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Blockchain-enabled Sustainability Labeling in the Fashion Industry

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Abstract

This study explores the relative impact of blockchain-enabled sustainability labeling on consumers purchasing behavior when shopping for fashion products. A conjoint experiment was conducted where participants ($n=84$) assigned scores to stimuli cards according to preference in a specific shopping scenario. Results showed that “blockchain trademarked” did not have much impact relative to “low price” and “high product rating”. Further analysis showed that “blockchain trademarked” had a relatively stronger impact towards those participants ($n=22$) who indicated that living a sustainable lifestyle is important. Our findings show that there is a need for educating consumers about blockchain and the associated benefits for improving future transparency in sustainability in the fashion industry. Overall, these findings provide valuable grounds for further research on how blockchain-enabled sustainability labeling can create value for both consumers and companies within the fashion industry.

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1. Introduction

Bhardwaj and Fairhurst [1] explain how the fashion industry has evolved over the last 20 years, when the boundaries of the industry first started to expand globally. Changing dynamics, including mass production and modified structural characteristics in the supply chain, have forced retailers to apply a model of low cost and high flexibility in design, quality, delivery, and speed-to-market [1, 2]. This makes competition extremely high and contributes to a phenomenon referred to as ‘quick fashion’ or ‘fast fashion’ [1, 3]. Consequently, the current fashion market is under pressure to continually renew products. Retailers encourage consumers to visit their stores more frequently with the idea of ‘here today, gone tomorrow’. This results in shorter life cycles for the products and higher profit margins for the retailers. However, it also brings about significant negative consequences for the environment [1]. By 2030, global environmental stress caused by this industry is expected to yield approximately 2791 million tons of CO₂ emissions, 118 billion cubic meters of condemned water, and 148 million tons of textile waste [4]. Mass consumption and rapidly growing demands for fast fashion put pressure on our natural resources. Due to increasing awareness of this challenge, the industry is forced to place more focus on sustainability in the future [5].

Sustainability can be described as thinking about the future in which environmental, social and economic considerations are balanced in the pursuit of an improved quality of life [6]. With billions of people in the world, there will always be a need for more clothes. Therefore, our society must change the way we produce clothes, adopt more sustainable supply chains, and welcome new and innovative technologies in the process. For the industry to meet consumer demands, a higher degree of transparency is required, including disclosure information with specific attention to ethics and sustainability [7]. Unfortunately, many organizations take advantage of the increasing awareness of sustainability and falsely claim green strategies to make a profit. This is also known as ‘greenwashing’. When organizations are dishonest about their social, environmental, and economic responsibility, trust of consumers and stakeholders is in danger of being broken.

According to Lim, Hashim [8], trust could be built using blockchain technology; this technology offers more detailed and transparent information within the supply chain. It also provides the opportunity to identify and trace data related to a product or a manufacturer, from raw material to the hands of the consumers, making it harder to hide unethical behavior or business practices [9]. Blockchain-enabled sustainability labeling is one type of solution where the sustainability of a product is validated using blockchain technology. Thus, this study aims to investigate whether blockchain-enabled sustainability labeling can provide supply chain transparency and trust for consumers in an online shopping context.

This study consists of four parts. First, a review of previous research related to blockchain and sustainability labeling is provided. Then, the study methodology is presented. Next, the findings are discussed and summarized. The paper concludes with a discussion of theoretical and managerial implications and provides directions for future research.

2. Literature review

Boukis [10] describes blockchain as a large, distributed digital database (or ledger), which stores records of transactions; in other words, blockchain is a growing list of records and data structures, known as ‘blocks’, which are linked and secured cryptographically. Similarly, Rejeb, Keogh [11] defines blockchain as a digital, decentralized, and distributed ledger in which transactions are logged and added in chronological order with the goal of creating permanent and tamperproof records. Further, Lim, Hashim [8] describes blockchain as a shared, secured ledger, which is distributed across a network of devices. Scholars collectively agree that blockchain is highly anticipated to transform several industries by, for instance, providing improved transparency, security, and decreased transaction costs [8]. Blockchain offers trust, data integrity, security, and anonymity without having to rely on central third-party organizations [12]. The technology behind blockchain relies on a protocol of cryptographic rules and techniques for processing transactions [12]. These include the use of hashing, timestamping, consensus mechanism (a collection of rules that allow network nodes to reach mutual agreement), and asymmetric encryption using both public and private keys [10]. Blockchain also sets out a new paradigm for performing transactions and exchanging value in an online environment [11, 13].

Boukis [10] suggests blockchain is a technology that provides new means for developing customer relationships, for instance by providing consumers with information related to their purchases, and better control of data. Additionally, Schlegel, Zavolokina [12] highlight its ability to benefit the consumer in multiple ways, including improvements in product and service quality, innovation, tailored solutions, and customer interaction convenience. However, Schlegel, Zavolokina [12] mentions three major challenges blockchain must overcome to gain wide uptake among consumers. These are technical, institutional, and human. Firstly, the technology is described as a complex process which is not perceived as user-friendly, something that is found to be very important among consumers [12]. Institutional challenges include, for instance, how governments appear restricting towards the application of new blockchain services [12]. The third challenge is rooted in the consumers themselves, e.g., how consumers are not used to the habit of backing up their money (such as Bitcoin) on a flash drive or a second device, or even encrypting their storage. Although they can act automatically and perfectly, the humans creating them do not [12]. An additional pitfall is that a blockchain never forgets; once a mistake is made, it is stored forever [12]. Boukis [10] discusses challenges raised by blockchain, including security risks that might result in wide repercussions and damaging experiences with the brand.

Boukis [10] mentions that consumer awareness of social and environmental issues has evolved over the past few decades. This has increased demands such as stepping up corporate social responsibility. As previously mentioned, consumers show interest in more detailed and transparent information about how brands impact their third parties, such as manufacturers or local communities. There is a challenge for firms to make their value chain more transparent – this is something blockchain could contribute to [10]. By providing information regarding the route of a product (i.e., from raw materials to manufacturer, distributor, retailer, and consumer), blockchain is likely to enable brands to become more transparent. For instance, De Beers monitors use blockchain apps to monitor their products through the supply chain to offer their customers registered and more responsibly sourced products. Increased visibility of supply chain activities, production processes and/or the service delivery process results in a more transparent supply chain, enabling firms to build long-term trust with consumers [10, 14].

Traceability is described as “the ability to identify and trace the history, distribution, location, and application of products, parts, materials, and services” [9]. Systems with traceability can record and follow information trails of products, parts, materials, and services from suppliers. The three pillars of sustainability supported by traceability are economic, environmental, and societal [9]. Scholars similarly mention how traceability provides the opportunity to identify and trace data related to a product. It could be used for something as simple as tracing the origin of raw materials used to produce a piece of clothing [9]. Agrawal, Sharma [9] describe a few limitations of a blockchain-based traceability system. Firstly, the cost could be a major drawback. Due to its complex network involving numerous transactions, the cost of maintaining a blockchain-based system might be high [9, 15]. Additionally, decentralized signature verification can be complex and result in a bottleneck, especially in the textile and clothing industry where there are thousands of products every season. Other limitations include human error, security, technology integration, and the fact that blockchain technology is still evolving [9]. Traceability can result in a more transparent supply chain, allowing more effective sharing of information on-demand [9].

Galvez, Mejuto [16] examine the potential of blockchain technology for traceability and authenticity in the food supply chain, where the technology is similar to the textile and fashion supply chain. Food authentication is described as a process by the compliance of food where description (e.g., including geographic origin, production method, processing technology, composition etc.) is verified [16]. Further, Galvez, Mejuto [16] states how consumers worldwide are increasingly demanding reassurance that the origin and content of their food complies with the information on the label. Although this is an example from a different industry, the importance is, arguably, also relevant to fashion retailing.

Based on the literature review, we suggest that blockchain technology could create value for consumers and organizations in fashion retail contexts by providing transparency and clear and reliable labeling of sustainability. This technology could arguably establish new trust in sustainability labeling and set new standards for the industry. Nevertheless, studies show that purchasing decisions are highly influenced by both price [17] and product ratings [18]. Therefore, we do not study the effect of blockchain-enabled sustainability labeling independently, but in a context where price and product ratings are also present and influential to the purchasing decision. To the best of our knowledge, this has not been studied. . Thus, the following research question guides our study: What is the relative

impact of blockchain-enabled sustainability labeling on consumers purchasing behavior when shopping for fashion products?

3. Method

Conjoint techniques are developed specifically to provide substantial insights into the development and composition of consumer preferences [19]. These methods have been used extensively for market research purposes, and for exploring environments where customers are faced with multiple alternatives [20]. However, the use of conjoint techniques has accelerated along with the widespread introduction of computer programs, and continues to develop in terms of design, estimation, and application within several areas of research [19]. They are widely adopted, especially in the United States and Europe [19].

Choice alternatives are presented to a group of consumers to evaluate which levels of product attributes are the most and least desirable. Mohr, Sengupta [21] describe conjoint experiments as tools in which participants must make judgements about their preferences for various combinations of factors and levels. We consider this research approach suitable because it has the potential to provide insights regarding which components are more highly valued by consumers in the decision-making process. More specifically, this approach examines the perceived value of sustainability labeling in comparison to other critical factors such as price and product ratings.

3.1. Participants

A total of 84 participants accepted an invitation on a social media platform to participate in this study. The age of the participants ranged from 18 to 56 years with the majority (54.76%) between 25 and 28 years old. Gender was not recorded.

3.2. Apparatus

The conjoint experiment was distributed through an online survey using Google Forms. An online survey was preferred due to ease of distribution, both in terms of time and reach.

3.3. Procedure

The participants were informed of a scenario whereby they go online shopping for a jogging suit from their mobile phone. Participants were then presented with 13 different purchasing situations where they were asked to estimate their likelihood of purchasing the product. Only one purchasing situation was shown at a time, and participants were required to estimate their likelihood of purchasing the product before moving on to the next situation.

3.4. Design

Sustainable labeling was operationalized on three levels: “blockchain trademarked”, “store’s own label” and “no label”. To increase ecological validity, we included two further attributes: price and product ratings. Price was based on a price search at the time the study was conducted and was operationalized on three levels: “high price”, “medium price” and “low price”. Product ratings was also operationalized on three levels: “high product rating” (5 out of 5 stars), “medium product rating” (3 out of 5 stars) and “low product rating” (1 out of 5 stars). Attributes and levels are presented in Table 1.

Table 1. Attributes and levels considered in the study.

Attribute	Levels
Sustainable labeling	1. Blockchain trademarked 2. Store's own label 3. No label
Price	1. High price 2. Medium price 3. Low price
Product ratings	1. High product rating 2. Medium product rating 3. Low product rating

Using IBM SPSS Statistics 27, a fractional factorial design resulted in 13 stimulus cards (including four hold-out cards). The scenario and an example of a stimulus card are presented in the Appendix. Likelihood to purchase the product (dependent variable) was measured on a scale from 0 (very unlikely) to 7 (very likely). Once all purchasing situations were answered, the participants were asked to answer demographical questions and one question related to the following statement “living a sustainable lifestyle is important” which was measured on a Likert scale from 0 (not at all important) to 7 (very important).

4. Analysis and Findings

The analysis shows correlations between the observed and estimated preferences for likelihood to purchase online (Pearson's $r = 0.976$, $p = 0.001$). The findings for all participants showed that “product ratings” was the most important predictor for purchasing, accounting for 53.32% of the results. “Price” was second in importance, at 42.12%, while “sustainability labeling” comprised 4.56 % of the overall importance. Table 2 lists the utility estimates which, in this case, indicate the likelihood of purchasing the product online for each level of the three attributes. As shown in Table 2, “blockchain trademarked” and “store's own label” did not have much impact relative to “low price” and “high product rating”. “No label” had some negative impact.

Table 2. The impact of attributes and levels on the likelihood of purchasing the product online for all participants (n=84).

Attributes and levels	Likelihood of purchasing	
	Impact estimate	Standard error
Sustainable labeling		
1. Blockchain trademarked	0.068	0.256
2. Store's own label	0.051	0.256
3. No label	-0.119	0.256
Price		
1. High price	-0.867	0.256
2. Medium price	0.007	0.256
3. Low price	0.860	0.256
Product ratings		
1. High product rating	1.047	0.256
2. Medium product rating	0.092	0.256
3. Low product rating	-1.140	0.256
(Constant)	2.550	0.181

Answers to the importance of living sustainably questions showed that 19% of the participants scored 0, 1 or 2, 54.81% of the participants scored between 3 and 4, and 26.19% of the participants scored 5, 6 or 7. Based on this, we analyzed the participants (n=22) who reported that they viewed living a sustainable lifestyle to be important. Correlations were found between the observed and estimated preferences for likelihood to purchase online

(Pearson's $r = 0.975$, $p = 0.001$). "Product ratings" remained the most important predictor out of the three attributes, accounting for 52.94%. "Price" was second in importance, at 36.40%, while the importance of "sustainability labeling" increased to 10.66%. Table 3 shows the utility estimates for the group that indicated that living a sustainable lifestyle is important. From Table 3 we can see that "blockchain trademarked" and "store's own label" had more impact relative to "low price" and "high product rating". "No label" continued to have some negative impact.

Table 3. The impact of attributes and levels on likelihood to purchase the product online for the group (n=22) that indicated that living a sustainable lifestyle is important.

Attributes and levels	Likelihood of purchasing	
	Impact estimate	Standard error
Sustainable labeling		
1. Blockchain trademarked	0.116	0.254
2. Store's own label	0.162	0.254
3. No label	-0.278	0.254
Price		
1. High price	-0.808	0.254
2. Medium price	0.116	0.254
3. Low price	0.692	0.254
Product ratings		
1. High product rating	1.040	0.254
2. Medium product rating	0.101	0.254
3. Low product rating	-1.141	0.254
(Constant)	2.793	0.180

5. Conclusion and Future Research Agenda

Results from our conjoint experiment indicate that participants evaluate product ratings as the most important attribute when making fashion purchasing decisions, closely followed by price. These two attributes score significantly higher than sustainability labeling of clothing items. This implies that sustainability is less important than expected for making purchasing decisions. However, these findings support studies that show that consumers consider online ratings from other consumers more reliable than other traditional sources of information [18, 22]. When repeating the analysis for a sample of participants who assigned high scores to the importance of living sustainable lifestyles, we found that preference to sustainability labeling increased and price was compromised. Ranking of product ratings remained the same. These findings support previous research stating that consumers who are more environmentally conscious are, to some extent, willing to look beyond price for ethically manufactured products [22, 23]. High price was assigned negative scores from both samples of the population and more sustainably conscious consumers, whereas low price was assigned the highest preference. Sustainably conscious consumers were slightly less price sensitive. Findings from this study show that participants preferred sustainability labeling provided by blockchain or the store; however, the absence of labeling was rated negative. Previous research has found that stakeholders want to invest in greener organizations [7]. This is explained as a result of consumer preferences moving in that direction which puts pressure on organizations to adapt and focus on greener strategies[24].

Szabo and Webster [25] state that consumers do not fact check claims of sustainability, while Shrum, McCarty [26] and Szabo and Webster [25] show that consumers who live in a more eco-friendly way are more critical against organizations with green marketing strategies. Third-party certifications, as mentioned by Szabo and Webster [25], can be a step in the right direction. Boukis [10] recommends blockchain for providing transparency through more credible identification, and to store tamperproof records of the entire supply chain, from raw materials to the hands of the consumer. Similarly, other scholars mention how transparency is related to trust, and that trust can be

increased by openly showing supply chains to consumers [10, 14]. To protect consumers and stakeholders against greenwashing, we suggest that blockchain can provide supply chain transparency and trust. This technology reveals greenwashing which may reflect badly on companies not acting in an acceptable way. Furthermore, with blockchain, organizations are not able to hide unsustainable practices. This provides strong assurance to both consumers and stakeholders, providing transparency for them to investigate which organizations they wish to support. If commonly used, blockchain would put pressure on the entire industry to provide customers with transparent information and act responsibly with regards to environmental, social, and economic aspects. However, our findings shows that there is a need for educating consumers about blockchain and the associated benefits for improving future transparency and trust in sustainability labeling. Lastly, there are some pitfalls associated with the implementation of such technology. For instance, it is irreversible [12] and requires high investment [9, 15]. However, scholars mention that an improved consumer experience can justify the upfront investment [10]. In other words, for it to provide value, blockchain-enabled labels of sustainability should contribute significantly to the purchasing decision. For blockchain to evolve further and potentially gain widespread adoption among consumers, there are several technical, institutional and human challenges that must first be overcome [27].

Appendix

Imagine that you are going to buy a jogging suit online via your mobile phone. The color you are looking for is one of the two presented in the pictures. Assume that you know the online store you shop at and that the jogging suit is not branded. The pictures have three attributes that will vary: other customers' feedback, price of the product, and an indication of whether the product is sustainable.

Example of a stimulus card (1 out of 13):



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