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Natural versus synthetic dyes: Consumers' understanding of apparel coloration and their willingness to adopt sustainable alternatives

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ABSTRACT

Sustainable alternatives such as natural dyes are much-needed, but also highly dependent on consumer acceptance and cognizance of the benefits of natural dyes versus those derived from synthetic origin. This study explores and describes consumers' understanding of environmental repercussions surrounding apparel coloration and their willingness to choose more sustainable alternatives. In adopting a qualitative paradigm, seven focus group discussions generated in-depth insight surrounding consumers' perspectives on the topic. A purposive non-probability sampling technique was used to recruit females aged between 20 and 55 years because they are generally more involved in apparel consumption decisions. The findings revealed that despite participants' convictions surrounding the fashion industry's environmental impact, their understanding of apparel coloration and the implications of synthetic dyes were limited. Participants also identified factors that may inhibit their choice of naturally dyed apparel. Information provision and the role of various stakeholders appear key in the pursuit of more sustainable choices.

1. Introduction

Diversely sourced from plant roots to insects, and sea snail secretions, natural dyes and their application in textile coloration can be traced back to ancient civilizations as early as the 12th-11th millennium BC (Melo, 2009). Before the invention of synthetic dyes, mankind was able to dress in colors for centuries, which is exemplified in the artifacts displayed in museums across the globe with some natural dyes being used well into the 20th century and even favored by some modern-day textile designers (Cardon, 2009). However, with the introduction of synthetic dyes during the mid-19th century, the use of natural dyes declined significantly (Saxena and Raja, 2014). Allowing mass production and superior apparel coloration qualities, chemically derived synthetic dyes soon gained overall dominance in the textile industry, but it was not without associated environmental implications. Today it is widely known that textile coloration, in particular, the production and use of synthetic dyes, has an immense impact on water bodies, with toxic effluent finding its way into the food chain and fostering severe repercussions for communities residing close to textile dye houses (Islam et al., 2021; Saxena and Raja, 2014). Given the critique directed toward the apparel supply chain and the fashion industry's devastating environmental and social repercussions, renewed interest has emerged

surrounding the use of natural dyes, especially over the past few years.

Despite the continued abundance and overindulgent use of synthetic chemical sources for textile coloration, experimentation with natural dyes has fortunately persevered. Even in emerging market contexts such as South Africa, there has been a revival in the use of natural dyes inspired by local artisans and designers, who have endeavored in creating rich palettes of color utilizing a broad array of local, seasonal foliage and plant extracts (Selander, 2022). Utilizing plant sources such as pine cones (Bahtiyari and Yilmaz, 2018), garlic stem extracts (Yilmaz et al., 2019), olive tree leaves (Yilmaz and Bahtiyari, 2020) cranberry fruit and branch extracts (Yilmaz et al., 2020), licorice (*Glycyrrhiza glabra* L. Root) (Yilmaz, 2020) and *Alpinia Officinarum* Rhizome (Koçak and Yilmaz, 2022), researchers have found that in addition to serving as an appropriate source of coloration for fabrics such as cotton and wool, these dye sources can also infuse antibacterial properties to the dyed fabrics. Results of washing fastness tests conducted on these naturally dyed fabrics differed from moderate to good depending on the specific dye source, mordanting agents, and dyeing processes used (Bahtiyari and Yilmaz, 2018; Yilmaz and Bahtiyari, 2020; Yilmaz, 2020; Yilmaz et al., 2020; Koçak and Yilmaz, 2022). In some instances, for example, when using cranberry fruit branch extract, light fastness tests delivered poor results (Yilmaz et al., 2020). Similarly, the lower light fastness of

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natural indigo dyes (derived from *Indigofera tinctoria* leaves) has, amongst others, curbed its widespread application in the textile industry (Renington et al., 2021). Compared to synthetic blue dyes, natural indigo dyes are less color stable, yet more expensive to produce, which requires innovative applications to extend its use in textile dyeing and printing processes (Renington et al., 2021; Rattanaphol et al., 2022).

In addition to the above, some other concerns have been raised against the use of natural dyes in general. One such concern is the potential impact that it may have on endangered species as a source of dye extraction. Yet, counterarguments have also been offered in that natural dyes could potentially be garnered from food waste (Popescu et al., 2021) or harvest/ crop residues that pose less threat to biodiversity. Given the size and volume of apparel production throughout the globe, the complete elimination of synthetic chemicals for apparel dyeing purposes will perhaps not be possible in the foreseeable future, but pursuing sustainable alternatives in the form of natural dyes remain important to combat the utter devastation caused by synthetic chemical apparel coloration processes. From a commercial perspective, consumer acceptance and cognizance of the environmental benefits of natural dyes versus those derived from synthetic origin will ultimately determine whether widespread application and utilization are accomplished. In this regard, problems relating to perceived color consistency, light-, and wash fastness (to name but a few), remain stumbling blocks that may inhibit broader application and consumer acceptance.

Against this backdrop, this study was focused on exploring and describing consumers' understanding of environmental repercussions surrounding apparel coloration and their willingness to choose more sustainable alternatives. Consumer understanding and knowledge have always featured prominently in the extant literature surrounding the acceptance of greener alternatives and more sustainable choices (Venter, 2017, 2021). Knowledge is said to fulfill a pivotal role in consumer decision-making while a strong association has for example been established between environmental knowledge and choice (Vicente-Molina et al., 2013; Carmi et al., 2015). More knowledgeable consumers are said to have the ability to choose the right product and to use and maintain it appropriately (Ateke et al., 2018).

Consumer knowledge is, however, a complex, multi-dimensional construct and has been interpreted in many different ways. For example, in the early seminal work of Alba and Hutchinson (1987), it is proposed that consumer knowledge has two key components namely familiarity (i.e. "the number of product-related experiences" a consumer has accumulated over time) and expertise (i.e. "the ability to perform product-related tasks successfully"). According to Alba and Hutchinson (1987), the concept of product familiarity refers to accumulated awareness and past reasoning about a product that may be a result of repetitive product-related experiences acquired over time. It thus reflects the continuous nature and quality of knowledge structure development. They further contend that product awareness may not necessarily come from actual product experiences but may also be acquired through exposure to infomercials, information searches, and advertisements. The premise is that the more familiar consumers are and the more they have had exposure to naturally dyed garments, the more their expertise will increase, hence allowing them to effectively differentiate between natural and synthetically dyed garments and appropriately evaluate and select naturally dyed apparel. Dimensions of consumer knowledge expertise that can be improved as product familiarity increases include reduced cognitive effort and the automaticity with which decisions can be made, refined cognitive structures and improved knowledge content, more advanced analytical processing of information, elaboration on given information with deeper problem-solving capabilities and enhanced memory of such information in a decision environment (Alba and Hutchinson, 1987).

Later on, Alba and Hutchinson (2000) add that the correspondence (i.e. "knowledge calibration") between what consumers know (i.e. objective knowledge/ factual understanding) and what they think they know (i.e. subjective knowledge / self-reported expertise) is also

important as it impacts among others, consumers' confidence in making judgments and also how much information they will gather to execute decisions. A consumer may for example feel confident in their understanding of natural dyes (i.e. subjective knowledge) – even though they do not possess much factual/ objective understanding – and may therefore not search for much information before evaluating naturally dyed garments, consequently reaching erroneous judgments about the apparel in question.

Studies to date have mostly evaluated consumer knowledge dimensions such as familiarity and expertise, as well as subjective and objective knowledge in a quantitative manner (Venter, 2017, 2021). Also, studies that have assessed consumers' environmental knowledge within the apparel domain have done so in general (Momberg et al., 2012) with few, if any, specifically delving into consumers' understanding of the environmental implications linked to apparel coloration. Moreover, cognitive psychological consumer research tends to relegate context as an independent, exogenous factor. However, the argument brought forward by Wagner-Tsukamoto and Tadajewski (2006), emphasizes that the contextual nature of consumer thinking and behavior necessitates the integration of context into the very explanation of cognition. Such integration may be achieved through the idea of "contextual cognition", which can be operationalized in terms of constructs such as "subjectively perceived context constraints and opportunities" (Wagner-Tsukamoto and Tadajewski, 2006). Within the South African emerging market context, which served as the setting for this research, context may represent a pivotal source of information and contribute to consumers' contextual cognition and understanding of sustainable alternatives such as natural dyes. Often, in day-to-day conditions of living, consumers rely on what is termed by Wagner (2002) as "practical thinking" and "bricolage" to logically consider options and solve problems in a specific choice context. Therefore, effective task performance such as differentiating naturally dyed apparel from synthetic versions, need not only be assessed based on scientific, factual, and objective correctness but also on how skillfully it was approached/ framed within the context given the perceived constraints (Wagner, 2002). A cognitive approach such as demonstrated by Wagner (2002) may often be more suitable for the scrutiny of sustainable decision-making due to its closeness to the common-sense explanations of everyday behaviors.

2. Materials and methods

To address the objectives set for this study, focus group discussions were conducted. While a thorough literature review was used to provide a theoretical framework for the study, the focus group discussions allowed a deeper exploration of the participants' understanding of environmental repercussions surrounding conventional apparel coloration and their willingness to adopt more sustainable alternatives.

A focus group discussion is defined as the assembly of a small group of people to discuss a certain topic in detail (Walliman 2011: 115; Leder et al. 2020). Although it might have some disadvantages, such as imposing social influences and conformity pressures (which was possible given the nature of this topic) this type of data collection has been proven to be very successful within the South African context. Due to South Africa's demographical diversity, decisions regarding research techniques often require a cautious approach (Venter, 2017:45). It is believed that the chosen qualitative technique (i.e. focus group discussion), not only ensured that all participants grasp / correctly interpreted the discussion points but, that it also elicited a much-needed debate, which was warranted considering the topic under investigation. Recent studies underscored that focus group discussions are ideal to evoke spontaneous discussions/debates because it tends to create excitement within a secure environment, that encourages participants to expose their own ideas (Venter 2017:45; Babbie and Mouton 2002:293). Participants in a focus group discussion tend to be more willing to volunteer information when compared to other qualitative research techniques e.

g. a personal interview (Leder et al., 2020). This might be due to the participant feeling less inhibited and hence by doing so encouraging others to follow suit.

In adopting a qualitative paradigm, seven focus group discussions were used to gather in-depth insight into the participant’s understanding of the topic at hand. To allow enough ‘air time’ for each participant to voice his/her views without extending the length of the sessions, a maximum of seven participants were included per focus group discussion. A purposive non-probability sampling technique was used to recruit female participants aged between 20 and 55 years (Table 1). Female consumers are generally more involved in households’ apparel purchasing and consumption decisions and are said to be more environmentally concerned, socially responsible, and willing to adopt sustainable alternatives compared to men (Schwartz and Rubel, 2005, Mostafa, 2007; Lee, 2009). Participants were not expected to have had prior exposure to naturally dyed apparel to participate in the study. The topic did however draw some individuals who had a more extensive background to volunteer. In the end, this created a platform for rich debate among the novices and those with more experience thus adding deeper insight into the findings.

The focus group discussions were all completed during February – March 2020. The venue at the University of Pretoria, South Africa ensured a neutral environment with an informal atmosphere that was conducive to group interaction. Participants gathered at the venue as per the prior appointment. After a brief warming-up session, the researcher facilitated the dialogue by introducing specific points of discussion as well as relevant textile apparel samples. The samples included various clothing items that were dyed with both natural and synthetic dyes. Prior to the commencement of the focus group discussions, participants looked at the displayed clothing items intently under direct light, examining the tactile feel and crocking propensity by rubbing the fabric between their fingers while some smelled the garments and ran their hands over the surface of the garments.

It was believed that the selected points of discussion coupled with the textile apparel samples supported a phenomenological approach, where attention could be given to ascertain not only participants’ personal understanding but also their experiences. All discussions were recorded with the consent of the participants, to ensure accuracy when transcribing. Due to the inherent “messiness” of qualitative data, it was decided to apply thematic analysis. This analysis allowed identifying common themes, possible differences, similarities, and relationships between text segments. The thematic analysis did not aim to interpret the underlying contextualization, ideologies, and assumptions of the participants. Instead, patterns were created to interpret the broader meanings, and where applicable set in relation to the existing literature.

3. Analysis and interpretation of the focus group discussions

Following an extensive review of the literature and relying on the theoretical framework proposed by Alba and Hutchinson (1987, 2000), as well as Wagner-Tsukamoto and Tadajewski (2006), four recurring main themes emerged from the analysis and were labeled as follows: (1) familiarity and expertise surrounding the identification and evaluation of naturally dyed apparel, (2) subjective knowledge and the search for information about sustainable alternatives (3) contextual cognition: the

perceived opportunities and constraints as well as (4) the role of various stakeholders in cultivating a willingness to adopt sustainable alternatives. Some of these themes also included subthemes, which are discussed in the sections to follow.

3.1. Familiarity and expertise surrounding the identification and evaluation of naturally dyed apparel

As the first point of discussion, participants were prompted to share their prior experience and exposure to naturally dyed apparel (i.e. familiarity) and their ability to differentiate, evaluate and select such apparel (i.e. expertise). In terms of familiarity, participants’ prior experience ranged from none, minimal to extensive. The participants who professed to have had no prior experience reported that they were hearing about natural dyes for the first time. During the focus group discussions, these participants would rely on their personal preferences and past experience with conventional apparel products to apply expertise in the evaluation of sustainable naturally dyed alternatives (“...how it feels on the skin, does it bleed when washed”). More experienced participants acknowledged their application of expertise (whether acquired through formal training and/or from past experience) to consider attributes beyond aesthetic appearance such as fiber content, ease of care, dye fastness, and the functionality of the apparel (“I think it’s maybe my background. I studied fashion design and I have worked with materials my whole life and so when I do choose fabrics and dresses or I buy something, I do consider it a little bit more than just face value”).

Overall, participants’ expertise in the evaluation and selection of naturally dyed garments revolved around garment coloration attributes such as the intensity of the color, crocking, and dye leveling. They admitted that it was not always easy to differentiate between natural and synthetic fabrics and dyes. Nonetheless, the intensity or saturation of the color was seen to be a key indicator of whether the item was naturally dyed or not. Brighter tones were associated with synthetic dyes while paler and softer tones were associated with natural dyes. As noted by one participant: “I think the color is definitely one of the first things that people tend to look at because usually, the brighter the color, the more synthetic or chemically made it is”. Apart from the intensity of the color, participants also mentioned the consistency of the dye. Naturally dyed garments were perceived to have poor dye levelness while synthetically dyed apparel exhibited even dye distribution. As one participant commented: “...it seems the color is not consistent all through”. Participants also held the notion that if a garment has multiple colors, it was probably dyed with synthetic dyes while naturally dyed garments were expected to be monochrome (“...also if a garment has more than one color in it, usually, I think it leans more towards synthetic”). Participants also reasoned that garments that are made from natural fibers (for example 100% cotton) were dyed with natural dyes while those made from synthetic fibers were dyed with synthetic dyes based on the assumption that synthetic fibers have no affinity for natural dyes: “Usually fibers that are more synthetic don’t catch on to the natural dyes.”. An interesting observation made by participants is that natural dyes are predominantly used for baby clothes, because babies’ skins tend to be more sensitive and prone to allergies, and would therefore benefit from natural organic dyes. Some participants were even deterred by brighter tones in the selection of baby clothes as they associated it with synthetic dyes: “If I

Table 1
Demographic characteristics of the sample.

Age			Employment			Income			Education		
Years	n	%	Status	n	%	Income	n	%	Education	n	%
18-29	31	72	Part-time	7	16	<R5000	8	19	<Grade 12	0	0
30 - 49	6	14	Full-time	27	63	R5000 – R9999	8	19	Grade 12	7	16
50+	6	14	Unemployed	2	5	R10000 – R14999	3	7	Grade 12 + Diploma / Certification	9	20
			Student	7	16	R15000 – R24999	5	12	Grade 12 + Degree	17	40
						≥R25000	19	44	Postgraduate	10	23

chose like a baby garment I would think twice if it is too bright. The bigger kids are already stunted by dyes and the babies are more susceptible for dyes”.

In summary, the findings surrounding this theme revealed that participants apply practical thinking and bricolage in the evaluation and selection of naturally dyed apparel as proposed by Wagner-Tsukamoto and Tadjewski (2006). They do not rely on a single garment cue but rather take into consideration a combination of coloration and fabric attributes based on what they have learned from various sources of information and prior apparel use. Many of these assumptions may not be factually correct (indicating a lack of objective knowledge) as they are often based on subjective experiences, but were nonetheless deemed appropriate for the task at hand. Familiarity and prior experience thus have an important role to play in evaluating, selecting, and wearing naturally dyed apparel (even if it is subjective), which underscores Alba and Hutchinson (1987) theoretical assumptions surrounding the development of knowledge structures through familiarity and expertise. However, as pointed out by Wagner-Tsukamoto and Tadjewski (2006), practical know-how of environmentally-oriented decision-making may also vary in a particular choice situation as a result of a person's prior subjective discovery of product attributes, choice task features, and the information available in the choice setting.

3.2. Subjective knowledge and the search for information about sustainable alternatives

Overall, participants displayed a reasonable amount of knowledge regarding the broader impact of the textile and apparel industry on the environment but were less confident in their judgments surrounding the implications of synthetic textile coloration processes versus those applied in the application of natural dyes. This was evident in the manner in which they contributed to the discussions by repeatedly stating “I assume...”, “perhaps...” or “I think...” In some of the focus groups, the discussions surrounding textile dyes and their impact on the environment were rather thin as participants grappled to offer insight on the topic. Yet, even if they did not know for sure what happens in dye houses, participants expressed suspicions that companies did not effectively manage textile dye effluent (“We are not sure how they [textile dye houses] dispose of the waste. What happens to the water? Where does it go and how is it treated?”) and attributed problems surrounding the quality of water in cities to textile dye effluent: “If you look at the city purifying system, the water that you drink, it will never be clean. I know there’s a water problem actually worldwide. You will never get clean water again”. The following subthemes emerged that provide a broader background on participants’ subjective knowledge and their accompanying search for information.

3.2.1. Subjective knowledge surrounding the broader impact of the fashion industry

Some participants candidly admitted that their knowledge about environmental issues was general and not specific to textiles. These participants did however recognize that their apparel choices were probably causing damage to the environment: “Nobody told me my jean is going to kill fish. I just buy a jean, people don’t talk about it. People talk about cars making gas that affects the environment”. Other participants indicated that even though they had no formal training/ education about the environmental impact of the fashion industry, they had gained awareness through exposure to popular documentaries, articles, and news. They recognized apparel production as one of the biggest contributors to global warming. Chemicals used in the textile finishing and coloration processes were seen as the main culprits of air-, ocean- and drinking water pollution as well as the loss of biodiversity. Concern was also expressed about increasing levels of post-consumer textile waste that potentially end up in landfills. China was earmarked as being the epicenter of global textile pollution because of fast fashion production which was then also associated with sweatshop manufacturing conditions. Participants associated the resultant severity of textile

pollution mainly with imported textile products with the assumption that locally produced textile products are safe and therefore exercise caution with imported apparel, especially from Asian countries. Throughout the discussions, participants seemed to know more about natural fibers and seemed to think that sustainable clothing alternatives were synonymous with clothing made from natural organic fibers, which erroneously disregards all other sustainable attributes that an apparel item may have.

3.2.2. Subjective knowledge surrounding synthetic dyes

Participants regarded synthetic dyes as mass-produced man-made dyes derived from non-biodegradable chemicals. These dyes were further described as “harsh” and “harmful” with immense environmental and health risks. Mass-produced fast fashion was thought to be predominantly synthetically dyed and responsible for a significant volume of emissions that pollute both the air and water systems. The pollution was partly blamed on ill-equipped and inefficient textile factories and effluent disposal malpractices that contaminated water, thereby affecting aqua life and the quality of water. Since these dyes were manmade, participants were however convinced that they could be engineered to be biodegradable, but could not verify whether such potential had already been realized. Despite the negative environmental impact of these dyes, participants acknowledged their advantages in terms of colorfastness, uniform dye levelness, and standardized replication of colors and shades.

3.2.3. Subjective knowledge about natural dyes

Natural dyes on the other hand were reported to be a better option for apparel coloration in that they are purer, less processed dyes made from biodegradable natural sources such as plants and therefore eco-friendly, whilst using less energy and chemicals in the production process. “Biodegradable” and “eco-friendly” was understood to mean textile products that have less or little impact on the environment. Some participants suggested that naturally dyed garments could be re-dyed when the color fades although they highlighted that such re-dyeing processes could be cumbersome. Participants highlighted that natural dyes might be costly to produce and not easy to mass produce. The difficulties associated with the mass production of natural dyes were attributed to the possible depletion of dye sources and unreliable dye source availability. The use of waste materials such as avocado seeds as a natural dye source was mentioned as an innovative way of turning waste materials into useful materials. However, some participants found the use of food materials such as beetroot and carrots which were mentioned by other participants as natural dye sources to be wasteful in light of food insecurity in the country. Participants also highlighted some imperfections of natural dyes such as poor color fastness and color inconsistency despite the application of laborious source extraction and dyeing processes.

In summary, some participants seem to be reasonably informed. Being qualitative in nature, this study’s data-gathering activities did not include objective knowledge tests, but some of the participants’ views can for example be confirmed from extant literature, e.g. textile wet processes in the form of residual toxic waste dye-infused liquid effluents have been a major issue for many years (Barclay and Buckley, 2000), which was pointed out in some of the discussions. There were however also hints of misguided opinions and discrepancies between what these participants thought they knew (i.e. subjective knowledge) and factual (objective) knowledge about the environmental impact of the textile industry in its entirety and also more specifically, relating to textile coloration processes. Alba and Hutchinson (1987) explain that the more people think they know, the less inclined they are to search for information. In this regard, decisions might be based on incorrect assumptions. To further delve into the dimensions of participants’ subjective knowledge, participants were asked whether they do in fact search for information and prompted about their sources of information.

3.2.4. The search for information about sustainable alternatives

Participants mentioned several sources that they consult for information about apparel such as clothing labels, websites, social media, cashiers, and shop assistants. Clothing labels were highlighted as the main point of reference when looking for specific information surrounding fiber content or how to care for a clothing item. Other participants were however quick to comment that they rarely looked at the clothing labels except when the fabric appeared delicate, or when they were checking for the size or price. Clothing labels however rarely provide information about the type of dye that was used in which case the participants relied on the specified fiber content: "We can check the label as well if the label says cotton and as you know cotton can be dyed with natural dye" Additional information on labels, logos or stickers that inform shoppers that the clothing item is organic was found to be a useful, especially when judging the price of the item. Participants also reported the use of websites and social media as sources of information which were mainly used to keep abreast of current trends, check for upcoming sales, and scout for online shops that offered organic clothing. Cashiers and shop assistants were also cited as sources of information, although they were not always deemed the most reliable sources of information on organic attributes, simply because they did not seem to know much about it.

3.3. Contextual cognition: the perceived opportunities and constraints

"Contextual cognition" acknowledges context as a legitimate source of information and can be operationalized in terms of subjectively perceived context constraints and opportunities (Wagner-Tsukamoto and Tadjewski, 2006) Focus group discussions revolved around several perceived constraints and opportunities toward the acceptance of naturally dyed apparel in the local emerging market context. Affordability was highlighted as a key determinant.

3.3.1. Affordability

Except for one participant (who contested that affordability depended on where one shops), there was a consensus among the participants that sustainable alternatives such as naturally dyed apparel tend to be more expensive and that affordability was an issue for many consumers: "I'd say the turn-around would be cost. If organic clothes are going to be cheap people will buy because currently, it is really expensive". Participants emphasized their reluctance to pay more for naturally dyed apparel, particularly in light of concerns surrounding poor colorfastness.

3.3.2. Quality concerns and care requirements

Most participants were of the opinion that naturally dyed apparel tends to fade and lose color over time with repeated use and was therefore of poor quality. They also noted that naturally dyed garments require special care ("...because you cannot put them in the washing machine with the rest of the laundry and use harsh detergents"), which is less desirable amidst the time pressures imposed by demanding lifestyles. Even participants who acknowledged that they had no prior experience with naturally dyed apparel, noted that their concern would relate to the care of such garments should they acquire them in the future.

3.3.3. Availability

Participants agreed that the limited availability of naturally dyed apparel and the poor visibility of organic clothing ranges in retail outlets compromised widespread acceptance of sustainable alternatives. Participants felt that they had to intentionally search for outlets often located in expensive upmarket malls while some frequently visited thrift shops and flea markets to acquire organic clothing. A few organic brands and online shops were mentioned, but participants could not say for sure whether these organic brands and shops included naturally dyed apparel in their ranges.

3.3.4. Greenwashing and transparency in the fashion supply chain

Participants expressed concerns about the authenticity of claims surrounding the use of natural dyes and potential greenwashing by some retail outlets and fashion brands that are unscrupulous in their strategies to gain profit from rising levels of environmental consciousness among consumers. They also complained about the lack of transparency in terms of production methods, chemicals usage, and closed communication systems that do not allow feedback from consumers, which then perpetuate uninformed purchase decisions. As a result of this, participants felt there would be very little change if any. Clothing manufacturers will continue to use the same production methods and dyes that negatively impact the environment given that they are focused on profit that is not necessarily sustainability-driven "The manufacturer isn't going to move to another method of production because they are not getting any complaints about it". To address this perceived constraint, participants recommended transparency in terms of production processes, chemicals, and dyes used by companies. Furthermore, they believed that an opportunity lies in the permeability of communication channels between manufacturers, retailers, and consumers to facilitate feedback mechanisms that drive innovations and eco-friendly designs.

3.3.5. Fashion styles and color variety to cater to personal aesthetic preferences

Participants complained that little effort is devoted to the styling of sustainable alternatives such as naturally dyed apparel. They described the styling of such garments as "bland" "dull" and limited in variety, mostly produced in neutral earthy colors which could easily stereotype the wearer as "an earth-conscious person" Some participants were very outspoken in their view that they would only be willing to pay more for a sustainable naturally dyed garment if they liked the style. The younger participants, in particular, mentioned the important role of fashion trends in self-expression and that they, therefore, rather acquire cheaper synthetically dyed fast fashion clothing in quantity than invest in a few sustainable, naturally dyed clothing items. Rather than being interested in the type of dye, they are drawn to preferred apparel colors: "It is either you like a lighter color or darker color; it is never the way it was dyed". "It's a personal preference for example I like a lighter color, bright clothes draw too much attention, I'm like that person please don't look at me, thank you". In this regard, variety is important: "As long as there's a variety of colors, we don't care how they get there".

3.3.6. Exclusivity

Participants highlighted a perceived opportunity for naturally dyed apparel to gain more acceptance by addressing consumers' need for uniqueness and their desire to maintain status by wearing hand-made, exclusive, and more expensive garments. Individuality was cited as an influential factor driven by social media. Aligned with this was the perception that organic naturally dyed clothing items are exclusive due to the inconsistency in the colors and the fact that it was not easy to mass produce: "It is one of a kind and difficult to manufacture"; "You won't get 200 units of the same pants...you think just get it because it is one of a kind". Some participants mentioned how they were drawn to apparel that has a unique story written on the swing tags: "If it tells or has a story behind it, then I will buy".

3.3.7. Country of origin

Some participants seemed highly sensitized and supportive of clothing that bears the proudly South African logo regardless of whether it was naturally dyed or not "I don't care about that, because if it is South African, that's enough for me". For these participants acquiring proudly South African merchandise (naturally or synthetically dyed) instilled a patriotic pride and represented their contribution to the economy since they were supporting local businesses and addressing issues of unemployment: "I would rather support local as that means the economy is raised and a better life for everybody". Participants also seem to perceive locally produced clothing as more sustainable because in their opinion local

firms use less energy, produce less waste, and have traceable production practices. Overall, the country of origin seemed to be an important issue as participants associated garments produced in Asian countries such as China with fast fashion and poor working conditions. Participants felt that they had no way of knowing whether the conditions under which the garments are produced beyond the borders of South Africa are ethical and were therefore skeptical of such clothing even if it is labeled as “organic” and/ or “naturally dyed”.

3.3.8. Health concerns

Some participants noted that skin reactions to synthetic fibers may encourage consumers to wear natural fibers such as cotton and by the same token, potentially instigate a preference for naturally dyed apparel: “Like women’s underwear, they tend to say go for cotton because I think it comes to a point as well where synthetic material causes discomfort”. Other participants were however dubious about the use of plant sources for natural dyes based on their own allergic reactions to some foods and were therefore uninspired by the prospects of wearing clothing that is dyed with pigments derived from fruit or vegetable origin.

The subjectively perceived constraints and opportunities identified by focus group participants highlight a few key elements that are in line with prior empirical research. Affordability remains key in the acceptance of sustainable alternatives (Sonnenberg et al., 2014), relegating ecological concerns to secondary considerations. Even those participants who had extensive experience and understanding of the environmental impact of synthetic dyes and the overall textile supply chain acknowledged that they were very much influenced by the garments’ price, quality, and aesthetic value regardless of whether the item is sustainable, organic, naturally dyed, or not. Apparel, in particular, is judged in terms of personal aesthetic preferences such as style trends and color which supersede the influence of environmental concerns, especially among young consumers who are into fast fashion. This is consistent with the notion that some consumers are hesitant to purchase sustainable alternatives purely because they are doubtful about their quality and aesthetic value (Min Kong and Ko, 2017).

3.4. The role of various stakeholders in cultivating a willingness to adopt sustainable alternatives

During the course of the focus group discussions, participants had much to say about how all of the stakeholders in the fashion industry had a role to play in the pursuit of sustainability. The following sub-themes summarize participants’ views on how various stakeholders, including themselves, could cultivate an increased willingness to adopt sustainable alternatives such as naturally dyed apparel.

3.4.1. Consumers

While participants were convinced that consumers are becoming increasingly more concerned about environmental impacts, they strongly felt that it was the responsibility of each consumer to do their own research about apparel products to be in a position to make informed decisions. To effectively mitigate the situation and encourage green production tendencies, it was reasoned that as end users consumers should concern themselves with where an apparel item was manufactured and the conditions under which it was manufactured as that adds to the impact of fast fashion on the environment. The influence on significant others at the consumer level was seen as a starting point toward the creation of awareness. It was reasoned that one can help at the individual level to create consciousness about the impact of what one buys by planting a seed through sharing the benefits of naturally dyed apparel with significant others like siblings and parents in conversations. Participants noted that this does not necessarily mean that this consciousness would immediately translate to buying sustainable apparel but the idea was to create awareness that would slowly but eventually bring about a behavioral change leaning more towards pro-environmental apparel selection. To systematically foster

environmental consciousness, it was stressed that consumers should be taught about the impact of the textile industry at the grassroots level in their formative years while they are receptive before they even engage in the acquisition of apparel: “...bring it up through education by starting it at the grass root level.”

3.4.2. Retailers and marketers

To increase the growth of the organic apparel sector and also more specifically naturally dyed apparel, participants suggested that retailers need to devote more attention to their outlets and distribution channels. Participants reported that they do not just walk into any fast fashion outlet but consciously search for information on online stores that sell sustainable organic clothing and also support outlets that focus on the whole holistic lifestyle (“I do kind of shop on websites that focus on that whole holistic lifestyle”) Since participants had difficulty in differentiating whether a garment was naturally dyed or not, a retail space that is specifically reserved for the display of such alternatives with attractive colorful visual merchandising increases the probability of it being noticed and gaining more acceptance. Participants stressed the need for retailers to promote the merits of sustainable apparel through effective marketing. The importance of using clear succinct and factual messaging in the marketing campaigns was emphasized. Such messaging should also not overwhelm consumers or elicit negative feelings because they feel they are being pressurized into action. Billboards, magazines, TV and radio adverts, and informative social media marketing were recommended as viable mediums for creating awareness. Participants noted that consumers are not keen on reading labels or product information brochures/pamphlets and therefore recommended the use of banners and employing knowledgeable retail personnel who could assist shoppers in the identification of sustainable apparel in-store. They also recommended the inclusion of hangtags bearing stories that highlight how the apparel item was produced and how it contributes to saving the environment. In light of the digital era, participants also suggested the addition of a QR code on the label that can be scanned to provide information about sustainable attributes such as the use of natural dyes.

3.4.3. Fashion designers and manufacturers

Participants expressed their views that for any effective change to be realized, the whole apparel production chain ought to be sensitized starting with fashion designers that should create earth-conscious, naturally dyed ranges while textile manufacturers should be focused on producing biodegradable natural dyes and fabrics that can be used for such ranges. The sentiment shared by participants is that more effort should be devoted to designing trendy styles that will appeal to a broader consumer population. Manufacturers, on the other hand, were urged to share product information transparently and inform consumers about aspects such as the type of dye that was used so that they could make fully informed purchase decisions. This was based on the observation that clothing labels do not include information about the type of dye used to color fabrics. Also, because participants were convinced that naturally dyed garments tend to bleed during the laundering process, they recommended that manufacturers should improve the colorfastness properties of naturally dyed garments to alleviate consumers’ concerns regarding the quality of such apparel.

3.4.4. Third-party verified labels

A final recommendation offered by participants is the formulation and use of internationally recognized standardized labels that denote sound environmental practices in the apparel supply chain. They lamented the uncommon use of internationally or locally recognized eco-labels that would authenticate claims of sustainability. This was a notably valid concern as the concept of eco-labels is relatively unknown in South Africa (Dreyer et al., 2016). In this regard, participants suggested that standards bodies such as SABS or ISO should come up with an internationally recognized and standardized symbol or logo that would authenticate claims of sustainable attributes such as the use of

natural dyes.

4. Conclusion and future research recommendations

In following a qualitative approach, the findings of this study produced rich insight into consumers' understanding of apparel coloration and their willingness to adopt more sustainable alternatives. These findings address an important gap in the current literature. Whilst, increasingly more is published surrounding dye extraction from various natural and sustainable sources as well as methods to improve quality and commercial viability, little is known about consumers' understanding of apparel coloration in general and also more specifically their awareness and knowledge of natural dyes versus those derived from synthetic origin. As pointed out in the introduction to this paper, consumer cognizance, and acceptance drive demand and will eventually govern whether sustainable and naturally dyed apparel gains widespread acceptance in the textile industry or not.

Not surprisingly, participants' knowledge surrounding the topic of natural dyes seems to fluctuate depending on prior experience and exposure to relevant information. What is of interest, is that even those with limited prior exposure to natural dyes, applied experience derived from conventional (synthetically dyed) apparel to judge the performance of naturally dyed apparel. In this regard, it is important that for natural dyes to become commercially viable, the dye performance needs to be further developed to measure up to that of synthetic dyes and cannot solely rely on consumer sentiment in favor of the environment. This was also evident in the subjectively perceived constraints that participants identified surrounding the more widespread acceptance of naturally dyed apparel. Participants were however also very forthcoming in offering recommendations on how these constraints could be mitigated, including the potential roles of various stakeholders throughout the apparel supply chain in cultivating a greater willingness to adopt sustainable alternatives. Information provision seems to be of key importance in facilitating more informed decision-making surrounding natural dyes, but equally important are factors surrounding affordability, availability, and conventional apparel attributes such as fashion style, color, and variety. The constant reference to the high prices of sustainable alternatives such as naturally dyed apparel, whether perceived or factual, cannot be ignored especially in an emerging market context such as South Africa. This may call for the implementation of remedial action such as advocating for economic support for the textile and apparel firms that employ cleaner production methods including the use of natural dyes.

As can be gathered from these findings, introducing natural dyes on a commercially viable scale to compete with synthetic options would depend on a consumer-centric approach to identify attributes that are of key importance in consumers' choice of apparel. Insights derived from this study can guide future interdisciplinary expertise to focus on various domains including sourcing of raw materials, dye extraction, analysis, properties, and application to comply with identified consumer preferences. In addition, this study may serve as a basis for future research that endeavors to quantitatively measure various facets that came to the fore in the focus group discussions, including an objective measurement of consumers' knowledge and the degree to which the perceived constraints inhibit consumers' preference for naturally dyed apparel as a more sustainable alternative.

CRedit authorship contribution statement

Letsiwe Mabuza: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft. **Nadine Sonnenberg:** Conceptualization, Methodology, Formal analysis, Project administration, Resources, Supervision, Validation, Writing – review & editing. **Nadene Marx-Pienaar:** Conceptualization, Methodology, Funding acquisition, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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