American Beech in Value-added Hardwood Products: Assessing Consumer Preferences

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The depleted state of the northern hardwood forests of Quebec, Canada has forced the hardwood flooring industry to adapt its production. American beech (*Fagus grandifolia*), a traditionally less desired species, is now increasingly being included in wood supplies to sawmills in western Quebec, where forest managers hope this resource can be valued before the onset of significant mortality and wood degradation from the beech bark disease. This study aimed: 1) to assess the preferences of consumers towards American beech flooring products compared to well known species traditionally used in this market; and 2) to compare results obtained in face-to-face surveys with web-based surveys of consumer preferences. Results from both survey types revealed that the finishing colour was the most important factor affecting the decision of respondents, followed by species and price. American beech ranked third in species preferences, just above birch. Divulgating species names only affected (positively) the perception of respondents towards oak. It was concluded that American beech could be included in the current wood flooring market, probably among cheaper options such as birch. The similarity of results from face-to-face and online surveys suggests that general trends in consumer preferences could be rapidly and cheaply assessed using the latter option.

Keywords: American beech; Flooring; Consumer preferences; Choice-based conjoint analysis; Value-added wood products; Face-to-face vs. online surveys

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INTRODUCTION

The northern hardwood forests of northeastern North America have been subject to a gradual depletion over the last decades, mainly due to inadequate silvicultural practices that involved a selection bias towards stems of the highest quality (Nyland 1992). As a result, industries that currently rely on these forests for their production have to adapt to the declining quality of their wood supply. Silvicultural solutions have been proposed (Nyland *et al.* 2007; Pothier *et al.* 2013; Havreljuk *et al.* 2014), but their effects on the composition and quality of the forest resource will only be measurable over the long term. In the short term, the hardwood processing industry has to produce desirable, value-added products from raw material traditionally considered of low grade. In this perspective, the addition of species once considered undesirable by wood processors offers an opportunity to present new products to consumers.

Because it is a major processing pathway for hardwood timber, the wood flooring industry could play a key role in resolving this issue. In Canada, this industry is mainly concentrated around the northern hardwood forests in the provinces of Quebec, Ontario,

and New Brunswick. At the global scale, this industrial cluster is considered the sixth most important regional hub of wood flooring production (FPInnovations 2009). In 2015, over 75% of the consumption of wood flooring products in the US, its main market, consisted of only four wood types: red and white oak, maple, and birch (NWFA 2016).

In addition to issues related to the quality of the resource, this industry has suffered from increasing international production, as well as from the economic crisis of 2008 that severely hit the US home building sector. In 2009, housing starts fell below 500,000 units in April 2009, while they reached over 1.3 million in January 2018 (Trading Economics 2018). Current market conditions appear to be improving with the recent recovery of the US housing sector. Also, the main purchases (60.1%) of hardwood flooring are made to replace existing residential floors, with new residential and commercial building representing 21.1% and 8.1%, respectively (Catalina Research in Floor Covering Weekly, 2014). It was estimated that hardwood flooring represented 16.4% of the overall US floor covering sales in 2015, for a total market sales value of $3.791 billion (Floor Covering Weekly 2016). The market sales value of the hardwood flooring industry in the US has continuously grown since 2011, when the market sales value was $2.052 billion. From 2013 to 2017, the American wood flooring imports from Canada have increased in value from $1.307 million to $11.979 million (USDA 2017).

A preliminary qualitative survey conducted among sawmillers, wholesalers, floor producers, architects, designers, and consumers confirmed that these stakeholders may be open to the idea of integrating American beech (*Fagus grandifolia*) to their products portfolio (Bernard *et* al. 2015). Architects and designers rated American beech samples first among other commonly used yet unnamed species. Significant mortality and wood degradation has been observed for this species due to beech bark disease (Houston 1994). However, this epidemic has been progressing slowly from the southeast of its distribution range to the northwest (Kasson and Livingston 2012). The level of damage remains relatively low in the Outaouais region of Quebec and in Ontario, where significant standing volumes can be found. American beech is mainly used in low-grade products such as pallet wood and firewood, and it is sparingly used for flooring (Bernard *et* al. 2015). Despite this, Pothier *et* al. (2013) showed that good quality sawlogs are commonly found among the smaller stems. Managers of the public forests in the Outaouais region are hoping that this resource can be utilized for manufacturing before the onset of significant damage from the beech bark disease (Sébastien Meunier, personal communication, March 8, 2017).

The four selected species are qualified as having satisfactory bonding characteristics, which means that they bond with good-quality adhesives and under well-controlled conditions (Frihart and Hunt 2010). It was reported that applying a finish (latex paint in this case) was easier on maple, beech, and birch than on oak (Williams 2010). Beech has higher tangential shrinkage than the other species, which tends to complicate its drying process (Table 2). Anatomically, beech, birch and maple belong to the diffuse-porous hardwoods while oak is ring-porous, which implies large variations of density between the early- and latewood (Williams 2010). The main wood properties of the four selected species are summarized in Tables 1 and 2.

Despite this potential interest for a lesser-known species, the level of appreciation of end-costumers remains unknown. Also, even if the grain and the general appearance of American beech wood is appreciated, the opinion of consumers may be altered when naming this lesser-known species, as was observed by Nicholls *et al.* (2004). Aside from factors related to the species, Bernard *et al.* (2015) also identified the retail price and stain

colour as other important factors potentially affecting the perception of a given wood sample.

Table 1. Various Wood Properties of the Selected Species

Species	Qualitative character-istics[1]	Colour	Sapwood (cm)[1]	Shrinkage from green to ovendry moisture content (in %)[2]			Air dried density (kg/m³)[3]
				Tangential	Radial	Volumetric	
Red oak	Heavy, hard, tough	White sapwood of about 5 cm wide[4] and light-reddish[4] to brown heartwood[1]	2 to 5	7.7	3.8	12.9	690
Sugar maple	Strong, stiff, hard, resistant to shock	White sapwood with a slight reddish-brown tinge and light reddish brown heartwood[1]	8 to 12	9.4	4.7	15.2	740
Yellow birch	Heavy, hard, strong and good shock-resistance ability	Sapwood is whitish, pale yellow or light reddish-brown and the heartwood is light to dark golden-brown to light reddish-brown[4]	NA	8.3	6.6	16	670
American beech	Heavy, hard, strong and high resistance to shock	White sapwood and dark[4] to reddish-brown heartwood[1]	7 to 13	11	5.4	17.3	750

[1]Wiemann (2010); [2]Mean values calculated from Jessome (2000) and Glass and Zelinka (2010); [3]Jessome (2000); [4]Flynn and Holder (2001)

Marketing studies focusing on wood products have usually used face-to-face surveys or conventional surveys by mail to document consumer preferences (Bumgardner and Bowe 2002; Bowe and Bumgardner 2004; Anderson *et al.* 2005; Aguilar and Vlosky 2007). Internet-based surveys are increasingly being used in marketing studies and the early adopters of this type of research were those with a high presence on the web, such as financial services, internet-based businesses, information technology, media and telecommunication, and governments (Wilson and Laskey 2003). Studies in psychology, health, and policy design have compared different types of surveys to evaluate the data

quality of results from online surveys comparatively to traditional surveys (mail, phone or face-to-face) (Best *et al*. 2001; Kaplowitz *et al.* 2004; Duffy *et al.* 2005; Heerwegh and Loosveldt 2008). Various pros and cons have been identified, but the main points are that online surveys are cheap and less time-consuming, although they generate higher sample bias. Duffy *et al.* (2005) have attempted to fix the sample bias by double weighting the data with demographics and attitude. For some question types, the approach proved successful, but in some of the other cases the difference between the survey types remained important.

Table 2. Mechanical Properties of the Selected Species

Species	Moisture content	Static bending			Impact bending (mm)	Compression parallel to grain(kPa)	Compression perpendicular to grain (kPa)	Shear parallel to grain (kPa)	Tension perpendicular to grain (kPa)
		Modulus of rupture (kPa)	Modulus of elasicity (MPa)	Work to max load (kJ m^{-3})					
Red oak	Green	60,750	10,050	103	1,360	25,450	4,820	8,250	5,870
	12%	98,850	12,200	109	1,270	48,200	7,945	13,485	6,010
Sugar maple	Green	67,750	11,200	109	1,195	29,550	5,145	10,620	7,180
	12%	112,000	13,350	128	1,220	53,700	9,910	16,405	9,210
Yellow birch	Green	56,900	10,450	119	1,310	23,400	3,180	6,450	4,105
	12%	110,000	14,000	143	1,460	54,200	6,970	13,835	6,910
American beech	Green	61,000	9,950	88	1,220	25,400	4,125	9,025	5,650
	12%	109,500	12,950	132	1,475	52,750	7,670	14,205	7,935
All values are the means of two values reported by Kretschmann (2010) and Jessome (2000)									

In the context of marketing wood products, some studies have used a web interface to reach customers (Lih*ra et al.* 2012; Chamberland *et al.* 2016), but to our knowledge no studies have attempted to assess the impact of the surveying method on the results. In addition, while consumer preferences have been assessed for wooden furniture (Donovan and Nicholls 2003; Nicholls *et al.* 2004a; Wang *et al.* 2004; Lihra *et al.* 2012) or for certified wood products (Forsyth *et al.* 1999; Cai and Aguilar 2013; Chamberland *et al.* 2016) few have focused on hardwood flooring characteristics.

The objectives of this study were twofold. First, this study sought to assess the perception of consumers towards American beech flooring products among better-known species traditionally used in this market. It was hypothesized that potential consumers would appreciate American beech products, but that their perception would be altered when the species is named. Second, this study aimed to compare results obtained in face-to-face and web-based surveys. For this objective, it was hypothesized that web-based questionnaires and traditional face-to-face surveys would yield similar assessments of customer preferences for flooring products.

EXPERIMENTAL

Materials

Questionnaire

A choice-based conjoint analysis was used to assess consumer preferences in this study (Gustafsson *et al.* 2007). The choice-based design allows an assessment of the relative importance of each attribute in the decision made by consumers. First, a questionnaire was developed in which the attributes were divided into different levels. The species selection was based on the main products available in the current market. The main species processed by the Quebec wood flooring industry are sugar maple (*Acer saccharum*), red oak (*Quercus rubra*), and yellow birch (*Betula alleghaniensis*) (Bruno Couture, QWEB, Personal communication, autumn 2017). They were thus selected in this analysis along with American beech, which was included as an atypical species that could be valued. The chosen price levels were taken from Chamberland *et al.* (2016), who surveyed specialized shops. They were deemed to be representative of the current market prices and were presented on a per-square-foot basis. Respondents were asked to imagine a purchasing situation for a standard living room of a 375-square-foot area. For colour grades, the natural and medium colours were offered as 'conservative' options, while the chocolate and grey colours were chosen as more 'modern' options associated with a less traditional design. The levels of all attributes are summarized in Table 3.

Table 3. Attribute and Attribute Levels Used to Develop the Product Matrix

Attributes	Levels
Species	Yellow birch
	American beech
	Sugar maple
	Red oak
Colour	Natural
	Medium
	Chocolate
	Grey
Price ($/ft^2)	3
	5
	7

The MktEx macro from the SAS® software version 9.4 (Copyright © 2002-2012, SAS Institute Inc., Cary, NC, USA) was used to design the choice-based experiment. The questionnaire consisted of 12 randomized choice tasks, each including three products. Respondents were asked to select the product they preferred under the scenario that they had to change the flooring in their living room. For each question, they were asked to imagine that only the three displayed products were available. Each product presented a combination of each attribute level, for a total of 48 products possibilities (4 species X 3 prices X 4 colours = 48 products). The design was randomized and balanced in order to have optimal choice tasks, which resulted in the choice of 36 products being presented with different levels of species, colour and price. To reduce the answering bias, the order of the questions was changed for every respondent.

In addition to the choice tasks, the respondents could also choose the "none of the above" option in all cases. Including this "none" option was deemed to be more

representative of a buying situation where the customer has the option of not buying what is available. To illustrate the products, pictures were included in the questionnaire (Fig. 1). In the face-to-face survey, wood samples were made physically available to the respondents. Prior to the choice tasks, six socio-demographic questions were asked to describe the samples by gender, age, income, house property status, and their real-life flooring purchase situation. Also, two questionnaires were developed, one including and one not including a presentation of the species names.

Fig. 1. Example of a choice task in the questionnaire that named the species

Methods

Wood attributes influencing consumer preferences

Studying consumer preferences is complex because several factors may influence buying choices. Bettman *et al.* (1998) have summarized that first, the choice made by consumers are guided by the options basket and by the goal of the decision maker. Second, the choice will depend on the complexity of the decision task, which means that a pressing need will not go through the same decision-making process as a non-pressing need. Third, the context of the purchase greatly influences the consumer choice, which implies that it is not only the characteristics of the chosen option that dictate the choice, but also those of the other options by comparison. Fourth, the choice selection can be influenced by the surveying approach. Online versus face-to-face methods, even when pursuing the same objectives, might not necessarily yield the same results. Finally, selection is dependent on the choice set display. As a result of this complex decision-making process, bias may arise from the fact that studies cannot look at the entire process, but only at a segment.

Being aware of the buying conditions, the studied defined products through a range of intrinsic attributes inspired by the literature. Roos and Hugosson (2008) considered five attributes when comparing hardwood and laminate floors: floor type, price, environmental certification, warranty, and DIY floor covering instructions. Aguilar and Vlosky (2007) concluded that environmental certification was not a major attribute in the consumers' decision-making process, and that it concerned only a certain category of respondents, such as people that believed in the certification and those with a household income over $40,000. For this reason, this study did not to consider this attribute.

Previous studies have shown an interesting potential for the use of undesired species in wood furniture (Donovan and Nicholls 2003; Wa*ng et* al. 2004). For wood furniture, the main observed attributes are the design or the style of the product, the price,

the density of marks or the wood grain, the warranty, the wood provenance, and the species. Bumgardner *et al.* (2007) showed that species information could alter the decision to buy a product or not. This factor was thus added to the list of attributes for this study.

In light of the results of previous studies and those of our preliminary research (Bernard *et al.* 2015), the appearance of the products might influence the consumer's choice (Jonsson 2005a; Roos and Hugosson 2008; Lindberg *et al.* 2013). Offering different colour options allows an assessment of the extent to which the appearance of the species matters compared to the processed appearance of the wood sample. In a real buying situation, the consumer could also decide among various types of wood finishes (*i.e.* barn wood, faux finish, dye, or varnish). In the interest of maintaining the simplicity of the analysis, this factor was not included in the surveys.

As it is obviously one of the main factors affecting any buying decision, the price of the products was also considered in an attempt to reproduce as closely as possible the choice made in a real buying situation. Therefore, the attributes considered for this study were the species, the price, and the colour.

Data collection

Face-to-face surveys were first conducted at two home shows, one in Laval (QC, Canada, January 2015) and one in Boston (MA, USA, February 2015). Then, internet-based surveys were submitted to two online panels, one in French destined to the Quebec province and the other in English for the United States. The questionnaire was the same as the face-to-face surveys and it was elaborated on SurveyMonkey (Copyright © 1999-2016). The web link was then sent through Lightspeed GMI's panels, a specialized firm in survey designs with a global panel of millions of respondents. For this study, the panels were composed of 1.3 million people for the US respondents and of 45,000 people for the French Canadian respondents.

In both surveys, a pre-test was performed. For the face-to-face survey, the pre-test was conducted at Laval University (QC, Canada) with students and professors from the Faculty of Forestry. For the online survey, Lightspeed GMI (Copyright © 2017, Lightspeed LLC) was in charge of conducting the pre-test. All questionnaires were then compiled and transferred to the Sawtooth software (Copyright © 2017 Sawtooth Software, Inc. All reserved rights).

Data analysis

The Sawtooth software was used to estimate all part-worth utilities (PWU) for each attribute level. The CBC/HB analytical tool from Sawtooth uses a hierarchical Bayesian (HB) modelling to calculate PWUs (Lenk and Rao 1990; Allenby and Ginter 1995; Lenk *et al.* 1996). This method generates PWUs for individual respondents for a choice based conjoint (CBC) analysis, including a "none" option. The PWUs were scaled to add zero within each attribute, with an increasing PWU value showing an increasing preference for a given level of customer choice. Then, the relative importance (RI) of each attribute (i) was calculated from Eq. 1 (Hollebeek *et al.* 2007).

$$RI_i = \frac{max\,(PWU_i) - min\,(PWU_i)}{\sum\,(max\,(PWU_i) - min\,(PWU_i)} \quad (1)$$

Using all PWUs calculated for each respondent, a comprehensive portrait of consumer preferences was obtained. The population of respondents was analysed into different categories, such as age, gender, and salary. Categories were also grouped by survey type (home show *vs.* online), species designation (named *vs.* non-named), and location (USA *vs.* Canada). The mean PWUs of respondents were used to compute RI and compare different levels of all attributes. Those results were analysed in R (R Core Team 2017) using the 'conjoint' package (Bak and Bartlomowicz 2012). Given the attributes used in this investigation, the overall preference (P) is a combination of each attribute utility (U). It can be predicted by the following model (Eq. 2):

$$P = Ucolor + Uprice + Uspecies + constant \quad (2)$$

A Levene test was done to test the variance homogeneity between groups. Differences were assessed using analyses of variance (ANOVA), and Tukey tests were run to compare among levels. A K-fold cross validation was used to calculate the predictive accuracy of the model (with k = 10) (Rodriguez *et al.* 2010). The dataset was divided into 10 random subsets of equal sizes. Nine subsets were used for model calibration, and the tenth as validation dataset. Pearson's R and Kendall's tau coefficients were calculated from this validation dataset. All subsets were sequentially used to validate the model through 10 repeated runs. This random split process was then repeated 50 times. The final model validation result is an average of all repetitions. Out of all 2,385 respondents, 96 preferred the "none of the above" option for the entire survey, including 87 in the online survey. They were excluded from the analysis.

Limitations

This study was conducted to understand the relative importance of only three out of the many attributes that buyers are confronted with when choosing a wooden floor. It is acknowledged that other attributes might play a role in a real buying decision, such as wood hardness, board width, interior design, wood finish, customer service, brand, and warranty. In addition, respondents were limited to the chosen levels and could not customize their choice. The respondents were also not in a real purchase situation when completing the survey. Finally, the survey populations in home shows and online are neither representative of the entire population of North America, nor of the population of potential buyers. These limitations should be kept in mind when interpreting the results.

Two survey approaches were selected to reach the second study objective. Although the sample sizes are large, both approaches (face-to-face and web survey) induced self-selection bias because respondents could decide not to answer the survey. Because of induced bias, the population of wood-flooring customers may not be adequately represented by either survey. Therefore, an absence of difference between the survey results cannot be taken as an indication that the population was adequately portrayed. Although it was not seen as a major obstacle to meeting the objectives of this study, further research efforts could use a probabilistic sample to palliate to this problem.

RESULTS AND DISCUSSION

Sample Demographics

A total of 1,042 usable questionnaires were obtained in the face-to-face surveys, among which 537 did not mention species, while the remaining 505 did. The online

survey produced 1,247 usable questionnaires, including 779 that did not mention species, and 468 that did. A higher proportion of men responded to the face-to-face survey (58%), while the online survey showed a balance between genders (Table 4). Respondents with a higher income and those that did not want to disclose their salary were proportionally more important in the face-to-face surveys. Also, the proportion of tenants was higher in online surveys, which was expected considering that face-to-face surveys took place in events targeted for homeowners.

Table 4. Sample Characteristics of Both Types of Surveys (Online or Face-to-Face) and Questionnaires (Species Named or Unnamed)

Variable	Category	All data		Survey types		Species	
		n (total)	Respondents (%)	Online (%)	Face-to-face (%)	Unnamed (%)	Named (%)
Gender	Female	1065	47	50	42	50	41
	Male	1224	53	50	58	50	59
Age (years)	18-24	115	5	6	4	6	4
	25-34	336	15	15	14	17	12
	35-44	341	15	14	16	16	13
	45-54	512	22	18	28	22	23
	55-64	584	26	23	28	24	28
	65 and over	391	17	23	10	16	19
	No answer	10	0	0	0	1	0
Income group ($US and $CAN per year)	0-29 999	341	15	23	5	16	13
	30,000-39,999	217	9	13	5	9	10
	40,000-49,999	257	11	11	11	11	12
	50,000-59,999	248	11	11	11	11	10
	60,000-69,999	172	8	7	8	6	10
	70,000-79,999	161	7	7	8	7	7
	80,000-89,999	123	5	4	7	6	4
	90,000-99,999	109	5	6	4	4	5
	100,000 and over	412	18	12	26	18	18
	No answer	248	11	6	16	11	11
Ownership	Tenant	595	26	35	15	27	24
	Owner	1694	74	65	85	73	76
Location	Canada	1017	44	37	53	39	51
	USA	1272	56	63	47	61	49

Relative Importance of Attributes and Differences between Levels

When both survey types were amalgamated, the relative importance (RI) scores showed that colour was the most influential factor (RI = 63.6%), followed by species (RI = 23.1%) and price (RI = 13.3%) (Table 5). The individual part-worth utilities (PWU) for each attribute levels revealed that the 'medium' colour was the most appreciated, while 'grey' was the least. Oak was the preferred species, followed by maple. Beech ranked third and was more appreciated than birch. Cheaper options were preferred to more expensive ones. According to the Tukey tests, all levels within each attribute were significantly different from each other, except for the species attribute, in which oak and maple did not differ significantly.

The fact that non-functional factors such as aesthetic attributes are key determinants of consumer preferences is in line with the results of previous studies (Bowe and Bumgardner 2004; Jonsson 2005b). The finding that finish is a more important factor than species in the decision-making process bears considerable significance for the wood flooring industry. It suggests that non-traditional species could be valued if the product finish is appealing to consumers. This could offer solutions to the depleted state of the northern hardwoods forest resource (Nyland 1992; Pothier *et al.* 2013; Hassegawa *et al*. 2015).

Investments in research linking the characteristics of the available forest resource to the development of new products that meet consumer needs and expectations could contribute to enhancing the profitability of the flooring industry. For example, Jonsson (2006) showed that product durability is another important factor desired by consumers. Even if durability was not assessed in this study, the basic physical properties of American beech are comparable to that of maple and birch (Jessome 2000).

Price being the least important attribute in the decision made by respondents is in contradiction with the result of a similar study on wood furniture (Lihra *et al.* 2012), and is likely not an accurate representation of the purchasing behavior of consumers. The present result may be attributable to the fact that the respondents were surveyed in a non-buying situation. To palliate this limit of our study, we suggest that the next step towards implementation should involve conducting a market study on the launch of American beech products, which would allow for the assessment of the effect of price in real buying situations.

Despite colour having a larger importance than species in our surveys, the latter remains an important factor in the purchasing decision. In reality, price and species cannot be considered as independent attributes. Consumers have to decide which tree species will best match both their aesthetic preference and monetary constraints.

When analyzing the results from both survey types, it appeared that the effect of naming the species or not only had a statistically significant effect on the RI score of red oak (Table 6). When red oak was named, respondents were more likely to select it instead of other options. For oak, the decision was not entirely based on the appearance of the wood grain, but likely on a generally positive perception of the species among consumers, which is in line with the results of other studies (Bowe and Bumgardner 2004; Roos and Hugosson 2008). The respondents' interest for oak is surprising when considering that the four species have similar density, stiffness, strength and resistance to shocks (Table 1).

Table 3. Relative Importance of the Attributes and Part-Worth Utilities of Each Level

Attribute	Level	PWU	Std. dev.	RI(%)	Std. dev.
Colour	Medium	0.9029	1.8097	63.6	16.0
	Natural	0.0766	1.7941		
	Chocolate	-0.1085	1.9926		
	Grey	-0.8710	1.3287		
Species	Red oak	0.2852†	0.7714	23.1	12.
	Sugar maple	0.2200†	0.4287		
	American beech	-0.1284	0.3699		
	Yellow birch	-0.3769	0.4169		
Price	3 $	0.1913	0.3551	13.3	11.4
	5 $	0.0521	0.2125		
	7 $	-0.2434	0.3828		

† All levels within each attribute were statistically different from each other ($p<0.05$), except for sugar maple and red oak in the species attribute.

These results tended to confirm the first hypothesis that consumers of flooring products could appreciate American beech. The species was more appreciated by respondents than birch products, a species that accounts for approximately 6% of the sales made by floor retailers (NWFA 2016).

The fact that naming the species did not alter the perception of respondents suggests that this lesser-known species is not associated with a negative image among potential consumers. American beech flooring could thus be sold at a similar price to birch flooring, which is typically among cheaper options. Despite processing constraints that may increase production costs (Bernard *et al.* 2015), profitability should be favoured by the low stumpage fees for this generally undesired species (MFFP 2017). However, the window of opportunity to develop wood products from beech is relatively small because of the current progression of the beech bark disease (Morin *et al.* 2007). The disease has caused substantial damage to the beech resource in northern hardwoods forests, although there remains an important volume of beech that has not yet been affected in the western part of Quebec. This situation may call for the development of a niche product that may trend for a few years.

There was no bias attributable to naming any other species than oak in our study. While this absence of positive bias is unsurprising for the lesser-known American beech and yellow birch, this result is more surprising for sugar maple, an emblematic species of the northern hardwoods forests (Forristal and Lehto 2009). This aligns with the fact that consumers are often unable to identify species correctly, even when stating their ability to do so (Bowe and Bumgardner 2004). It follows that if quality flooring from any species can be produced and marketed, some consumers will likely be inclined to purchase it. This provides further evidence of the possibility to use non-traditional species for value-added appearance products (Donovan and Nicholls 2003; Nicholls *et al.* 2004; Bumgardner *et al.* 2007).

Table 4. Relative Importance Scores when Species were Named *vs.* Unnamed

Species	Questionnaire type	RI (%)		Std. dev.
Red oak	Named	0.2923	**	0.8872
	Unnamed	0.1793		0.7733
Sugar maple	Named	0.1668	NS	0.4585
	Unnamed	0.2027		0.4081
American beech	Named	-0.1085	NS	0.4283
	Unnamed	-0.0941		0.3907
Yellow birch	Named	-0.3506	NS	0.4828
	Unnamed	-0.2879		0.4381

NS indicates that the difference is not statistically significant (p>0.05); ** indicates a statistically significant difference (p<0.01) between the questionnaire types.

Comparison between Subgroups

Despite the differences, the ranking of attributes remained the same in both survey types, with colour being the most important factor, species second, and price last (Fig. 2).

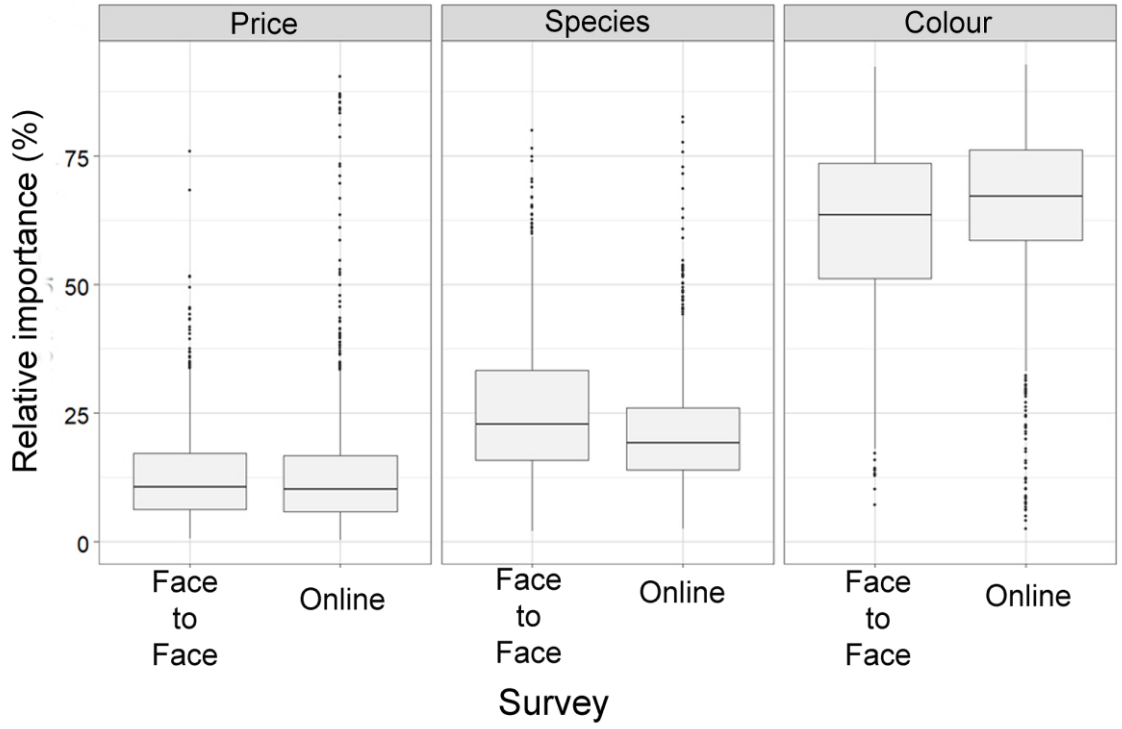

Fig. 1. Relative importance of each attribute for both survey types

All variables included in the analysis (survey type, species named or unnamed, survey location, salary, age, and gender) had significant effects on the RI of both the colour and species in the decision-making process (Table 7). However, the RI of the price was unaffected by the survey type, location, and species disclosure (Table 7). The species tended to have a greater importance in the face-to-face survey (p<0.01). Also, when species were named, the species attribute had a higher influence on the decision. The survey location had a small but statistically significant influence on the relative importance of the colour and the species attributes. In Canada, the species had a slightly

higher relative importance (RI 1.9% higher) than in the US, and the opposite trend was observed for the colour. For all attributes, different subgroups were observed among salary and age groups (Table 7). Finally, differences were also found between genders. Women attached slightly more importance to the colour (RI 3% higher), while men gave more importance to the price (RI 1.6% higher) and to species (RI 1.5% higher). Overall, the selected attributes explained a relatively small proportion of the variation in respondent's choices, as indicated by the Pearson's R and Kendall's tau values of 0.36 and 0.30, respectively. Although additional wood attributes could have been used, this may also reflect the large, intrinsic variation among the preferences of wood-flooring consumers.

Table 5. Relative Importance for Each Attribute per Subgroup

Variable	Classes	Colour		Price		Species	
		RI (%)	Std. dev.	RI (%)	Std. dev.	RI (%)	Std. dev.
Survey	Salon	61.5**	16.2	13.1NS	9.2	25.4**	13.0
	Internet	65.3**	15.7	13.6NS	12.9	21.1**	10.9
Species	Named	60.1**	17.1	12.8NS	9.1	27.0**	14.2
	Unnamed	62.8**	15.1	13.3NS	9.3	23.9**	11.7
Location	USA (Boston)	62.5**	15.7	13.2NS	9.1	24.3**	12.3
	Canada (Laval)	60.6**	16.6	12.9NS	9.3	26.4**	13.6
Salary ($)	0 – 29,999	62.7a	16.5	15.1a	15.1	22.1a	11.8
	30,000 – 39,999	63.1a	15.9	14.1a	11.9	22.8a	12.1
	40,000 – 49,999	64.1b	14.8	13.1b	9.5	22.8b	11.4
	50,000 – 59,999	61.8b	17.2	13.9b	12.7	24.3c	13.4
	60,000 – 69,999	63.9b	16.5	12.8b	10.1	23.3d	12.1
	70,000 – 79,999	65.0b	14.6	11.3c	7.5	23.7d	12.2
	80,000 – 89,999	64.7b	16.7	13.0c	12.4	22.3d	11.4
	90,000 – 99,999	64.8c	16.4	13.3d	11.2	21.9d	11.4
	100,000 and over	64.4c	15.6	12.6d	9.3	22.9e	12.2
Age	18-24	61.6a	14.6	14.0a	10.2	24.4a	12.0
	25-34	62.2a	17.0	15.2a	12.7	22.6a	11.8
	35-44	63.8b	18.1	14.1a	13.2	22.2b	12.3
	45-54	63.4c	16.5	12.9a	10.9	23.6b	12.7
	55-64	62.8c	15.6	13.5a	11.8	23.7b	12.4
	65+	66.5d	13.1	11.2b	8.2	22.2c	10.9
Gender	Female	65.2**	14.6	12.5**	10.2	22.3**	11.2
	Male	62.2**	17.0	14.1**	12.3	23.8**	12.8

** indicates a statistically significant difference between two levels ($p<0.05$), while NS indicates that the difference is not statistically significant ($p>0.05$); Levels with different letters are statistically different ($p<0.05$ according to the Tukey tests);

The study's methodology does not allow for distinguishing the effects of the surveying method and of the population, which differed between survey types. Considering the large sample of respondents that were surveyed in each case, statistically significant differences between the online and the face-to-face samples were expected. However, the overall tendencies were very consistent between the two approaches, a

result that is also supported by Huang's (2006) more comprehensive analysis of the subject. Although the relative importance scores of the colour and species attributes were statistically different, the general pattern remained very similar.

This result has significant implications for future marketing studies dedicated to the appearance of wood products. For rapid, general assessments, online surveys could be the most efficient option. This would be the case, for example, if the need is to compare colour types (*i.e.* cold or hot) or different textures (Chen 2012; Lindber*g et* al. 2013). However, other attributes, such as species grain, subtle differences between similar colours, or varnish texture, would be better served by more costly and time-consuming face-to-face assessments. In addition, the quality of the on-screen display is likely to affect selection in online assessments, but this factor cannot be controlled. Online methods are thus unlikely to fully replace face-to-face surveys in a foreseeable future, but their use could help gather general information about consumer preferences rapidly and at low cost.

CONCLUSIONS

1. This study used a marketing approach to identify a potential solution to the current decline of quality in timber supply from northern hardwoods forests. The results suggest that it is possible to include a new species in the traditional range of wood flooring products.
2. Because the conducted surveys highlighted the importance of the finishing colour on the perception of respondents, as well as changes in perception that may arise from a priori knowledge of a given species, it was concluded that a suitable marketing strategy should be adopted to add American beech to the current market.
3. Face-to-face assessments of consumer preferences can be costly and time-consuming, but the present study confirmed that cheaper online surveys could be used to assessed general trends.
4. The potential of other undesired species, not only for flooring but also for high-end products such as furniture or cabinets, should be assess in further studies.

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