moral intelligence (Vallor, 2016). The adoption of Artificial Intelligence (AI) in fashion marketing is one area that raises substantive concerns and needs close scrutiny in this regard.

**The Nature of AI in Marketing**

AI emerged as a branch of computer science that sought to synthesise machine learning, logic and natural language processing to develop a ‘thinking machine’ that could emulate and even surpass human intelligence. McCarthyet al (1955) are credited as introducing the term ‘artificial intelligence’ in a funding proposal to the Rockfeller Institute for what is now referred to as the ‘Dartmouth Workshop’ held in 1956 (e.g. Solomonoff, 1985). Turing (1950) introduced the first operational test of intelligence in a scenario that he called ‘The Imitation Game’: in short, a human interrogator poses open questions, which are written so that the interrogator cannot rely on tones of voice, and a computer passes the test if, on average, an interrogator cannot tell whether the written responses come from a person or from a computer. To pass this test, a computer demands capabilities of natural language processing, knowledge representation, automated reasoning, and machine learning (Russell and Norvig, 2020). This oft-cited test, known as the Turing Test, has broadened to include aspects that test a subject’s perceptual and physical abilities, requiring additional computer vision and robotics, known as the ‘total Turing test’ (Russell and Norvig, 2020). These six areas comprise the modern interpretation of AI. Currently, most applications in business contexts are ‘cognitive technologies’ that emulate human thinking and decision-making processes in key areas such as data analysis and customer interaction (Davenport and Ronanki, 2018). However, despite outperforming humans in many areas, AI is less effective than humans at facial recognition and the more intuitive or creative aspects of mathematics.

Cognitive technologies fall two broad categories: Narrow or Weak AI; and General or Strong AI. At present, virtually all AI is narrow, meaning it can only do what it is designed to do. This means that for every problem, a specific algorithm needs to be designed to solve it. Narrow AIs are mostly much better i.e. faster and more efficient than humans at the task they were made for: for example, chess and similar games e.g. Go, computational algebra, data analysis for patterns, and with the advent of big data, translation. However, narrow AI is precisely that: the algorithms and software implementations do not transfer from one narrow domain to another. The holy grail of AI is a General AI, a single system that can learn and then solve any problem it is presented with. This is exactly what humans do: they can specialise in specific topics, such as maths, psychology, sports or art, and become experts at them (Deloitte, 2017). Davenport and Kirby (2016) distinguish between task automation and context awareness, which map onto the concepts of Narrow and General AI.

By processing vast amounts of data and recognising patterns in data, AI produces insights and analytics that are beyond human capability. The ever-increasing amount of consumer data available online, in big data systems, social media or mobile devices, makes AI particularly relevant to marketing, as its applications areas are mostly based on data analysis (Jarek and Mzurek, 2019). In fact, McKinsey & Co. indicated that the greatest potential value of AI pertains to sales and marketing domains, especially in consumer-driven industries such as retail (Chui et al, 2018). It is already being used to replace human expertise in areas of digital marketing such as online targeting and dynamic attribution, and could best offer solutions at a scale and speed that would be impossible for a human to achieve (Wirth, 2018). It offers massive potential gains in engagement, efficiency and productivity. AI is predicted to significantly influence both marketing strategies, in terms of business models, sales processes and customer service options, as well as consumer behaviours (Davenport et al, 2020).

Since AI spans many technologies across various sectors (Schiff et al, 2020), one of the main issues is how the technology is actually defined. In the broadest sense of the term, AI is a type of computer science system that automates so-called ‘intelligent’ processes, such as decision making, problem solving and learning; as noted above, the notion of a ‘thinking machine’. It enables computers to do things that would otherwise require human intervention. A truly artificially intelligent system is one that can learn on its own, for example an AI system that is trained to learn the association between brand preference and consumer profiles (Wirth, 2018). However, the AI term is often used interchangeably with notions such as automation or robotisation, and also tends to be confused with machine learning or algorithm application (Jarek and Mazurek, 2019). Predictive models, such as regression, and many machine learning approaches are not AI, although some of them can be leveraged when developing AI solutions – an AI solution should be capable of learning, knowledge representation, reasoning, and prediction or planning (Wirth, 2018). Is AI just a synonym for extremely powerful algorithms and neural networks or is there more to it? The current hype around AI is creating a blurry picture (Wirth, 2018) with views ranging from outright alarmist to euphoric (Kaplan and Haenlein, 2019) and therefore requires clarification (Wirth, 2018).

**The Ethics of AI**

Having traditionally drawn the attention of engineers, IT experts and analysts, AI is now developing a stronger presence in the fields of management and marketing (Jarek and Mazurek, 2019) and thus prompting an increasing academic interest from broader disciplines such as marketing, business, psychology and sociology (Davenport et al, 2020). There is also an emerging stream of practitioner and academic literature focusing on the ethical perspectives of AI in business and marketing (e.g. Steimer, 2018; Danaher, 2018; Davis Kho, 2019; Martin, 2019; Letheren et al, 2020).

According to Orr and Davis (2020, p.2), “the apparent inevitability of AI’s continued growth, paired with broad public anxiety about its social implications, have prompted a flurry of attention and channelling of resources towards understanding AI systems, predicting their effects, and devising social and technical interventions to minimize harm and optimize social good”. Whilst advocates recognise its potential for vast economic growth and social benefit, critics of AI have raised concerns about ethical, legal and social risks such as “algorithmic bias, disproportionate harms to vulnerable populations, failures of accountability and transparency, technological unemployment – and even the possibility of existential threats from ‘superintelligence’” (Schiff et al, 2020). The creep of automation into the mental and cognitive elements of tasks (the so-called ‘algorithmic cognitive outsourcing’) makes AI ethically contentious, since in modern societies, much of our self-worth and value is determined by the mental and cognitive (Danaher, 2018). Algorithmic outsourcing is accused of being dehumanising, leading to cognitive degeneration, and robbing humans of freedom and autonomy (Danaher, 2018). The use of AI in marketing also raises questions around privacy, security and use of data (Davis Kho, 2019). The Leverhulme Centre for the Future of Intelligence (an interdisciplinary research community with a remit to help maximise AI’s opportunities for the benefit of humanity) note the need for safe, ethical, and socially beneficial AI development, if AI is to serve the public interest and bring about benefit worldwide. This is increasingly being addressed in governance documents such as the OECD Principles on Artificial Intelligence (2019), which highlight the need for AI stakeholders to work proactively to promote “inclusive growth, sustainable development, and well-being” (Schiff et al, 2020). Therefore an important consideration is the types of applications that AI should or should not be used for (Davenport et al, 2020).

The stakeholders in the debate over AI and ethics are various and there is both consensus and difference over the ethical issues (Schiff et al, 2020). Ethical theories can aid in exploring the ethical dimensions of AI and associated judicious decision-making. The main two approaches in modern Western philosophical ethics are consequentialist (e.g. Jeremy Bentham and John Stuart Mill’s utilitarianism) and deontological or rule-based (e.g. Immanuel Kant’s categorical imperative). In the first approach, the focus is on the outcome of the act, whereas in the second approach, it is the act itself, regardless of the outcome. However, a weakness of rule or principle-based ethics as arbiters of sound moral judgment is the potential of morally counter-intuitive implications for exceptions to the rule or principle. Therefore Vallor (2016) argued that virtue ethics are more suited as a lens to aid decision-making in the complex, novel and unpredictable moral landscapes that are presented by today’s emerging technologies, such as AI. With virtue ethics, it is the character traits of the moral agent (individual or firm) that act as the driving force for ethical behaviour, rather than the act itself or any outcome.

Given the multi-layered and complex ethical terrain of AI, it is vital that researchers begin to explore these issues. We attempt to shed light on them by focusing on three specific areas of the fashion industry in which the application of AI could bring potential benefits but also entails ethical concerns. Our objectives are to 1) map a research terrain for the study of AI applications in the fashion industry and 2) critically examine the ethical issues of current and predicted adoption of AI within fashion. We first discuss three key areas of AI application within fashion. Within these areas, we identify key ethical issues worthy of further scrutiny and suggest research questions to stimulate further study of these important problems.

**AI in the Fashion Industry**

The fashion industry is a multi-billion pound global business characterised by constant renewal of products, intense competition and demanding consumers. There are distinct sectors to this industry: one produces high fashion, luxury garments and accessories worthy of those in the most admired social classes, while the other produces fast fashion, cheap clothes sold to the masses to wear in their everyday exploits. In the UK alone, there are 11,500 specialised clothing stores and annual expenditure on clothing in 2018 was valued at £58.4 million (Sabanoglu, 2020). Online retailing has revolutionised distribution channels with greater demand fuelled by sophisticated social media marketing activities especially in fast fashion, but has also led to greater carbon emissions, increased products returns and waste, and also raised questions about the wellbeing and mental health implications of keeping up with fashion, especially for younger consumers. Global fashion consumption is forecast to rise as a result of increasing demand in Asia Pacific and in developing countries whose populations and disposable incomes are growing, but at the same time, fashion is a significant contributor to environmental impacts through the volume of waste clothing which is landfilled or incinerated, and its carbon footprint. There are calls for industry players to address their social responsibilities and environmental footprint in terms of carbon emissions, resource use, pollution and textile waste (House of Commons Environmental Audit Committee, 2019). It is ever more vital that researchers continue to explore the consequences of our daily consumption routines, and that businesses take responsibility for the impact of their actions. Advanced technologies such as AI have the potential to revolutionise fashion through greater precision, accuracy and effectiveness in decision-making, but at what cost? Or might unintended consequences of technology exacerbate the issues even more?

AI is increasingly being utilised throughout the entire fashion industry, from sales forecasting to textile and apparel manufacturing and supply, and for garment design and comfort (Thomassey and Zeng, 2018). It is also used within the marketing function and business processes. Marketing insights, automation and execution will allow marketers to drive better business results and spend more time on strategy and creative development (Olson and Levy, 2017). AI-informed technologies driving change within the consumer journey include voice control, digital assistants and augmented reality (Mintel, 2020). Voice control is when the consumer uses voice commands to communicate with smart speakers, displays, smartphones, tablets and other devices that include a voice-controlled digital assistant. This type of search is the fastest-growing mobile search type (Robbio, 2018). Digital assistants refer to software that can answer natural language requests in a ‘chatbot’ style request-response interaction, which can include voice-controlled or typed requests. Augmented reality combines digital information such as image, text and sound and incorporates them onto a real-world view, creating an advanced experience that blurs the boundaries of fantasy and the real-world. Through these technologies, AI has the potential to revolutionise fashion by enabling greater precision, accuracy and effectiveness in decision-making. It could empower designers, brands and retailers to make better products and create more compelling shopping experiences.

From analysing the different recent technological advancements pertinent to fashion, it is clear that the technologies described above do not exist in isolation, with many applications using multiple aspects of these technologies to deliver their service (Davenport et al, 2020). Through observation and secondary research in this context over the past two years, we have identified three key areas that capture the consumer-facing applications of AI in fashion marketing: personalisation, customer interaction, and AI-enhanced digital technologies. Table 1 below provides a summary of industry examples and academic studies in each area.

|  |  |  |  |
| --- | --- | --- | --- |
| **Fashion AI Application** | **Personalisation**  | **Customer Interaction** | **AI-enhanced Digital Technologies** |
| **Technology Used/AI Examples** | BirchboxStitchfixTrendy ButlerEcho LookGoogle Lens | Levi’s Virtual StylistKik Chatbot (H&M)Tommy Hilfiger Facebook ChatbotBurberry Chatbot | CGI fashion influencersFilteringPre-SetsModifaceVirtual Catwalk |
| **Previous****Academic Studies** | Gibbs (2017)Brill et al. (2019)Andre et al. (2018) | Chung et al. (2018)Ho et al. (2018) | Watson et al. (2018)Kim and Cheeyong (2005)Rauschnabel et al. (2016)Yaoyuneyong et al. (2014) |

Table 1. Key AI applications in fashion marketing and previous studies

Next, we discuss each area in turn with specific reference to their ethical implications and raise questions for further research.

**Personalisation**

Content management systems utilise big data and AI for audience segmentation and behavioural targeting, proposing content or products that a person is likely to enjoy consuming given their current choices, allowing consumers to effortlessly discover content of interest. Acknowledging that one consumer’s reality is different to another consumer’s reality, AI enables companies to serve highly personalised adverts and content based on predictive profiles drawn from big data analysis of real-world and digital information. Deeper relationships are made possible with analysis of real-time insights (Olson and Levy, 2017).

Greater personalisation of content and services might mean better choices made by consumers. Personalisation saves time and effort, relieving consumers of the cost of searching and also from choice overload, option attachment, guilt and trade-off conflicts, but may undermine consumers’ sense and right for autonomy (André et al, 2018). Rather than feeling more empowered in their choices, consumers may feel more alienated from their ability to choose. This could ultimately result in learned helplessness and a weakened sense of personal responsibility (André et al, 2018).

Algorithms that personalise users’ online experiences could lead to the siloisation of consumers into their own ‘filter bubbles’ – an isolating situation in which an internet user encounters only information and opinions that conform to and reinforce their own beliefs. Feeds would become more attuned to a user’s existing worldview and serve up more content that reinforces it (Davis Kho, 2019). Only being exposed to the content that is similar to previous content a user saw, or content that companies think a user profile should be exposed to, may limit a user’s aspirations and ambitions (Trurow, 2012). Alternatively, as AI learns what people to respond to, it could encourage addictive online behaviour. There is an issue of deception in terms of whether people know it exists, or know whether it is possible to ‘switch off’, for example by disabling cookies to stop personalisation online.

AI is not necessarily free from the social neuroses and discriminations that can plague humans, since machine learning originates from human makers, meaning those shortcomings can be passed along via algorithms and data input (Steimer, 2018), resulting in algorithmic bias (Schiff et al, 2020). Algorithms create moral consequences, reinforce or undercut ethical principles, and enable or diminish stakeholder rights and dignity (Martin, 2019).

AI offers opportunities for hyper-personalisation (Jarek and Mazurek, 2019) which is of particular value to the fashion industry in terms of enabling greater accuracy in trend forecasting for product development and online styling advice for subscription business models. Consumer preferences are difficult to predict with accuracy, but getting it wrong could result in unsold stock and pre-consumer waste, with implications for both bottom line and environmental footprint. AI that predicts garment suitability and offers greater customisation for consumers may reduce waste and over-consumption (Snow, 2017). Offering products with greater relevance would help to reduce returns, markdowns and warehouse space and increase customer satisfaction. Although better consumer decision-making supported by AI could result in less wastage of resources in terms of unsold stock and less post-consumer textile waste, AI causes its own environmental footprint in terms of its energy requirements. Energy is required to power up the servers to run the computers, as computers give off heat and need to be cooled. Software algorithms run on hardware, so electricity is needed to power them, which mainly comes from nuclear/fossil fuel. Hard disk drives are more common as they are cheaper, but are less energy efficient than solid state drives. There is a carbon footprint implication of the increasing amount of data that is created and stored, which requires energy. Moreover, is it ethical to even encourage consumers to buy more products, given environmental challenges and the current climate crisis?

Examples of AI-powered personalisation in fashion retail include Amazon’s development of ‘Echo Look’, which combines computer vision with predictive AI and human analysis to assess a consumer’s current wardrobe choices and provide recommendations of what to wear. Users can ask the machine to rate two different possible outfits in terms of current trends and actual appearance (Gibbs, 2017). Online styling subscription Stitch Fix uses machine learning algorithms to determine its customers’ preferred styles and offer personalised recommendations. It sends its 2.7 million active American clients suggestion boxes of clothes selected by cross-referencing a client’s stated preferences with the recent purchases of others of similar age and demographic. Preferences are identified based on data gathered from customers using both direct questions about their preferences and indirect elicitations from their Pinterest pages and likes. Stitch Fix uses proprietary AI algorithms to analyse the non-numeric social media data and regards these as very useful, since customers cannot always articulate their preferences on numeric scales (Davenport et al, 2020). These data are then summarised for the (human) fashion stylists it employs, who are then better informed to be able to make suitable recommendations of clothing for customers.

However, machine learning algorithms need sufficient data to inform accurate and relevant predictions. In the case of rare events, the machine may not be able to collect enough data to learn from observations and make a prediction (Agrawal et al, 2018). More pressing in the case of consumer industries is privacy concern, which could manifest as refusal of some humans to provide certain information, and also limits the ability of the machines to collect sufficient data to inform an accurate prediction (Agrawal et al, 2018).

AI could revolutionise online retailing – the current process is that customers order then retailers ship products. But if with AI, online retailers could accurately predict what customers will want, retailers could transition to a shipping-then-shopping business model, using AI to identify customers’ preferences and ship items to customers without a formal order (Agrawal et al, 2018; Gans et al, 2017; Davenport et al, 2020).

But to what extent can and should AI replicate and replace human creativity and presence in an industry sector founded on human input in creating new trends? Using AI for trend forecasting could also result in a reduction in trend forecasting job roles (as Schiff et al (2020) term ‘technological unemployment’), although it could lead to a better outcome if AI supports rather than replaces human employees. According to Davenport et al (2020), the experience of Stitch Fix’s senior managers was that their application of AI works best when it augments the capabilities of the (human) stylists, rather than replacing them completely. When emphasising the assistive role of AI, it is typically referred to as ‘augmented intelligence’ (e.g. Gartner, 2020).

The resurgence of interest in AI and its potential for application derives chiefly from computing power; and many of the underpinning algorithms are statistical in nature (e.g. Han et al, 2012). This means they are driven by historical data; therefore, there is very little chance that anything truly new would be offered to consumers. An individual consumer might be recognised as having a similar profile to another and thus be offered items that she has not considered based on what similar consumer groups select; however, she would not be shown things ‘outside of envelope’, or truly creative. One possible means of addressing this might be to emulate the approach pioneered by Netflix: it paid thousands of people to watch films and make notes, i.e. tag the movie as they watched, enabling the development of more than 80,000 ‘micro-categories’. These micro-categories admit of a more flexible and creative means of making recommendations, but even these are limited because the approach does not consider the quality of a recommendation (Marr, 2016).

**Customer Interaction**

Automating repetitive tasks could save money and time for greater value-added activities, for example through the use of chat-bots for online customer service. AI is always available, has a greater capacity and is more consistent in responses. In terms of human resource management, there is no overtime pay needed and in terms of delivering consistency in customer experience, there are no mood swings to contend with.

AI-enabled chat-bots emulate human interaction by giving advice via a choice of responses, emulating cognitive processes that are choice processes e.g. responding to a choice of words. There is a distinction between robotic process automation and AI-enabled bots, or intelligent conversation agents, such as chat-bots. The use of chat-bots ranges from engaging in simple conversations with customers, for example, by responding to frequently asked questions or holding more complex dialogues. These are commonly used across all market levels in fashion retail, for example H&M’s Kik Chatbot, Tommy Hilfiger’s Facebook Chatbot and the Burberry Chatbot. There are two distinctive types of chat-bot, depending on the type of technology employed:

* *Software bot* – this refers to robotic process automation (lower end of the skill spectrum, highly defined sequence of steps and clear choice points and specific prescribed response choice to each point). This is akin to Huang and Rust’s (2018) Mechanical Intelligence (very basic). Problems are solved through brute computer force rather than emotional intelligence.
* *AI-enabled chatbot* – this type can emulate human interaction, such as giving advice, by choosing from a range of responses, emulating cognitive processes that are choice processes e.g. responding to a particular choice of words. There are lots of ambiguities in human languages so this is an advanced type of technology.

Some AI is so advanced that interacting with it can feel like talking with a real person. As the technology improves, there may be a case for alerting customers that they’re not talking with a real person (Steimer, 2018). If customers discover that they are interacting with a chat-bot, they may become uncomfortable, which could lead to negative consequences for the brand or retailer (Davenport et al, 2020). More worryingly, some individuals may subconsciously buy into the illusion, and come to sentimentalise interactions that do not in fact constitute genuine relationships (Sparrow, 2002). This is based on the ELIZA effect, named in 1966 for the chatterbot developed by an MIT computer scientist. It refers to the anthropomorphism of computer systems, whereby users have a sincere and conscious belief that computers are human and/or deserving of human attributions (Kim and Sundar, 2012). This occurs as a result of a subtle cognitive dissonance between the user's awareness of programming limitations and their behaviour towards the output of the programme. It has been found that even extremely short exposures to a relatively simple computer programme could induce powerful delusional thinking in normal people. ELIZA parodied a Rogerian psychotherapist, largely by rephrasing the patient's replies as questions, but a surprise finding was its success in eliciting emotional responses from users who, in the course of interacting with the programme, began to ascribe understanding and motivation to its output. Researchers discovered users unconsciously assuming ELIZA's questions implied interest and emotional involvement in the topics discussed, even when they consciously knew that ELIZA did not simulate emotion. More recently, Sparrow (2002) raised the point of moral duty towards some individuals who may buy into the illusion and come to sentimentalise interactions that fail to constitute genuine relationships. But in terms of parasocial interaction, is a relationship with a real-life online influencer any different? Blackford (2011) questioned whether there is a duty to others to avoid delusion and to apprehend the world correctly. However, he acknowledged that a fierce commitment to truth may not be a desirable moral virtue, as sentimentalising interactions that do not constitute genuine relationships is continuous with much of the minor sentimentality already indulged in on a daily basis.

In terms of the employment and jobs implications of replacing humans with AI-enabled bots, the growing capacity for technology to think and act will affect the workplace through a re-invention of worker roles, assigning some to humans and some to machines and some to a hybrid model (Wolhunter, 2018). Analytical skills may become less important, as AI takes over more analytical tasks, giving the ‘softer’ intuitive and empathetic skills even more importance for service workers. Eventually, AI will be capable of performing even the intuitive and empathetic tasks, which enables innovative ways of human–machine integration for providing service but also results in a fundamental threat for human employment (Huang and Rust, 2018). However, the authors assume a fixed world – jobs will be replaced, but what about new analytical tasks that do not exist today? Makridakis (2017) questioned whether the new jobs being created will compensate for, or even augment those lost by technology as in the past? Opinions differ greatly on this issue as some are arguing that there is a fixed supply of work to be done, while others, with Milton Friedman the most notable advocate, claim that human wants and needs are infinite and that clever entrepreneurs will always devise ways to fulfil them as long as sufficient buying power is available (Susskind and Susskind, 2016). But what about job obsolescence if the jobs of the future are also potentially automatable? While service jobs, even low-skilled ones, were traditionally considered to be more difficult to automate due to their heavier reliance on contextual understanding and spontaneous interactive communication compared to manufacturing jobs (Autor and Dorn 2013), this may no longer be the case as AI has a very fast rate of learning. Wirth (2018) questioned whether an AI solution could replace the human expertise required to generate valuable marketing insights, consequently trigger respective actions, and continuously learn from what it is doing? But even highly skilled jobs could be affected, for example high level IT tasks that could be automated using algorithms such as those available through Amazon's Web Services. The impact of job obsolescence and loss would probably be more pronounced in developing countries than in developed ones - firstly, as unskilled and semi-skilled labour will be replaced by computers and robots, there will be no reason for firms to move their production to developing nations to exploit their cheap supply of labour as they can achieve the same or cheaper costs with AI, thus increasing the trend towards reshoring back to advanced countries (Ford, 2016), and secondly as developing countries will not be able to invest in AI. But how is it reshoring if it does not lead to jobs back home, but merely AI back home?

Algorithmic cognitive outsourcing could lead to human cognitive degeneration (Danaher, 2018) so the question of what to do with left-behind or redundant workers if industries such as fashion allow their key functions to be replaced by AI must be considered. The up-skilling of workers to use AI is also an important area as not everyone can be up-skilled, and even with vast retraining programmes it may not be easy to avoid societal disruptions as the new jobs would require skills that may not be so easily attainable, for example social and interpersonal skills as well as creativity and innovation. What is the cost of human ‘manpower’ wasted as computers take over? If businesses replace workers with robots, the income tax implications might be detrimental to the national economy, as AI is free from income taxation. Can the social structure withstand such massive change or would a new societal infrastructure need to be designed to manage the effects of AI? How will work and leisure change, and what might be the implications for fashion product requirements?

**AI-enhanced Digital Technologies**

AI-informed computer-generated imagery (CGI) technology enables the development of online characters mimicking the role of social media influencers and models. This represents a bridge between the realm of digital technology and real life, whilst also delivering unique brand experiences (Mojapelo, 2018). For example, ‘Miquela’ has 1.6 million Instagram followers, collaborates with luxury brands (including featuring in a video for Calvin Klein in which she ‘interacted’ with human fashion model Bella Hadid, merging the digital and the real worlds) and has event launched her own clothing brand, despite not being real. Lil Miquela is not true artificial intelligence: she is an example of CGI avatar that is guided, i.e. programmed, to act in a manner that simulates human expression. However, companies such as Brud, the LA-based start-up responsible for creating Lil Miquela, and Betaworks (<https://betaworks.com/>) are developing platforms to synthesise the algorithms underpinning chatbots with advances in CGI rendering to create influencers that will exhibit standalone ‘human’ characteristics, decision making and conversational powers.

It has been mooted that CGI technology could extend and expand the career of real models, because there will be the potential for them to make very detailed scans of themselves to produce a so-called avatar, which could then be sent on multiple jobs around the globe, with additional benefits for carbon footprint reduction. It could also avoid the potential of career slowdown due to ageing: through the avatar, they could effectively be immortalised, so that a model’s career could last decades or even centuries (Newbold, 2018). However, these technological innovations are not without critique, and could further inflame the ongoing ethical debate about using digital technologies at the risk of opportunities for real people, for example diminishing already scarce opportunities for black models (Graham, 2018) or fetishisation and objectification of people of colour (Cadogan and Alemoru, 2018). The world’s first digital supermodel Shudu is a black female created by a white man, but media critics asked how a white man could realistically realise and represent a black woman (Newbold, 2018)?

CGI models allow us to explore the limits of beauty through blurring boundaries of the real and the unreal, but could introduce norms of artificial appearance and personal aesthetics impossible for ‘real’ people to achieve. However, despite their lack of authenticity, how different are CGI influencers from many of the heavily-edited social media influencer accounts that already exist (Condon, 2018)? Do CGI models represent a clever comment on authenticity on social media or evidence the fashion industry’s obsession with perfection? We might also question who is controlling the CGI influencer, the developer or a brand? In 2018, the head of luxury fashion house Balmain, Olivier Rousteing, worked with CGI artist Cameron-James Wilson (who also created the world’s first digital supermodel Shudu) to create two Balmain-exclusive digital supermodels, Margot and Zhi. CGI influencers by their nature are more open to manipulation than a human influencer, which raises further questions of who is working for a brand and who is being authentic? Should this be explicitly disclosed to the followers of the account? Increasingly stringent regulation of influencer marketing in the UK and the US requires influencers to disclose when they are being paid to engage in social media marketing, but it is unclear whether Federal Trade Commission/Advertising Standards Authority regulations and guidelines set for human influencers apply to CGI influencers too. A recent study found that many young followers did not realise the CGI influencer was not a real person (Tatum, 2019), so there are ethical issues over the duty to avoid deception, whether intended or not. However social media, and in particular Instagram with its influencers who curate their lives for online consumption, could be perceived as masquerading highly artificial content as a documentation of reality, leading to a debate about whether postmodern ideas of representation are in fact preferable to the actual thing represented (Allwood, 2018).

**Conclusion**

In summary, there are numerous benefits and opportunities of AI in its various applications for the fashion industry, but also valid concerns about its use, which have implications for social and environmental responsibility, raising questions for further research. The ethical dimensions of AI are multi-layered and complex but can be explored using a number of ethical frameworks, such as principle and rule-based theories or virtue ethics. This paper has identified three key areas of the fashion industry that each present unique ethical considerations. Subsequently, it is imperative to map and match such considerations onto a comprehensive ethical framework encompassing of the various philosophical approaches. This paper contributes to beginning the development of a new realm of understanding around how AI can be best managed, valued and applied for a more ethical and sustainable society.

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