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Regenerated Cellulose Fibers (RCFs) for Future Apparel Sustainability: Insights from the U.S. Consumers

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Abstract: An increasing number of apparel companies are inventing novel green technologies to produce regenerated cellulose fibers (RCFs) out of textile waste. RCF can significantly reduce virgin cotton production and decrease textile waste in incinerators or landfills. However, our knowledge on U.S. consumers' willingness to purchase RCF-made apparel is still limited given its newness. To address the gap in the literature, this study aimed to identify the factors significantly influencing the U.S. consumers' purchase intention toward RCF-made apparel. Building on the Theory of Planned Behavior (TPB), a research model including attitude, subjective norm, perceived behavioral control, perceived consumer effectiveness, and past environmental behavior as predictors was proposed to investigate the U.S. consumers' intention to purchase RCF-made apparel. The primary data were collected by a Qualtrics survey of U.S. consumers. A total of 544 eligible responses were gathered for data analysis and hypothesis testing. The multiple regression method was applied for determining the proposed statistical relationships. Attitude, perceived consumer effectiveness, and past environmental behavior positively affect U.S. consumers' purchase intention toward RCF-made apparel, while the effects of subjective norm and perceived behavioral control are insignificant. Attitude plays a partial mediating role between past environmental behavior and purchase intention toward RCF-made apparel. A higher level of consumer environmental behavior leads to a more positive attitude toward and a greater likelihood to purchase RCF-made apparel. The proposed research model exhibits a good explanatory power, accounting for 64.8% of variance in U.S. consumers' purchase intention toward RCF-made apparel.

Keywords: sustainability; regenerated cellulose fiber; apparel; purchase intention; U.S. consumers



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1. Introduction

In recent years, concern for the environment, climate change, and sustainability has become an ever-increasing phenomenon that is changing consumers' attitude, behavior, and lifestyle [1]. Consumers become more aware of adverse environmental impacts of the apparel and textile industry [2,3]. The apparel and textile industry is of great concern because production and consumption have steadily increased due to the growing population, increased incomes, and improved living standards. Fast fashion trends stimulate people to buy more apparel products and dispose of them in shorter time frames, which consequently increases demand. This demand leads the textile industry to consume high amounts of natural resources and energy, which therefore creates large volumes of textile waste [4–6]. According to the Ellen McArthur Foundation, approximately USD 100 billion worth of apparel is discarded in the United States every year [7]. The EPA estimated that only 15.2% of the annual 16.9 million tons of textile waste generated in the U.S. was recycled [3].

When it comes to apparel and textile purchases, most consumers prefer cellulose fibers, mainly cotton, for a variety of reasons including being soft and comfortable, durable while breathable, hypoallergenic, biodegradable, odor-free, cling-free, and pilling-free [8]. World cotton consumption reached 26 million tons in 2021 with consumption exceeding

production [9]. Despite being such a popular and well-loved fiber, conventional virgin cotton is not necessarily the most sustainable option, due to irrigation, water contamination, soil erosion and degradation, and the use of cultivation chemicals and fertilizers [10]. Cotton also produces a great amount of waste during the yarn, fabric, and apparel manufacturing processes [11]. Lyocell is another type of cellulose fiber that is considered sustainable because it is made from wood cellulose or pulp, which is biodegradable, does not produce any harmful by-products, uses less energy and water during production, and does not require pesticides or irrigation [12,13]. It is also stronger, absorbs more moisture, and has a greater stability and drapability compared to cotton [14]. However, Lyocell is too expensive for most consumers because of the technology required for processing and it does not resolve the pressing issue derived from the ever-increasing textile waste [4,13].

One promising solution is regenerated cellulose fibers (RCFs) produced using cotton waste and linters [11,15]. Currently, about 75% of pre-consumer waste is recycled by saving and reusing cotton fibers for lower-grade yarns or nonwoven products such as furnishings, automotive uses, and building insulation [16]. This reclaiming process is defined as extracting cotton fibers out of waste and reusing them. In comparison, the rate of recycling post-consumer cotton waste is very low and most cotton waste ends up in landfills or incinerators. Therefore, recycling post-consumer cotton products into RCF is an auspicious solution [4,11]. Typically, cotton is recycled by a mechanical process that results in a quality inferior to virgin cotton, so it is usually mixed with virgin cotton [17]. Recently, a new process to produce RCF out of cotton waste was invented that is a more environmentally conscious method [11]. This process starts with any 100% cotton or cotton blend apparel products (i.e., pre- and post-consumer textile waste) that are cut down to small pieces of yarns about 1–2 mm in length and shredded. Then, the shredded cotton is hydrolyzed with sulfuric acid. Through a series of eco-friendly low-impact chemicals such as sodium hydroxide and urea or lithium hydroxide and urea, the fibers are dissolved into liquid. Finally, the liquid is wet-spun into new RCF [11]. These fibers are high quality and have the potential for their properties to be manipulated to make specific variations of fabric end uses [11]. By removing cotton waste from landfills or incineration, RCF is more environmentally friendly in the production process and more cost-effective [4]. RCF apparel made by an eco-production process can largely reduce waste, pollution, and resource consumption and is becoming a promising direction for affordable environmentally friendly apparel.

While an increasing number of companies such as H&M Group, Patagonia, PVH Corp., and Wrangler have started using more RCF in their products to scale-up their sustainability efforts, there is limited knowledge on consumers' preferences toward RCF-made apparel. Therefore, this study aimed to identify the factors significantly affecting the U.S. consumers' intention to purchase RCF-made apparel. Specifically, the objectives of this study were fourfold. First, based on the Theory of Planned Behavior (TPB), a research model including attitude (AT), subjective norm (SN), perceived behavioral control (PBC), perceived consumer effectiveness (PCE), and past environmental behavior (PEB) as predictors was proposed to investigate the U.S. consumers' intention to purchase RCF-made apparel. Second, the psychometric properties of the proposed research model were examined using the gathered U.S. consumer survey data. Third, the effects of significant factors on U.S. consumers' intention to purchase RCF-made apparel were determined. Finally, some theoretical and applicable implications were provided for academia and industrial practitioners.

Understanding the key determinants driving U.S. consumers' intent to buy RCF-made apparel can have significant implications for sustainability, market demand, innovation, and policy. If U.S. consumers are willing to purchase RCF-made apparel, it could lead to a shift in the apparel industry toward more sustainable production methods. The knowledge can help apparel companies understand market demand and develop marketing strategies to promote RCF-made apparel. This could lead to increased sales and profitability. Consumer demand can influence policy decisions related to sustainability and environmental protection. If U.S. consumers show a strong preference for RCF-made apparel,

it could lead to policy changes that encourage the use of more sustainable materials in the apparel industry.

The remainder of the article is organized as follows. In Section 2, we introduce the theoretical framework, review the relevant literature, and propose hypotheses. The proposed research model and developed survey instrument can be found in Section 3. In Section 4, we present the data collection procedure, statistical analysis method, and hypothesis testing results and discussions. The conclusions and implications are provided in Section 5. Finally, Section 6 discusses the limitations and future studies.

2. Theoretical Framework and Literature Review

2.1. The Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) is a further development of the Theory of Reasoned Action (TRA) to predict an individual's intention to engage in a specific behavior [18]. The theory aims to explain the behavioral intention over which an individual has the ability to exert self-control. It claims that the individual's intention to perform a specific behavior is mainly influenced by three key elements—attitude, subjective norm, and perceived behavioral control—and an individual with strong intention is more likely to perform an actual behavior [19–21].

The TPB is an effective framework that has been widely applied in textiles and apparel-related topics, such as used apparel donation [16], luxury fashion consumption [22,23], second-hand apparel shopping behavior [19], willingness to buy environmentally friendly apparel [8,21], slow fashion consumption [3], and fashion collaborative consumption [24]. Chi et al. [8] proposed an extended TPB and revealed that attitude, subjective norm, perceived consumer effectiveness, and environmental knowledge significantly affected U.S. consumers' purchase intentions toward environmentally friendly apparel. Ganak et al. [16] identified that young U.S. consumers' attitude, subjective norm, and perceived behavior control drove their behavior toward donating used apparel. Chi et al. [3] reported that attitude, perceived behavioral control, willingness to pay, and perceived consumer effectiveness significantly affected U.S. consumers' willingness to buy slow fashion apparel. McCoy et al. [24] indicated that attitude, subject norm, perceived consumer effectiveness, past environmental behavior, and fashion leadership significantly influenced Gen Z consumers' intentions to use apparel rental services. The successful applications of TPB in prior studies have proved its versatility and applicability in the present research.

2.1.1. Attitude

Attitude is a crucial element in shaping consumers' purchase intentions. It is usually applied to interpret and project consumers' purchase intentions toward products or services, such as environmentally friendly apparel [8,21]. Eagly and Chaiken [25] defined attitude as a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor. Attitude has been proven to be one of the most influencing factors to have a positive connection with consumer sustainable consumption willingness and actual behaviors [3,8,24,26]. If a person expects to have a positive experience after purchasing a product or service, they are more likely to form a positive attitude toward the behavior that consequently leads to purchasing behavior [16,19,24].

Ganak et al. [16] stated that we can predict consumers' recycling behavior from their attitude and intention. The attitude toward sustainability not only affects consumers' purchase behavior but also influences companies' sustainable policy and decisions [27]. Sustainable actions should work on both sides of the trading relationship. The sustainability attitude of consumers and firms could potentially alter the trading environment to become more sustainable and healthier [8].

Attitude is influenced by a person's beliefs about the consequences of the behavior, their values, and past experiences with the behavior. A positive attitude toward sustainable products increases the likelihood of having a strong intent to purchase the products, while a negative attitude reduces it [3,8,21]. Chi et al. [3] stated that consumers with more

knowledge about slow fashion products and textile waste show a positive attitude and are consequently inclined to buy slow fashion products. McCoy et al. [24] indicated that attitude is the most influential factor in forming individuals' willingness to use the environmentally friendly services in the fashion industry. Thus, the following hypothesis was proposed.

H1: *U.S. consumers' attitude toward environmentally friendly apparel positively affects their purchase intention toward RCF-made apparel.*

2.1.2. Subjective Norm

Subjective norm refers to an individual's perception of what is considered to be acceptable or normative by significant others, such as friends, family, and peers [28]. Subjective norm is an external factor that could affect whether people are going to carry out a specific behavior [18]. The subjective norm can reveal how much consumers value others' perspectives in terms of sustainable shopping and how crucial it is to maintain a positive image outside of personal life [29].

People tend to search for a sense of belonging. They are motivated to understand and to follow the norms of groups that we belong to and care about [30]. The reason for people valuing social norms so much is because the way we react to those social regulations could affect the status and place in specific communities [31]. Prior studies found that subjective norm could be a great influencer of purchasing sustainable products but also an incentive for people against doing so under peer pressure [8,16,21].

Nowadays, everyone can be influential on social media by expressing their opinions, insights, experiences, and perspectives with others [32]. It is impossible to isolate ourselves from other people in the age of the internet. How to set a line between ourselves and others is an important issue in modern society. In the literature, there are more researchers supporting the correlation between attitude and intention of behavior than subjective norm and intention of behavior in the TPB model. Kumar [33] stated that there is a relatively weak connection between subjective norm and behavioral intention. McCoy et al. [24] also demonstrated that subjective norm accounts for a lower variance of consumer intention to use fashion rental services than attitude. As society and consumer lifestyle have been evolving quite significantly in recent decades, the way people interact with each other could be changing, so further research is necessary on the relation between subjective norm and behavioral intention. Thus, the following hypothesis was proposed.

H2: *Subjective norm positively affects U.S. consumers' purchase intention toward RCF-made apparel.*

2.1.3. Perceived Behavioral Control (PBC)

PBC is defined as one's perceived extent of how simple or challenging it is to engage in a behavior [34]. The concept indicates that people with resources and skills would increase their intention to perform specific actions [35]. Additionally, it is assumed to reflect the anticipated obstacles and past experiences [18]. Joshi and Rahman [36] identified that PBC positively affects consumers' green purchase behavior. Kostadinova [37] reported that attitude, subjective norm (SN), and perceived behavioral control (PBC) of the Theory of Planned Behavior are reliable predictors of purchase intention toward environmentally friendly products. Chi et al. [3] indicated that PBC should be investigated in any sustainability product or service adoption studies as perceived control over a behavior affects consumers' decision making. Therefore, we propose the following hypothesis.

H3: *Perceived behavioral control (PBC) positively affects U.S. consumers' intention to purchase RCF-made apparel.*

2.2. Extension of TPB: Perceived Consumer Effectiveness (PCE)

Perceived consumer effectiveness was first proposed by Kinnear, Taylor, and Ahmed [38], which can be broadly defined as the level of how consumers believe their efforts can improve or solve the social and environmental problems [39]. People perceiving higher consumer effectiveness on environmental protection show greater concern for environmental issues [21]. PCE is considered as the connection between environmental awareness and eco-conscious consumer behavior [39]. Vermeir and Verbeke [40] indicated that if consumers believe what they do has a certain positive influence on the ecosystem, they will be more likely to promote and purchase environmentally friendly products. Ganak et al. [16] reported that U.S. millennials who are confident about their positive impact on environmental protection are more inclined to recycle their used denim jeans. McCoy et al. [24] also demonstrated that consumers with a higher PCE show a higher likelihood to try fashion rental services instead of purchasing clothing. Therefore, the following hypothesis was proposed.

H4: *Perceived consumer effectiveness (PCE) positively affects U.S. consumers' purchase intention toward RCF-made apparel.*

2.3. Extension of TPB: Past Environmental Behavior (PEB)

Van der Werff, Steg, and Keizer [41] found that it is effective for increasing individual's environmentally friendly action by reminding them of their past pro-environmental behaviors. Consumers who have more knowledge on environmental issues and possible solutions are more likely to form environmentally friendly behaviors [21]. Thøgersen and Ölander [42] indicated that consumers' previous behavior in sustainable movement positively affects their future pro-environmental actions. Prior studies reported that consumers show a greater possibility to purchase eco-friendly products if they have conducted environmentally friendly actions in the past [8,24,41,43]. Hence, the following hypothesis was proposed.

H5: *Past environmental behavior (PEB) positively affects U.S. consumers' intention to purchase RCF-made apparel.*

Additionally, the relationship between attitudes and behavior is well established in the previous research [24,41,43]. Lauren, Smith, Louis, and Dean [44] concluded that people exhibiting sustainable behaviors are more likely to adapt their attitudes to correspond with these behaviors. According to Cervellon and Carey [45], purchasing eco-friendly products is the action where consumers express their concerns, while Lundblad and Davies [46] advocated that green consumption improves consumers' confidence on their contribution to environmental protection. Zheng and Chi [21] reported that the past environmental behavior of a consumer is a good predictor of their attitude toward green consumption. Chi et al. [3] also demonstrated the linkage between past environmental behavior and consumer attitude toward sustainable apparel consumption. Therefore, the following hypothesis was proposed.

H6: *Past environmental behavior (PEB) positively affects U.S. consumers' attitude toward RCF-made apparel.*

3. Proposed Research Model and Developed Survey Instrument

Based on the literature review above, a conceptual model including all the proposed relationships is illustrated in Figure 1. Attitude (AT), subjective norm (SN), perceived behavioral control (PBC), perceived consumer effectiveness (PCE), and past environmental behavior (EB) may affect U.S. consumers' intention to purchase regenerated cellulose fiber (RCF)-made apparel. In addition, past environmental behavior may affect consumer attitudes toward RCF-made apparel. The demographic variables including gender, age, income level, and education level are included as control factors.

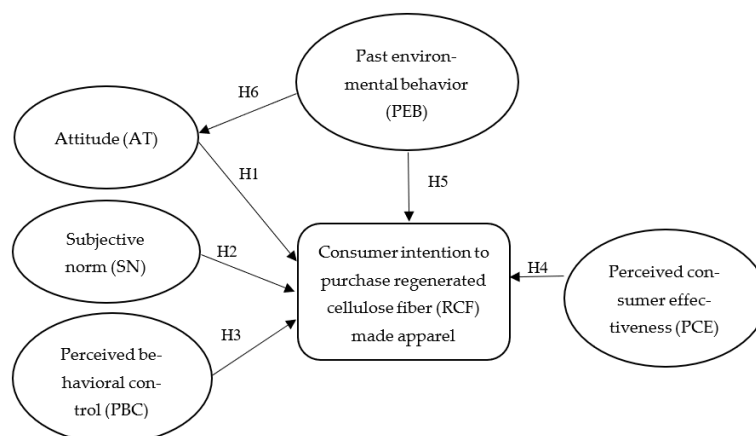


Figure 1. Proposed enhanced TPB model.

The scales for purchase intention (PI), attitude (AT), and subjective norm (SN) were adapted from Chi et al. [8]. The scales for perceived behavioral control (PBC) and perceived consumer effectiveness (PCE) were adapted from Zheng and Chi [21]. The scale for past environmental behavior (EB) was adapted from Fraj and Martinez [47]. Table 1 lists all the constructs and their corresponding measurement scales.

Table 1. Constructs and corresponding measurement scales.

Construct	Measurement and Scale	Source
Attitude (AT)	AT1: I like the idea of purchasing RCF made apparel. [0.914] AT2: RCF made apparel is a good idea. [0.887]	Chi et al. [8]
Subjective Norm (SN)	AT3: I have a favorable attitude towards purchasing RCF made apparel. [0.906] SN1: People important to me support my RCF made apparel purchase behavior. [0.801] SN2: People who influence me think that I should purchase RCF made apparel. [0.907] SN3: People whose opinions I value prefer that I should purchase RCF made apparel. [0.875]	Chi et al. [8]
Perceived Behavioral Control (PBC)	PBC1: Purchasing RCF made apparel is entirely within my control. [0.802] PBC2: I had the resources and ability to acquire RCF made apparel. [0.794] PBC3: I have complete control over the number of RCF made apparel I will buy for personal use. [0.816]	Zheng and Chi [21]
Perceived Consumer Effectiveness (PCE)	PCE1: By purchasing RCF made apparel, every consumer can have a positive effect on the environment. [0.887] PCE2: Every person has the power to influence environmental problems by purchasing RCF made apparel. [0.846] PCE3: It does not matter whether I purchase RCF made apparel or not since one person acting alone cannot make a difference. * [Dropped due to low factor loading]	Zheng and Chi [21]
Past Environmental Behavior (PEB)	PEB1: I guess I've never actually bought a product because it had a lower polluting effect. * [0.710] PEB2: I keep track of my congressman and senator's voting records on environment issues. [0.719] PEB3: I have contacted a community agency to find out what I can do about pollution. [0.766] PEB4: I make a special effort to buy products in recyclable containers. [0.722] PEB5: I have attended a meeting of an organization specifically concerned with bettering the environment. [0.805] PEB6: I have switched products for ecological reasons. [0.740] PEB7: I have never joined a clean-up drive. * [Dropped due to low factor loading] PEB8: I have never attended a meeting related to ecology. * [Dropped due to low factor loading] PEB9: I subscribe to ecological publications. [0.709]	Fraj and Martinez [47]
Purchase Intention (PI)	PI1: I intend to buy RCF made apparel because they have less negative environmental impact. [0.879] PI2: I will try to buy RCF made apparel in the future. [0.914] PI3: I will switch to environmentally friendly alternatives of apparel products. [0.881]	Chi et al. [8]

Note: Five-point Likert scale from "Strongly disagree = 1" to "Strongly agree = 5". *: Reversed measures. Numbers in the parentheses are the factor loadings to respective constructs.

4. Methodology

4.1. Data Collection

The primary data were collected through an online survey distributed through the professional survey platform Amazon Mechanical Turk (<https://www.Mturk.com>). Amazon Mechanical Turk provides for a wide range of consumers to partake in studies, with high reliability [8,21,48]. Online surveys provide many benefits compared to traditional surveys including low cost, quick response, more diverse samples, and easy data access [49,50].

The profile of survey respondents is presented in Table 2. A total of 544 eligible responses were received and used for data analysis. Of the 544 respondents, 48% were female and 52% were male. The ages of the respondents varied from 18 years old to over 65 years old, mainly distributing (79%) in the range from 18 to 44 years old. Most of the respondents had some college education, associate's degree, or bachelor's degree (80%), followed by high school (10%), master's degree (8%), and doctorate (2%). In terms of ethnicity, the majority of the respondents were White, Caucasian at 67%, followed by African American/Black at 10%, Hispanic and Latino at 10%, Asian and Pacific Islander at 9%, Native American at 2%, and others at 2%. The respondents' reported personal pre-tax annual income indicated 18% at less than USD 25,000 to more than USD 200,000 at 1%. The remaining reported incomes from USD 25,000 to 34,999 were at 18%, USD 35,000 to 49,999 at 20%, USD 50,000 to 74,999 at 22%, USD 75,000 to 99,999 at 11%, USD 35,000 to 49,999 at 19.4%, USD 50,000 to 74,999 at 24%, USD 75,000 to 99,999 at 11%, USD 100,000 to 149,999 at 7%, and USD 150,000 to 199,999 at 3%. With regard to annual total expenditure on apparel, 27% of the respondents indicated that they spent between USD 100 and 299, followed by 24% at USD 300–499, followed by 16% at USD 500–699, 10% at USD 0–99, 8% at USD 900–1099, 8% at USD 1000 to 1499, 3% at USD 1500–1999, and 3% at USD 2000 or more.

Table 2. Profile the survey respondents.

	Percentage		Percentage
Gender		Education level	
Male	52%	High school diploma	10%
Female	48%	Some college, no degree	24%
Age		Associate's degree	14%
18–24	10%	Bachelor's degree	42%
25–34	36%	Master's degree	8%
35–44	33%	Doctoral degree	2%
45–54	14%	Annual household income	
55–64	6%	Less than USD 25,000	18%
65 and up	1%	USD 25,000 to 34,999	18%
Annual expenditure on apparel		USD 35,000 to 49,999	20%
USD 0–99	10%	USD 50,000 to 74,999	22%
USD 100–299	27%	USD 75,000 to 99,999	11%
USD 300–499	25%	USD 100,000 to 149,999	7%
USD 500–699	16%	USD 150,000 to 199,999	3%
USD 700–999	8%	USD 200,000 or more	1%
USD 1000–1499	8%	Ethnicity	
USD 1500–1999	3%	White, Caucasian	67%
USD 2000 and more	3%	African American, Black	10%
		Hispanic, Latino	10%
		Asian, Pacific islanders	9%
		Native American	2%
		Others	2%

Note: 544 eligible responses.

4.2. Statistical Analysis

Common method bias was checked by performing Harman's one-factor test using SPSS 29 software. The results show that the one-factor solution only explained 28.5% of the variation, falling far short of the 50% threshold [51].

Table 3 presents correlations and psychometric properties of all the constructs. The skewness and kurtosis scores of all the constructs were between +2.0 and −2.0, which demonstrate that there were no violations of the normality assumption [52]. All VIF values were below 5.0, suggesting that there were no multicollinearity issues among the investigated constructs.

Table 3. Correlations and psychometric properties of all constructs.

	AT	SN	PBC	PCE	PEB	PI
AT	1	0.357 **	0.264 **	0.593 **	0.298 **	0.616 **
SN	0.127	1	0.129 **	0.261 **	0.369 **	0.426 **
PBC	0.070	0.017	1	0.348 **	0.025	0.247 **
PCE	0.352	0.068	0.121	1	0.166 **	0.563 **
PEB	0.089	0.136	0.001	0.028	1	0.420 **
PI	0.379	0.181	0.061	0.317	0.176	1
Mean	4	3	4	4	3	4
S.D.	0.7	0.9	0.8	0.9	0.9	0.9
VIF	3.261	1.939	2.075	2.647	1.405	3.556
Cronbach's alpha	0.885	0.827	0.726	0.757	0.781	0.871
Construct reliability	0.929	0.897	0.846	0.858	0.883	0.921
AVE	0.814	0.743	0.646	0.751	0.556	0.795
χ^2 test <i>p</i> value	0.112	0.087	0.093	0.135	0.080	0.158
Skewness	−0.54	−0.07	−0.59	−0.46	−0.08	−0.73
Kurtosis	0.65	−0.24	0.60	0.17	−0.42	0.57

Note: The italic numbers are the squared corresponding correlations. **: correlation is significant at the 0.01 level (2-tailed). PI = Purchase intention; AT = Attitude; SN = Subjective norm; PBC = Perceived behavioral control; PCE = perceived consumer effectiveness; PEB = Past environmental behavior.

The unidimensionality, reliability, and validity (discriminate validity and convergent validity) of investigated constructs were all examined [53,54]. After exploratory factor analysis, the measurement variables labeled as PCE3, PEB7, and PEB8 dropped due to low factor loading (see Table 2). All the factor loadings of the remaining measurement items to their respective constructs were above 0.7 and statistically significant, while their loadings to other constructs were below 0.3 (see Table 2) [52,55]. This also proves unidimensionality for the constructs. In addition, the χ^2 test's *p* values of all the constructs were insignificant, which also support the evidence of unidimensionality. Cronbach's alphas of all the constructs were above 0.7, while construct reliability scores of all the constructs were greater than 0.8, indicating that reliability was rigorously met [56]. The average variance extracted (AVE) scores for all the constructs were above the desired threshold of 0.5, suggesting convergent validity. All AVE scores were greater than the squared corresponding correlations, which demonstrate satisfactory discriminant validity [57].

4.3. Hypothesis Testing Results and Discussion

Once the adequacies of all the constructs were demonstrated, the proposed hypotheses were tested using the multiple regression technique. A single score was calculated for each construct by averaging across the measurement items as the unidimensionality of each construct was proven [58–60]. Table 4 presents the results of all the hypotheses testing. Among six hypotheses, four of them (H1, H4, H5, and H6) were statically significant at the $p < 0.05$ level. H2 and H3 were found to be insignificant.

Specifically, U.S. consumers' attitude toward environmentally friendly apparel positively affects their purchase intention for RCF-made apparel ($\beta = 0.307$, $t = 5.892$), supporting H1. U.S. consumers who perceive the consumption of environmentally friendly apparel as a way of environmental protection are more likely to purchase RCF-made apparel. This finding meshes with previous findings on the relationship between consumers' attitude and purchase intention toward environmentally friendly products from Chi et al. [8], Zheng and Chi [21], and Nam et al. [29]. However, subjective norm (SN) does not significantly influence U.S. consumers' purchase intention toward RCF-made apparel ($\beta = 0.052$,

$t = 0.323$), not supporting H2. This indicates that significant others' opinions do not decide U.S. consumers' willingness to buy RCF-made apparel. This seems to support the notion that consumers are willing to hear others' opinions but make their own decisions [33,39]. Similarly, perceived behavioral control (PBC) does not significantly affect U.S. consumers' intent to purchase RCF-made apparel ($\beta = 0.054$, $t = 0.321$), not supporting H3. This reveals that having the resources and ability to acquire environmentally friendly apparel is not a major concern for U.S. consumers to purchase RCF-made apparel. In contrast, perceived consumer effectiveness (PCE) significantly affects U.S. consumers' purchase intention toward RCF-made apparel ($\beta = 0.309$, $t = 2.478$), supporting H4. This finding is aligned with the previous studies that have reported individuals' belief of their positive behavioral impact on the environmental protection as one of most influential predictors for consumers' purchase and consumption of green products [8,39,61].

Table 4. Results of hypothesis testing.

Hyp.	DV	IDV	Std. Coef. (β)	t-Value	Sig. at $p < 0.05$	Control Variable	Std. Coef. (β)	t-Value	Sig. at $p < 0.05$	R ²	Sig. at $p < 0.05$
H1	Y	PI	Cost.	−0.975	0.338	Age	−0.011	−0.092	0.927	0.648	<0.000
H2	N		AT	0.307	5.892	Gender	−0.060	−0.423	0.676		F= 5.318
H3	N		SN	0.052	0.323	Education	0.215	2.096	0.003		(9/26)
H4	Y		PBC	0.054	0.321	Income	0.234	2.152	0.002		
H5	Y		PCE	0.280	2.478						
			PEB	0.360	2.608						
H6	Y	AT	Cont.	1.288	0.208	Age	0.048	.271	0.788	0.276	<0.000
			PEB	0.385	3.338	Gender	0.188	1.045	0.304		F= 3.766
						Education	0.249	2.789	0.001		(5/30)
						Income	0.296	3.038	0.001		

Note: Y = Hypothesis supported; N = Hypothesis not supported; Std. Coef. = Standardized Coefficients; DV = Dependent variable; IDV = Independent variable; PI = Purchase intention; AT = Attitude; SN = Subjective norms; PBC = Perceived behavioral control; PCE = perceived consumer effectiveness; PEB = Past environmental behavior.

Past environmental behavior (PEB) shows a significantly direct impact on U.S. consumers' intention to purchase RCF-made apparel ($\beta = 0.360$, $t = 2.608$) while also positively affecting U.S. consumers' attitude toward environmentally friendly apparel ($\beta = 0.385$, $t = 3.338$). Thus, both H5 and H6 are supported. Attitude plays a partial mediating role between past environmental behavior (PEB) and purchase intention toward RCF-made apparel. A higher level of consumer environmental behavior leads to a more positive attitude toward environmentally friendly apparel as well as a greater likelihood to purchase RCF-made apparel. As Chi et al. [3] indicated, the lifestyle shift toward more environmentalism among U.S. consumers, particularly young consumers, helps continuously grow the sustainable product market.

Figure 2 illustrates the identified relationships in the proposed research model. Attitude, perceived consumer effectiveness (PCE), and past environmental behavior (PEB) positively affect U.S. consumers' purchase intention toward RCF-made apparel, while the effects of subjective norm (SN) and perceived behavior control (PBC) are insignificant. Past environmental behavior (PEB) also positively affects the attitude of U.S. consumers toward RCF-made apparel. Among the demographic variables, both education level and income level positively affect U.S. consumers' attitude and purchase intention toward RCF-made apparel. U.S. consumers with higher education level and higher income level show a more positive attitude toward RCF-made apparel and are more likely to make a purchase. The proposed research model exhibits a good explanatory power, accounting for 64.8% of the variance in U.S. consumers' purchase intention toward RCF-made apparel.

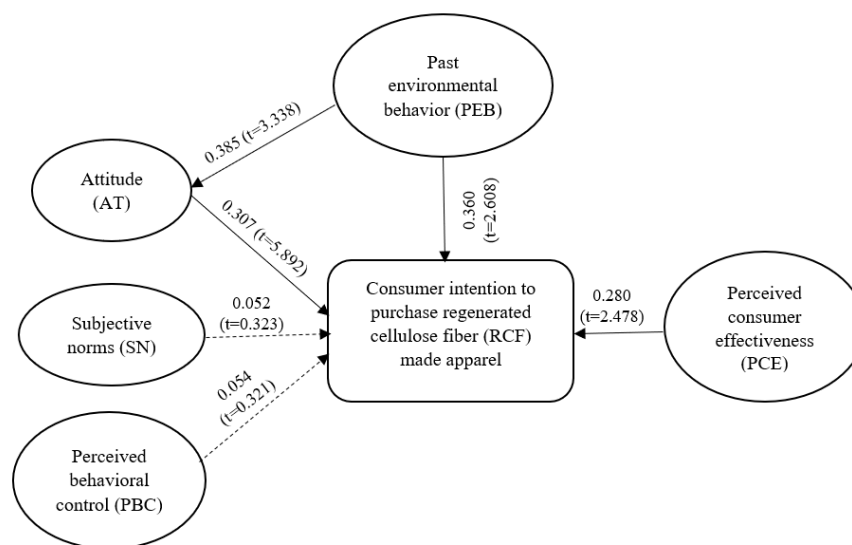


Figure 2. Identified relationships in the proposed model.

5. Conclusions and Implications

In recent years, the trend toward sustainable development in the textile and apparel industry has become prominent [3]. Brands and retailers are offering more environmentally friendly alternatives to meet the growing needs of consumers. More consumers are demanding genuine products that can scale-up the sustainability efforts and truly address the pressing issues caused by environmental deterioration [44].

This study attempts to expand the knowledge on the key factors influencing U.S. consumers' purchase intention toward RCF-made apparel, which is considered an effective solution to the ever-increasing textile waste. Overall, this study contributes to the existing literature in five ways. First, the study further develops the theory of planned behavior (TPB) through the inclusion of additional relevant constructs (i.e., perceived consumer effectiveness and past environmental behavior) to help understand the consumer purchase intention toward environmentally friendly products. The proposed enhanced TPB model shows a good explanatory power, collectively accounting for 64.8% of the variance in U.S. consumers' purchase intention toward RCF-made apparel. Second, the mediating effect played by attitude to purchase intention is demonstrated. Attitude plays a partial mediating role between consumers' past environmental behavior and their intention to purchase RCF-made apparel. Consumers who have conducted certain environmental behaviors are more likely to show a positive attitude and consequently a greater willingness to buy environmentally friendly products. Third, the proposed model shows sound and stable psychometric properties, and the statistical criteria are all well met. Therefore, the research model may be applied to investigate consumers' purchase intention toward other sustainable products or services. Fourth, although there are no statistically significant differences between ages and genders with regard to consumers' intention to purchase RCF-made apparel, U.S. consumers with higher education level and higher income level show a more positive attitude toward RCF-made apparel and are more willing to make a purchase. Finally, the enhanced TPB model provides new insights to the understanding of the motivations of U.S. consumers to purchase RCF-made apparel. Particularly, the perception of the impact of consumers' consumption on the environment has a direct influence on their willingness to buy environmentally friendly products. When more consumers realize the linkage between their actions and environmental protection, their willingness to make concrete efforts to address environmental issues become more evident.

Due to the rise in environmental awareness among U.S. consumers, an increasing number of fashion brands and companies have redesigned their business model to respond to the market movement toward sustainable development. More environmentally friendly products and services are becoming available to consumers. Green marketing and

promotion are prevailing. However, it is not necessary for all the companies diving into this trend to gain more profit or grow their market share. The reality could often be the opposite. It is critical for brands and companies to truly understand consumers' perspective on sustainable initiatives and their genuine demand on environmentally friendly products. There are certain types of consumers who are the major buyers of environmentally friendly products. The education, knowledge on environmental issues, and willingness to take actions to protect the environment make consumers embrace sustainable consumption and support the market growth of environmentally friendly products. Some environmentally friendly products do require a price premium. Therefore, consumers with a higher income level tend to be the target customers. With the accelerating consumer environmentalism in the U.S., brands and companies that can prove their products as a solution to environmental problems (e.g., RCF-made apparel to reduce textile waste) will attract consumers and win the market.

6. Limitations and Future Studies

Although this study sheds light on the key determinants of U.S. consumers' purchase intention toward RCF-made apparel, it still has some limitations that provide opportunities for future research. First, the findings of the study were limited to RCF-made apparel. Hence, the generalization of the findings to other environmentally friendly products requires further validation. Second, a quantitative research method was applied in this study. Although the quantitative approach enables examination of the casual relationships between independent factors and consumers' intention to purchase RCF-made apparel, it is considered weak in discovering the underlying reasons to the phenomenon. Some qualitative methods such as grounded theory or a case study can be applied in future studies to reveal more detailed reasonings about the relationships identified in the quantitative analysis. Finally, this study was focused on U.S. consumers. Future research could include cross-country comparison.

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