

Consumer Research Analysis

Exploring the Impact of Knots in White Pine on Consumer Preference and Pricing

Aayusha Chapagain and Paul Crovella

Biophilia describes the innate human affinity for nature, with wood serving as a biophilic material that supports human well-being. Despite mass timber's growing role in reducing building-related carbon emissions, approximately 30–40% of harvested wood is discarded due to visual defects such as knots, even though these defects have minimal structural impact in stiffness-governed applications like floor and roof decks. This reflects a persistent assumption that consumers prefer defect-free wood. A previous study (Chapagain & Crovella, 2025) examined physiological responses, creativity, concentration, and psychological reactions to wood with and without defects. Building on this work, the present study tests how knots in Eastern white pine influence consumer preference and perceived monetary value across self-identified Eastern and Western cultural backgrounds. Sixty participants (30 Eastern, 30 Western) evaluated AI-generated images of wood products with varying knot configurations through open-ended preference assessments and pricing tasks, and the data were analyzed using in-vivo qualitative coding. Results show that knots may not be universally disliked. Preferences depend on the number, placement, and visual integration of knots, with the strength of these preferences varying by product type and slightly differing across cultures. Pricing seemed to align closely with aesthetic preferences, while income had minimal influence. These findings challenge the bias toward defect-free wood in design and support the design-led use of knotty wood to reduce material waste while aligning sustainability goals with consumer acceptance.

Keywords: Wood, Defects, Knots, Consumer Preferences, Pricing

Introduction

The biophilic hypothesis proposes that humans have an inherent tendency to seek connections with nature, which contributes to the widespread perception of wood as a warm, natural, and health-supportive material (Zhong et al., 2022; Candido et al., 2021). Over several decades, research has examined both physiological and psychological responses to wood as a biophilic element. A study of interior environments demonstrates that wooden surfaces, such as walls, ceilings, and floors, can meaningfully influence human experience by engaging multiple sensory modalities, including visual, tactile, olfactory, and auditory perception (Jalilzadehazhari & Johansson, 2019). Empirical evidence links the presence of wood to enhanced well-being, including reduced stress, lower blood pressure, more positive emotional states, and increased feelings of calmness and warmth (Shigue, 2021; Tsunetsugu et al., 2007; Tsunetsugu

et al., 2002; Sakuragawa et al., 2005). Comparative research further indicates that wood elicits more positive emotional responses than non-natural materials such as plaster, reinforcing its psychological benefits (Demattè et al., 2018). Together, these findings highlight wood's capacity to support well-being through multi-sensory engagement, providing a foundation for examining how variations in wood appearance, such as natural defects like knots, may further shape human perception and response.

1.1. Wood defects: Knots

Wood defects are generally classified into three main types: growth-related defects caused by physiological factors, pest-induced damage resulting from pathological causes, and processing-related defects associated with human activities (Sang, 2013). Among the growth defects in timber, knots, cracks, slashes, burrs, and resin capsules are noteworthy, with most of these defects arising from the natural growth of trees (Sang, 2013). However, in the context of wood panel utilization, these are considered wood defects. For this study, we will specifically focus on knots.

Knots emerge as a distinctive surface feature in wood, originating from the remnants of branches within the tree trunk (Nakamura et al., 2022). Knots are considered defects in various studies (Qu et al., 2020; Budakci & Cinar, 2004; Kılıç et al., 2019; Karaszewski et al., 2013). However, the Northeastern Lumber Manufacturers Association (NELMA) describes knots as natural characteristics. NELMA is the rules-writing agency for Eastern White Pine lumber and the grading authority for the SPFs grouping of species that includes Eastern Spruce, Balsam Fir, Red Pine, and other commercially important softwood lumber

Contact

¹Aayusha Chapagain
State University of New York
College of Environmental Science and Forestry
Email: achapaga@syr.edu

Paul Crovella
State University of New York
College of Environmental Science and Forestry
Email: plcrovella@esf.edu

species grown in the northeast and Great Lakes regions in the United States. In addition, NELMA is a leading agency for wood packaging export certification and the marketing voice for the region's wood products industry (Nelma Grader Academy, 2025). Although knots are considered natural characteristics in visual grading systems such as NELMA's classification of Eastern White Pine, this study adopts the term wood defects in line with previous psychological and consumer-focused research.

1.2. Impact of Wood Defects on Consumer Preferences and Pricing

Some studies have investigated how wood defects influence consumer preferences and pricing. A study conducted in Japan (Nakamura et al., 2022) highlights that while knots indicate the wood's origin from a living tree, they are considered undesirable surface attributes that substantially diminish both the mechanical properties and aesthetic appeal of lumber.

On the other hand, a study in the U.S. (Wood, 2022) suggests that wood with a limited number of surface knots is generally preferred, as indicated by several research studies focusing on this pattern. Survey findings suggest that a few knots are intriguing, while an abundance of knots is generally disliked.

In Northern Europe, several studies have identified a distinct consumer preference for clear wood surfaces over knotty ones. Specifically, a study in Sweden (Broman, 2001) suggests that the selection of knotty surfaces hinges on achieving a delicate balance between visual harmony and texture activity. A study (Nyrud et al., 2008) in Norway found that a homogeneous surface texture and medium color intensity are significant to consumer preferences for knotty wood deck products. Similarly, another study (Høibø & Nyrud, 2010) underscored the experimental link between surface homogeneity and preferred wood products, an association significantly influenced by the presence of knots.

There is a limited amount of research on the impact of wood defects on pricing. Among the few, one study (Jayawardhane et al., 2016) was conducted in Sri Lanka. In Sri Lanka, when buying teak logs, customers assess their quality by visual appraisal of surface characteristics such as visible defects. Hence, the buyers' preference for logs with the desired attributes is reflected in the market price. The presence of a high number of knots had the highest detrimental impact on price, followed by the higher bend fraction, presence of hollows at the top end and/or middle of the log, presence of heart rot, and presence of buttresses, respectively.

1.3. Culture and its role in the experience of perceiving different products

Culture is a system of shared beliefs, values, customs, behaviors, and artifacts that members of a society use to navigate their environment and interact with one another, passed down from generation to generation through learning (Bates, 1990). A study (Afrough, 2009) conceptualizes culture as consisting of six interconnected layers: (1) worldview, beliefs, and attitudes toward existence; (2) value systems used to judge what is good or bad, pleasant or unpleasant, and right or wrong; (3) shared behavioral patterns, including norms, customs, traditions, and rituals; (4) symbolic expressions such as language, architecture,

music, and visual forms; (5) ideologies grounded in collective values; and (6) material and social technologies, where material technology refers to skills involved in making and using objects, and social technology relates to modes of communication and social organization.

Within the field of design, culture is considered one of the most important issues affecting users' perception of products, as well as designers' thinking and insight (Afrashteh et al., 2020). Because product design is inherently concerned with the creation of material objects, it is deeply influenced by designers' cultural backgrounds and the cultural contexts of the communities in which products are embedded. A study (Spencer-Oatey, 2021) further suggests that physical artifacts, such as products, constitute one of the fundamental levels through which culture is expressed and experienced. As a result, the relationship between culture and products is significant, influencing not only the need for a product and its formal development, but also how it is perceived by users (Afrashteh et al., 2020).

User perception, in particular, has been shown to vary across cultural contexts (Çakmakçioğlu, 2017). Designers' and users' interpretations of products are shaped by shared cultural frameworks, which influence how meaning is constructed through interaction with an object. When designers and users share similar cultural references, product understanding tends to be more intuitive. Examining cultural influence, therefore, becomes especially relevant when investigating whether users from different cultural backgrounds experience and interpret the same product in distinct ways (Afrashteh et al., 2020).

Rationale for the study

The main objective of this study is to examine whether consumer preferences and pricing differ between wood with and without defects (Eastern White Pine with and without knots) and whether the preference is influenced by the consumer's cultural background.

When exploring ways to expand wood utilization, it is vital to consider the potential for increased use, including that with defects. Since the ratification of the Paris Agreement at the United Nations in New York in 2016, nations globally have actively engaged in initiatives focused on resource conservation, enhanced energy efficiency, and diminished carbon emissions (Chen et al., 2023).

In the practical realm of wood production, safeguarding forest resources and optimizing wood utilization have gained increased significance (Broman, 2001). Wood processing industries have consistently aimed to maximize yields in their operations, thereby minimizing the volume loss of wood (Broman, 2001). Notably, within wood processing, only 50 to 70% of logs are utilized after the removal of defects, bark, and branches, and the rest are discarded (Zhuang, 2010).

Moreover, the use of wood in construction helps in reducing carbon emissions in the building sector. Mass timber construction, driven by innovative engineered wood products like Cross-Laminated Timber (CLT), offers significant potential for reducing embodied carbon emissions in the building sector (Gu et al., 2021; Duan et al., 2022). The use of mass timber primarily depends on its stiffness, which is minimally influenced

by the presence of knots (Rocha et al., 2018). However, wood containing knots is typically avoided on exposed surfaces due to aesthetic considerations. Therefore, it is crucial to consider the inclusion of wood with defects (knots) for increased wood utilization.

Additionally, research examining wood defects in wood products and their influence on consumers has largely focused on participants from single countries or cultural contexts (Jayawardhane et al., 2016; Broman, 1995; Ramanakoto et al., 2017; Matsumoto et al., 2016), and the results may not be directly applicable to different countries and cultures. To address this potential bias, the present study categorizes participants into two broad cultural groups: Eastern and Western. While this classification may be considered a colonial perspective and oversimplifies global cultural diversity, it is employed here to provide a general framework for examining whether culture affects responses to different wood characteristics. These terms are used solely for comparative purposes and are not intended to reinforce cultural stereotypes, acknowledging the wide variety of values, experiences, and perspectives within each group.

In summary, this study addresses a gap in the literature by examining participants from two broad cultural backgrounds to explore how wood defects influence consumer preferences and pricing, while highlighting the potential role of defect-inclusive wood in design.

2. Method

Figure 1 illustrates the overall research framework, encompassing both pre-arrival and post-arrival phases. The pre-arrival phase involved participant screening, cubicle construction, participant selection, and an availability survey. The post-arrival phase comprised physiological measurements, psychological assessments, creativity and concentration tasks, as well as evaluations of consumer preferences and pricing via an open-

ended questionnaire. The open-ended questionnaire is the main focus of this study.

2.1. Participants Pre-Arrival

This stage took place before the day of the actual experimental design. It included all the preparation stages, such as sample size calculation, participant selection via screening survey, construction of cubicles, and an availability survey.

Participants: The study included 60 student participants, a sample size informed by prior power calculations (Ojala et al., 2023) and adjusted to ensure equal cultural representation (30 Eastern, 30 Western), based on self-identified cultural background.

Participants recruitment and selection: Participants were recruited from universities in Syracuse, New York, through posters and email distribution, and screened via a Qualtrics® survey for eligibility (18+, student status, consent) and cultural identification. Cultural background was assessed using multiple indicators, including values, communication style, individualism-collectivism, and social norms. The demographics of the selected participants are shown in Table 1.

Cubicles Construction: Two experimental cubicles (Figure 2) were constructed using Eastern White Pine, one with visible defects (knots) (Figure 3) and one without (Figure 4). The wood was selected for its availability, contrast, and versatility, and was used in specific grades, finished with a water-based sealer. Participants scheduled visits via Calendly® between February and March 2025.

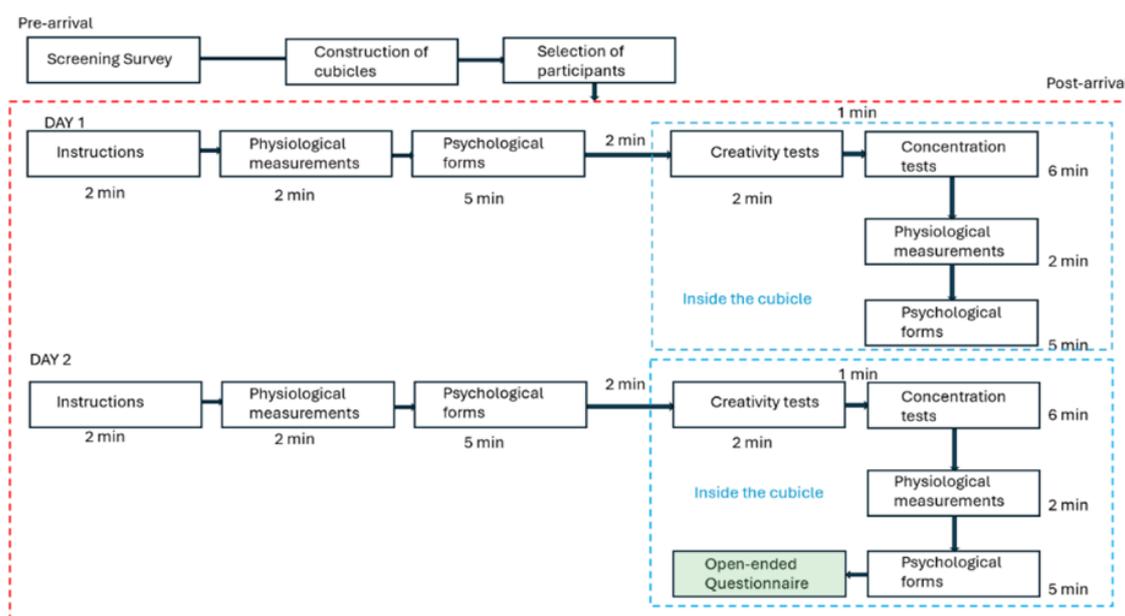


Figure 1 Diagram showing the different stages of the complete research framework; the Open-ended Questionnaire, which is the main focus of this study, is highlighted in green.

Table 1: Demographics of the 60 participants chosen for the experimental study from a total of 178 individuals who completed the online screening survey.

Participants	n	Percentage (%)
Age		
18-24	17	28.3
25-34	35	58.3
35-44	7	23.3
45 and above	1	1.6
Ethnicity		
Caucasian	22	36.6
African American	3	5
Latino Hispanic	1	1.6
Asian	29	48.3
Two or more	1	1.6
Other/Unknown	4	6.6
Annual Income		
Less than 25k	43	71.6
25k-49k	11	18.3
50k-74k	5	8.3
75k-99k	1	1.6
Self-identified culture		
Eastern	30	50
Western	30	50

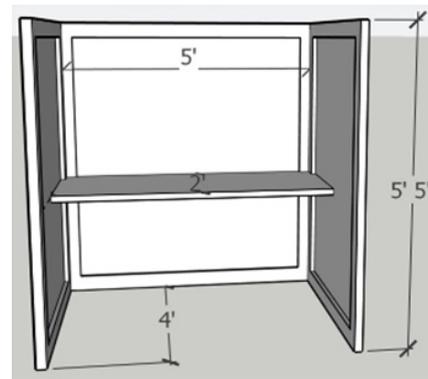


Figure 2 Dimensions of the cubicles used in the study



Figure 3 Cubicle made of Eastern White Pine with knots used in the study



Figure 4 Cubicle made up of Eastern White Pine without knots used in the study

2.2. Participants’ Post-Arrival and Experimental Design

This stage took place on the day of the experimental design, following the completion of preparatory stages and ensuring all arrangements were in place. It involved administering pre- and post-psychological forms, conducting physiological measurements, performing concentration and creativity tests, and filling an open-ended questionnaire. The experiment was repeated twice on separate days. All tests and procedures were consistent across both days, with the exception of the open-ended questionnaire, which was administered only on the second day. Participants were exposed to both conditions in a counterbalanced design: those assigned to the cubicle with defects on Day 1 were placed in the cubicle without defects on Day 2, and vice versa, with sessions conducted at the same time of day and separated by a two-week interval.

The methods, results, and discussion related to aspects other than consumer preferences and pricing have been reported in a prior publication (Chapagain & Crovella, 2025) and are therefore not addressed in this study. The present analysis focuses exclusively on findings from the open-ended questionnaire, which capture consumer preferences and pricing perceptions.

2.2.1. Open-ended questionnaire: At the end of the second visit, after approximately 30 minutes spent in the cubicles completing other tasks, each participant completed a brief open-

ended questionnaire while inside the cubicle. Participants were presented with the AI-generated images of two sets of similar objects (a key ring-Figure 5 and a pencil holder-Figure 6), options consisting of ‘wood with defects’ and the other of ‘wood without defects.’ These images were created using the Artificial Intelligence (AI) image generator feature of ChatGPT 4.0. Participants were asked to express their preference between the two sets and provide reasons for their choice. They were also asked to assign a price to each of the four items. Participants were free to set any price they wanted, with no concerns about budget limitations or affordability. The responses were then collected. The open-ended questionnaire did not have any time limit and was used to determine consumer preferences and their impact on pricing.



Figure 5 Question No. 1 of an open-ended questionnaire featuring Two Options for a Key Ring

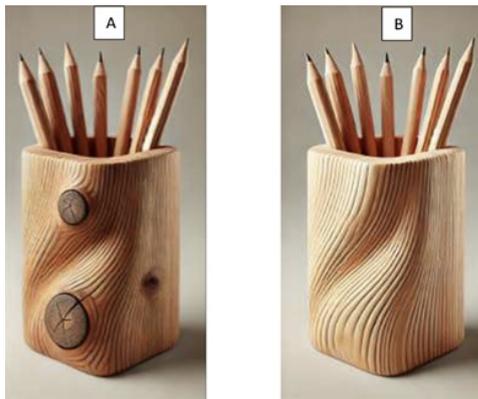


Figure 6 Question No. 2 of an open-ended questionnaire featuring two options for a Pencil Holder

The questions asked in the questionnaire were:

1. Which option would you prefer for Question 1 and Question 2, and why?
2. Assign prices for both options (A and B) in both questions (Question No. 1 and 2).

2.2.2. *Data Analysis:* Open-ended questionnaire responses were examined using in vivo coding, where participants’ actual words served as codes to identify themes. Codes were organized in Excel and visualized through pie charts. All analyses were conducted for 60 participants in total, followed by subgroup analyses within Eastern ($n=30$) and Western ($n=30$) cultural groups, and comparative analysis between the two.

3. Results

The data analysis provided results for consumer preference and pricing, first for the total number of participants, then separately within Eastern and Western cultural groups for ‘with and without’ conditions.

Open-ended Questionnaire

The four questions in the open-ended questionnaire yielded insightful results. Two of the questions focused on participants’ preferences among four products, with two featuring wood defects and two without defects. The remaining two questions

required participants to assign prices to each of the four products.

Question 1 (Figure 5: Key Ring): When asked to choose between Option A (wood without defects) and Option B (wood with defects), 28 participants (46.6%) preferred Option A, while 32 participants (53.3%) selected Option B, as shown in Figure 7.

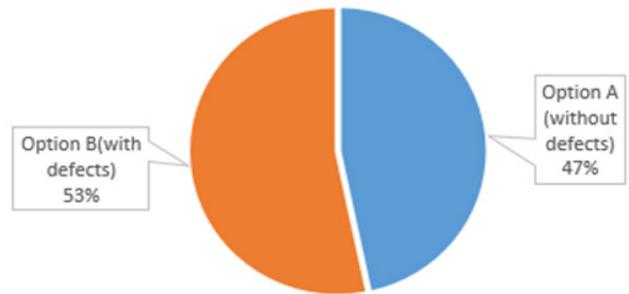


Figure 7 Pie chart showing the total (%) of participants who preferred Option A or Option B in Question 1 (Keyring) in an open-ended questionnaire

Among the participants who selected Option A (without defects) in Question 1 (Keyring), the most common reason cited was related to a Minimalistic Aesthetic, which included responses such as “clean,” “clear,” “simple,” or “smooth.” This group accounted for 46.42% (13 out of 28 participants). The second most common theme was Positive Emotional Response, encompassing terms such as “appealing,” “attractive,” “calm,” or “peaceful,” reported by 17.85% (5 participants). A specific Dislike of Knots was noted by 10.71% (3 participants), reflecting an aversion to natural knots in wood. The remaining 25% (7 participants) provided responses that differed from those categorized. The results are summarized and tabulated in Table 2.

Among the participants who selected Option B (with defects) in Question 1 (Keyring), the most frequent reason was related to Cognitive Engagement, with 37.5% (12 out of 32 participants) describing the keyring as “interesting.” The second most common theme was Closeness to Nature, including responses like “tree ring” or “tree pattern,” mentioned by 18.7% (6 participants). Reasons tied to Perceived Personality or Uniqueness, such as “unique” or “character,” were cited by 15.6% (5 participants), as were responses categorized under Others, also making up 15.6% (5 participants). Finally, Visual or Aesthetic Qualities, such as the keyring being “better looking,” accounted for 12.5% (4 participants). The results are summarized and tabulated in Table 3 below.

Question no. 2 (Figure 6: Pencil Holder): Among the participants, 19 individuals (31.6%) preferred Option A (wood with defects), while 41 individuals (68.3%) selected Option B (wood without defects).

Of the participants who selected Option A (with defects) in Question 2 (Pencil Holder), a total of 19 individuals (representing 31.6% of all respondents) chose this option (Figure 8). The most frequently cited reason was Natural Appeal, including terms like

Table 2 Table showing the reasons behind the responses of participants choosing Option A (without defects) in Question 1 (Key ring)

Group Name	Includes	Number	% (out of 28)
Minimalistic Aesthetic	Clean/Clear/Simple/Smooth	13	46.42
Others	Others	7	25
Positive Emotional Response	Appealing/Attractive/Calm/Peaceful	5	17.85
Dislike	Disliking knots	3	10.71

Table 3 Table showing the reasons given by participants for choosing Option B (with defects) in Question 1 (Key Ring)

Group Name	Includes	Number	%
Cognitive engagement	Interesting	12	37.5
Close to Nature	Tree ring/Tree pattern	6	18.7
Others	Others	5	15.6
Perceived personality or uniqueness	Unique, Character	5	15.6
Visual or Aesthetic Qualities	Better looking	4	12.5

Table 4 Table showing the reasons given by participants for choosing Option A (with defects) in Question 2 (Pencil Holder)

Group Name	Reason	Number	% (out of 19)
Natural appeal	Tree/Natural	8	42.1
Emotional Engagement	Interesting/ Appealing	6	31.6
Design Value	Unique design/design	5	26.3

“tree” or “natural,” mentioned by 42.1% (8 out of 19 participants). This was followed by reasons reflecting Emotional Engagement, such as “interesting” or “appealing,” reported by 31.6% (6 participants). The remaining 26.3% (5 participants) referenced Design Value, highlighting responses like “unique design” or simply “design.” The results are summarized and tabulated in Table 4.

A total of 41 participants (68.3%) selected Option B (without defects) in Question 2 (Pencil Holder). The most common reason given was related to a Minimalist and Orderly Aesthetic, including responses such as “clean,” “simple/sleek,” “order and uniformity,” and “smooth,” cited by 48.7% (20 out of 41 participants). Dislike of knots was the next most frequent reason, reported by 24.4% (10 participants). Positive Aesthetic Response, including terms like “attractive” or “pleasing,” accounted for 12.2% (5 participants), while the remaining 14.6% (6 participants) gave responses classified under Others. The results are summarized and tabulated in Table 5.

When analyzing participant preferences by cultural background, the responses were divided into Eastern and Western culture groups for the two questions (Figures 9 and 10).

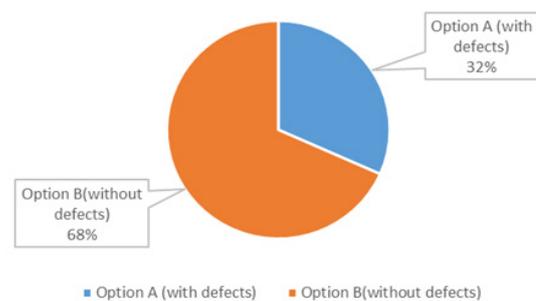


Figure 8 Participant’s preference (in %) between Option A (with defects) and Option B (without defects) for Question 2 (Pencil Holder), asked in an open-ended questionnaire

Eastern Culture

For Question 1 (Keyring), 14 participants selected Option A (without defects) and 16 selected Option B (with defects). A chi-square goodness-of-fit test indicated that this distribution did not differ significantly from equal proportions ($\chi^2(1) = 0.13, p = 0.72$).

For Question 2 (Pencil Holder), 8 participants preferred Option A (with defects), while 22 preferred Option B (without defects), representing a statistically significant deviation from equal preference ($\chi^2(1) = 6.53, p = 0.01$).

Table 5 Table showing the reasons given by participants for choosing Option B (without defects) in Question 2 (Pencil Holder)

Group Name	Includes	Number	%
Minimalist and Orderly Aesthetic	Clean, Simple/Sleek, Order and Uniformity, Smooth	20	48.7
Dislike	Disliking knots	10	24.4
Others	Others	6	14.6
Positive Aesthetic Response	Attractive/Pleasing	5	12.2

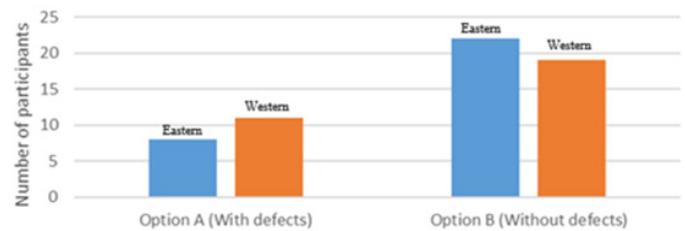
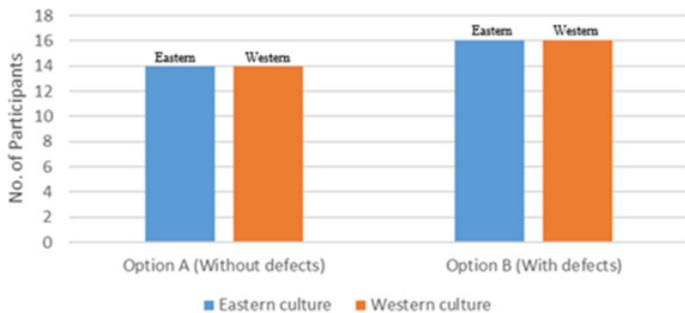


Figure 9 The number of participants choosing Option A (without defects) and Option B (with defects) in Eastern VS Western culture for Question 1 (Key Ring)

Figure 10 The number of participants choosing Option A (with defects) and Option B (without defects) in Eastern VS Western Culture for Question 2 (Pencil Holder)

Western Culture

For Question 1 (Keyring), preferences were similarly balanced, with 14 participants selecting Option A (without defects) and 16 selecting Option B (with defects); this difference was not statistically significant ($\chi^2(1) = 0.13, p = 0.72$).

For Question 2 (Pencil Holder), 11 participants preferred Option A (with defects) and 19 selected Option B (without defects). Although this distribution suggested a numerical preference for the option without defects, the difference did not reach statistical significance ($\chi^2(1) = 2.13, p = 0.14$).

Cross-Cultural Synthesis: While a slight numerical preference for the option with defects was observed for the keyring across both cultural groups, the lack of statistical significance suggests that small or isolated defects were generally acceptable in this context. Conversely, preferences shifted more decisively toward the pencil holder, with participants in both groups favoring the defect-free option. This trend reached statistical significance among Eastern participants but remained a non-significant trend among Western participants. Taken together, these results indicate that, while the direction of preference was consistent across cultures, the strength of the response varied by product type, highlighting the roles of visual complexity and defect integration in shaping consumer evaluation.

Assigning prices to the products

Participants also assigned prices to the four products. Out of a total of 120 responses obtained from 60 participants (Figure 11), 68 responses showed that most participants placed a higher value on the products they preferred. However, in 14 responses,

participants assigned a higher price to products they did not prefer, while 38 responses indicated that participants valued the products equally.

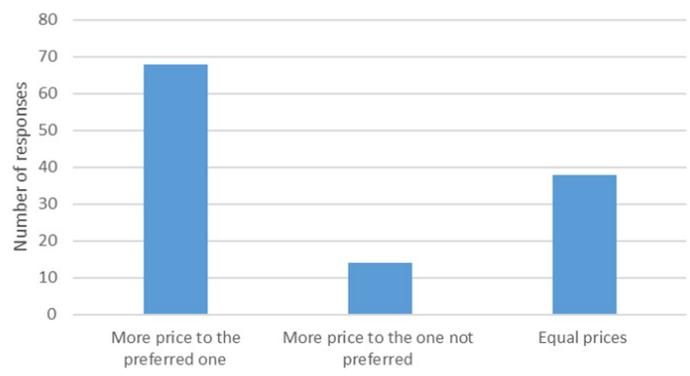


Figure 11 Price allocation of the four options (two with defects and two without defects) based on 120 responses from 60 participants

For Question 1 (Keyring), the mean price for Option A (without defects) was \$10.80, whereas Option B (with defects) had a marginally higher average of \$10.82. However, because the p-value is 0.98, well above the 0.05 threshold, the difference between these two averages is not statistically significant. In Question 2 (Pencil Holder), Option A (with defects) received an average price of \$14.40, while Option B (without defects) was assigned a higher average of \$15.30. Yet again, with a p-value of 0.49, the difference is not statistically significant. The graph (Figure 12) shows the average price assigned for the four options.



Figure 12 Average price assigned by 60 participants for four options (two with defects and two without defects) in two questions (Keyring and Pencil Holder) in an open-ended questionnaire

Table 6 The relationship between economic status and the price range assigned to the products

Economic status (\$)	Price range (\$)
Less than 25k	\$1-\$90
25k-49k	\$5-\$80
50k-74k	\$8-\$40
75k-99k	\$25

4. Discussion

This study seeks to determine if the presence of knots in Eastern White Pine influences consumer preference and pricing, and whether these evaluations are shaped by cultural background.

Consumer preference analysis indicated nuanced perceptions of wood defects, where the “naturalness” of a defect was weighed against its impact on visual order. While a numerical majority preferred the keyring with a single central knot, describing it as natural and visually engaging, this preference did not reach statistical significance, suggesting that small, isolated defects are generally acceptable but not necessarily a primary driver of choice. Conversely, the pencil holder with two knots was significantly less popular, particularly among Eastern participants, as it was perceived as chaotic and disordered. These results align with the principle that aesthetic preference depends on the visual balance between harmony and activity (Broman, 2001). Ultimately, consumer evaluation appears to be influenced by the number, location, and integration of knots. While Western participants showed a slightly higher numerical acceptance of defects, the strength of this cultural divergence remained a non-significant trend, requiring further study with larger sample sizes.

Pricing data further supported the link between preference and valuation. Participants tended to assign higher prices to items they preferred, with 68 of 120 responses reflecting this trend. Products with more defects received lower valuations, consistent with previous studies showing that too many knots reduce perceived worth (Jayawardhane et al., 2016). Income level showed minimal impact on pricing decisions, indicating that aesthetic and emotional factors, rather than economic background, may primarily drive valuation.

Overall, these findings challenge the assumption that wood defects are universally undesirable. When knots are well-integrated and contribute to visual harmony, they may enhance aesthetic appeal and emotional connection, suggesting that “defects” in Mass Timber are not intrinsically negative. Their acceptability depends on a combination of visibility, function, and the meaning assigned to the space. For example, while a “chaotic” distribution may be rejected in small, tactile objects like pencil holders, similar features in large-scale Mass Timber installations might be celebrated as a biophilic connection to nature. Encouraging the use of wood with natural defects across all scales, from consumer goods to structural timber, can significantly reduce material waste and improve industrial efficiency while remaining aligned with evolving consumer preferences and market potential.

5. Limitations of the Study

While this study provides meaningful insights into consumer preferences and pricing, several limitations should be acknowledged. The broad classification of participants into Eastern and Western cultural groups oversimplifies cultural diversity, as it cannot fully represent the nuanced regional, linguistic, and experiential differences within each category. Since participants self-identified their cultural group, individual variations in exposure to multiple cultures or differing value systems may not have been fully captured. Future studies could adopt more refined cultural frameworks and validated orientation scales to better understand how cultural context shapes responses to natural materials. The relatively small sample size ($N = 60$) further limits generalizability, and the absence of a pilot study may have constrained opportunities to refine methodology

and ensure data reliability. All findings are based on Eastern White Pine, whose distinct appearance and scent may not represent other wood species. Finally, the use of AI-generated wood images introduced slight realism issues in grain patterns, which may have influenced participant perceptions.

6. Conclusion

The study of consumer preferences and pricing for wood with and without defects revealed several important insights. Preferences appeared to be influenced by the location, number, and integration of defects within the product. Contrary to the assumption that defects are inherently undesirable, knots and natural variations that contribute to visual harmony may be perceived positively, sometimes even preferred over defect-free wood. These aesthetic preferences might influence pricing, with consumers assigning higher value to products that are visually engaging or environmentally meaningful. Extending these findings to Mass Timber suggests that embracing well-integrated defects in architectural and structural applications may enhance material character, foster biophilic connections, reduce waste, and improve industrial efficiency. Despite these insights, the study has limitations: future research should incorporate more diverse cultural and demographic samples, explore socio-economic influences, and examine how perceptions of wood defects evolve over time. Such work could deepen understanding of human-wood interactions and support more sustainable and aesthetically informed timber design practices.

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Conflicts of Interest: The authors declare no conflicts of interest.

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