Examining the influential factors of consumer purchase intentions for blockchain traceable coffee using the Theory of Planned Behaviour

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Abstract

Purpose - Given the increasing industry interest in blockchain technologies for supply chain management and product traceability, this paper aims to investigate consumer purchasing intentions for blockchain traceable coffee and their psychosocial antecedents, utilising an extended model of the Theory of Planned Behaviour (TPB).

Design/methodology/approach - An online questionnaire study of 123 participants was deployed, using two traceability systems (one based on blockchain and one on a more established traceability certification) for organic coffee.

Findings - Adding variables such as environmental protections, trust and habits significantly increased the predictive power of TPB. The results suggest that attitude, perceived behavioural control, and environmental protections drive intentions to purchase blockchain traceable coffee.

Originality - This study is the first to explore consumer purchasing intentions for blockchain traceable coffee and establish the psychosocial variables behind them contributing, in that way, to an understudied area in academic literature as well as providing insights for a more consumer-centric design of such products.

Research Implications - Apart from establishing the factors affecting consumer intentions for blockchain traceable coffee, our study validates the TPB as a model of explaining coffee purchasing intentions and provides evidence of new variables that can significantly increase the model's predictive power.

Practical Implications - The proposed format of presenting traceability information along with the significant variables revealed in our study, can function as a guide for designing product features and marketing strategies for blockchain traceable organic coffee. Increasing consumer awareness on product traceability will also play a crucial role in the success of these products.

Keywords - Theory of planned behaviour, Coffee, Blockchain, Traceability

Paper type - Research Paper

1. Introduction

Blockchain, and its various implementations, is usually associated with cryptocurrencies, digital coins and applications in the financial domain (Guo and Liang, 2016). However, over the past decade, both the industry and the academic world have been experimenting with various other use cases for this technology, with supply chain transparency and traceability emerging at the top of the list (Casino *et al.*, 2019; Tönnissen and Teuteberg, 2020).

This experimentation coincides with a more general digital and regulatory transition global supply chains are undergoing. In a recent survey conducted by the French consultancy Capgemini (Capgemini Research Institute, 2018) among 447 organisations that are investigating blockchain implementations in the supply chain domain, they reported that the main issues in procurement and supply chain management (and consequently the main drivers behind their blockchain experimentation) are the lack of traceability and transparency, the dependency on manual processes, as well as regulatory compliance in a globalised market. If we also consider consumer demands for ethical consumption (Newholm and Shaw, 2007), improved business practices, and corporate responsibility (Castaldo *et al.*, 2009), the importance of tackling the abovementioned challenges becomes critical.

For many, blockchain is a well-suited solution for addressing these issues since it can enhance transparency by documenting a product's journey through the supply chain, it can provide better scalability as any number of people can access it from any touchpoint, and it can provide better security through its decentralised and immutable nature (Kshetri, 2018; Wang *et al.*, 2019). That is why, over the past few years, several companies have transitioned from research and proof of concept stages and have released blockchain solutions to the mainstream market. Project Provenance (2015) designed a decentralised system where modular programs deployed on a blockchain will track down the supply chain in its entirety, covering product such as wine, fresh produce and cosmetics. iFinca (2020) has adopted a similar solution for connecting coffee farmers and producers with the end consumer in a bid to enhance transparency in the coffee value chain.

Despite the overall interest in blockchain and its potential to enhance supply chain transparency, current research on the topic has mostly focused on conducting scenario analysis and developing the technical infrastructure required for these systems (Nie and Luo, 2019). Very little attention has been given to exploring consumers' purchasing intentions for products based on blockchain traceability systems, the factors influencing those intentions and how they compare with existing traceability solutions. To bridge that research gap, this paper will investigate consumers' purchasing intentions and their psychosocial antecedents utilising an extended model of the Theory of Planned Behaviour (TPB). To achieve that aim, we conducted an online questionnaire among 123 participants using two traceability systems (one based on blockchain and one on a more traditional certification) for organic coffee.

Blockchain technologies offer the potential to streamline supply chains processes, make production and business practices more transparent (Hastig and Sodhi, 2020), and pass those benefits directly to an end consumer that is increasingly concerned about sustainability issues and fair-trade of their coffee (Lee *et al.*, 2018). Therefore, filling the abovementioned research gaps utilizing and expanding an established framework in consumer food choice (Nardi *et al.*, 2019), that is the TPB, will ensure that the design of these new systems will be built not only around addressing the technical and logistical challenges coffee farmers and producers face but, at the same time, also addressing current consumers' needs and concerns.

Since purchasing intentions have been found to signal actual purchasing behaviour (Yang, 2021) and, more importantly, retain existing and attract new customers (Morwitz, 2012), establishing the variables that predict them when it comes to blockchain traceable coffee can benefit all actors in the coffee value chain. That is, benefit both for businesses that can design their traceability systems based on their customers' requirements and current market trends, and for consumers that can feel confident the product they are buying is in line with their values and lifestyle.

In the next section, we will explore the current literature and set out our research goals, followed by a description of the materials and methods employed in our research. We will next present the results of our questionnaire study and discuss its findings. Finally, we conclude with our study's implications both on a practical level of presenting traceability information and increasing consumer awareness on traceability systems as well as on a research level of expanding the product and system range the TPB can explain and variables that can increase the model's predictive power. Future research suggestions are also provided.

2. Literature Review

Numerous food scandals in various industries over the past decade have jeopardised consumer confidence both in the regulator's capacity to establish frameworks that guarantee food safety and in the industry's ability to ensure and monitor their supply chains transparently (Martinez and Epelbaum, 2011). From contaminated food incidents (e.g. Peanut Corporation of America salmonella scandal; see Leighton, 2016) to questionable business practices (e.g. Nestle and Jacobs Douwe Egberts use of slave labour in Brazilian coffee farms; see Hansen, 2016), governments realised the need for stricter and more effective rules, which resulted in enhanced regulations and protocols such as the EU General Food Regulation (EC, No 178/2002) and the subsequent requirements for "one step back" – "one step forward" traceability systems (Charlier and Valceschini, 2008). At the same time, these changes compelled the food industry to move beyond compliance with the newly formed legislation in order to restore consumer confidence, either in the form of technological innovation than ensures traceability through the integration of information at all stages of the supply chain or in the form of elaborate certification schemes and quality standards (Martinez *et al.*, 2007).

Although a variety of definitions for traceability have been proposed, the UK Food Standards Agency (2019) defines traceability *"as the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution"* (p.8). Apart from regulatory compliance, the main benefits of incorporating a robust traceability system include improvements in inventory management, better handling of food crises and recalls, and increased marketability of goods that provide unique, verifiable quality attributes (Aung and Chang, 2014).

For many years, traceability in the food supply chain has been achieved through Enterprise Resource Planning systems that allow for the connection between supply chain data with business processes. However, these systems are costly and not fit for purpose in an ever-changing global supply chain with multiple actors across multiple jurisdictions (Hollands *et al.*, 2019). Calls for more effective and decentralised cloud-based IT traceability solutions can be traced back to the early 2010s. For instance, Trienekens *et al.* (2012) described such a system that consisted of joint infrastructure, coding standards and integrated databases for all supply chain actors.

Despite blockchain not being a coherent solution for supply chain traceability in the early 2010s, these proposed systems are similar in their technical nature and overall aims. As described in the original white paper (Nakamoto, 2008), in a blockchain information is stored on a distributed network in data pieces (called blocks) that are cryptographically secured, with each new block also containing details about the previous blocks, thus creating a chain that is sealed using cryptographic hash functions. Moreover, participants in the network get to validate the information added to a new block, and, for it to be part of the chain, the network must agree and reach consensus, with each computer in the network storing an identical and continuously updated copy of the ledger that everyone participating can exam and verify its legitimacy. Depending on the industry and the specific use case, various blockchain approaches regarding validation and consensus exist, aiming for a different balance between availability, consistency and trustworthiness (Tschorsch and Scheuermann, 2016).

As noted by Levine (2017), the reason that blockchain makes sense for supply chain traceability is that in contrast to other sectors (e.g. financial services), the absence of other available alternatives to solve the communications problem in shipping and trackability makes this technology an attractive and potentially cost-effective option. Additionally, since blockchain enables parties to share information in a transparent, reliable and secure way, even supply chain actors located at the edges of a system would access direct and updated information, preventing communication inefficiencies (Seebacher and Schüritz, 2017).

Early research has shown that for actors at one edge of the supply chain, that is the consumers, traceability systems can reduce uncertainty and, consequently, enhance purchasing intentions (Choe *et al.*, 2009). Kher *et al.* (2010) suggested that such systems can also decrease information asymmetry and increase consumer confidence. Other studies have found that additional traceability information/certifications can affect consumers' willingness to pay a premium for a product (Dopico *et al.*, 2016; Hou *et al.*, 2019), although results can vary between consumer categories (Nie and Luo, 2019).

Notwithstanding the positive attributes of traceability systems and the public's concerns over food safety, research suggests consumers' cognition level about the concept of traceability is low (Hansstein, 2014; Martinez and Epelbaum, 2011). A possible reason for that limited awareness is the industry's practice of utilising certification labels to convey a traceability system's existence and benefits. Moreover, although products with certification schemes have positive effects on consumers, in terms of purchasing intentions (Batte *et al.*, 2007; Johe and Bhullar, 2016) and reducing uncertainty (Chen and Huang, 2013), the labels representing those schemes on a product convey little information regarding production processes and conditions (Sander *et al.*, 2018).

In a blockchain-based traceability system, consumers are granted "reading" access to that additional information via a QR code on the product, which they can scan on their mobile phones. The QR code leads them to a website where they can examine the entirety of their product's journey. In the academic literature, Bumblauskas *et al.* (2020) proposed such a system, in which all the complex and technical information regarding productions processes and standards, as well as all the different locations in the product's journey stored in the blockchain, are conveyed to consumers on their mobile phone by scanning a barcode. Applications on the market utilise a similar approach while also adding visual aids (e.g., maps) to depict a product journey. Some systems go even further, with iFinca providing a "Meet the Farmer" QR code for their coffee, allowing consumers to get in contact with local coffee producers (iFinca, 2020).

Despite the continuous emergence of applications that use blockchain for provenance purposes, research on what these new blockchain-based traceability systems imply for the consumer and the influential factors behind their intentions to purchase a product bearing them is limited (Schlegel *et al.*, 2018), although emerging findings describe a positive effect. Sander *et al.* (2018) found that using a blockchain system for meat traceability positively influenced consumer quality perception and purchasing decisions. On the influential factors, Nie and Luo (2019) reported that consumer trust, perceived benefit, familiarity and perceived risk had a significant positive impact on the purchasing intentions for blockchain traceable goods.

Our study aims to explore consumers' attitudes and purchasing intentions regarding blockchain-traceable organic coffee (compared to coffee with conventional traceability certification) and identify the main psychosocial antecedents behind these intentions. We choose organic coffee because, apart from being one of the most traded commodities in the world (International Coffee Organization, 2019) and consistently topping the Sustainable Market Share Index as on the most sustainably marketed products (Kronthal-Sacco and Whelan, 2020), consumers report increased ethical concerns about coffee production practices and fair trade, due to perceptions about the use of child labour and the effect of growing practices on environmental sustainability (Lee *et al.*, 2015).

For our conceptual framework, we employed the TPB (Ajzen, 1991), one of the most utilized and discussed theoretical models for predicting intentions and behaviours (Hoppe *et al.*, 2013). The TPB suggests that three main components, namely, attitudes (favourable or unfavourable evaluations of the behaviour), subjective norms (whether significant others approve or disapprove of the behaviour) and perceived behavioural control (PBC) (the individual's perception of the ease or difficulty to perform the behaviour), shape an individual's behavioural intentions, which in turn determines their behaviour. While the TPB has been successfully used in various contexts in the consumer choice literature (e.g., online shopping behaviour; see Lin, 2007), research has also established its robustness in the food choice context, especially in determining motivational factors for choosing one product over another (Nardi *et al.*, 2019), as well as in predicting behaviour and consumer intentions towards organic products (Armitage and Conner, 2001), in general, and organic coffee (Lee *et al.*, 2015), in particular. Therefore, in line with the theory, we suggest that the more favourable the three main components of TPB are, the stronger the intentions to purchase blockchain traceable coffee.

In an effort to increase the model's predictive power in the context of food choice, researchers over the years have contributed significantly with the addition of complementary constructs to the original TPB. Even Ajzen (1991) himself encouraged such exploration, suggesting that *"The TPB is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behaviour after the theory's current variables have been taken into account"* (p.199). Recent studies suggested that including constructs such as trust and past habits increased the predictive power of the TPB in areas such as traceable chicken and honey (Menozzi *et al.*, 2015), and traceable beef (Spence *et al.*, 2018). In the context of organic coffee, Lee *et al.* (2015) found that environmental protections were strong contributors to all original components of TPB (i.e., attitudes, subjective norms, PBC), indicating the potential of this variable to directly predict purchasing intentions and increase TPB's predictive power as a standalone construct.

Consequently, the current study will initially test the original TPB model by measuring how participant's attitudes towards blockchain traceable organic coffee (compared to UTZ certified organic coffee), perceived social pressure (subjective norms), and their perceived ability to both identify and comprehend origin information and production processes (PBC), influence their purchasing intentions. Next, we will test an extended TPB model and whether including variables such as participants' past habits, trust, and environmental protections could increase the explained variance. The study's overall aim is to contribute towards the role psychosocial variables play in explaining purchase intentions for blockchain traceable coffee and how such variables could contribute towards the design of the relevant blockchain applications. On a secondary level this study aims to reaffirms the validity of TBP in predicting purchasing intentions in the food choice context and establish additional factors that could increase the model's predictive power.

3. Materials & Methods

3.1 Data Collection and Sample Description

An online questionnaire involving a convenience sample of 123 participants (61% response rate) was conducted in September-October 2020 via the online platform Callforparticipants.com and via emailing lists (students and staff) at the University of Nottingham. All responders had to be above 18 years old and consume at least 1-2 cups of coffee per week. At the beginning of the questionnaire, we informed participants about the project's funders and that our study had no commercial motives. It was also emphasised that were no wrong or right answers and that all data collected will be treated anonymously and in line with Nottingham University's guidelines. The study was approved by the Nottingham University Business School Ethics Committee, and consent was obtained from each participant at the beginning of the study.

Table I contains the demographic details of the sample and their characteristics. The majority of our sample drinks at least one coffee cup per day (77.2%), but they are equally split in their familiarity with coffee certification schemes. Most of the responders have heard of food traceability systems (68.3%), and they are aware that such systems can provide additional information to consumers (65.9%). However, almost half of the participants were unaware that food traceability systems could prevent food risks (48%) and track safety problems (43.9%). Finally, most of our sample have heard of blockchain technologies (63.4%).

Table I.
Demographics and Characteristics of the Study Sample

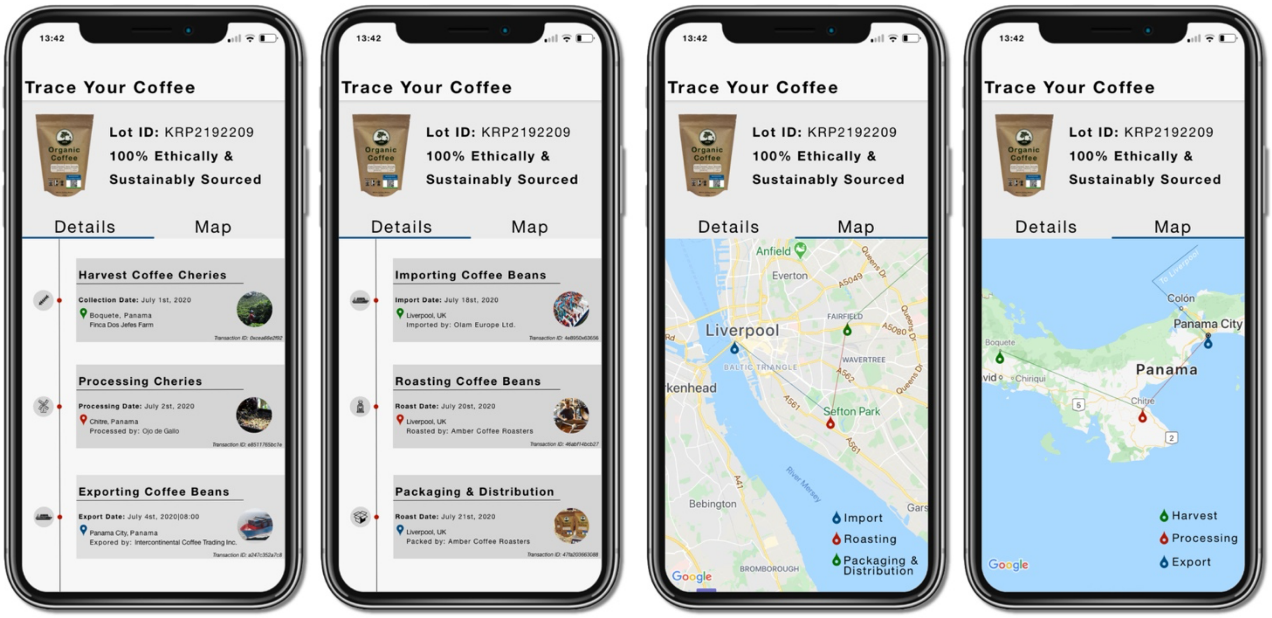
		N=123 %
Gender	Male	41.5
	Female	53.7
	Non-binary	3.3
	Prefer not to say	1.6
Age	18-29	47.2
	30-39	35
	40-49	13
	50-59	4.9
Education	GCSE	3.3
	A-level	8.9
	BSc degree	26
	MSc degree	41.5
	PhD	20.3
Employment	Employed full time	35.8
	Employed part time	13.0
	Unemployed	4.1
	Student	43.9
	Prefer not to say	3.3
Coffee Consumption Frequency	1-2 Cups a day	50.4
	More than 2 cups a day	26.8
	1-2 Cups a week	6.5
	3-4 Cups a week	6.5
	Less than a cup a week	9.8
Are you familiar with sustainable coffee certification schemes	Yes	52
	No	48
Have you ever heard of food traceability systems?	Yes	68.3
	No	31.7
Do you know that food traceability systems can prevent with food safety risks?	Yes	52
	No	48
Do you know that food traceability systems can track food safety problems?	Yes	56.1
	No	43.9
Do you know that food traceability systems can provide information to consumers?	Yes	65.9
	No	34.1
Have you ever heard of blockchain Technologies?	Yes	63.4
	No	36.6
Willingness to Pay (WTP)	Yes	75.6
(Yes if participants were willing to pay more for blockchain coffee than the standard price)	No	24.4

3.2 Definitions and Visual examples of Blockchain and UTZ organic coffee

Upon granting consent, filling out their demographic information, and answering the questions regarding their familiarity with traceability systems, participants were given a short set of instructions regarding the questionnaire's next steps. They were then presented with two different traceable coffee products (both products are fictional and were created for the purposes of the study), one with a conventional traceability certification scheme (UTZ) and another based on blockchain traceability certification (Figure 1). We chose UTZ as the conventional certification scheme because it is the most extensive program for sustainable coffee (UTZ, 2017). The products were otherwise the same apart from their traceability label.

Figure 1. Organic Coffee Visual Aids (UTZ & Blockchain)

In order to set a basic information background among participants, both products were accompanied by a detailed description of what exactly its system offers and how it operates. These descriptions included a brief history of each system, what it does and how it works, as well as its advantages and disadvantages. For the blockchain traceable product, we also offered a visual aid, depicting the website participants' view when they scan the QR Code, which contained production details and the product's journey (Figure 2). The visual aid design was based both on commercial blockchain traceability applications (iFinca, 2020; Project Provenance, 2015) as well as on the application proposed by Lee *et al.* (2015). Adopting such design made sure that participants had at least a sufficient amount of information for both products before answering the questions and thus addressing Sirieix's *et al.* (2013) concerns that although consumer might recognize the label and what it represents, they do not have complete information of what it means.



Details 1/2 *Details 2/2* *Map 1/2* *Map 2/2*

Figure 2. Blockchain Traceability App Visual Aids

3.3 Questionnaire design and Measures

Following the product descriptions and the visual aid, participants answered the main questionnaire. The questionnaire items were developed drawing on guidelines proposed by Ajzen (1991, 2006) on how to structure a TPB questionnaire as well as on previous research on using the TPB model to explore food traceability (Lee *et al.*, 2015; Menozzi *et al.*, 2015; Spence *et al.*, 2018). The questionnaire contained closed-ended questions, and items (listed in Table II) were scored on a 7-point Likert-type scale (1 = "Strongly Disagree" – 7 "Strongly agree") unless otherwise indicated.

We measured attitudes towards purchasing traceable blockchain coffee compared to UTZ certified traceable coffee using a four semantic differential scale covering both the affective (bad-good, displeased-pleased) and the cognitive (foolish-wise, harmful beneficial) aspects of attitude. Five social norms were used to assess the perceived social pressure (subjective norms) of purchasing blockchain traceable coffee, including family, scientists, media, the food industry and important others. The participants' ability to acquire and comprehend information on production processes and origin (PBC) regarding blockchain traceable coffee was assessed using six items.

Table II.

Means (SD), Cronbach's Alpha, and Standardised Factor Loadings of Questionnaire Items Which Were Scored on a 7-Point Likert-Type Scale (1: "strongly disagree", 7: "strongly agree", unless otherwise indicated)

Variables (No of items)	*Mean (SD)*	*Alpha*	*Factor Loadings*
Attitudes (4 Items)	4.78(1.30)	0.94	
Buying Blockchain traceable coffee instead of UTZ certified coffee would make me feel:			
Scale: bad (1) - good (7)	4.83(1.47)		0.86
Scale: displeased (1) - pleased (7)	4.87(1.44)		0.87
I think that buying blockchain traceable coffee instead of UTZ certified coffee is:			
Scale: foolish (1) - wise (7)	4.76(1.29)		0.72
Scale: harmful (1) - beneficial (7)	4.65(1.46)		0.84
Subjective Norms (5 Items)	4.02(1.27)	0.84	
I would buy blockchain traceable coffee because:			
My partner, family and friends approve of it.	3.83(1.63)		0.77
The scientific community is in favour of it.	5.03(1.59)		0.46
The media (TV, radio, social media) are in favour of it.	3.47(1.62)		0.70
My partner, family and friends approve of it.	3.68(1.69)		0.74
People important to me buy/prefer this type of coffee.	4.11(1.66)		0.80
Perceived Behavioural Control (6 Items)	5.22(1.89)	0.94	
Regarding the additional information about the production processes and origin of the blockchain traceable coffee (obtained via the QR code):			
It will be easy to find/obtain the additional information	5.52(1.58)		0.73
I will be confident that I will find/obtain the additional information	5.31(1.50)		0.54
I will be able to find/obtain the additional information without the help from others.	5.43(1.54)		0.80
It will be easy to understand the additional information	5.08(1.63)		0.89
I will be confident that I will find the additional information	5.00(1.57)		0.93
I will be able to understand the additional information without help from others	4.99(1.66)		0.89
Habits: Country of Origin (4 Items)	3.81(1.92)	0.95	
When I buy coffee, looking for information about the country or region of origin is something:			
I do automatically	4.11(2.15)		0.80
I do without having to consciously remember	3.89(2.06)		0.82
I start doing before I realize I am doing it	3.70(1.99)		0.77
I do without thinking	3.58(2.07)		0.77
Habits: Production Process (4 Items)	2.92(1.64)	0.95	
When I buy coffee, looking for information about the production process that is needed to make the coffee (e.g., harvesting, processing, roasting etc) is something:			
I do automatically	2.99(1.72)		0.85
I do without having to consciously remember	2.97(1.77)		0.79
I start doing before I realize I am doing it	2.83(1.76)		0.87
I do without thinking	2.89(1.79)		0.85
Habits: Food Assurances (4 Items)	3.76(1.82)	0.96	
When I buy coffee, looking for food assurance schemes, such as UTZ, FairTrade or smaller 'niche' schemes that aim to meet particular consumer demands such as higher environmental or organic standards or good business practices, is something:			
I do automatically	3.99(1.97)		0.92
I do without having to consciously remember	3.84(1.95)		0.92
I start doing before I realize I am doing it	3.62(1.88)		0.96
I do without thinking	3.58(1.87)		0.89
Trust (3 Items)	5.08(1.27)	0.92	
I trust:			
That blockchain traceable coffee can be tracked back to the actual plantation	5.28(1.38)		0.75
The information provided about the production process and origin of the blockchain traceable coffee	5.12(1.32)		0.74
Blockchain traceable coffee is authentic, which means it has not been tampered with in any way and is what it says it is	4.84(1.42)		0.66
Environmental Protection (4 Items)	3.89(1.47)	0.93	
Regarding blockchain traceable coffee, in comparison to UTZ certified coffee available in the market:			
Blockchain traceable coffee is produced without breaking the balance of nature	3.63(1.61)		-0.79
Blockchain traceable coffee promotes environmentally friendly packing procedures	3.91(1.48)		-0.71
Blockchain traceable coffee promotes environmentally friendly production processes	4.04(1.54)		-0.69
Blockchain traceable coffee is produced with environmental protections in mind	4.00(1.72)		-0.71
Intentions (3 Items)	4.18(1.58)	0.89	
When blockchain traceable coffee becomes available:			
I intend to buy it	4.32(1.69)		-0.81
I will look for it	4.82(1.88)		-0.91
I will be important to me to buy it	3.41(1.65)		-0.63
Behavioural Beliefs (9 Items)	4.21(1.29)	0.93	
Regarding blockchain traceable coffee, in comparison to UTZ certified coffee available in the market:			
Blockchain traceable coffee will likely be healthier	3.56(1.64)		0.57
Blockchain traceable coffee will§ likely be tastier	3.35(1.54)		0.55
Blockchain traceable coffee will likely be more expensive	4.51(1.43)		0.53
Blockchain traceable coffee will more likely be of known origin	5.25(1.56)		0.64
Blockchain traceable coffee will likely be safer	4.46(1.59)		0.66
Blockchain traceable coffee will likely be of more satisfying quality	3.82(1.62)		0.62
Blockchain traceable coffee will more likely be authentic which means it has not been tampered with in any way and it is what it says it is	4.61(1.59)		0.67
Blockchain traceable coffee will likely be more environmentally friendly	4.00(1.77)		0.53
Blockchain traceable coffee will likely have higher production standards	4.32(1.86)		0.58

Three types of purchasing habits were assessed, namely, country of origins, production processes and food assurances ("[When buying coffee, behaviour X is something ...]" "I do automatically", "I do without having to consciously remember", "I start doing before I realize I am doing it", "I do without thinking"). Trust was evaluated on three items, including trusting the information about the product's place of origin, production processes and authenticity. Four items were used to measure the participant's perception of environmental standards regarding blockchain traceable coffee. Purchasing intention was measured by three items: "[When blockchain traceable coffee becomes available...]" "I intend to buy it", "I will look for it", "It will be important to me to buy it". Finally, behavioural beliefs were assessed on nine statements, in which participants had to compare blockchain traceable coffee to certified traceable coffee on whether they believe it will be healthier, tastier, more expensive, safer, more satisfying, authentic, more environmentally friendly and of higher productions standards.

At the end of the questionnaire, we also asked participants the following question (adopted from Spence *et al.*, 2018) regarding how much more they are willing to pay (WTP) for blockchain traceable coffee, as a percentage of the convection product price: “Suppose the price of organic coffee currently available in the supermarket is £3.05 for a 250g pack. The price of the blockchain traceable coffee with the unique identity details and the additional available information will be higher, but it is not determined yet. How much more would you be willing to pay to purchase 250g of blockchain traceable coffee?”. Participants then chose their preferred WTP from the following range of options: 0%-25% in increments of 5 & 30%-100% in increments of 10.

3.4 Data Analysis

All data analysis was conducted using IBM Statistics for macOS, Version 27.0. A p-value $p < 0.05$ was considered to be significant.

At the first stage, a Principal Component Analysis with OBLIMIN rotation was performed on the questionnaire's 46 items. Multicollinearity was not an issue in our analysis, while the Kaiser–Meyer–Olkin (KMO) measure verified the sampling adequacy for the analysis (KMO = 0.85). Based on Kaiser's criterion on retaining factor with eigenvalues greater than 1, the analysis yielded a 10-factor solution which, in combination, explained 80.9% of the variance. The extracted communalities range from .539 to .912, with the average communality being 0.8. This solution is also in line with the literature the questionnaire was based upon. Each variable cleanly loaded onto one factor above the recommended level of .40. We also performed reliability analysis (Cronbach's α) for each of those factors. All values are above the recommended level of .70.

Additionally, all items in each factor correlate well with the total. Table II shows the factor loadings along with internal reliabilities.

A hierarchical multiple regression examined the relationship amongst TPB model constructs and intention to purchase blockchain traceable coffee at a first stage. We then tested the extended version of TPB, which included habits, trust and environmental protections. Finally, Pearson correlations measured the strength of the relationship between constructs within the models, behavioural beliefs and attitude, and behavioural beliefs and intention.

4. Findings

4.1 Descriptive Summary

Participants reported a high level of PBC, especially in their ability to obtain additional information from the blockchain traceable coffee and do so with confidence and without help from others. They also expressed a considerable degree of trust towards the information provided regarding production processes and that the coffee can be traced back to the actual farm. There was a generally favourable attitude for the blockchain traceable coffee, with participants stating that buying it would be wise/beneficial and make them feel pleased/good.

Participants also reported positive behavioural beliefs, particularly regarding blockchain traceable coffee being of know origin, more expensive and have not been tampered with throughout the production process. However, they did not believe it will be healthier or tastier. Subjective norms were slightly positive, with the scientific community having the most significant influence in buying the blockchain traceable coffee. The same level of agreement was expressed for environmental protections, with participants reporting that blockchain traceable coffee promotes environmentally friendly production processes and protections compared to UTZ coffee.

Intentions to purchase blockchain coffee when it becomes available were also positive, with participants reporting that they will look for it and intent to buy it, but this purchase will be of neutral importance. Country of origin and food assurances habits were centred around the midpoint while habits regarding production processes fell to lower levels. Finally, when asked how much more they are willing to pay above the base organic coffee price, 75.6% of participants indicated that they are willing to pay at least 5% more for the blockchain traceable coffee, with the majority indicating a price premium ranging from 5% - 30% of the base price.

4.2 Predicting Purchasing Intentions

A hierarchical multiple regression examined the association between TPB model constructs (attitude, subjective norms and PBC) and intentions to purchase blockchain traceable coffee. Then, we tested an extended version of the TPB model, including habits, trust, and environmental protections. Before performing our analysis, we checked for potential bias in our model. Inspecting the plot of standardized predicted values against standardized residuals revealed no concerns regarding linearity and homoscedasticity. Checking the correlations between our constructs (Table III) suggests there is no multicollinearity in the data ($r > 0.90$), with the highest significant correlation being between trust and PBC ($r = 0.62$, $p < .001$). Finally, no influential outliers were found on the dependent or the independent variables.

Table III.
Correlations Between Intentions and All Other Constructs Within the TPB and Extended TPB Models

Constructs	1	2	3	4	5	6	7	8	9
1. Intentions	-								
2. Attitude	**0.54*** **	-							
3. Subjective Norms	**0.39*** **	**0.49*** **	-						
4. Perceived Behavioural Control	**0.46*** **	**0.50*** **	**0.44*** **	-					
5. Habits (Country of Origin)	**0.25** **	0.01	0.03	-0.08	-				
6. Habits (Production Process)	**0.29*** **	0.05	0.01	-0.03	**0.67*** **	-			
7. Habits (Food Assurances)	**0.26** **	-0.01	**0.17* **	-0.02	**0.48*** **	**0.45*** **	-		
8. Trust	**0.43*** **	**0.50*** **	**0.48*** **	**0.62*** **	0.14	0.05	0.09	-	
9. Environmental Protection	**0.59*** **	**0.61*** **	**0.42*** **	**0.41*** **	0.15*	**0.25** **	**0.18* **	**0.46*** **	-

$p \leq 0.05$*; < 0.01**; < 0.001***; numbers in bold indicate significance

Table III contains the correlations between the model constructs. All variables correlated significantly with the intention to purchase blockchain traceable coffee. Environmental protection, attitude and PCB had the strongest positive correlations with attitudes, indicating that having a positive evaluation about the blockchain traceable coffee, feeling able to understand the additional information and holding favourable views regarding its environmental protections will make intentions to purchase it more likely. On the other end, all three habits recorded the lowest correlations with intentions.

For the first model in the hierarchical regression, attitudes, subjective norms and PBC are used as predictors (Table IV). The R value is 0.59, with an R^2 value of 0.34 and an R^2_{adj} of 0.33, indicating that this model accounts for 33% of the variance in purchasing intentions. Additionally, this prediction is statistically significant F (3, 119) = 20.80, $p < 0.001$. Habits, trust, and environmental protections were added as predictors for the second model in the hierarchical regression. For the extended TPB model, the R value is 0.70, with an R^2 value of 0.49 and an R^2_{adj} of 0.46, meaning that adding these predictors increased the variance in intentions to 46%. This prediction is also statistically significant F (5, 114) = 6.71, $p < 0.001$

Table IV.
Standardised Regression Weights (β) for TPB and extended TPB constructs

Independent Constructs	TPB			Extended TPB		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Attitude	**0.45**	**0.11**	**0.37*****	**0.28**	**0.11**	**0.23***
Subjective Norms	0.13	0.11	0.10	0.04	0.10	0.03
Perceived Behavioural Control	**0.26**	**0.10**	**0.23****	**0.28**	**0.10**	**0.24****
Habits (Country of Origin)				0.09	0.08	0.12
Habits (Production Process)				0.09	0.09	0.09
Habits (Food Assurances)				0.10	0.07	0.12
Trust				-0.03	0.12	-0.2
Environmental Protections				**0.31**	**0.10**	**0.28****
R^2_{adj}	0.33			0.46		
F	**20.83*****			**13.88*****		
ΔR^2	-			0.15		

$p \leq 0.05$*; < 0.01**; < 0.001***; numbers in bold indicate significance

For the 1st model, there are two significant predictors that positively correlate with intentions. Attitudes ($\beta = 0.37$, $t\,(119) = 4.07$, $p < 0.001$) and PBC ($\beta = 0.23$, $t\,(119) = 2.60$, $p < 0.001$). Hence, having a more positive attitude towards blockchain traceable coffee and a higher PBC in finding the additional traceability information was associated with greater intention to purchase it. Subjective norms did not emerge as significant predictors. For the 2nd model, there are three significant predictors that positive correlate with intentions. Attitudes ($\beta = 0.23$, $t\,(114) = 2.47$, $p < 0.05$), PBC ($\beta = 0.24$, $t\,(114) = 2.64$, $p < 0.01$) and environmental protections ($\beta = 0.28$, $t\,(114) = 3.11$, $p < 0.01$). Subjective norms, habits (all three categories) and trust did not emerge as significant predictors for purchasing blockchain traceable coffee in the extended TPB model.

Table V.
Correlations of Behavioural Beliefs with Attitude and Intentions

Behavioural Beliefs	Correlations (*r*) with Attitude	Correlations (*r*) with Intentions
Blockchain traceable coffee will likely be healthier	.449*	.472*
Blockchain traceable coffee will likely be tastier	.426*	.465*
Blockchain traceable coffee will likely be more expensive	.436*	.352*
Blockchain traceable coffee will more likely be of known origin	.484*	.451*
Blockchain traceable coffee will likely be safer	.569*	.469*
Blockchain traceable coffee will likely be of more satisfying quality	.551*	.527*
Blockchain traceable coffee will more likely be authentic which means it has not been tampered with in any way and it is what it says it is	.545*	.473*
Blockchain traceable coffee will likely be more environmentally friendly	.578*	.515*
Blockchain traceable coffee will likely have higher production standards	.595*	.442*

*p < .001

4.3 Explaining Purchasing Intentions

To further understand the reasons influencing the intention to purchase blockchain traceable coffee, the behavioural beliefs were correlated with attitudes and intentions. Table V illustrates that for all behavioural beliefs, there was a significant positive correlation ($p < 0.001$) both with attitudes and intentions. Blockchain traceable coffee will have higher production standards, be more environmentally friendly and is likely to be safer had the highest positive correlation with attitude, while beliefs that this coffee will have more satisfying quality, be more environmentally friendly and has not been tampered with had the highest positive correlations with intentions.

5. Discussion

The numerous food safety incidents over the past decade led governments and companies to the realisation that an up-to-date traceability system is a vital prerequisite for regaining consumer confidence and succeeding in the food industry's ever-changing landscape. At the same time, these incidents created consumer expectations that they will be able to access quality and traceability information when making purchasing decisions. Since observing the positive signs of blockchain implementations in other industries (e.g., finance), supply chain actors started implementing the technology in their systems in an attempt to enhance traceability and transparency in the food industry. This study aims to investigate the attitudes and intentions to purchase blockchain traceable coffee and identify the psychosocial determinates of these purchasing intentions using the TPB and testing an extended TPB model.

Our research revealed that participants' confidence in their ability to find and understand the additional product information and do so without any help were the most positive connections to traceable blockchain coffee, followed by the trust that the coffee can be traced back to the actual farm and the belief that blockchain traceable coffee is more likely to be of known origin This finding is in line with Spence *et al.,* (2018) that reported analogous high PBC scores when investigating a similar (but not based on blockchain) traceability system for beef. The high scores reported for the place of origin and confidence that the coffee can be traced back to the farm are also in line with previous research in meat and honey items (Menozzi *et al.*, 2015; Spence *et al.*, 2018; Van Rijswijk *et al.*, 2008).

The TPB model explained 33% of the purchasing intention variance while adding the new variables increased its predictive power to 46%. The first finding aligns with the meta-analysis Armitage and Conner

(2001) conducted and found that among 185 independent studies, TPB variables accounted on average for 39% of the variance in intentions, as well as with previous research (Giampietri *et al.*, 2018; Menozzi *et al.*, 2015; Sayogo *et al.*, 2018) which reported a range between 28% and 39%. For the TPB, attitudes and PBC were significant predictors of purchasing intentions, while subjective norms did not emerge as one. Although some researchers have reported that subjective norms is the least good predictor in the TPB model (McDermott *et al.*, 2015) and others have even proposed that it is rarely able to predict intention and removed it from their research (Armitage and Conner, 2001), in several studies subjective norms have emerged as a significant predictor (Giampietri *et al.*, 2018; Menozzi *et al.*, 2015; Sayogo *et al.*, 2018; Spence *et al.*, 2018). Further research, especially in the context of coffee and food traceability, is needed to establish this variable's role.

The additional variables accounted for a 13% increase in the predictive power of the TPB. However, only environmental protection emerged as a significant predictor, with trust and habits not predicting intentions. PBC and attitudes remained significant predictors, while subjective norms were not significant. This increase in the extended TPB's predictive power is in contrast with Menozzi *et al.* (2015) and Spence *et al.* (2018), who reported an increase between 2% and 5% in their extended models. While all three extended TPB models include trust and habits, our case's distinguishing factor was environmental protections, which emerged as the strongest predictor from our analysis. Previous research has reported that environmental protections are a significant positive contributor towards attitude, subjective norms and PBC regarding organic coffee (see Lee *et al.*, 2015) but our research further suggests that this variable can also directly predict purchasing intentions.

Trust did not emerge as a significant predictor in our analysis, despite research emphasising its importance in purchasing intentions (Sander *et al.*, 2018; Song *et al.*, 2017). Other researchers have also reported mixed results regarding trust as a significant predictor in the extended version of TPB, with Menozzi *et al.* (2015) and Spence *et al.* (2018) reporting significant findings for some products and some countries but not for others, implying the potential effects of a product-specific and a cultural element. Future research might clarify the importance of that factor and dive deeper into potential moderation effects. Habits also did not emerge as significant predictors of purchasing intentions. Although previous research has demonstrated that past behaviour might function as a primer for future intentions, participants in our study scored low scores for habits regarding looking for information about production processes, food assurance and country of origin, confirming what Nie and Luo (2019) suggested that although consumers care about traceability, their cognition levels are low.

Another interesting detail from our study is the participants' willingness to pay a price premium for blockchain traceable coffee. Although they believed that this type of coffee would be more expensive, 75.6% of participants indicated that they are willing to pay at least 5% more for the blockchain traceable coffee, with the majority price premium ranging from 5% to 30%. This finding aligns with a recent survey from IBM, in which 71% of participants who indicated that traceability is a crucial feature were willing to pay a premium for brands that provide it (Haller *et al.*, 2020).

The main limitation of the study is the focus on purchasing intentions rather than actual purchasing behaviour. Although intentions account for a significant amount of behaviour (Ajzen, 1991), future research should consider investigating actual in-store purchases of blockchain traceable products. Another potential limitation is that most of our participants (63%) have heard of blockchain technology and were potentially aware of its benefits. Therefore, future research should investigate the responses blockchain traceability systems might elicit from participants less familiar with the technology.

6. Conclusions and Study Implications

This study contributes to the existing research on traceability systems, the consumer psychosocial attendances that drive purchasing intentions and expands that literature by looking at one of the most discussed technologies of today: blockchain. To our knowledge, this is the first study exploring consumer perception of blockchain traceable organic coffee using the TPB. Positive attitudes and PBC accounted for 33% of the variance in participants intention to purchase blockchain traceable coffee compared to its UTZ counterpart. The predictive power of the model increased to 43% when environmental protection was added. In contrast to literature suggestions, trust, habits, and subjective norms did not emerge as significant predictors.

On a research level, our study establishes the factors that affect consumer purchasing intentions for blockchain traceable products and specifically organic coffee, an understudied but increasingly prevalent area in the literature, especially as such products become more common in the market. Additionally, it further establishes the validity of the TPB in explaining purchasing intentions in the food choice context by expanding the product and traceability system range this model can reliably explain. We also provide evidence that factors such as environmental protections can be directly included in the model and significantly predict intentions and increase its overall predictive power.

On a practical level, our study has a threefold contribution. First, the format the additional product information was presented to participants (both for the general details in the systems and the visual information in the phone app) was highly effectual (as indicated by the high PBC scores) and could provide the basis for the user interface design of similar systems. Second, the emerging role of the environmental protections a product offers in predicting purchasing intentions is of particular interest to supply chain actors since it could function as a pilar both for designing features in their blockchain-based platforms as well as for marketing and promotion purposes. Finally, the confirmation of participants' low cognition level regarding traceability (as indicated by the low scores on all habits categories) suggests the importance that information campaigns (especially supported by the scientific community and significant others) around traceability, its significance and benefits could play in increasing consumer awareness, especially given the prominent role such increase can play in positively shaping purchasing intentions.

Ways in which blockchain's internal benefits can be transferred to the consumer, in which format, and how they affect their purchasing intentions compared to what already exists in the market, is a research area requiring further investigation, especially as this technology becomes more prominent in the market and more products adopt it for traceability and transparency purposes.

Funding/Acknowledgements

The research described in this paper is supported by the Horizon Centre for Doctoral Training, University of Nottingham (RCUK Grant No. EP/L015463/1) and the Digital Catapult. The authors would like to thank Dr Robert Learney from the Digital Catapult for his constructive comments and feedback. The information described in this paper reflects the authors views. The Horizon Centre for Doctoral Training and the Digital Catapult are not liable for any information contained in this paper.

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