The Role of Artificial Intelligence in Consumer Choices in the Fashion Industry

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Zachary Wang

Spring 2024

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Joshua Earle, Department of Engineering and Society

Introduction

Zara, one of the most valuable fashion companies in the world, was founded in 1975 by Amancio Ortega, the son of a railway worker. Over time, Ortega continued to open new store fronts, beginning in Galicia, Spain, and eventually spreading internationally. Now, the mega corporation Inditex, of which Zara is their biggest brand, boasts over 2,300 stores worldwide. Zara has made an impact on the fashion industry that can't be ignored.

Zara was able to find such great success through pioneering a business model called "fast fashion." The company produces clothes quickly that imitate luxury fashion brands and distributes them to stores efficiently, keeping prices low. New designs are sent to stores frequently, incentivizing consumers to frequently buy new clothes. This strategy has brought Zara and other imitators great success, as the global fast fashion market has reached a valuation of $93.66 billion dollars as of 2022 (Kings Research, 2023).

This success does not come without consequences. Today, clothes are worn just 7 to 10 times on average before they are thrown away (Thomas, 2019). Because of this and a slew of other reasons, fast fashion, known for its fast-paced trends and substantial resource consumption, is one of the largest contributors to climate change (Sull & Turconi, 2008). As the face of fast fashion, Zara has made huge environmental impacts.

Zara and other fast fashion companies are looking to utilize new technologies in order to expand their business. One such technology is Artificial Intelligence (AI). The ramifications of AI, especially in the fashion industry, carry significant implications for the global environment. It is a well established fact that the fashion industry negatively impacts the health of the environment (Niinimäki et al., 2020). The negative effects have the potential to continue to worsen as the fashion industry grows, powered by AI. Therefore, it is essential to understand

how the use of AI might influence consumers into supporting the fashion industry, influencing the industry's impacts on our world.

The European Parliament defines AI algorithms as "systems that display intelligent behaviour by analysing their environment and taking action – with some degree of autonomy – to achieve specific goals" (Boucher, 2020). With its increasing mainstream appeal in recent years and rapid growth and development, AI will soon be integrated into almost every aspect of our lives (Haan, 2023).

In this paper I study the effects of AI algorithms on consumer desires, through the lens of the fashion industry. This study revolves around the following research question: How does the fashion industry leverage AI algorithms to drive consumer choices? This question is significant because AI represents the cutting edge of software innovation and has only become more and more prolific and commonly used (Haan, 2023). Therefore, understanding its potential impacts in the fashion industry is essential to mitigating any potential harmful effects, and bolstering any positive ones. I conclude that the fast fashion industry and specifically H&M and Zara use AI extensively to optimize supply chains and improve customer experiences, increasing consumption of clothing products.

I begin with an overview of the methods used to conduct my research, specifically following the ANT framework. Next I recount the results of my findings, followed by an analysis of these results to determine the implications of my findings. I conclude that fast fashion companies use AI throughout their businesses, from supply chain optimizations to advertising algorithms, in order to intensify their fast fashion models and drive consumers to buy more clothes. Lastly, I will discuss what my findings mean for the world at large, and the future of AI in the fashion industry.

Methods

I utilize the Actor Network Theory (ANT) framework throughout my research. This framework focuses on both human and non-human actors and the networks between them in order to understand how they affect one another. ANT suggests that all actors are equally important (Sismondo, 2010), so we can fully understand how each actor contributes without potentially undervaluing some.

This framework was appropriate for my research because I was studying how AI developers affect the fashion industry and how the fashion industry affects consumers. One of the human actors I focused on were the fashion industry decision makers and marketers. These are the people who decide how to advertise to consumers, and how they will apply AI to do so. Other human actors I researched were the consumers themselves; how they make decisions, how they can be influenced, and what causes them to make a purchase. Finally, regulators and policy makers make up another human actor group. They define how companies are allowed to use AI within business operations.

A relevant non-human actor was the AI algorithms themselves. These are the tools that fashion companies use to create advertisements for their product, optimize supply chains, and other applications. Depending on the algorithm, there are many different application possibilities. Another important non-human actor is the facet of a company in which AI is applied. This includes social media, where advertising is displayed, the supply chains themselves, or stores where AI is used. The environment was my final non-human actor. While not the focus of my research, the environment is the reason for the study, and is greatly affected by the other actors in the network.

Treating each of these actors as equally important ensured that I did not undervalue any one group's contribution to the network, human or non-human. Through building and understanding the networks between these actors, I was able to understand how they affected one another. Fashion companies use AI algorithms to enhance various aspects of their business. These enhancements lead to lower prices for the consumer, more options, or greater ease of use. Consumers have an easier time making the choice to buy clothes. This is a simple network of relationships.

To gather the information necessary to build the networks, I used 3 main types of sources. The first were books on topics such as AI, the use of AI in the fashion industry, and consumer behavior. The second were journal articles. These included research papers on the effects of fast fashion on the environment, specific instances of AI use in fashion companies, and how fast fashion companies operate. Finally, were primary sources from fast fashion companies themselves, wherein they discuss how they utilize AI in their business. For example, a recording of a talk given by Errol Koolmeister, H&M's lead data scientist, explains how the company uses AI. I synthesized the information and data I gathered to construct networks and determine the relationships between the actors. These sources covered different areas of research, so I was able to determine how they connect and how they affect one another. To find these sources, I used UVA Virgo library search, as well as normal Google searches.

Through research into each actor in the network, I was able to draw the connections between the actors, forming a network. What this network reveals is the crux of my study.

Results

Fast Fashion

Fast fashion is a business model in the fashion industry characterized by quickly produced, low-cost clothing that is inspired by the latest trends. It relies on rapid turnover and short production cycles to bring new styles to the market at an affordable price. Brands within the fast fashion realm, such as Zara, H&M, Primark, or Uniqlo, often produce large quantities of clothing in response to current fashion trends, utilizing cheap materials and labor to keep costs low (Hansen, 2012). The emphasis is on speed and cost efficiency, with garments quickly moving from design to production to retail shelves in a matter of weeks. This approach allows fast fashion brands to offer a constant stream of new styles, enticing consumers to regularly update their wardrobes with the latest trends (Sull & Turconi, 2008).

However, the rapid pace and disposable nature of fast fashion have severe environmental consequences. The production of cheap, mass-produced clothing contributes to resource depletion, water pollution, and increased carbon emissions. Fast fashion is responsible for an estimated 8-10% of global emissions per year (Niinimäki et al., 2020). Fast fashion's reliance on synthetic fabrics and the use of harmful chemicals in the dyeing process further exacerbates environmental issues. Moreover, the short lifespan of these garments encourages a throwaway culture, leading to significant textile waste. The environmental impact of fast fashion has raised concerns about sustainability and ethical practices in the fashion industry.

Fast fashion is not entirely negative. The increased efficiency of supply chains reduces waste. If clothes were bought at the same scale with inefficient supply chains, the environmental impacts would be even worse. Additionally, the lower prices reduce the fashion barrier to entry, so more people can afford to buy stylish clothes. The vast number of options allows consumers to keep their style fresh, and express themselves how they want.

Artificial Intelligence

Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks typically requiring human intelligence. These tasks encompass a wide range of capabilities, including learning, problem-solving, speech recognition, visual perception, and understanding language. AI systems can be designed to analyze large datasets, identify patterns, and make decisions or predictions based on the acquired knowledge. Machine learning, a subset of AI, involves training algorithms with data to enable them to improve their performance over time without explicit programming. AI applications are diverse, ranging from virtual assistants and image recognition software to complex systems used in healthcare, finance, and autonomous vehicles. The goal of AI is to create machines that can mimic human cognitive functions, enhancing efficiency and providing innovative solutions to various challenges across different industries.

Artificial Intelligence in the Fashion Industry

The fashion industry has found many use cases for AI technology. Luce separates AI applications into 4 categories: shopping and product discovery, sales, designing, and supply chain (Luce, 2018). Within these categories, there are different strategies and algorithms used to enhance the company's business operations within the category. I will discuss examples of AI use within the discovery and supply chain categories. Other potential applications of AI include prediction of consumer desires, advertising, and enhancing overall customer experience.

To enhance the shopping experience for the customer, fashion companies might make use of Natural Language Processing (NLP). NLP is an area of AI that can process and understand normal, human sentences with context. This allows companies to create chat bots that can understand user needs and generate conversational responses. This can be used for customer service in the broader retail industry, or for personalized shopping experiences within the fashion

industry. A customer can describe what type of clothing they are looking for, and through NLP, the AI chatbot can find clothes that match the customer's desires. Other shopping enhancement techniques include making use of computer vision in smart mirrors, neural networks for searching with images, and virtual style assistants (Luce, 2018).

AI powered demand forecasting is effective for supply chain optimization. The demand for certain items can be predicted using AI. Supply chains can alter their operations based on these predictions. For example, if a company predicts that their red jeans will go out of style and have less demand, they can reduce or end production of this item, reducing waste and unnecessary costs. Optimizations can be created in every area of the supply chain, including manufacturing, inventory management, distribution, and other logistics (Luce, 2018).

Zara

Inditex, Zara's parent company, uses AI in multiple ways. Goals include increasing efficiency within the company, a key part of Inditex's success, or improving the working conditions of their staff. The company uses technology to improve upon their "channel integration, anticipation of demand and stock management," and even "the well-being of our people and communities and care for the planet" (Inditex, 2021). One such example of AI to improve operations is the implementation a technology system that "identifies and sorts the garments that will subsequently be entered into the system which has required advanced artificial intelligence systems underpinned by research at some of the world's leading technological centres," a system that was created to "improve [their] customers' end experience" (Inditex, 2021).

Another example of Zara's use of AI is for the purpose of the health of their employees. The annual report states that "to improve our people's health and ergonomics and to optimise

their time, we have implemented an automatic rotation system in logistics tasks which, based on our Orquest staff scheduling tool and on artificial intelligence, switches the duties performed by operators at distribution centres" (Inditex, 2021). This tool, whose justification is the well being of staff members, also has the dual purpose of improving the efficiency of these staff members.

Furthermore, Inditex has recently joined IndesIA, a Spanish consortium whose goal is to "position Spain as a leader in data and artificial intelligence applications for industry and boost the development of the economy and the country's recovery" (IndesIA, 2022). Other notable members of IndesIA include Microsoft and Airbus, as well as other leading Spanish companies. For Inditex, "Its incorporation to IndesIA is consistent with its strategy of continuous process improvement in all its areas of activity, commercial management and industrial and logistics processes" (IndesIA, 2022). By joining IndesIA, Inditex signals its commitment to using AI to enhance the company's business operations.

H&M

H&M is a clothing retailer whose business model is similar to that of Zara's, as they both follow the fast fashion ideology. As such, H&M has worked to integrate AI throughout the company as well. Errol Koolmeister, H&M's lead data scientist, describes the company's approach to AI: "It's really about starting small, thinking big, and scaling fast" (Hyperight AB, 2019). H&M is actively expanding its use of AI in business operations. They are, similar to Zara, "increasingly relying on the capabilities of artificial intelligence (AI) to help improve its supply chains, benefit customers and reach its sustainability goals" (Pauwels, 2021).

A specific example of a new AI initiative is H&M's partnership with Google Cloud. According to Google Cloud's press release, "As the partnership develops, this will translate to increased optimisation of internal supply chains, as well as next-generation customer experiences

across a variety of sales channels, from physical stores to ecommerce" enabled by the "further development of data science and AI capabilities throughout H&M Group's business" (Google Cloud Announces New Partnership with Global Fashion Retailer, 2022). Through partnering with Google Cloud, H&M positioned itself to become a leader in AI use within the fashion industry.

Analysis

To examine the influence of AI use on consumer decision making, I analyze how lower prices and greater ease of use and accessibility drive consumers towards fast fashion. Through the lens of Actor-Network Theory, we can understand the relationships between fashion companies, consumers, regulators and policymakers, AI algorithms, the areas in which the AI is applied, and the environment.

Fast fashion companies commonly use AI to optimize their supply chains. Businesses are able to manufacture and distribute their clothes very efficiently, lowering wasted efforts and therefore costs. This allows the company to keep their prices low. Low prices make for easier decisions, thus driving consumers to buy fast fashion clothing.

Additionally, AI is used to predict consumer desires. AI can predict the coming trends which fashion companies can leverage in a variety of ways to bring value. Optimizing the supply chain reduces waste and increases efficiency, saving the company money. This extra money can again lead to lower prices for the consumer or allow the company to invest in other areas of their business. Additionally, predicting trends allows companies to stock items that consumers are likely to want. Buyers are incentivized towards companies that sell clothing that is within the buyers' taste.

Predicting consumer desires also allows companies to design and create more effective advertising campaigns. Companies can use AI and data from consumers to create targeted ads. They can also analyze which ads are the most effective. Ads chip away at a consumer's psyche, so that the advertising brand is fresh in the mind. Targeted, more effective advertising drives up profits for fashion companies.

Furthermore, promoting certain trends based on predictions can also increase the popularity of the trend, in a somewhat cyclical manner. Consumers feel social pressures to keep up with the latest trends, pushing them towards companies that sell products that are in today's style. Fashion as a sociological phenomenon makes people feel left out if their clothes aren't in vogue. The vast number of options and shifting styles provided by fashion companies impels consumers to buy more and more clothes more frequently.

Real Life Implications: Zara & H&M

Throughout my research, I uncovered 3 key points of Zara's relationship with AI throughout the company. These are using AI to optimize their supply chain, using AI to improve the lives of their employees, and joining an AI consortium. These strategies all help to increase desirability from the lens of the consumer. These actions create choice architectures in which the deploying company is the easier choice.

Zara uses AI to anticipate demand, which subsequently helps them to better manage their levels of stock. Optimizations to the supply chain, such as this one and those discussed above, eventually drive consumers towards buying more clothes. Zara also claims that these optimizations improve the end experience for the customer.

Using AI to improve employee health also leads to desirable choice architectures. Zara uses AI to manage their employees at distribution centers. This leads to happier employees

whose time is more efficiently utilized. Happier employees lead to greater productivity, compounding the AI management's time optimizations. Overall greater productivity is itself a supply chain optimization, reducing prices for the customer.

By joining IndesIA, Inditex and subsequently Zara can influence consumers in another way. Zara's brand image is elevated by joining the consortium. Zara is seen as a more legitimate company, dedicated to the economic growth of its home country. Consumers then view Zara as a business more worth supporting. Additionally, the members of the consortium might build upon one another's knowledge and technology, becoming better able to utilize their existing AI techniques and implement new ones, enhancing all of the AI use cases mentioned above. All actions for the end goal of increasing company profits.

Like Zara, H&M has 2 connections to AI that I was able to research, and again like Zara, the ultimate goal is to increase profits. First, general use of AI throughout business operations to improve supply chains, benefit customers, and reach sustainability goals. Second, a partnership with Google Cloud. These two examples are analogous in their functionality to Zara's improvements to supply chain management and partnerships. H&M lowers prices through more efficient supply chains and can improve their AI techniques with the help of Google Cloud, a partnership which also signals H&M as a serious player in the technology space within the fashion industry.

Overall, the general uses of AI to create optimal choice architectures, as well as the specific examples analyzed, all help to further drive consumers towards fast fashion companies. Zara, H&M, and others make it very easy to decide to buy clothes from them, through cheaper prices, more options that are in-style, and overall ease of use. These techniques are only possible

on such levels with AI, effectively making the technology responsible for fast fashion's growing potential for impact on the environment.

Fast fashion companies, along with AI algorithms and other actors, form a network. The human actors involved are the fashion companies themselves, the consumer, and regulators and policymakers. The non-human actors are the AI algorithms, the areas in which the AI is applied, and the environment. By applying Actor Network Theory, we can explore how these actors affect one another.

Fashion companies want to increase their profits. This can come in the form of selling more clothes or increasing their margins. To do so, they decide to utilize AI algorithms, a very effective one being consumer desire predicting, among other strategies. They apply various types of algorithms and techniques to the different areas of their business. This includes the supply chain, advertising, and store fronts. These changes lead to savings for the company, as well as incentivizing the consumer to buy more clothes from fast-fashion companies. Increased consumption harms the environment. Therefore, regulators and policymakers have a responsibility to take action to contain fast fashion, empowered by AI, so that it does not harm the environment beyond repair. These relationships and effects between actors form a network.

However, the nature of these actors is constantly evolving. AI is growing at a rapid pace, with new applications being created and implemented frequently. These developments are applied to fashion when they have the potential to increase profits for the companies employing them. This continues to exacerbate the effects on the environment, increasing the need for regulators. However, as public consciousness continues to become more aware of the dangers of fast fashion and shift away from it, fashion companies are forced to adapt. Whether this means increased usage of AI, but with different strategies, or decreased usage to appear more

environmentally friendly is a business decision that needs to be made. Overall, the network's relationships remain mostly the same, the impacts and implications of these relationships can change every day.

Discussion

The impacts of fast fashion, spearheaded by giant companies like Zara, are not limited to trends and consumer choices. The success of the fast fashion business model, driven by the implementation of Artificial Intelligence (AI), has the potential to bring about a huge environmental toll. Clothes are discarded after only 7 to 10 uses, contributing significantly to climate change and resource depletion. As AI becomes an integral part of the fashion industry's operations, understanding its influence on consumer behavior allows us to mitigate potential harmful effects on the environment.

The integration of AI technology in the fashion industry, especially in fast fashion companies like Zara and H&M, has significantly influenced consumer decision-making. AI implementation in optimizing supply chains has not only streamlined production processes but also contributed to cost efficiencies, enabling companies to offer lower prices. Easier decisions, such as purchasing affordable clothing, are more likely to be made by consumers. Additionally, AI's capability to predict consumer desires has allowed companies to start trend forecasting, personalized advertising campaigns, and stock optimization, continuing to push consumers towards purchasing clothes that align with their preferences and current trends.

Real-life examples of Zara and H&M show how AI is leveraged across various aspects of business operations, from supply chain management to employee well-being and strategic partnerships. These actions create choice architectures that make the utilizing company the easier and more desirable choice for consumers.

The network of relationships and effects can be studied using Actor Network Theory. Through this analysis, we can understand the human and non-human actors of fast fashion companies, the consumer, regulators and policymakers, AI algorithms, the areas in which the AI is applied, and the environment all have substantial and ever evolving impacts on one another.

To address the impact of AI on the fashion industry and its subsequent effects on the environment is not an easy task. Broussard, in her book *Artificial Unintelligence*, writes that "We must investigate the wider application and implications of our technical choices and be prepared for the fact that we might not like what we find" (Broussard, 2018). Consumers need to be more aware of the environmental repercussions of fast fashion and the role AI plays in perpetuating this cycle. Whether this comes in the form of a movement to educate the general population, or from legislation forcing companies to be more transparent with their practices, education can empower consumers to make more informed and sustainable choices, encouraging a shift towards responsible and eco-friendly alternatives.

Additionally, policymakers must establish guidelines and regulations that require ethical AI use within the fashion industry. A balance between technological innovation and environmental responsibility is essential for the long-term sustainability of the industry. Companies themselves have little incentive to establish more sustainable practices, so legislation and policy must be put in place to ensure AI use and innovation.

In conclusion, the integration of AI in the fast fashion industry shapes consumer behavior and influences decisions on a global scale. Understanding the substantial consequences of these actions is the first step towards a more sustainable future. Through consumer awareness and industry regulations, the fashion industry can leverage AI for positive change and minimize its

environmental footprint, and the consumer can make more informed choices for the better of our planet.

Bibliography

Boucher, P. (2020). *Artificial intelligence: How does it work, why does it matter, and what we can do about it?* Publications Office. https://data.europa.eu/doi/10.2861/44572

Broussard, M. (2018). *Artificial Unintelligence: How Computers Misunderstand the World*. MIT Press. http://ebookcentral.proquest.com/lib/uva/detail.action?docID=5355856

Google Cloud Announces New Partnership with Global Fashion Retailer. (2022, June 30). Google Cloud Press Corner. https://www.googlecloudpresscorner.com/2022-06-30-Google-Cloud-Announces-New-Partnership-with-Global-Fashion-Retailer

Haan, K. (2023, April 24). *How Businesses Are Using Artificial Intelligence In 2023 – Forbes Advisor* [Newspaper]. Forbes. https://www.forbes.com/advisor/business/software/ai-in-business/

Hansen, S. (2012, November 9). How Zara Grew Into the World's Largest Fashion Retailer. *The New York Times*. https://www.nytimes.com/2012/11/11/magazine/how-zara-grew-into-the-worlds-largest-fashion-retailer.html

Hyperight AB (Director). (2019, April 11). *AI Driven Retail—Errol Koolmeister, H&MxAI*. https://www.youtube.com/watch?v=9RmWXsxG8iM

IndesIA. (2022, June 22). *Inditex joins IndesIA, the artificial intelligence consortium of the Spanish industry, as a partner. – Técnicas Reunidas*. https://www.tecnicasreunidas.es/inditex-joins-indesia-the-artificial-intelligence-consortium-of-the-spanish-industry-as-a-partner/

Inditex. (2021). *Inditex Annual Report*. https://static.inditex.com/annual_report_2021/en/documents/innovation-vital-transformation.pdf

Kings Research. (2023, August 7). *Fast Fashion Market Size to Hit USD 167.50 Billion by 2030, Driven by Rising Customer Interest in Stylish Clothing, States Kings Research*. Yahoo Finance. https://finance.yahoo.com/news/fast-fashion-market-size-hit-151900251.html

Luce, L. (2018). *Artificial Intelligence for Fashion: How AI is Revolutionizing the Fashion Industry*. https://learning.oreilly.com/library/view/artificial-intelligence-for/9781484239315/

Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment*, *1*(4), Article 4. https://doi.org/10.1038/s43017-020-0039-9

Pauwels, E. (2021). *H&M Group Case Study*. UNICEF. https://www.unicef.org/globalinsight/media/2196/file

Sismondo, S. (2010). *An Introduction to Science and Technology Studies* (2nd ed.). Blackwell Publishing Ltd.

Sull, D., & Turconi, S. (2008). Fast fashion lessons. *Business Strategy Review*, *19*(2), 4–11. https://doi.org/10.1111/j.1467-8616.2008.00527.x

Thomas, D. (2019, August 29). The High Price of Fast Fashion. *Wall Street Journal*. https://www.wsj.com/articles/the-high-price-of-fast-fashion-11567096637