ATTENDING TO THE ABSTRACT: THE ENVIRONMENTAL AND SOCIAL IMPLICATIONS OF FAST FASHION

by

RILEY O'CONNELL

A THESIS

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Approved: *Hollie Smith, Ph.D.*
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This thesis seeks to frame fast fashion, an abstract social and environmental issue, as concrete to reduce the public's psychological distance and promote pro-environmental behavior. Fast fashion is the current business model of fashion, characterized by fast-moving trends that are mass-produced with low-quality materials and sold at low prices. By employing a theoretical framework of Construal Level Theory (CLT), this thesis aims to provide an accessible and comprehensive account of the social and environmental implications of fast fashion revealed through tracing the life cycle of a prototypical polyester garment, one of the most common and extractive fabrics in fast fashion production. This analysis marks a movement forward from past life cycle assessment (LCA) studies, typically communicated in a highly scientific and convoluted manner while failing to integrate social implications. Similarly, because of a lack of accountability in fast fashion, brands rarely disclose the full details of their garments' environmental and social impacts. Thus, a prototypical life cycle integrating these fragmented sources offers a representative and concrete portrayal of the issue. Following this, I created an alternative life cycle based on the prototypical life cycle, demonstrating where social and environmental sustainability can improve. This thesis also includes an interactive infographic of each life cycle, providing a visual overview for readers to aid their comprehension while simultaneously providing an alternative, pointing to where action can be taken and encouraging pro-environmental behavior.

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Introduction

The fashion system consists of clothing marketers, media, fashion associations, fashion schools, lead users and influencers, and consumers, all playing a role in creating symbolic cultural meanings and imposing them on goods (Ozdamar Ertekin & Atik, 2014). The fashion system, previously creating high-cost and long-lasting products, radically changed with industrialization and subsequent developments in production methods during the second half of the 20th century, as mass-produced, cheap, and trendy clothes became more accessible (Ozdamar Ertekin & Atik, 2014). These changes in production allowed trends and consumption to accelerate, which, when mixed with globalization, reduced social constraints, and high disposable incomes, created the perfect conditions for fast fashion, today's dominant yet most environmentally and socially destructive fashion system (Bick et al., 2018). As a result, today's fashion industry accounts for 10% of the world's carbon emissions, 17-20% of global water pollution, and creates approximately 12 million tons of clothing waste a year in the U.S. (Brewer, 2019).

Fast fashion is defined as a process characterized by quick style developments and trends, often copied from high fashion, that are mass-produced with low-quality materials and then sold at low prices (Boyer et al., 2019). Several scholars have acknowledged the model's negative environmental, social, and economic impacts at the cost of consumer, worker, and ecosystem welfare. Literature has mainly focused on environmental impacts, examined via life cycle assessment (LCA) studies. A LCA is an analysis technique that examines a product's environmental impacts at every stage of its life, including its inputs, use, and disposal (ScienceDirect, 2017). An identified weakness in current literature is that these LCA studies often only focus on one or a few stages of the product's life cycle and rarely integrate the garment's social impacts (Munasinghe et al., 2021). Additionally, few organized and comprehensive accounts of the social implications of garment production exist in current literature, with most focusing on the broader conception of fast fashion as an issue of environmental injustice (Bick et al., 2018). Thus, communicating fast fashion and its alternatives in a concrete, accessible, and comprehensive manner to encourage pro-environmental behavior and change policy preferences is increasingly important, especially in the face of global climate change.

Methods

To create an effective communication tool regarding fast fashion and its alternatives, the following questions were used to structure the research.

Research Questions

1. What are the environmental *and* social implications of polyester production in the context of fast fashion?
2. How can abstract social and environmental issues like fast fashion be effectively communicated?
3. How can current literature on polyester production be synthesized with effective communication techniques to produce an accessible account of fast fashion and an alternative model to encourage pro-environmental behavior?

Archival Analysis Methods

I have answered the above research questions using a literature review of secondary sources. The first step of the literature review focused on existing life cycle assessment (LCA) studies of polyester garments. I synthesized fragmented studies focusing on different life cycle phases into a prototypical polyester garment life cycle, exemplifying fast fashion and its environmental impacts. Then I researched the social implications of polyester and fast fashion to integrate into the previously established life cycle, providing a more comprehensive and holistic account of fast fashion. The last step was to research alternative fashion models, such as circular economies and slow fashion. This research informed the reimagined circularized and sustainable life cycle, offering the audience an actionable alternative.

Theoretical Framework

Construal Level Theory (CLT) is the guiding theoretical framework of this research and its coordinated communication. CLT is a theory of psychological distance, proposing that we transcend our direct experiences in the here or now by forming abstract mental constructions of distant concepts or objects in the form of predictions, memories, and speculations, which mediate evaluation, action, and outcomes (Trope & Liberman, 2010). Psychological distance is the subjective and egocentric understanding of something close or far away in time, space, or social distance from one's self (Trope & Liberman, 2010).

Under CLT, people can reduce psychological distances by forming mental constructions, though the more psychologically distant object, the more abstract the mental construction and vice versa (Trope & Liberman, 2010). Thus, by communicating the psychologically distant object or topic in ways that make mental constructions more concrete, psychological distance can be reduced, providing a holistic perspective that is relevant and tangible to broad audiences, thereby influencing outcomes and actions (Jones et al., 2016; McDonald et al., 2015). Altering the level of abstraction is much easier and more effective than manipulating one's perceived psychological distance, shaped by highly personal experiences and thus requiring more individualized messaging (McDonald et al., 2015).

Abstract	Concrete
• High-level construals • Decontextualized • Broad categories • Words • Low level of detail, omitting incidental object features • Temporally distant- distant future • Spatially distant- remote locations • Colloquial and polite language • Hypotheticals, novel, or imaginary events • Action in terms of a low-level goal • Strangers • Third person perspective • Value-led	• Low-level construals • Contextualized • Narrow, specific categories • Pictures • High level of detail and specificity in description • Temporally close- near future • Spatially close- near locations • Normative language • Probable events • Action in terms of a high-level goal • Familiar individuals • First person perspective • Likelihood • Sense of taste, smell, and touch

• Sense of hearing and seeing • Desirability • Emotions of guilt, shame, anxiety, love • Interpretive action verbs, state verbs, adjectives	• Feasibility • Emotions of sadness, fear, lust • Directly observable action verbs

Table 1: Abstract versus concrete mental constructions.

Criteria characterizing abstract and concrete mental constructions, as informed by Trope & Liberman (2010).

Past scholars have applied CLT to the communication of several environmental issues, such as climate change (Jones et al., 2016), plastic pollution (Barnes, 2019), recycling (White et al., 2011), green products (Ibrahim & Al-Ajlouni, 2018), and organizational sustainability practices (O'Connor & Keil, 2017). Consumers from high-income countries (HICs) often perceive these issues as "out of sight and out of mind," simultaneously exporting the related environmental and social costs to distant ecosystems in low and middle-income countries (LMICs). For instance, CLT's application to plastic pollution details how consumers ship their plastic waste to LMICs, polluting seemingly distant communities (socially and spatially) while their local pollution disappears, resulting in further consumption because of such distorted perceptions (Barnes, 2019). Applying the criteria above characterizing concrete issues, Barnes (2019) suggested educating consumers on the health impacts of microplastics to employ emotions of fear; localizing waste management to reduce spatial, social, and temporal distancing as the consequences of the consumer's actions are placed closely, more immediately affecting themselves and those more familiar; focusing on the specific social benefits gained by defined communities through exercising preferred pro-environmental behaviors; and improving the efficiency and accessibility of recycling to remove barriers to preferred behaviors and increase their feasibility.

This framework can similarly be applied to fast fashion, a highly globalized issue fueled by consumption in HICs who externalize and export environmental and social costs to LMICs. Because of distancing at every step of the product's life cycle, consumers view the issue as highly abstract or not a problem at all, failing to act, continuing unsustainable behaviors as environmental and social impacts escalate.

That said, there have been recent criticisms of CLT, suggesting the theory may insufficiently describe the diversity and complexity of climate change in the following conditions: when treating psychological distance as a stable belief, employing CLT in broad decision-making situations, or applying the CLT assumption that higher spatial distance correlates with higher temporal distances to climate change contexts (Keller et al., 2022). Critics have suggested that when applying CLT, researchers should focus on the specific contexts where distance affects climate change cognition and action (Keller et al., 2022). Mindful of these commentaries, this thesis applies CLT in the specific context of understanding the role distance plays in perceiving fast fashion's environmental and social impacts, seeking to reduce this distance and inspire action. CLT critics have suggested that the best way to handle the shortcomings of CLT may be to use it in conjunction with supplementary theories that focus on other aspects of distance or to develop CLT further (Keller et al., 2022). This thesis seeks to develop CLT further, applying this theoretical tool to new contexts of fast fashion.

Communication Methods & Products

To communicate the abstract issue of fast fashion and polyester fabric production as concrete, I used methods of storytelling and visual aids. Although there is no single definition of a narrative, they generally follow a structure describing the cause-and-effect relationships of events that impact given characters (Dahlstrom, 2014). Several scholars have demonstrated storytelling as an effective means of scientific communication to non-expert audiences as narratives make complex processes more accessible, intuitive, and memorable, helping audiences understand how science is relevant to their own lives (Downs, 2014). Thus, storytelling can help contextualize an issue, making it more familiar and probable to the audience, consequently reducing the level of abstraction.

A life cycle of a garment structures the story in this thesis. Life cycle assessments (LCA) are an analysis technique examining a product's environmental impacts at every stage of its life, including its inputs, use, and disposal (ScienceDirect, 2017). This framework can account for environmental impacts at local and global levels, providing a structure for integrating social implications at each stage. A story of an individual garment's life cycle can create a single intuitive narrative that contextualizes a multi-scalar, far-reaching, and complex issue. In such a narrative, the impacts and processes at each stage in the life cycle (raw material extraction, fabric manufacturing, retailing, use, and end of life) may be considered the events. The garment itself, consumers, garment workers, influencers, the media, and clothing marketers or producers may be considered the characters. Following this portrayal, I constructed an alternative life cycle story using the same framework to provide the audience with an alternative, avoiding a hopeless representation of the issue and instead encouraging direct, concrete forms of action.

After creating both garment life cycles, I created an interactive infographic for each to provide readers with a visual overview to aid their comprehension. I made these visuals by synthesizing and summarizing research via the digital tools Canva, Procreate, and Genial.ly. Infographics combine text and images, making effective tools for guiding individuals through complex information. Specifically, when environmental issues are communicated using infographics, as opposed to text or images in isolation, viewers are more likely to evaluate environmental messages critically, as the tool intuitively guides them through more complex information (Lazard & Atkinson, 2014; Bongers & McCarthy, 2020). CLT further underlines the value of infographics, as images can make ideas far more concrete (Trope & Liberman, 2010).

Moreover, in today's digital age, it is increasingly important that information is presented in formats that are easy to digest, as attention spans have shortened, and audiences are faced with an information overload (Smiciklas, 2012). Human brains process visuals faster than text alone, so by using infographics, audiences can quickly and easily connect with the information (Smiciklas, 2012). Additionally, these easy to digest formats can increase shareability on digital channels, providing the opportunity to increase the reach of the communication product (Smiciklas, 2012).

These infographics have also been made interactive, with clickable designs for further details on each life cycle stage. Interactive infographics are best suited for communicating information in this case, as the expansive and complex nature of a life cycle can be presented in a digestible format that the audience can engage with for longer periods than static infographics (Krum, 2013). With an interactive infographic, the user is presented with the big picture life cycle, offering them context before exploring the details of each life cycle stage (Krum, 2013). This also allows the original infographic to remain relatively simple and easy to understand so that users do not get overwhelmed (Krum, 2013). When clicking on details, the user has control over which and how much information to engage with, simulating a learn-as-you-go process to make the information more memorable (Segel & Heer, 2010). This may also provide starting points for further exploration of topics of interest (Segel & Heer, 2010). Furthermore, in the context of CLT, letting the user tailor the information to their interests allows the information to be more individualized and, therefore, more concrete (Trope & Liberman, 2010). Overall, the interactive infographics provide additional accessibility while offering an opportunity for a deeper and individualized connection with the material for a wider audience.

Prototypical Lifecycle

Raw Material Extraction

The beginning of a polyester garment's life started millions of years ago during the Mesozoic era when dinosaurs still roamed the Earth. The remains of ancient organisms were deposited and buried by sediment over time, experiencing high temperatures and pressure, forming crude oil. Today we extract that oil with drilling machines to create polyester fibers from places like Saudi Arabia, which contain some of the leading oil reserves in the world (CFDA, 2019).

Oil entails a complex history of political and social issues, making polyester a conflict material (CFDA, 2019). Additionally, oil spills during this process happen much more often than one might think, averaging eight spills per day, with a yearly loss of 23,600 barrels of oil and 170,223 barrels of wastewater (Palacios-Mateo et al., 2021, p. 3). Following the spill, oil pollutes ecosystems and communities, harming both human and other organisms' health. Other serious accidents such as spills, explosions, fires, and blowouts may occur, all of which create hazardous working conditions and threaten the local ecosystem and community (Borasin et al., 2002).

Figure 1: The Deepwater Horizon Oil Spill

Above is an image of the Deepwater Horizon oil spill off the Gulf of Mexico, known as the biggest marine oil spill to date. The oil spill took place April 21st, 2010, following an explosion at the Deepwater Horizon oil rig (U.S. Coast Guard, 2010).

Even in the absence of oil spills and accidents, oil exploration, drilling, and extraction often result in physical, chemical, and biological disruptions to the environment (Borasin et al., 2002). Human encroachment on these often "pristine" environmental areas frequently deforests and disrupts habitat via heavy machinery and equipment. Subsequent noise pollution, chemical pollutants, emerging infectious diseases, animal mortalities, and altered topographies change and degrade ecosystem dynamics (Borasin et al., 2002). Additionally, oil extraction is the primary driver of climate change, as it permits greater consumption and combustion, further exacerbating the greenhouse effect.

Manufacturing

Oil Refining

Once the oil has been extracted it travels to an oil refinery, often in China, currently the largest importer of crude oil with a growing oil refining industry (US Energy Information Administration, 2018). Here, the oil undergoes a cracking process where high inputs of heat, fuel, electricity, pressure, solvents, and catalysts are used to break down petroleum into useful ingredients (CFDA, 2019). Afterward, these ingredients undergo a series of chemical reactions called polymerization to form polyethylene terephthalate (PET) plastic pellets, the same plastic used to create water bottles (CFDA, 2019).

Figure 2: Polyethylene Terephthalate (PET) Pellets

Above is an image of plastic PET pellets manufactured by the petrochemical company Indorama Ventures.

Oil refining often results in the release of several toxins such as benzenes, particulate matter, nitrogen oxides, sulfur oxide, and carbon monoxide, posing a threat to the worker's health and the local environment as they are released into the atmosphere (Palacios-Mateo et al., 2021, p. 3). In addition, at least 0.3% of crude oil byproducts are released into the environment during refining, which at an average-sized refinery that processes over 3.8 million gallons of oil a day means that over 11,000 gallons of oil[1] are released into the environment every day, not accounting for oil spills (Borasin et al., 2002).

Because of the high energy demands of the process, large amounts of carbon dioxide and greenhouse gases are released into the atmosphere during combustion, further contributing to climate change. It is also worth noting that the longer distance transport from the oil reserve to the refinery results in additional emissions and increased risks of oil spills.

Fabric Production

After refining, the plastic PET pellets undergo the drawing process. The PET pellets are reheated and extruded through spinnerets, forming long threads which cool into fibers. These fibers can then be twisted together and wound onto bobbins to form polyester yarn which can be woven or knitted into fabric (CFDA, 2019).

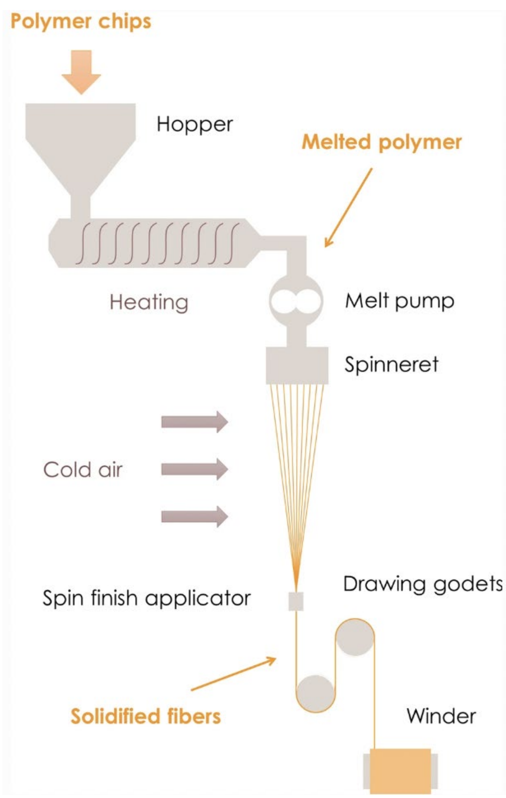

Figure 3: The Spinning Process from Pellet to Fiber

Above is a diagram of the process by which plastic PET pellets become polyester fibers (Palacios-Mateo et al., 2021, p. 4).

Like the refining process, high energy inputs are required, releasing greenhouse gases that further contribute to climate change. To quantify this, 14.2 kg of CO2 is released into the atmosphere per kilogram of polyester produced, and in 2015, the production of polyester clothing emitted 282 billion kgs of CO2 (CFDA, 2019).

Pollution by contaminated wastewater, or untreated water full of chemical residues and microfibers, is often released into nearby bodies of water. Microfibers are fibers that range in size from 1 micrometer to 5 millimeters in length and are also released into the air during fabric production (Liu et al., 2019). The microfibers threaten the worker's and the local community's health, as studies have associated microfibers with elevated risks of lung cancer, asthma, allergies, autoimmune diseases, and neurodegenerative diseases (Palacios-Mateo et al., 2021, p.13).

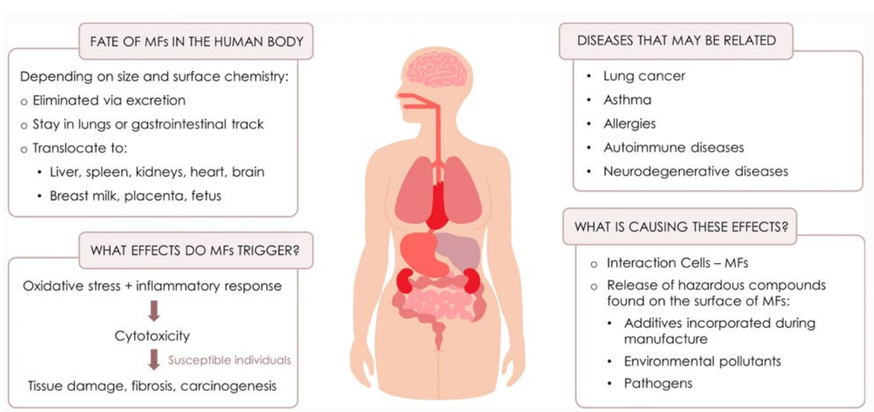

Figure 4: A Summary of Effects of Microfibers on the Human Body

Above is a diagram summarizing the effects of microfibers on the human body, demonstrating how they may enter the body, elevating risks of lung cancer, asthma, allergies, autoimmune diseases, and neurodegenerative diseases (Palacios-Mateo et al., 2021, p. 13).

There are also social costs of exploitative labor at this stage, along with all the other stages before the garment arrives to the consumer. Driven by global competition for low production costs to keep the cost of the garment low, exploitative labor conditions have been exported from the U.S. and Europe to LMICs. Laborers in these LMICs work in poor conditions with low wages, exposed to toxins and chemicals that increase their risk of illness and reduce their lifespans (Claudio, 2007). Due to minimal political infrastructure and organization in LMICs, few environmental and occupational standards are enforced, resulting in long-term health hazards, poor working conditions, and low wages that corporations exploit, cutting corners to keep production costs low (Bick et al., 2018). Reported health hazards faced by garment workers have included increased risk of lung disease and cancer from high exposure to toxic substances used in production, musculoskeletal overuse injuries, various accidental injuries, adverse reproductive and fetal outcomes, endocrine function damage, and even death (Bick et al., 2018). Exploitative wages are as little as 12–18 cents per hour for some garment workers (Claudio, 2007, p. 450). Fast fashion is thus a critical issue of environmental injustice, as consumers in HICs are given greater choice at the cost of these workers, and LMICs in general, who disproportionately bear the environmental and health burdens (Bick et al., 2018).

Figure 5: The Ranza Collapse

In 2013, an eight-story building containing garment workers crumbled to the ground (Ahad, 2013). Despite known instability of the building and poor construction, garment workers were sent to work because of the high demands of fast fashion. 1134 workers were killed, illustrating the disastrous outcomes of the hazards and unethical conditions garment workers are exposed to, yet still little has been done to improve the working conditions (Bick et al., 2018).

Garment Production

The fabric is transported to clothing factories to be cut by mechanical or thermal processes and sewn together into garments. A process of batch dying is typically used to dye the polyester garment, where it is placed in an aqueous solution consisting of dispersing agents, synthetic pigments, and mordants (Palacios-Mateo et al., 2021). These additional metallic compounds, which are often toxic, ensure the dyes don't fade. Then, the garment is finished, with chemicals such as flame retardants, stain repellents, and softeners added to the garment (Palacios-Mateo et al., 2021).

At this stage, fabric loss and waste become a huge problem, with 13-18% of fabric lost during cutting and any defective items going straight to the waste stream (Boyer et al., 2019, p. 10). Additionally, the wastewater from the dying process often goes untreated due to a lack of infrastructure. The dyes with various chemicals, pigments, and microfibers go out through pipes into the sewage and eventually into nearby bodies of water (Chavan, 2013). These polluted bodies of water are harmful to communities and ecosystems as the water becomes unsafe to drink, irritates the skin, kills wildlife, and increases other health risks (Chavan 2013).

Figure 6: Water Pollution in Sakar, Bangladesh

Above is an image of some of the wastewater pollution in Sakar, Bangladesh, following the Ranza collapse (Hasan, 2013).

The process of batch dying is often necessary for synthetic fibers like polyester to get the dye to penetrate the durable fabric, though it requires high energy inputs and consumes substantial water, with 150 liters of water used per kg of fabric (Palacios-Mateo et al., 2021, p. 5). The high energy inputs required for dying, cutting, and sewing the garment, along with the transport from the fabric production to garment production factories, produce additional greenhouse gas emissions that exacerbate climate change.

Retail

The finished garments are shipped by air cargo from garment factories to retail distribution centers. The distribution centers are typically in high-income (HIC) consuming countries like the United States, where the garments are packaged and transported to local retailers. Shipping by air cargo is common in fast fashion to keep the product moving as fast as possible, but this comes at a much higher cost of fuel consumption, exacerbating the release of emissions and climate change. It was measured that shipping garments from China generate an additional 0.16 kg of CO_2 per kg of textile (Palacios-Mateo et al., 2021, p. 6). During distribution, extensive amounts of unnecessary packaging are also incorporated, as each garment is typically individually wrapped in polybags, creating excessive waste.

Once the retailer obtains the garment, the consumer enters the story. Often encouraged by magazines, advertisements, television, and social media, consumers are impacted by the pressures of the season's "must haves" and to keep up with the quick-moving trends (Claudio, 2007). This encourages more consumption, multiplying environmental and social impacts, and stimulates early disposal out of fear of being deemed "unfashionable" or "out of touch." This is considered a part of planned obsolescence, or the business strategy of making products go out of use quickly to ensure the consumer replaces the product with new models, increasing business profits (Kramer, 2012). Manufacturers and corporations often plan for the product to go obsolete early by releasing messages deeming the garment unfashionable paired with frequent design changes, poor quality materials, and unrepairable designs.

Figure 7: July 2017 InStyle Magazine Cover

The InStyle magazine cover from the July 2017 issue above is an example of the media creating social pressures to keep up with the quick moving trends, encouraging greater consumption and stimulating early disposal to magnify environmental and social impacts (InStyle, 2017).

After the consumer visits the retailer to purchase the garment and transport it to their home, the use phase begins, where the consumer will wear the garment an average of forty times (Smith and Barker, 1995, p. 239). Additional emissions are created from transport from the retail distribution center to the retailer to the consumer's home, although minuscule compared to shipping across the globe from garment factories.

Use

The largest environmental impact in the use stage comes from laundering, specifically laundering behavior. North Americans have notoriously bad laundering behavior with inefficient washing machines and the frequent use of high-heat cycles, consuming far more water and energy (Palacios-Mateo et al., 2021). This behavior results in substantial emissions and associated climate impacts from increased fuel consumption.

The detergent used during washing is another environmental impact that many fail to consider. Not only does an impact result from the detergent's production and life cycle, but the detergent from laundering entering the wastewater isn't always properly treated. The untreated wastewater can disrupt ecosystems by eutrophication, or the depletion of oxygen from the water from excess nutrients in the detergent, resulting in the mortality of several organisms, reproduction disruptions, and overall damage to water quality (Palacios-Mateo et al., 2021, p. 8). Additionally, drying results in even higher emissions than washing, consuming five times as much energy as a washing machine (Palacios-Mateo et al., 2021, p. 8).

The release of microfibers is also its worst during laundering. Continued wear of the garment form protruding fibers, often called fuzz balls, which come off when additional force is applied by the washing machine (De Falco et al., 2019). To quantify this, studies have estimated that about 640 thousand to 1.5 million individual microfibers come off per wash (De Falco et al., 2019). The wastewater from washing then takes these microfibers out through the sewage to wastewater treatment plants (WWTPs). Because of their microscopic size, they often pass through the WWTP and directly enter nearby oceans and other bodies of water (De Falco et al., 2019, p. 1).

Once these microfibers enter the ocean, they sink to the deepest parts of the ecosystem, the benthic zone, because of their higher density. Ocean currents carry microfibers to areas of high biodiversity, where they enter the food chain. This occurs via a phenomenon of biomagnification. Biomagnification begins with smaller organisms consuming small amounts of microfibers from their environment. A medium-sized predator then consumes them along with other smaller species that have also consumed microfibers, accumulating a larger quantity of microfibers in the predator. A large predator higher up in the food chain will eventually consume the medium-sized predator and other organisms of the same size and microfiber concentrations, further increasing microfiber concentration. This process will continue up to the top of the food chain, increasing microfiber (and microplastic) concentrations at each level.

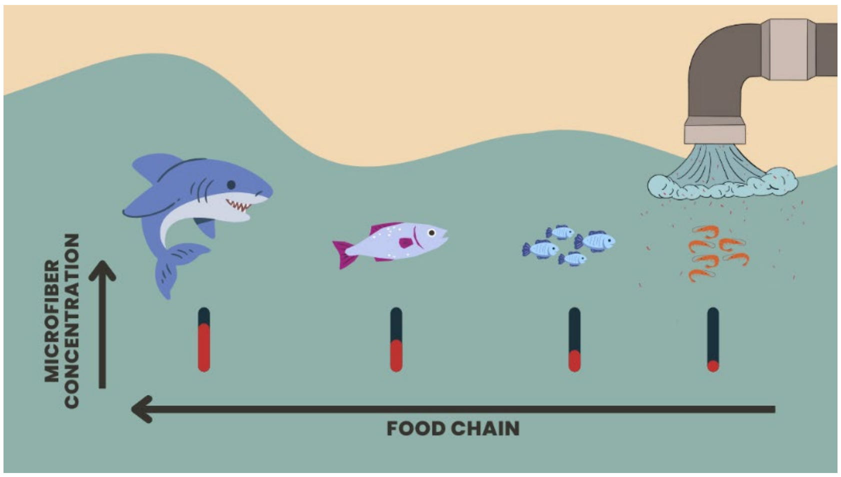

Figure 8: Biomagnification

Above is a drawing exemplifying the process of biomagnification, whereby microfiber concentration increases with each trophic level in the food chain.

Studies have shown that microfiber consumption in aquatic organisms results in increased early mortality and inhibits movement and reproductive behavior, posing a threat to several ecosystems (Jemec et al., 2016). Microfibers are also accumulating in the seafood we consume, posing a threat to human health. Studies have detected microfibers in 20.5% Icelandic cod, 17.5% red mullet, and approximately 15% sardines, which will only continue to increase with the growth of fast fashion (Palacios-Mateo et al., 2021, p. 11).

Figure 9: Rainbow Runner found with microplastics in its stomach

Above is a Rainbow Runner, a common fish to eat, found with 17 plastic bits in its stomach, many of which microplastics (Eriksen, 2015). Microfibers coming from polyester garments are also considered microplastics because polyester is made from plastic, and thus this fish represents how these microfibers from our garments are entering aquatic ecosystems.

Microfibers are also entering the food chain on land. The microfibers that get filtered out at WWTPs often end up entering agriculture and food systems as sewage sludge, used as fertilizer. Microfibers alter soil structure, microbial activity, and water dynamics, thereby affecting the productivity of agriculture and posing a threat to food security, as this problem will only worsen with the growth of fast fashion (Li et al., 2020).

It is estimated each human consumes 52,700–73,600 particles of microplastics per year (Palacios-Mateo et al., 2021, p. 13). These microplastics are excreted from the body or accumulate in the lungs, gastrointestinal tract, liver, spleen, heart, kidneys, or brain. To put that into perspective, it is estimated that we consume a credit card's worth of plastic every week from microplastics, with a significant portion coming from polyester microfibers (Gruber et al., 2022).

Disposal

After the garment's life has ended, in many instances prematurely due to quick-moving trends and stylistic norms which make the clothing obsolete, it enters the disposal phase (Claudio, 2007). Consumers tend to dispose of their clothes by placing them in household trash, which gets carried directly to the landfill. Approximately 3.8 billion pounds of the clothing Americans consume is sent to landfills as solid waste every year, amounting to nearly 80 pounds per American per year (Bick et al., 2018, p. 1). Because polyester is non-biodegradable, if it remains in the landfill it will sit for decades until its decomposition, degrading into microplastics and other harmful substances. However, most of our waste is incinerated.

Though, incinerating the waste does not mean it disappears, rather it just transforms it into harmful gases and ash which pollute our atmosphere, posing a threat to human health. More than 160 compounds are released during the incineration of polyester, including carbon dioxide, carbon monoxide, benzenes, methane, biphenyl, hydrocarbons, and more (Conesa et al., 2009). These greenhouse gases, like the others which have accumulated throughout the garment's lifespan, will remain in the atmosphere for decades, as greenhouse gases are cumulative, contributing to climate change for decades to come.

Alternative Life Cycle

A Circular Economic & Slow Fashion Perspective

One approach to changing fast fashion has been applying a circular economic (CE) perspective, which seeks to take the linear production model and close it into a loop, improving resource efficiency and reducing waste (Brydges, 2021). However, these efforts only look at the environmental impacts and waste created at the end-of-life stage in the garment's life cycle, failing to account for the environmental and social implications throughout the rest of the life cycle. While CE provides insight into how the fashion industry can move in a more sustainable direction, a more holistic alternative that considers the environmental and social impacts throughout the garment's value chain is required.

Accordingly, slow fashion has emerged, serving as a countermovement to fast fashion. Kate Fletcher founded slow fashion in 2007, drawing inspiration from the "Slow Food" Movement and the following slow movements it generated that have connected pleasure with awareness and responsibility (Fletcher, 2007). Slow fashion offers a holistic alternative to fast fashion, accounting for environmental, social, and economic concerns (Ozdamar Ertekin & Atik, 2014). Balance characterizes the countermovement, slowing down the time of production and consumption to produce fewer garments of higher quality, giving time to build relationships among consumers, producers, workers, and retailers (Ozdamar Ertekin & Atik, 2014). Such relationship-building creates awareness and appreciation, leading to the protection of communities, workers, and the environment, reducing disposability (Ozdamar Ertekin & Atik, 2014). Clark (2008) outlined the three pillars underlying the conceptual framework of the slow approach to fashion, including:

4. Local design and production to encourage and maintain ecological, social, and cultural diversity.
5. Transparent production systems as a means to reduce intermediation between consumers and producers, leading to collaboration and relationships of co-creation.
6. Sustainable and sensorial products that are long-lasting and highly valued by consumers, reducing disposability.

In implementing these frameworks of slow fashion and circular economic principles to envision a more sustainable and ethical fashion system, a new life cycle emerges as a practical manifestation of this revolutionized fashion system, characterized by the life cycle stages outlined below.

Inputs

Under a more sustainable and ethical fashion system, ideally, there is no extraction, hence the renaming of this life cycle stage from "raw material extraction" to "inputs." Instead of extracting raw materials from the Earth and labor from LMICs, inputs come from recycled materials or are produced via reciprocal practices based on stewardship, with personal relationships central to the process. During the inputs stage, this means mutually beneficial relationships between the ecosystem, consumers, designers, and producers. In the most optimal situation of this alternative life cycle stage, however, no inputs or design is required as we buy less, re-wearing, repairing, repurposing, and sharing garments to reduce the overall demand. Though it isn't realistic or feasible to stop the production of new garments entirely.

Local design and production make up the first pillar underlying the conceptual approach to slow fashion. Thus, designers must consider local context and decide which fiber is most sustainable and suitable for their community. Factors that go into this decision might include recycled material availability, growing conditions (water availability, climate, soil conditions, space availability, etc.), and community member preferences. For instance, a community with an abundance of healthy soils, sufficient space, a mild climate, and adequate rainfall might find hemp as the most sustainable choice. Another community facing a drought with little space and an excess of recycled materials might find that recycled PET (rPET) is the most sustainable choice. That said, synthetic fiber use should be minimized, recycling existing materials and avoiding the production of new synthetics (Manfroni et al., 2019). Additionally, harmful chemicals and overproduction should be avoided, and energy inputs must be renewable. Thus, natural fibers should be organic and grown using regenerative farming techniques to give back to the land (Manfroni et al., 2019).[2] Ultimately, durable fibers and textiles must be selected to minimize environmental impacts and lengthen the product's life for the given community.

Crucial to the transformation of this life cycle stage and the life cycle as a whole is phasing out fossil fuels and facilitating the sweeping green transition, ending greenhouse gas emissions in all areas, including the fashion system, to reduce harm to the environment and community's health. While individual consumption practices do play a role in the cycle of fast fashion and sustainability, especially in high-income countries (HIC) like the United States, it is especially important to pay attention to systemic drivers and factors that uphold fast fashion. For instance, corporations and oil companies must be held accountable, as 71% of global emissions since 1995 can be attributed to just 100 energy companies, which equates to one trillion tons of greenhouse gasses (CDP, 2017).

A sensible first step in phasing out fossil fuels as a source of energy and materials would be legislation that would impose taxes on greenhouse gas emissions, discontinue fossil fuel subsidies, and incentivize renewable energy (Palacios-Mateo et al., 2021). Here, joining broader climate justice movements is also critical to pushing for sweeping systemic change, which will also prompt change in the fashion system.[3]

Manufacturing

Under a vision of a slow and circular fashion system, production would be local, transparent, and relational. In practice, this means manufacturing the garment near recycling or where fibers were grown to reduce emissions from transportation and help support the local community. Fibers would be assembled as compact yarn structures, and fabrics would be cut via thermal cutting methods with intentionally designed patterns to reduce microfiber release and fabric waste (Palacios-Mateo et al., 2021). Any resulting scraps would also be reused and recycled where possible. During the dyeing and finishing process, low impact natural dyes are ideally used slowly in small batches that require less water (Palacios-Mateo et al., 2021). This dying process would start with identifying the desired natural colorant, which may come from vegetable, insect/animal, or mineral origin (Yusuf et al., 2017). Most dyes should ideally come from vegetable or plant origins, including barks, leaves, fruits, flowers, or other plants grown using regenerative principles of agriculture. After the natural colorant is identified, it can be extracted by drying and grinding the plant material before adding a solvent (which will depend on the nature of the dye) (Yusuf et al., 2017). Then to optimize resources, a pre-mordanting process may be used to apply the dye to the textile, where textiles are treated with mordants (ideally from plant extracts) before dying rather than the simultaneous application of mordant and dye (Yusuf et al., 2017).

It is important to note that not all natural dyes are low impact. Some natural dyes have low absorption rates, requiring considerable natural dyestuff which may be produced unsustainably with large fossil fuel inputs and resulting in extensive quantities of wastewater

(Mukherjee, 2015). Low impact dyes are classified by the Oeko-Tex Standard 100 certification, ensuring dyes do not contain toxic chemicals or mordants and that they have high absorption rates to reduce rinsing and subsequent wastewater (Amutha, 2016).

Garment workers must also be paid fair wages in safe working conditions. The relationality and local production of the new life cycle, as proposed by slow fashion, would create awareness and improve transparency to strengthen accountability and protect the environment and workers (Ozdamar Ertekin & Atik, 2014). Additionally, without the time pressure, suppliers can plan orders and predict the required number of workers, allowing businesses to avoid temporary or subcontracted workers and excessive overtime (Ozdamar Ertekin & Atik, 2014).

Legislation that may aid this transition and keep various businesses and producers in check might include those that discontinue hazardous chemicals and dyes, mandate strict certifications like the Oeko-Tex Standard 100 certification, impose treatment standards and chemical management to reduce wastewater pollution, enact due diligence laws, audit technical production processes, audit social and ethical practices, and audit supplier guidelines (Palacios-Mateo et al., 2021). Progress on policies around improving labor conditions in the fashion industry is already being made, as California passed Senate Bill 62, or the Garment Worker Protection Act, in September 2021. The bill requires an hourly minimum wage for garment workers, prohibits piece rate pay, and penalizes producers and brands that participate in wage theft (S.B. 62, 2021). While this is only a small step in the right direction, it can provide an important framework for future policies on the federal level.

Consumers can also help improve labor conditions in the fashion industry by using their voices to show support for policies like S.B. 62 and encourage its adoption on the federal level.

There are also various social media campaigns and petitions consumers can support, such as the #PayUp campaign, demanding brands protect and pay their garment workers. Consuming less and seeking out sustainable and ethical brands can also create demand for companies to change, but consumers must not fixate on personal consumption practices.

This relates to important concerns over a lack of affordability and accessibility with sustainable and slow fashion. Given COVID-19 and the resulting economic fallout that has brought hardship for many across the world, it is imperative to remain sensitive to this concern (Center on Budget and Policy Priorities, 2021). Though, the goal of this alternative life cycle is to reflect dramatic systemic change that addresses the political, economic, and social systems at the root of these inequities and environmental exploitation. If larger systemic change is brought about, fast fashion is just one of many social and environmental concerns that may be addressed.

Furthermore, under a model of Slow Fashion based on relationality, individuals must see themselves as a part of a collective, located in a network of relationships. In this view, actions can be placed within a larger movement, helping individuals see the impact of their action and find support from one another to bring about long-term, meaningful change, as opposed to individualized approaches to action which may leave people feeling isolated or ineffective. Thus, collective action and community organizing will be the most effective and rewarding.

Retail

Ideally, in an alternative life cycle, sewn and finished garments would be sold in the same communities where they were produced to reduce environmental costs resulting from transportation and to build community. Polybags would be eliminated where possible or made of biodegradable materials if necessary to reduce waste. Here, addressing the status quo and systemic ideas that uphold the system of fast fashion is crucial for reforming the stage. For instance, practices of planned obsolescence, or the business strategy of making products go out of use quickly, play on and perpetuate consumer insecurities to keep them buying more and replacing the product with new models, increasing business profits (Kramer, 2012). Addressing these concerns and consumer psychology will require dramatic changes to the status quo, whereby consumers must be empowered to find confidence and worth outside consumption. Hence why relationship building is a critical component to the alternative fashion system, as the most sustained feelings of joy, happiness, and contentment arise from social connections, not money or the things money can buy (Mogilner, 2010).

Some first steps aiding this transition may be encouraging consumers to let their individuality guide fashion choices rather than quick-moving trends. There have already been initiatives by stylists to help consumers reimagine their existing wardrobes and restyle what they own instead of making impulse purchases in attempts to redefine themselves and temporarily resolve feelings of insecurity. Stylist Nina Gbhor, the founder of Eco Styles from Australia, has held restyling workshops, coining the phrase "getting off the fashion treadmill," advocating that consumers let their individuality and self-knowledge determine what they wear, not fast fashion trends (Eco Styles, 2022).

Some additional steps that could be taken during the retail phase by businesses to improve sustainability and ethicality may be reselling and repairing garments in stores or creating a clothing subscription service where communities work to share and repair garments together (Palacios-Mateo et al., 2021). Governments could also implement strict labeling standards to improve traceability and make purchasing sustainable clothes easier (Palacios-Mateo et al., 2021).

Use

To lengthen the use phase and reduce consumption we must address the same model of planned obsolescence discussed above, whereby businesses profit off consumer insecurities. Like the retail phase, slow fashion advocates for relationship building to create appreciation and valuation for the garment, reducing disposability and prolonging the use phase (Ozdamar Ertekin & Atik, 2014).

Improving laundering habits is central to reducing the environmental impacts resulting from the use phase. This may include individual measures such as washing clothes at lower temperatures and line drying clothes, when possible, to reduce energy consumption. To reduce microfiber release, washing a full load to avoid high water volume to garment ratios and adding filters to capture microfibers may be helpful personal measures (Palacios-Mateo et al., 2021).[4] To address the impacts caused by detergents, biobased powder or liquid detergents should be used, as they have the lowest greenhouse gas emissions and cause the least disruption to ecosystems, although further research is still required (Palacios-Mateo et al., 2021).

Some legislative initiatives might include those that set stricter standards on the production of washing machines in terms of required energy and water use efficiency or legislation that improves and incentivizes greywater recycling systems to reduce wastewater and energy usage (Palacios-Mateo et al., 2021).[5] Advanced research is also needed at this stage regarding microfibers to better improve our understanding of their effects on people and the environment and to study possible retroactive solutions.

End-of-life

Ideally, in an alternative life cycle, clothes are repurposed and recycled repeatedly instead of being thrown away, hence the change of the life cycle stage name from “disposal” to “end-of-life.” Circular economic initiatives like take-back programs, repair services, clothing swaps, reselling clothes, clothing libraries, and material recycling may support the diversion of garments from the landfill (Brydges, 2021).

However, not all materials can be recycled or recycled continuously. Here, the input and design stage play a prominent role in determining recyclability, as fabric blends, additional chemicals or dyes, and fiber type can make recycling more difficult (Palacios-Mateo et al., 2021). For instance, when faced with an abundance of polyester and seeking to reuse to material and create recycled polyester (rPET), concerns including material losses, required additional energy inputs, and the limited times the material can be recycled due to quality concerns, may diminish rPET’s recyclability and sustainability (Braun et al., 2021). This may suggest then that recycling existing materials like polyester may be a less sustainable option than producing natural fibers, though this is dependent on local context and must be evaluated by designers and community members in the input stage.

Improving transparency of the value chain is also critical to enhancing recyclability. When more is known, better decisions can be made on how to recycle or dispose of the garment when necessary. Recycling may also grow by increasing the number and accessibility of collection containers, improving educational measures regarding the correct disposal processes, and incentivizing retail store programs which offer to dispose of the garment for the consumer (Palacios-Mateo et al., 2021).

When disposal is necessary, incineration plants should be modernized to improve air pollution control systems and implement heat and electricity recovery (Palacios-Mateo et al., 2021). When the garment enters the incinerator along with other waste, heat is released which can turn water into steam in a boiler and turn the blades of a turbine to create electricity (U.S.

Energy Information Administration, 2021). Further research is also required to determine the feasibility of biodegradation and improve monomer recycling technologies (Palacios-Mateo et al., 2021).

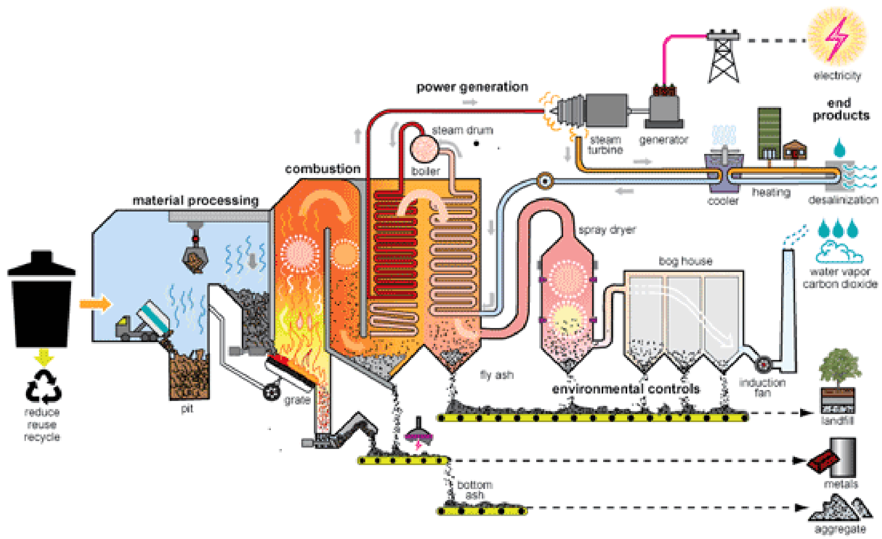

Figure 10: Waste-to-energy Plant

Above is a diagram of a waste incineration plant that implemented electricity recovery (U.S. Energy Information Administration, 2021).

Conclusion

In the face of climate change, it is pressing that we address fast fashion and its negative environmental, social, and economic impacts. Through a framework of slow fashion incorporating principles of circular economics, a more sustainable and ethical fashion system may be built. The first step in achieving this alternative fashion system is communicating the issue in concrete ways to mobilize action. This thesis marks steps in this direction, synthesizing environmental and social impacts resulting from fast fashion conveyed through the representative and concrete story of a polyester garment's life cycle. Furthermore, this thesis communicates the alternatives to fast fashion, avoiding a hopeless representation of the issue and encouraging concrete, direct, and meaningful forms of action. This thesis provides communication tools and methods. Meaningful engagement with the stories and infographics will be the next step. Additionally, audiences must take these suggested forms of action, change behaviors, and collaborate with one another to effectively transform the fashion system to one that is more ethical and sustainable. Hence, readers should understand this thesis as a starting point for better understanding the impacts of fast fashion and how they can bring about change, taking action in the avenues suggested that best fit into their circumstances and sharing the tools with others to amplify that change.

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