Exploring Fashion Hair Dyeing Behavior through the Stimulus-Response Model: The Mediating Effects of Professional Technology and Transaction Interaction

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted to explore hair dyeing behaviors among Taiwanese adolescents; analyze future market trends for fashion hair dyes; investigate the effects of social media, fashion trends, and product awareness on behavioral intentions; identify the mediating effects of professional technology and transaction interactions on behavioral intentions; and validate the overall fit of a

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model outlining the interrelationships between the aforementioned factors.This study was conducted in general and vocational schools across northern, central, and southern Taiwan. Students were surveyed between February 7, 2023, and July 21, 2023.

Drawing inspiration from the Stimulus-Organism-Response theory, we constructed a comprehensive model incorporating six dimensions—social media, fashion trends, product awareness, transaction interaction, professional technology, and behavioral intention. The survey gathered 370 valid responses, primarily from female students in technical senior high schools. Students' responses on a 32-item questionnaire were rated on a 5-point Likert scale. Reliability analysis, partial least squares structural equation modeling, and validity analysis were performed to assess the study model.Our findings revealed a high reliability and a good fit in structural equation modeling. Validity analysis confirmed convergent and discriminant validity. Bootstrapping revealed substantial differences between ordinary and technical high schools in hair dyeing behaviors. Professional technology mediated the correlation between fashion trends and behavioral intentions and that between product awareness and behavioral intentions.This study advances our theoretical understanding and offers valuable practical insights for businesses in the hair care industry. The application of the Stimulus-Organism-Response theory revealed adolescents' complex hair dyeing behaviors. The observed model fit indicates the relevance of this framework in explaining the multifaceted dynamics of consumer decision-making. Regarding practical benefits, this study guides businesses toward natural hair dyes aligned with consumers' health and environmental preferences.

1. INTRODUCTION

With the changing trends in socioeconomic development, the disposable income of individuals continues to increase. People have higher expectations for pursuing fashion aesthetics, and hair dyeing has become a part of achieving the perfect fashionable image. However, the use of synthetic hair dyes during the dyeing process can have different effects on hair awareness and skin due to variations in their ingredients. As a type of hair cosmetic, hair dye products have gained popularity, especially among young people, leading to a continuous increase in sales. Since the 20th century, the development of organic hair dyes has driven the fashion trends of hair dyeing, and it has been widely accepted by consumers in the 21st century. There is now a wide variety of one-time dye products available in the market. However, the potential harm caused by long-term use of hair dyes has become a concern for consumers. This study aims to delve into the issue of hair dye consumption behavior among Taiwanese adolescents. Consumer awareness on social media, product awareness based on fashion trends, and adopting new thinking patterns are important factors to consider when purchasing hair dye products. It is recommended that consumers choose products that cause minimal harm to the environment. The awareness of products and environmental improvement have become a global focus of attention.

Given the global climate change and the awakening of environmental consciousness among consumers, chemical hair dyes often incorporate ingredients such as p-phenylenediamine (PPD), which can cause allergic reactions to the skin. Chemical hair dyes are widely used by the general public due to their low cost, diverse color options, and fast coloring speed. In recent years, with the improvement of cosmetic hygiene and safety standards and the increasing concern for consumers and environmental protection, the use of natural plant-based ingredients in hair dyes has gradually emerged in hair salons. Despite being relatively expensive, these options are still popular among the majority of consumers. The use of healthy and safe hair dyes has become an important topic in the future hair care market trends.

The motivation behind this study aligns with the eco-friendly aesthetics of hair dyeing. By exploring consumer experiences, it aims to delve into the values associated with the pursuit of hair dyeing aesthetics. Hair dye is a type of cosmetic product used to change natural hair color. According to historical records, as early as ancient Egypt, plant-based hair dyes were used. Henna, extracted from the roots and leaves of

the Henna plant, was used as a red-brown hair dye. In ancient China, people used flowers, leaves, roots, and stems of plants to achieve different hair colors. Currently, chemical hair dyes dominate the hair care market. The question is how to guide consumers to choose environmentally friendly products and reduce their impact on the environment when purchasing hair dyes. Green consumption seeks to maintain health while pursuing fashion hairstyles and achieving the beautification of appearance. It is the responsibility and business ethics that hair care professionals cannot overlook. This study focuses on consumer perception of hair dyes and explores whether social media, fashion trends, and product awareness influence consumer behavioral intentions. By collecting relevant information and conducting quantitative analysis, this study can contribute to the hair dye market, provide effective marketing strategies for hair care companies, and offer recommendations based on research findings. The objectives of the research are as follows:

1. Understand the hair dye consumption demands and the future development of the hair dye market among typical high school students and vocational high school students.
2. Investigate the influence of social media, fashion trends, and product awareness on behavioral intentions.
3. Examine the mediating effects of professional technology and transaction interactions on behavioral intentions.
4. Validate the overall model fit of the interrelationship between social media, fashion trends, product awareness, transaction interactions, professional technology, and behavioral intentions.

2. LITERATURE REVIEW

Nowadays, there is a wide variety of hair dyes available in the market, categorized based on their chemical composition as semi-permanent, temporary, and permanent hair dyes. Hair dyes are classified as medicinal cosmetics and require approval from the health authority before being marketed. The packaging should include relevant information such as the license number, indicating that it is a qualified product. In recent years, there has been an increasing emphasis on environmental and health consciousness, leading to the popularity of natural hair dyes within the category of permanent hair dyes. Most natural hair dyes are made from extracts of herbs such

as rosemary, chamomile, and henna. They easily bind to the hair's protein composition, achieving the desired color.

2.1 Stimulus-Organism-Response Model

The Stimulus-Organism-Response (S-O-R) model, developed from environmental psychology by Mehrabian & Russell [1], explains how environmental stimuli such as product perception and social media elicit emotional responses including arousal, dominance, and pleasure, which ultimately influence consumers' behavioral decision-making. Arousal refers to the excitement consumers experience during the shopping process, while pleasure indicates their feelings of happiness and satisfaction. Dominance refers to the control and freedom consumers have during the purchasing process [2]. Fei et al. [3] defined the S-O-R framework as interactive text, informational conformity (stimulus), endogenous attention, exogenous attention (organism), and purchase intention (response). This framework effectively captures the consumer's online shopping experience and business model, facilitated by innovative real-time social interaction between influencers and audiences.

2.2 Social Media

Through social media, entrepreneurs can effectively establish a positive relationship with consumers [4]. Social media provides a platform for close and friendly relationships with customers, allowing fans to connect and interact with each other. This helps build emotional connections between customers and sellers, turning customers into fans and achieving a transactional relationship [4]. Kim and Ko [5] stated that the marketing aspects of social media, including interactivity, trendiness, and purchase intention, have significant effects on luxury brand marketing. Wu, Yang, and Chou [6] pointed out that teenage internet addiction stems from psychological factors, as teenagers seek self-identity and values, and social media platforms conveniently provide a means to gain self-worth. Social media allows sharing of images, texts, videos, and communication through platforms like LINE. Major brands and businesses collaborate to increase exposure, enhance brand awareness, and engage in product sales. The interaction between social media software and sellers creates economic value in the market [7]. A study conducted in an eastern university in India with 360 college

students found that collaborative learning through social media had a positive and significant impact on teacher-student interaction, peer collaboration, and online knowledge sharing behavior [8]. Myrick & Zeitany's [9] research revealed that the preference for indoor tanning habits among women increased the incidence of skin cancer. In their study focusing on adolescents in the southeastern United States, they also found that the use of social media decreased the intention to engage in tanning behaviors. In the business sector, transaction interaction between enterprises and customers through social media includes unidirectional interaction, bidirectional interaction, and collaborative interaction. Unidirectional interaction refers to businesses conveying messages or content to customers through social media, such as one-way advertising campaigns. Bidirectional interaction allows customers to respond, comment, or share feedback on the messages from the enterprise, fostering two-way communication and interaction. Collaborative interaction involves joint efforts between the enterprise and customers in participating in activities or creating content, enhancing mutual engagement. Through these forms of interaction, businesses can establish trust relationships with customers, thereby improving the effectiveness of marketing strategies, leading to a competitive advantage and outstanding performance [10].

In this study, it is hypothesized that teenagers often use social media to gain knowledge about hair dyeing trends. Promotional activities on e-commerce platforms have a significant impact on consumers' impulse purchases due to usability and information interactivity [11]. This study aims to explore whether social media plays a mediating role between transaction interaction and behavioral intentions, and proposes the following hypotheses:

H1: Social media has a positive and significant impact on behavioral intentions.
H2: Social media has a positive and significant impact on transaction interaction.

2.3 Fashion Trends

Lin [12] pointed out that the so-called aesthetic experience is a highly free experience for humans. Aesthetics can be freely generated among isolated objects, creating a transcendent beauty. Psychologist Maslow's "Hierarchy of Needs" theory was initially proposed in 1954 with five levels, and after 16 years of academic

research and experimental verification, it was expanded to seven levels in 1970. It represents the highest level of spiritual realization, where all ideals and needs of an individual can be fulfilled [13]. The global fashion market continues to experience growing demand, and the fashion industry has successfully captured consumer interest through recommendation systems. These systems not only provide information on consumer transaction interactions but also incorporate feedback mechanisms, allowing design schemes to be repeatedly evaluated and adjusted to meet the expectations of designers [14]. Consumers now primarily utilize Instagram to search for fashion trends in hairstyles. Research indicates that when hairstyling content exhibits more authenticity and intimacy, consumers' behavioral intentions also rise accordingly [15]. Hair dye design, combined with color coordination, involves the interaction of artistic perception and appreciation, allowing for aesthetic appreciation and sharing.

The 21st century is the era of aesthetic creation. Under the global trend of globalization, fashion trends become competitive, and consumers' aesthetic literacy is improving. The socio-economic development trend increases consumers' expectations and aesthetic levels, with particular attention given to hairstyle design. Hairstyle design is a tool to convey aesthetics. In an era where one's appearance and image represent their personal value, hairstyle design is considered an important factor in representing one's identity, as it can create diverse images and emphasize aesthetics [16,17]. Consumer choice of hairstyling comes from personal needs, individual conditions, and the dimension of fashion trends. Through business operations, service processes, and technology, interactions with consumers contribute to service awareness, emphasizing professional technology, creating industry value, and enhancing market competitiveness [2]. The trend of transparent hair has been on the rise in Japan, becoming a momentary sensation in hair color fashion trends and a focal point in the fashion industry. Interestingly, there are significantly different perspectives on hair transparency between professional stylists and consumers. In the Japanese hair dye market, there is a widespread preference for transparency, and this trend is further quantified through the perceptions of Japanese/Chinese professional stylists using mathematical models. This not only decodes the mystery behind transparent hair but also elucidates the trend. The study paves the way for

developing new shades, aiming to better meet consumers' demands for hair color. This marks an important step for the fashion industry in facing new challenges [18].

H3: Fashion trends has a positive and significant impact on transaction interaction.
H4: Fashion trends has a positive and significant impact on behavioral intentions.
H5: Fashion trends has a positive and significant impact on professional technology.

2.4 Product Awareness

Zhou et al. [19] mentioned that with the advancement of location-based product technology, the clarity of GPS sports watch market positioning is related to the maturity of product technology development. Consumers' perception of GPS sports watch product attributes has a significant positive impact on repurchase intention. From the consumer's perspective, hair dye products continue to innovate in technology, and the drive of various factors of consumers has made green consumption a global trend, verified by the SNQ awareness label. Green products are also environmentally friendly. Currently, Taiwan is actively promoting the awareness label verification system and qualified mark to protect the consumers' purchasing power. Consumer behavior is shifting towards buying high-awareness products with safe ingredients. Lin & Hua [20] mentioned that roasted coffee has a unique and strong personal style, emphasizing high product awareness and freshness. The study found that consumers' perception of coffee products has a significant positive impact on purchase intention.

H6: Product awareness has a significant positive impact on professional technology.
H7: Product awareness has a significant negative impact on behavioral intention.

2.5 Transaction Interaction

Consumer interactive behaviors can create a significant effect of word-of-mouth promotion [21]. The interaction between consumers and brands is no longer just about purchasing, but about consumer participation in activities and deriving benefits from it. Companies must focus on building mutual relationships with customers and promoting interaction between consumers and the company [22]. Social media has created a new learning environment where students can explore and engage in interactive learning through videos, editing, and sharing courses [23]. With the continuous advancement of technology applications, consumers heavily rely on internet search and retrieval, stimulating the development of interactive video retrieval methods. Advanced video retrieval methods have made progress in content analysis, enabling consumers to benefit from it [24].

The web has become a global trend, and consumers should understand the emerging trends of web search because web search engines have a tremendous impact on online information and services. Research has found that web search engines interact with consumers [25]. In 2019, the total transaction volume of Taobao Live exceeded 200 billion yuan. Considering the rapid development of live streaming, information systems interact with consumers through audience curiosity and comment tendencies, successfully generating consumer behavioral intentions [3]. Consumers' perceived product reality, product selectivity, and transaction interaction have a significant positive impact on online shopping platforms [26].

H8: Transaction interaction has a significant positive impact on behavioral intention.

2.6 Professional Technology

Zhang & Li [27] pointed out that using the Technology Acceptance Model (TAM3), teachers' online teaching behavioral intentions showed a significant positive relationship with the perceived usefulness and perceived ease of use of the system. Therefore, it is necessary to improve the teaching environment, actively enhance the awareness of internet broadband, and enhance teachers' professional technology to cultivate their online teaching technology. Lü et al. [28] mentioned that through professional technology training, companies can effectively improve their marketing strategies to cater to market demands. Professional technology include techniques such as hair straightening, haircutting, and hair dying. Utilizing online tutorials with professional knowledge, hiring professional technical talents to record educational videos and interact through online live streaming, and maintaining good interaction and after-sales service with consumers can enhance the professionalism and competitiveness of hair designers. The core dimensions of professional hairdressing include basic technical courses, application technical courses, professional theory courses, and

conceptual courses [29]. Consumers consult with designers with professional technology for advice and make choices for their personal image [2].

H9: Professional technology have a significant positive impact on behavioral intention.

2.7 Behavioral Intention

Ajzen [30] proposed that behavioral intention is influenced by consumers' attitudes, perceptions, subjective norms, and perceived behavioral control towards a behavior. Behavioral intention leads to actual behavioral change, indicating people's willingness to try a certain behavior with high expectations. Heskett & Schlesinger [31] mentioned that consumer behavior has three dimensions: retention rate of service satisfaction, product continuation rate, and sharing rate. Grewal et al. [32] pointed out that consumers' behavioral intention involves evaluating product awareness and generating future consumption behaviors such as willingness to share with friends and family, repurchase, and recommendation. In this study, we explore the relationship between social media, fashion trends, product awareness, and behavioral intention, which may differ from transaction interaction and professional technology dimensions, in hopes of obtaining some new insights. Chiou et al. [33] believe that consumer

satisfaction with services, product awareness, and social reference contribute to increased willingness to recommend and repurchase behavior.

3. METHODS

3.1 Research Model

Based on the literature review, this study designs a research model with six dimensions, including "social media," " fashion trends," "product awareness," "transaction interaction," "professional technology," and "behavioral intention." In line with the Stimulus-Organism-Response (SOR) theory proposed by Mehrabian & Russell [1], this study aims to explore the impact of these dimension variables on consumers' behavioral intention when engaging in hair dye consumption behavior. Social media, fashion trends, and product awareness serve as stimuli for consumers, while transaction interaction and professional technology represent the organisms' response. Behavioral intention represents consumers' willingness to consume. Therefore, this study considers transaction interaction and professional technology as mediating variables and integrates them into the research framework, as shown in the diagram below:
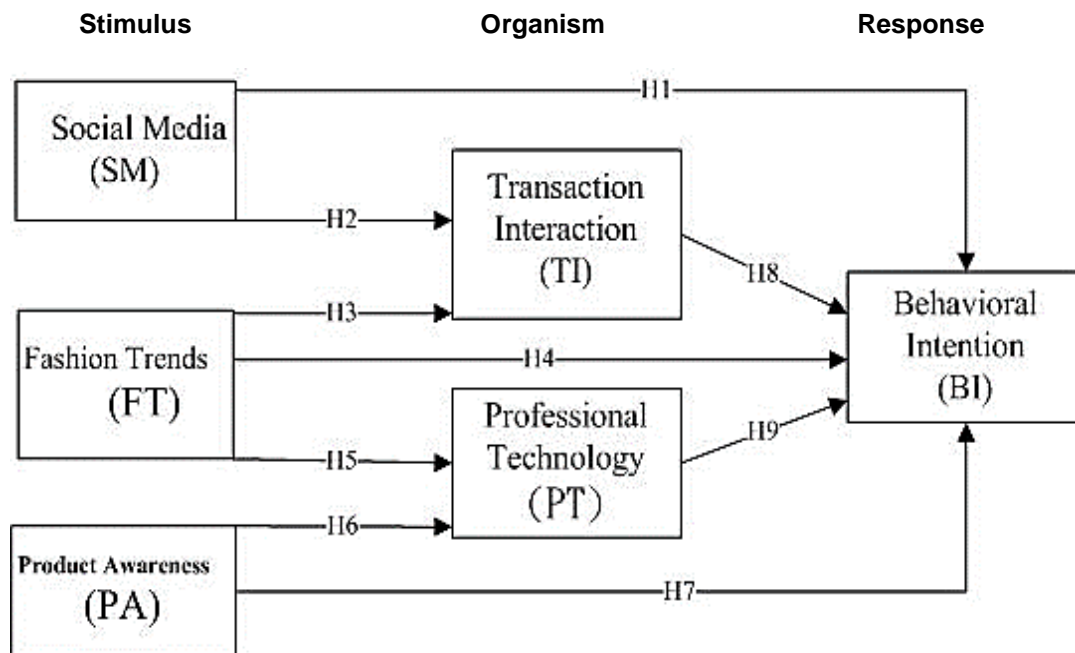
Fig. 1. Research Model of the Present Study
Source: Compiled by the present study

3.2 Definition and Measurement of Variables in the Present Study

Table 1. Definition and measurement of variables

Research aspect	Operational definition/measurement items	Reference scholars
SM	Social media allows me to experience the value of hair dye products, provides a platform for communication, and helps me make purchasing decisions. SM1. Social media provides information about hair dye products. SM2. Social media teaches me how to use hair dye products. SM3. Social media allows me to understand the value of hair dye products. SM4. Social media helps me make purchasing decisions. SM5. Social media provides a platform for exchanging information about hair dye products.	Stephen & Toubia, [7] Huang, Jinghua, Jin Yue, & Zhang Jing [34]
FT	By interacting with customers, providing detailed product information, and being willing to engage with customers online, businesses can effectively understand product messages and meet the demands of hair dye trends through social media platforms and online stores. FT 1. I dye my hair to show my unique beauty and personality. FT 2. I am willing to try popular hair colors every year. FT 3. I dye my hair for convenience in matching fashion and pursuing a sense of style. FT 4. Dyeing my hair can make my features look more three-dimensional and have an anti-aging effect visually. FT 5. Fashion hair dye is an important part of my life. FT 6. I am confident in my ability to judge fashion trends.	Lee [16]；Seo [17] Weber, S., & Weber, O. [35]
PA	Consumers choose hair dye products that emphasize environmental friendliness and health. Attractive hair dyes with certification labels should meet the principles of "safety" and "health". PA1. I would choose environmentally friendly hair dye products because of their appeal. PA 2. I would choose hair dyes with quality certification labels. PA 3. I believe that purchasing green and environmentally friendly products is friendly to the environment. PA 4. I would choose trustworthy products. PA 5. Hair dye should adhere to the principles of "safety and health." PA 6. I believe that products approved by hygiene management regulations can protect consumer rights.	Lin, Xiuyi [36]
TI	By interacting with customers, providing detailed product information, and being willing to engage with customers online, businesses can effectively understand product messages and meet the demands of hair dye trends through social media platforms and online stores.	Geng, Qingrui [37]

	TI1. I often browse websites for hair dye products to better understand the products. TI 2. I often browse websites for trendy information to match my personal style. TI 3. I often interact and exchange information on shopping websites to gain detailed information. TI 4. I often interact with influencers online, which effectively helps me understand information. TI 5. I change my consumer behavior by browsing hair dye information on Instagram.	
PT	Consumers choose trustworthy and service-oriented designers and are open to the suggestions of designers to achieve the desired hairstyle. PT1. I would choose a trustworthy and service-oriented hairdresser. PT 2. I would choose a hairdresser with professional skills. PT 3. Through cooperation with the hairdresser, I can achieve the perfect look. PT 4. I would choose a hairdresser with more experience in hair dyeing. PT 5. By interacting with the hairdresser, I can get the hairstyle I want.	Xiong Jie & Sun Daoyin [38] Chen Juhong et al. [39]
BI	Behavioral intention is driven by overall satisfaction with the awareness evaluation, leading to a willingness to continue consumption, share recommendations with friends, and be open to trying new products and service awareness. BI1. I would recommend that my friends consume hair dye products. BI 2. I pay attention to the quality of hair dye products and excellent service when consuming. BI 3. I am willing to try new products and thoughtful services. BI 4. I like to purchase hair dye products through websites. BI 5. I will continue to purchase hair dye products through websites.	Deng Xinming et al. [51]

Source: Compiled by the present study

4. RESULTS AND DISCUSSION

4.1 Description of Sample Structure

This study focuses on the consumer behavior of teenagers towards hair dye products. Relevant literature was reviewed and summarized, and scholars and experts were invited to provide feedback for refinement and revisions. A Likert five-point scale was used to measure the research questionnaire. The questionnaire was divided into two parts: the first part collected basic information, and the second part investigated the hair dye consumption habits of teenagers. This second part included six dimensions: social media, fashion trends, product awareness, transactional interactions, professional technology, and behavioral intentions. There were a total of 32 items, and respondents were asked to rate their agreement on a scale from "strongly agree" to "strongly disagree", with scores of 5, 4, 3, 2, and 1, respectively. The questionnaire was distributed online, and a total of 370 valid responses were collected. SPSS 25 was used for data analysis and processing, including factor analysis and reliability analysis to assess the internal consistency and validity of the questionnaire. The Cronbach's alpha coefficient for all factors was found to be above 0.7.

The sample survey was conducted in schools located in the northern, central, and southern regions. With the assistance of teachers and students, the questionnaire was distributed to both vocational high schools and general high schools. The survey will be distributed from February 7th, 2023 to July 21st, 2023, with a duration of approximately 6 months for respondents to complete. The study obtained valid questionnaires for the analysis of demographic variables. Among the participants, 21.1% were males and 78.9% were females. Furthermore, 27.8% attended regular senior high schools, while 72.2% attended technical senior high schools. These findings suggest that the majority of consumers regarding hair dyeing behavior are female students in technical senior high schools.

4.2 Reliability Analysis

Chen Kuan-Yu and Wang Cheng-Hua [40] mentioned that reliability refers to the consistency and stability of test results. By using the same statistical measurement tool and conducting repeated tests, consistent and stable values are obtained. The higher the value, the more valuable the data is for research. In this study, the Partial Least Squares (PLS) structural equation modeling analysis was used, and the widely used reliability test method in practical applications is Cronbach's alpha. Coefficients between 0.7 and 0.98 indicate a more stable questionnaire scale. Values below 0.35 indicate low reliability levels [41]. Cronbach's alpha was used in this study as a reliability analysis to verify internal consistency.

Table 2. Basic information of samples

Demographi variables	Times and percentages (N=370)
Gender	Female: 292 (78.9%)
	Male: 78 people (21.1%)
Course	Ordinary high school: 103 (27.8%)
	Technical high schools : 267 (72.2%)
Grade Structure	First grade : 68 (18.4%)
	Sophomore : 111 (30.0%)
	Third grade : 191 (51.6%)
School location	North Side: 184 (49.7%)
	Central District: 93 (25.1%)
	Southern District: 93 (25.1%)
Number of hair dyes	Never: 126 (34.1%)
	Occasionally 1-2 times: 158 people (42.7%)
	Frequently more than 3 times: 86 people (23.2 %)
Your Hair Color Consumption Behavior	Online channels to buy hair dye: 53 people (14.3 %)
	Hair coloring in physical stores: 190 people (51.4 %)
	Consumer behavior without hair dyeing: 127 people (34.3 %)

Source: Compiled by the present study

4.3 Validity Analysis

Validity refers to the degree of fit between conceptual definitions and operational definitions. By measuring the construct using appropriate instruments, researchers can capture the essence of the topic being measured and achieve the desired measurement objectives [40]. This study adopted convergent validity and discriminant validity based on the literature to ensure that the questionnaire can measure the items related to the constructs.

4.4 Confirmatory Factor Analysis (CFA)

In terms of reliability analysis, this study used internal consistency reliability for analysis, and overall, it demonstrated good fit in terms of internal structural consistency. Following the suggestion of Hair et al. [42], when Cronbach's alpha is higher than 0.7, it indicates sufficient reliability of the questionnaire. Confirmatory factor analysis was used for convergent validity and discriminant validity analysis. When the composite reliability (CR) is higher than 0.7 and the average variance extracted (AVE) is higher than 0.5, it indicates sufficient convergent validity. Table 3 shows the results of convergent validity analysis, indicating that the factor loadings of each item are greater than 0.5, indicating sufficient correlation between the items and constructs. This suggests that the scale has sufficient convergent validity.

Table 3. Convergent validity analysis results

Facet	Item	Factor loadings	Cronbach's alpha	CR	AVE
TI	TI 1	0.771	0.882	0.896	0.682
	TI 2	0.862			
	TI 3	0.888			
	TI 4	0.731			
	TI 5	0.867			
PT	PT 1	0.925	0.964	0.965	0.876
	PT 2	0.960			
	PT 3	0.958			
	PT 4	0.911			
	PT 5	0.925			
FT	FT 1	0.768	0.893	0.897	0.653
	FT 2	0.757			
	FT3	0.843			
	FT4	0.856			
	FT 5	0.794			
	FT6	0.826			
PA	PA 1	0.658	0.920	0.933	0.720
	PA 2	0.865			
	PA 3	0.847			
	PA 4	0.918			
	PA 5	0.886			
	PA 6	0.890			
SM	SM 1	0.805	0.899	0.902	0.714
	SM 2	0.838			
	SM 3	0.884			
	SM 4	0.837			
	SM 5	0.857			
BI	BI 1	0.803	0.778	0.801	0.536
	BI 2	0.752			
	BI 3	0.826			
	BI 4	0.543			
	BI 5	0.701			

Source: Organized by this study

4.5 Discriminant Validity

Discriminant validity in this study refers to the differentiation between one factor and other factors. As shown in Table 4, the square root of the Average Variance Extracted (AVE) for each construct is greater than the correlation coefficients with other constructs. This meets the criteria proposed by Fornell and Larcker [43]. The square root of the average variance extracted for each dimension ranges from 0.732 to 0.936, indicating sufficient discriminant validity of the scale. Based on the overall fit, intrinsic structural fit, and confirmatory factor analysis results, the consumer behavior model of hair dyeing among teenagers in this study is an acceptable model. The reliability and validity of the scale in this study meet the standards mentioned in previous literature, so there is no need to eliminate any items for subsequent analysis.

4.6 PLS Model Analysis

In addition to exploring the relationships between constructs, this study uses bootstrapping (with 5000 iterations) to examine the existence of mediation effects. The details of the PLS model analysis are described as follows.

Based on the results of the PLS path coefficient analysis (Table 5), it was found that, except for the insignificant impact of product awareness on behavioral intentions, all other regression paths were positively significant. Specifically, social media had a significantly positive impact on transactional interaction (t=7.073, p<0.001) and behavioral intentions (t=4.189, p<0.001). Fashion trends significantly influenced transactional interaction (t=12.847, p<0.001), professional technologys (t=4.871, p<.001), and behavioral intentions (t=4.341, p<0.001). Product awareness had a positive and significant impact on professional technologys (t=11.745, p<0.001). Transaction interaction had a significant positive impact on behavioral intentions (t=2.020,

p=0.043), and professional technologys positively influenced behavioral intentions (t=5.593, p<0.001). Please refer to Fig. 2 for the analysis results. Overall, except for hypothesis H7 where product perception was found to have no significant impact on behavioral intentions (t=1.550, p>0.05), the remaining hypotheses were supported by the data.

4.7 Mediation Effect Analysis

This study used bootstrapping to analyze the four mediation effects in the PLS model. The results of the mediation effect analysis, which are based on the values obtained from the model, are summarized in Table 6. These results meet the four conditions proposed by Baron & Kenny [44] in the causal steps approach. The results indicate that there is no mediation effect from social media to transactional interaction to behavioral intentions, with a total effect value of p=0.059 and t=1.890. Similarly, there is no mediation effect from fashion trends to transaction interaction to behavioral intentions, with a total effect value of p=0.051 and t=1.955. As shown in Table 6, Path 3 and Path 4 are significant, indicating that professional technologys mediate the relationship between fashion trends popularity and behavioral intentions as well as between product awareness and behavioral intentions. In other words, professional technology act as a significant mediating factor in these two paths. When considering the impact of both the independent variable and the mediating variable on the dependent variable, the coefficient and p-value of Path 3 (fashion trends to professional technology) remain significant, with a p-value < 0.001 and t-value of 4.334, indicating a partial mediation effect. However, Path 4 (product awareness to behavioral intentions) has a p-value of 0.121 and t-value of 1.550, which is not significant. The significance is reached when considering the mediation of professional technology, with a p-value < 0.001 and t-value of 4.745, indicating a complete mediation effect.

Table 4. Discriminant validity analysis of each facet

facet	TI	PT	FT	PA	SM	BI
TI	0.826					
PT	0.554	0.936				
FT	0.768	0.574	0.808			
PA	0.576	0.741	0.537	0.848		
SM	0.691	0.521	0.648	0.555	0.845	
MI	0.694	0.709	0.714	0.651	0.677	0.732

Note: The diagonal diagonal is the square root of AVE of each facet, and the lower triangle is the correlation coefficient of each facet
Source: Organized by this study

**Table 5. Analysis results of PLS path coefficients**

Return path	Coefficient	Standard error	T value	P value
SM -> TI	0.333	0.047	7.073	<.001***
SM ->BI	0.211	0.050	4.189	<.001***
FT -> TI	0.552	0.043	12.847	<.001***
FT -> PT	0.247	0.051	4.871	<.001***
FT -> BI	0.245	0.056	4.341	<.001***
PA->PT	0.608	0.052	11.745	<.001***
PA->BI	0.091	0.059	1.550	0.121
TUI -> BI	0.132	0.065	2.020	0.043*
PT -> BI	0.318	0.057	5.593	<.001***

* p <0.05, ** p <0.01, *** p <0.001
Source: Organized by this study

Table 6. PLS intermediary analysis results

path	Intermediary path	coefficient	standard error	T value	P value
one	SM -> TI -> BI	0.044	0.023	1.890	0.059
two	FT-> TI ->BI	0.073	0.037	1.955	0.051
three	FT->PT -> BI	0.079	0.018	4.334	<.001***
Four	PA -> PT -> BI	0.194	0.041	4.745	<.001***

* p <0.05, ** p <0.01, *** p <0.001
Source: Organized by this study
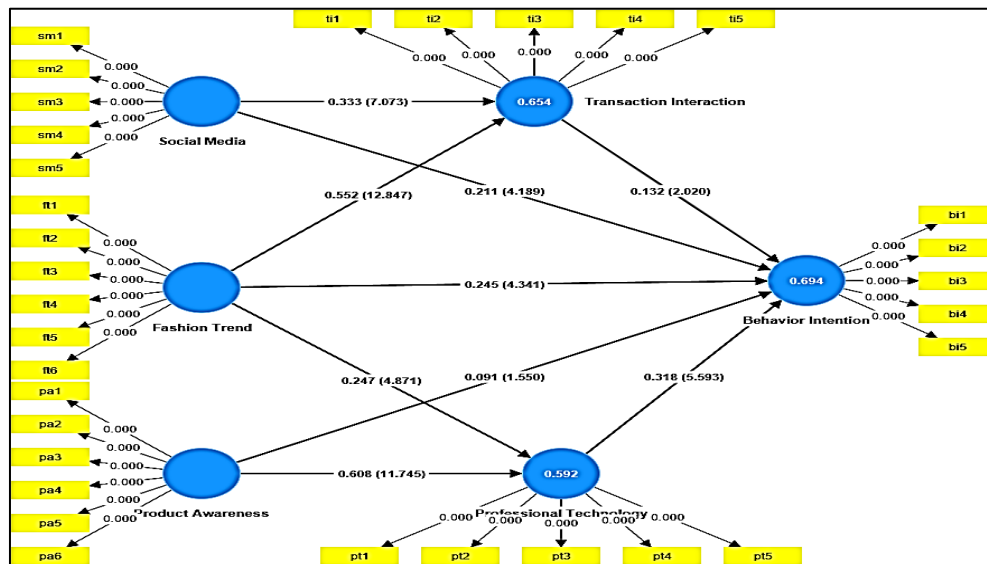
Fig. 2. PLS path analysis results
Source: Organized by this study

4.8 Consumer Behavior of Hair Dyeing between Regular Senior High Schools and Vocational Senior High Schools in Taiwan

The differences between ordinary high schools and technical high schools in Taiwan regarding "hair dyeing consumption behavior" are shown in Table 7. The results of independent sample t-tests indicate that there are significant differences between technical high schools and ordinary high schools in terms of variables such as "frequency of hair dyeing," " fashion trends," " professional technology," and "overall six constructs."

Table 7 shows the differences between Taiwanese general high schools and technical high schools on "hair dyeing consumption behavior ". The t-test results show that: There

Table 7. The results of the independent samples t-test on the differences in "hair dye consumption behavior" between regular and vocational senior high schools in Taiwan

Hair dye consumption behavior	factor facet	course	average	standard deviation	T value	P value
	number of hair dyes	Ordinary high school	1.5922	.69221	-4.920	.000
		technical high school	2.0075	.74082		
	factor facet	**course**	**average**	**standard deviation**	**T value**	**P value**
	fashion trend	Ordinary high school	3.3738	.91866	-3.571	.000
		technical high school	3.7116	.77250		
	factor facet	**course**	**average**	**standard deviation**	**T value**	**P value**
	professional technology	technical high school	4.1087	.87706	-2.322	.021
		Ordinary high school	4.3176	.73297		
	factor facet	**course**	**average**	**standard deviation**	**T value**	**P value**
	whole facet	Ordinary high school	3.7315	.71197	-2.687	.008
		technical high school	3.9292	.60184		

*Note: *P< .05, **P< .01, ***P< .001*
Source: Organized by this study
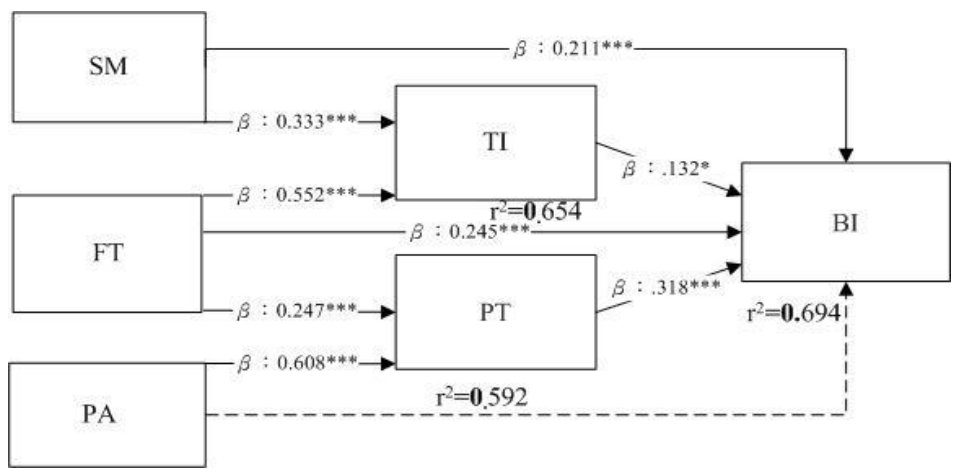
Fig. 3. Hypotheses and verification results

are significant differences in the variables of "hair dyeing frequency", "fashion trend", "professional technology "and "overall six constructs" from technical high schools.

4.9 Good Overall Model Fit

The research model, which applies the Stimulus-Organism-Response theory, explores the hair dye consumption behavior of high school students. Few studies have differentiated products types in exploring this behavior. This study considers social media, trends, and product perception as environmental stimuli that generate emotional responses and arouse transaction interaction, with professional technology as a mediating variable, ultimately leading to behavioral intentions. The research

model confirms a good overall fit of social media, trends, product perception, transaction interaction, and professional technology with behavioral intentions. Of the nine paths in the model, eight paths are significant, with path 7 indicating a negative significant effect of product perception on behavioral intentions. The results suggest that the model has good overall fit. After analyzing the sample structure reliability, confirmatory analysis, and mediation effect model, the results are summarized and depicted in Fig. 3.

4.10 The Influence of Fashion Trends and Product Awareness on Consumer Behavioral Intention through the Mediating Variable of Professional Technology

The construct of fashion trends indirectly influences behavioral intention through the mediating effect of designer's professional technology, resulting in a positive impact. Product awareness must fully depend on the mediating effect of designer's professional technology to indirectly influence behavioral intention. However, there is a lack of research on the mediating effect of professional technology in the relationship between fashion trends, product awareness, and behavioral intention in the current literature. This study discovered that professional technology have a complete mediating effect on product awareness and hair-dyeing behavioral intention. This suggests that product awareness does not directly influence hair-dyeing behavioral intention, but through the technical expertise of professional designers, consumers gain confidence in hair-dyeing. This highlights the importance of vocational education and talent training. In terms of practical management implications, this study proposes the following recommendations: training trainees to become excellent designers who possess (1) professional practical technology in hairstyling techniques such as perming, dyeing, styling, cutting, and blow-drying, (2) professional knowledge in hair theory, and (3) the ability to creatively apply hair-dyeing techniques to fashion styling.

5. CONCLUSION AND RECOMMEND-ATIONS

5.1 Conclusion

The consumption behavior of hair dye among vocational high school students is significant.

Compared to general high schools, vocational high schools focus on professional subjects and internships to enhance students' future employability. The study found significant differences in the variables of "frequency of hair dyeing" and "overall six constructs" among vocational high school students. A high percentage of students (51.4%) choose physical stores for hair dyeing, and 65.9% of students have experience with hair dyeing. With the spread of information and technological advancements, new business models and e-commerce services have emerged, and online searching for information and shopping have become a fashion trend. The study validates that Taiwanese teenagers are influenced by social media, fashion trends, and product awareness, and pay particular attention to their hairstyle design.

6. PRACTICAL IMPLICATIONS

In the emerging field of hair dye, to attract new customers and retain existing ones, businesses need to make important decisions. According to this study, consumers prioritize health and environmental friendliness in their product choices. Natural hair dyes present a significant market opportunity as consumers increasingly prioritize health. Within natural hair dyes, there should be a focus on developing a wider range of colors to cater to the younger consumer group. Madden and Zickuhr [45] found that 83% of young people aged 18 to 29 interact with colleagues through social media. A study conducted with 233 students in higher education in the United States showed that students' confidence in collaborative learning is effectively enhanced through interactions on social media [46]. The research findings also suggest that social media and transaction interaction contribute to strengthening customer behavioral intentions. In the domestic fashion hair industry, following the trends and implementing new marketing strategies can help foster long-term customer engagement, which is crucial for sustainable business operations [47-51].

7. RESEARCH LIMITATIONS AND FUTURE RESEARCH RECOMMEND-ATIONS

Due to multiple limitations in research funding and time, this study only focused on investigating hair dye consumption behaviors in regular and technical high schools in Taiwan. However, the

hair care industry is a diverse market with ever-changing consumer segments. Therefore, there are still various research opportunities that can be explored in the future. It is recommended to expand the research scope to include a wider range of consumer groups and conduct in-depth interviews with businesses to obtain more comprehensive results. It is also suggested that businesses should embrace innovation and transformation by (1) Actively developing online community platforms and introducing online booking and interactive information about products to guide consumers.(2) Adding innovative service offerings and service processes to attract more customers.(3) Responding to consumer questions in real-time on interactive platforms to meet their needs.(4) Gaining insights from new business model theories to strengthen relationships with consumers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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