

Article

# Preferences for Urban Building Materials: Does Building Culture Background Matter? <sup>†</sup>

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**Abstract:** A fast-growing global population, increasing urbanization, and an increasing flow of people with different building cultural backgrounds bring material use in the housing sector into focus. The aim of this study is to identify material preferences in the building environment in cities and to determine if the building cultural background impacts those preferences. The data in this study consisted of responses from two groups of dwellers in Norway, including immigrants from countries where wood is an uncommon building material and native Norwegians from a building culture where wood is common. We found that the most preferred materials were often the same as the most common materials currently used in city buildings. Only small differences were found between the two groups of dwellers that were studied. Most differences were related to concerns about material choice in general and where individuals wanted to live. Respondents who preferred city living preferred commonly used city materials, such as concrete and steel. For cladding materials, stone/bricks were the most preferred. However, stained or painted wood was one of the most preferred, even though it is not commonly used in city buildings.

**Keywords:** marketing; material preference; urban housing; immigrants; building culture background; building material

## 1. Introduction

A fast-growing global population [1] and a focus on sustainable development and climate change bring the housing sector and materials used for housing into focus. United Nations estimates place the global population at approximately 9.6 billion by 2050 [2]. Currently, the global demand for new housing is approximately five million units per year [3]. Given the state of housing stock and the mentioned growth in the population, a significant increase of housing units is needed by 2050. A growing proportion of the global population will reside in urban areas, where housing density is a factor in sustainable development [4].

In addition to the fast-growing global population and increasing urbanization, immigrant flow is accelerating due to differences in income, social networks, and various state policies, thus leading to an overall growing number of immigrant cities [5]. In Western Europe, an unprecedented number of

newcomers have arrived during the last two decades. When considering cities with more than 100,000 immigrants, North American and Western European cities are key immigrant destinations [6].

Impending climate change means that the carbon footprint has gained importance as a key metric in the assessment of the environmental impacts of buildings. Embodied energy and emissions of materials are vital parts of this picture. In the future, embodied energy and choice of material will be even more important since energy consumption from operational use will decrease and building material consumption will increase [7]. Therefore, timber-framed buildings, which are found to have lower global warming potential than concrete and steel structures [8,9], might play an important role with regard to the reduction of environmental consequences of city buildings. However, wood is not a common modern city building material, and might therefore be a material less preferred by consumers. Further, residents from countries where wood is hardly used in any buildings might have lower preferences for wood than people coming from countries where wood is more common.

In Norway, developments close to city centers are mainly buildings of four to eight stories. These building types are easily constructed with wood-based products [10]. New building codes and more sprinkler systems further facilitate timber use.

There is a growing body of consumer preference studies on building materials [11,12]. However, little research has been done on material preferences in the context of the urban built environment and changes in demographics resulting from immigration and movement.

As city officials, urban planners, architects, and construction companies plan for future housing, it is imperative that they understand the housing [1] and material preferences of city dwellers, especially in light of the changing demographics of regions resulting from immigration and movement to urban locales. Additionally, in Norway, the population is urbanizing. In a recent forecast, it was suggested that the Oslo region will receive up to 310,000 new inhabitants by 2020, thus adding to its current population, and an additional 600,000 in the period from 2020 to 2040. Housing these new arrivals will significantly impact the Oslo region [13]. The newcomers will partly come from Norway, where wooden houses are common, but newcomers will also come from countries where wood is hardly used. Accordingly, this study seeks to identify the differences between consumers with different building material backgrounds with regard to their preferences for materials in structural, interior, and exterior urban housing applications.

In the remainder of this article, we first provide a background regarding material preferences and the context of housing related to an urbanizing population that includes a significant proportion of immigrants. Next, we provide a background leading to research questions regarding the material preference differences between residents that have immigrated to Norway from countries where wood is hardly used in any buildings and native Norwegians. We use this as an example that may be considered in other global settings as cities plan their future housing expansion. We then discuss the methods used in the study, provide a description of the results, discuss those results, and provide specific policy and business implications.

### *Background*

The materials used in buildings are a function of the availability and suitability of materials, as well as various cultural norms and traditions. For instance, in regions with termites, wood is less frequently used, and brick and stone buildings are more common. In some cultures or countries, wood-based housing is seen as inferior [12] and can even be considered a material associated with low social status, while in other countries, the traditions for using wood are strong. In Norway, a long tradition of using wood is illustrated with more than 800-year-old wooden buildings, and today, approximately 78% of the dwellings in Norway are one- and two-story wood structures [14].

Earlier studies have found relationships between tradition and material preferences [15] and between personal tradition and residential choice from a life style perspective [16], and have also revealed that choices are related to familiarity [1]. Extensive research has investigated the relationship between preferences and social expectations and the idea that the exterior of a house conveys meaning

about the owner to others [17,18]. Individuals may also use the house exterior to define their identity [19]. Hauge and Kolstad [20] suggest that there may be differences between genders or among ethnicities and cultural backgrounds with regard to what the interior and exterior of a house says about the owner. Accordingly, we might expect that people coming from different regions with different material traditions have different preferences. On the other hand, since preferences are also most likely related to where the material is used and modern building traditions in cities around the world tend to be similar, less differences between people from different parts of the world with regard to what they expect and prefer regarding materials used in multistory city housing may be expected.

In addition to studying differences between people with backgrounds from regions with different building material traditions, our study also includes analyses of the stated preferences for how and where to live. Since the exterior of a house might convey meaning about the owner to others [17,18] and people might use the house to define their identity [19], individuals who prefer city living might, to a greater extent, identify themselves with and be more positive regarding the buildings made of materials that are common in cities compared to buildings made of materials that are more common outside cities.

## 2. Materials and Methods

The work described below is partly based on the same survey as that used by Høibø et al. [21]. Here, we emphasize how material preferences are related to the respondent's origin and where and how they want to live, while Høibø et al. [21] focused on material preferences related to attitudes regarding durability and solidity, how environmentally friendly the material is, knowledge about wood, and experience with remodeling.

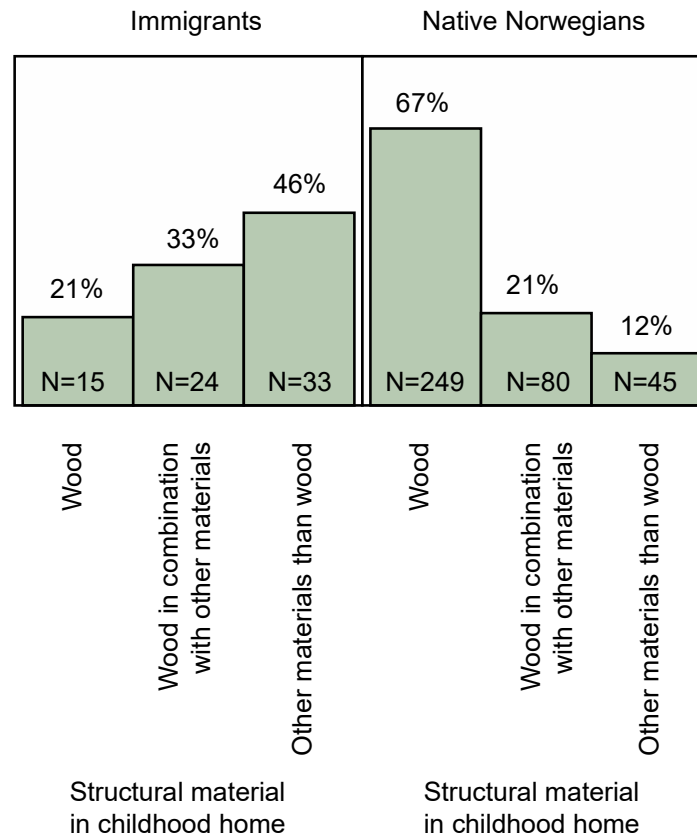
We collected responses through an online survey from individuals in immigrant families coming from countries where wood is not commonly used in houses (hereafter referred to as immigrants) and native Norwegians. Native Norwegians in this study are defined as those born in Norway with both parents from Norway. Immigrants are those with both parents born outside Norway (the individual respondent could be born inside or outside Norway).

### 2.1. Sampling

A total of 1751 persons were asked to participate in the study. However, the collection of data stopped when six hundred and sixty two people had completed the questionnaire. The respondents were part of the TNS Gallup As (today Kantar TNS AS) recruited probability panel, certified according to ISO 9001, ISO 20252, and ISO 26362:2009. The recruitment of the Gallup panel is mainly done through telephone listings and their sampling matrix design weights for biases based on how easy different groups of people are to reach. Panel members do not know the nature of the study before they access the electronic questionnaire. Demographic data about the respondents from the TNS Gallup AS database were added to our data set.

TNS Gallup AS did not have a large enough panel of immigrants specific to Oslo and several surrounding communities (Oslo region). Therefore, an additional set of respondents outside the Oslo region was targeted, in addition to the survey that Høibø et al. [21] used. Of the 662 responses received, 532 responses fit our definition of native Norwegians and immigrants, thus resulting in 437 native Norwegian responses and 95 immigrant responses. Of the 95 immigrant respondents, 67 were born in countries other than Norway. Thirty-nine immigrant respondents reside outside the Oslo region. Since there were two groups of immigrants, one residing in the same counties as the native Norwegian respondents, and a group residing in other counties, the total material is not completely random. Adjustments with a dummy variable were therefore made in some analyses. If there was no significant effect of this grouping, all respondents were considered to represent the same region. Most of the immigrants (71) had a background from Asia, Africa, or South America, while the rest came from Poland, which represents a large immigrant group in Norway.

Figure 1 shows distributions of the types of houses, in terms of structural material, that the immigrants and the native Norwegians had mainly lived in until they were 16 years old. The respondents that did not know how they lived in this period are not included in the figure. Table 1 provides additional information about the respondents.



**Figure 1.** Distributions in N (number) and % of what kind of houses with respect to the structural material that the immigrants and the native Norwegians respectively had lived in the most until they were 16 years old.

**Table 1.** Statistics for the respondents.

Description of the Respondents	N (Number)
Region of origin immigrants/native Norwegians	95/437
Age (mean = 45.4, Standard deviation = 16.6)	
Gender female/male	277/255
Currently living in city	343
Currently living in large town	87
Currently living in small town	87
Currently living rural	13
Currently living in apartment, 3-story building or more	271
Currently living in row house	125
Currently living in detached house	104
Currently living in other type of housing	30

## 2.2. Description of Variables and Questions

Even though it may have been more difficult for respondents, we did not want them to react to visual images, but rather to provide their more basic material preferences. To help mitigate the issue of lack of knowledge, we provided an “I don’t know” category for many questions. The questionnaire

was tested on a small sample of respondents. The feedback was positive, and we made no major changes to the questionnaire.

All variables used in the statistical tests and models are shown in Table 2. For importance, knowledge, and preferences, a nine-point scale was used. For example, the scale ranged from “not important” to “very important” or from “do not like” to “like very much” [21]. Because we collected data via a questionnaire, all measures of preferences were stated preferences, as is commonly recommended [1].

**Table 2.** Variable definitions and abbreviation list.

Variables	Abbreviation	N Levels
Type of material for structural use	MStr	3 types 9 point scale
Type of material used on indoor walls and ceilings	MInd	5 types 9 point scale
Type of material for outdoor cladding	MCl	4 types 9 point scale
Preference for living in city, population more than 100,000	PrCity	9 point scale
Preference for living in rural areas	PrRur	9 point scale
Respondents' region of origin: immigrants and native Norwegians	ResOr	2 levels
Importance of the structural materials used	ImpStru	9 point scale
Importance of the materials used for indoor walls and ceilings	ImpInd	9 point scale
Importance of the materials used for outdoor cladding	ImpCl	9 point scale
Effect of different sampling between immigrants and inside and outside the Oslo region	EfSamp	2 levels

Three main questions about material preferences were included in the questionnaire [21]. One question was about the materials used in the structural part of the building. Answers were given individually for concrete, steel, and wood [21]. The next question was about the materials used for cladding. Answers were given individually for untreated wood cladding, painted or stained wood cladding, metal sheeting, and stone/bricks [21]. The last question was about the materials used for inside walls and ceilings. Untreated wood; lacquered, stained, or painted wood; paint or wallpaper on gypsum boards; paint or wallpaper on wood-based boards; and paint or wallpaper on concrete were the options [21]. Individual questions about the importance of the material used for structural purposes, outdoor cladding, and indoor walls and ceilings were also included [21].

Other questions included the following:

In what setting would the respondent prefer to live?

In a city (population more than 100,000).

In a large town (population between 10,000 and 100,000).

In a small town (population less than 10,000), or

In a rural area.

In what type of housing would they prefer to live?

In a detached house.

In a row house, or

In an apartment in an apartment block with three stories or more.

Importance of closeness to stores, schools and other services.

Importance of closeness to family, friends, and acquaintances.

Importance of low price.

Relationship to and knowledge about buildings and the construction industry.

### 2.3. Analysis

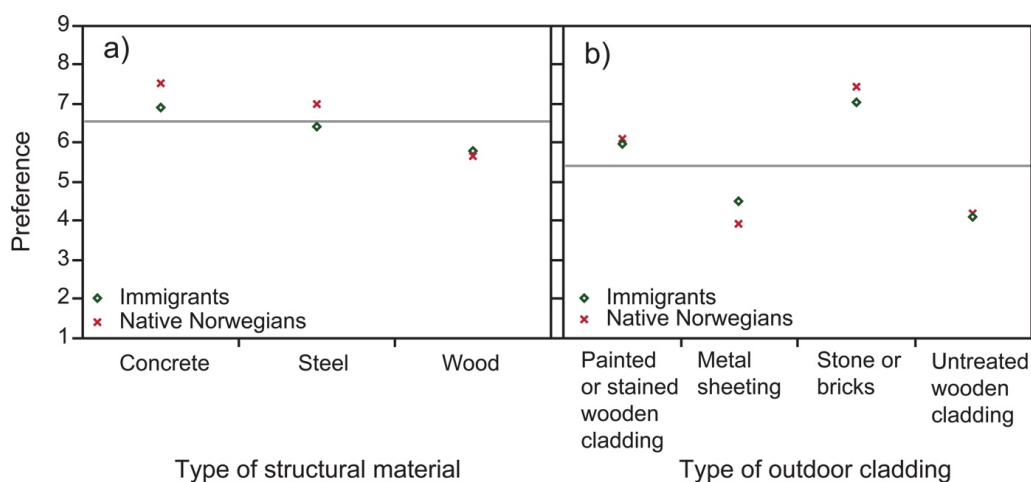
The statistical software JMP version 10.0 from the SAS Institute Inc. (Cary, NC, USA) [22] was used in the data analyses. Where appropriate, contrasts were tested with F-tests. However, some of the data exhibited heteroscedasticity and nonnormality, and so we chose to use a logistic regression and chi square tests in most analyses. For the comparison of groups, we used chi square tests and, when necessary, we merged cells to maintain greater than 80% of cells with five or more responses. The responses of “do not know” were not included in the analyses. The logistic regression calculated the probabilities for each level of the response and gave nine probabilities, depending on the values of the independent variables. To do this, eight fitting lines were calculated (when a nine-point scale was used) (see figure caption Figure 3).

A small effect of the difference in sampling between immigrants inside and outside the Oslo region was found for the analyses on indoor wall and ceiling material preferences and where they want to live, thus requiring a correction via a dummy variable. If nothing else was said, variables were rejected if the probability of type I error was smaller than 0.05.

## 3. Results

### 3.1. Material Preferences

Native Norwegians had somewhat higher mean preferences for concrete and steel structural materials than immigrants (Figure 2a). However, the differences were small. For wood as a structural material, it was the opposite, but the difference was minor (Figure 2a). The differences in preferences between wood and concrete and between wood and steel, respectively, were not significantly different between immigrants and native Norwegians.



**Figure 2.** Mean preferences for different structural materials (a) and cladding materials (b).

For outdoor cladding, the only significant difference between immigrants and native Norwegians was the native Norwegians’ somewhat higher preference for stone/brick cladding ( $p = 0.038$ , chi-square test). However, when testing the difference with an F-test, the  $p$ -value was only 0.088. Immigrants had a somewhat higher preference for metal sheeting, but this difference was not statistically significant (Figure 2b). For painted or stained wooden cladding and untreated wooden cladding, native Norwegians and immigrants had almost the same preferences (Figure 2b). Overall, there were significant differences in the preferences for the different cladding materials ( $p < 0.0001$ , chi-square test).

No significant differences were found between native Norwegians and immigrants for the five indoor materials. Overall, there were significant differences in indoor material preferences ( $p < 0.0001$ , chi-square test).



### 3.2. Location and House Type Preference

No significant differences were found between immigrants in the Oslo region and native Norwegians with respect to detached and row houses. However, across all respondents, a significant difference in the preferences between types of house was found ( $p < 0.0001$ , chi-square test). Detached houses were the most preferred, while row houses and apartments in multistory buildings had almost the same preference for respondents from the Oslo region. For immigrants outside the Oslo region, apartments in multistory buildings were less preferred than other types of housing.

Closeness to stores, schools, and other services was significantly more important for immigrants from the Oslo region than for non-Oslo region immigrants and native Norwegians ( $p = 0.023$ , chi-square test). Closeness to family was also significantly more important for immigrants from the Oslo region than for native Norwegians ( $p = 0.029$ , chi-square test). For immigrants outside the Oslo region, the importance for living close to family was less important than it was for immigrants in the Oslo region. The effect of the dummy variable was almost significant at the 5% level. When excluding this effect, no significant effect of respondents' region of origin was found. No significant difference between immigrants and native Norwegians was found for the importance of closeness to friends and acquaintances.

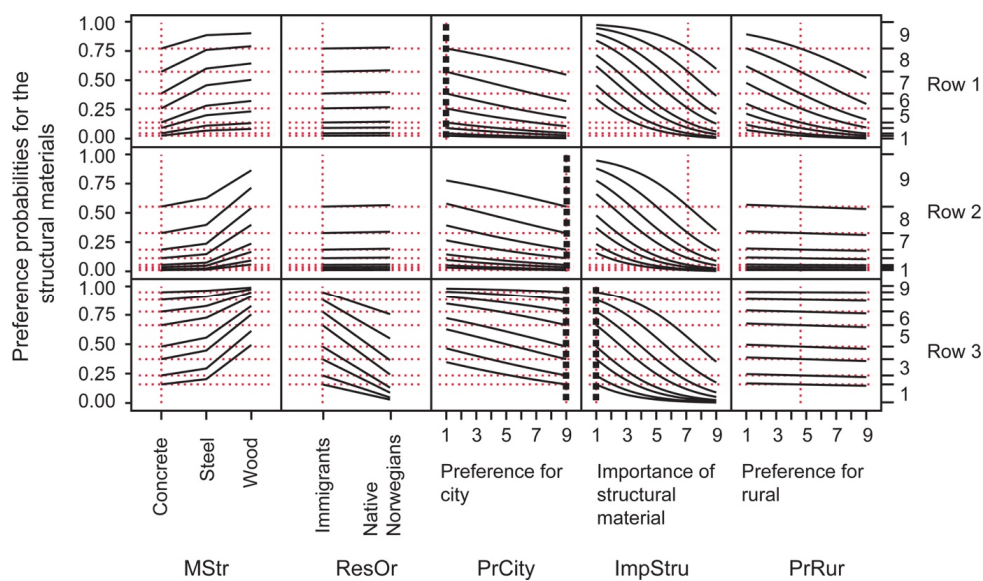
Finally, low price was significantly more important for immigrants, regardless of where they currently reside, than for native Norwegians ( $p < 0.0001$ , chi-square test).

### 3.3. Multiple Models

Model 1 (Table 3) includes the variables that were found to be important for structural material preferences. Concrete was the most preferred material (largest probability for 9 and 8 preferences, left column plots, Figure 3).

**Table 3.** Statistics for the multiple logistic regressions.

	<b>Model 1 Structural Materials</b>	<b>Model 2 Outdoor Cladding</b>	<b>Model 3 Indoor Walls &amp; Ceilings</b>
<b>Summary statistics for the different models</b>			
Entropy $R^2$ (Coef. of determin.)/Gen $R^2$ (Coef. of determin.)	0.049/0.18	0.079/0.29	0.024/0.098
N	1165	1725	2325
<i>p</i> -values for the independent variables in the different regressions			
MStr	<0.0001		
ResOr	0.73	0.35	0.31
PrCity	<0.0001	0.0011	0.0025
MStr $\times$ PrCity	0.021		
ImpStru	<0.0001		
ResOr $\times$ ImpStru	0.0006		
PrRur	0.0001	0.0010	
PrCity $\times$ PrRur	0.0002		
MInd			<0.0001
MInd $\times$ PrCity			0.0033
ImpInd			<0.0001
ResOr $\times$ ImpInd			0.0036
MInd $\times$ ImpInd			0.0002
MCl		<0.0001	
MCl $\times$ PrCity		0.0841	
ImpCla		<0.0001	
ResOr $\times$ ImpCla		0.0038	
MCl $\times$ ImpCla		0.014	
EfSamp			0.048



**Figure 3.** Profile plots showing the preferences for different structural materials, depending on the values of various independent variables in Model 1. The profile plots show the preferences for different structural materials, depending on the values of various independent variables in Model 1 (Table 3). Three rows of plots are included to show how the preferences for the different structural materials change with changes in the independent variable values. The thick vertical dashed lines indicate where the researcher set the value of the independent variables. The distances between the horizontal lines in the first column of plots show the probability for the different preference values. The probability for preference 9 is the distance between the upper most line and 1.00. The distance between lines 7 and 8 shows the probability for preference value 8. The probability for the lowest preference value is between 0.00 and the lowest line. For example, in row 2, column 1, approximately 40% of the respondents rated their preference for concrete as the highest value of 9, given by the independent variables setting values, as shown by the vertical dashed lines. Although some of the data in Figure 2 is categorical, the lines between categories are provided only for the ease of the visual interpretation of changes in level from one category to the next. This figure text is partly the same as the figure text in Figure 1 in the article of Høibø et al. [21].

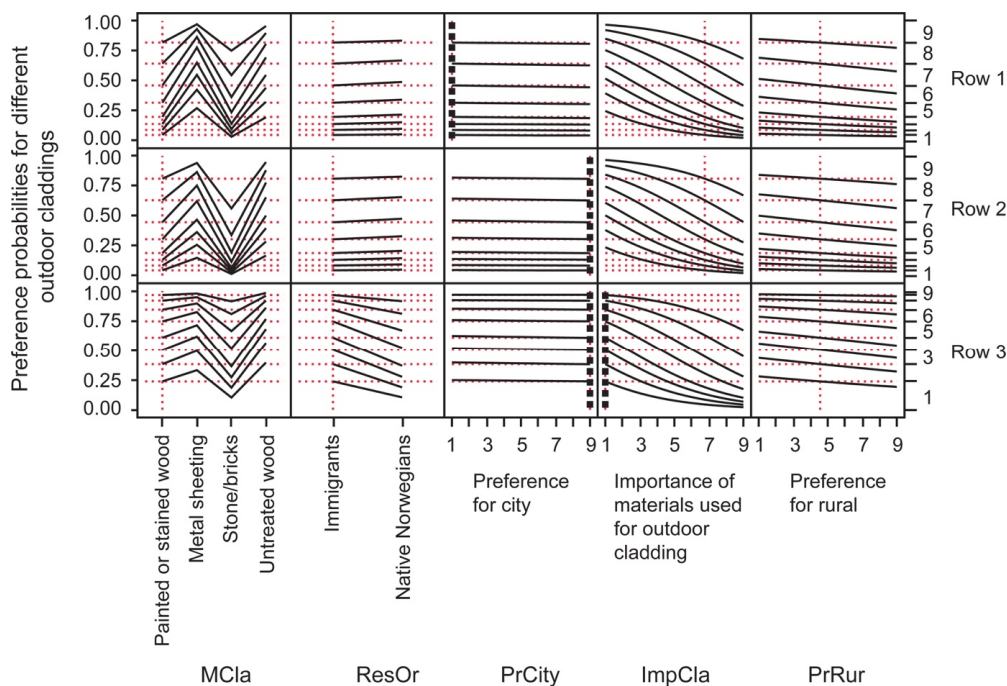
Model 1 includes a significant interaction effect between the type of structural material and preference for living in a city. A higher preference for living in a city corresponds with an increasing preference for steel and concrete (changes are larger for steel than concrete) rather than wood (Figure 3, row 1 and row 2). Preference for living in a city was the only variable with a significant interaction effect on the 5% level with the type of structural material.

The other interaction effects are mainly related to the level of structural material preferences. Nevertheless, for respondents saying that the structural material type in general is of little importance, the probability for the highest preference decreases the most for concrete, somewhat less for steel, and the least for wood, compared to that of the respondents who reported that structural material was important for them (Figure 3, row 2 and row 3). However, the probability for the lowest preference increases the most for wood with the respondents saying that the structural material type in general is of little importance, compared to that of the respondents who stated that structural material was important (Figure 3, row 2 and row 3). Model 1 also includes a significant interaction effect between the respondent's region of origin and the importance of the structural material. For the respondents saying that the type of structural material was of little importance, the immigrants responded with lower preferences than the native Norwegians (Figure 3, row 3). A significant interaction effect between preferences for living in cities and preferences for living in rural areas was also included. This effect only affected the levels of preferences across the different structural materials.



An interaction effect between the type of structural material and the respondent’s region of origin was also tested, but it was not significant. This result means that the differences in preferences between the different structural materials were not significantly different between immigrants and native Norwegians.

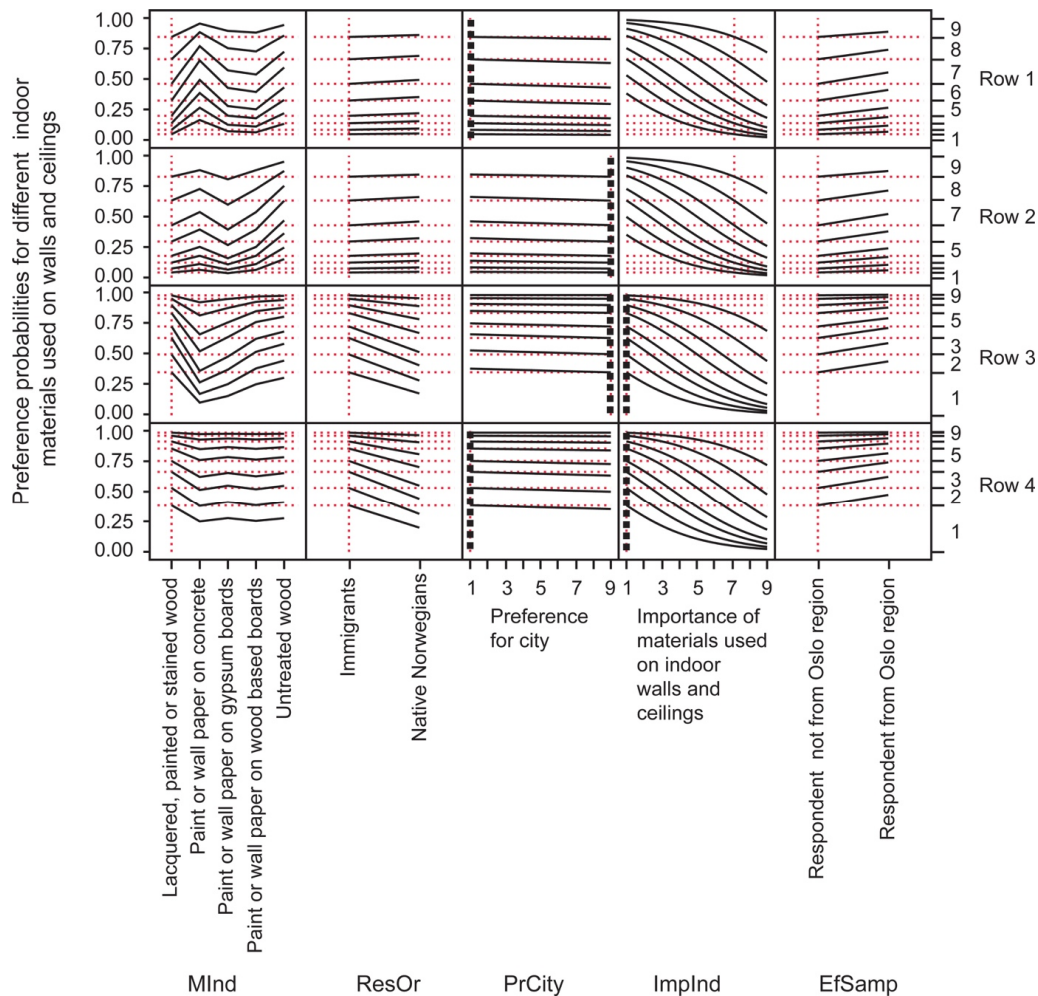
Model 2 (Table 3) includes variables that were important for the preferences for the different materials used for outdoor cladding. Stone/bricks were the most preferred cladding material, followed by painted or stained wood. Metal sheeting and untreated wood were the least preferred (Figure 4, row 1, column 1). Model 2 includes an interaction effect between the type of material for outdoor cladding and preference for living in a city, even though it was only significant at the 8.4% level. The interaction effect resulted in higher preferences for stone/bricks than for the other materials when preferences for living in a city were high (Figure 4, row 1 and row 2). A significant interaction effect between the type of material for outdoor cladding and the importance of the material used for outdoor cladding was also included in Model 2. The interaction effect resulted in fewer differences in preferences between the different types of claddings when the importance of the material used for outdoor cladding was small (Figure 3, row 2 and row 3). Model 2 also includes a significant interaction effect between the respondent’s region of origin and the importance of the materials used for outdoor cladding. For respondents saying that the material used for outdoor cladding was not important, the native Norwegians responded with higher material preferences in general than immigrants (Figure 4, row 3). Higher preferences for rural living adjusted the level of the fitted lines, thus resulting in a general increase in preferences across the different cladding materials (Figure 4, the last column of plots).



**Figure 4.** Profile plots showing the preferences for different outdoor cladding materials, which depend on the values of the different independent variables in Model 2. Three rows of plots are included in the figure to show how the preferences for the different outdoor cladding materials change with differing settings of the independent variables. This figure text is partly the same as that in Figure 4 in the article of Høibø et al. [21].

Model 3 includes the variables found to be important for the preferences for different materials used on indoor walls and ceilings (Table 3). Model 3 shows that lacquered, stained or painted wood,

and paint or wallpaper on different boards were the most preferred (Figure 4 first row). Paint or wallpaper on concrete together with untreated wood were the least preferred indoor materials for respondents that did not prefer to live in a city (Figure 5, row 1). When respondents preferred to live in a city, the preference for untreated wood was the lowest (Figure 5, row 2). Respondents who preferred to live in a city and also said that the material used on indoor walls and ceilings was of low importance, preferred paint or wallpaper on concrete the most (Figure 5, row 3). For these respondents, lacquered, stained, or painted wood together with untreated wood were the least preferred materials (higher probability for the lower preferences).



**Figure 5.** Profile plots showing the preferences for different indoor materials, which depend on the values of the different independent variables in Model 3. The four rows of plots are included in the figure to show how the preferences for the different indoor materials change with changes in independent variables. This figure text is partly the same as that in Figure 3 in the article of Høibø et al. [21].

Respondents with low preferences for living in large cities who also said that the material used on indoor walls and ceilings was of low importance had relatively equal scores for the different materials (Figure 5, row 4). When the materials used on indoor walls and ceilings was of low importance, the native Norwegians gave a higher score for all materials than the immigrants. Nevertheless, the relative difference between the different materials did not vary much between native Norwegians and immigrants.

#### 4. Discussion

Craig et al. [15] found relationships between material traditions and material preferences, Vasanen [1] found that choices are related to familiarity, and Hauge and Kolstad [20] suggested that there might be differences between genders or among ethnicities and cultural backgrounds with respect to what the interior and exterior of a house says about the owner. Accordingly, we could expect to find differences between native Norwegians and immigrants regarding material preferences since the two groups have different building cultural backgrounds and different experiences with regard to building environments. However, only small differences were found between the two groups. Even with the extensive use of wood in one- and two-story houses in Norway, which represents approximately 78% of housing [14], the structural material preferences of Norwegians did not differ from those of immigrants. For both groups, concrete was the most preferred structural material, followed by steel. Wood was the least preferred. Since native Norwegians also had a significantly higher preference for stone/brick cladding than immigrants, and the immigrant group in this study have a building culture background from areas where wood is less frequently used and stone is more frequently used, the strong Norwegian wood tradition outside cities appears to play almost no positive role for wood used in a city context.

However, the overall high preferences for concrete and low preferences for wood fit well with the material tradition [15] in cities. Concrete is the dominant structural material in large buildings in Norway [23], while wood structures in multistory city buildings are uncommon. It therefore seems that preferences are mostly related to city building material traditions. However, according to the hypothesis of the material traditions in cities, we would not have expected painted or stained wooden cladding to fare that well in the evaluation. The visual presence of wood in landmark buildings and a general focus on wood as a natural and renewable resource may have influenced general attitudes. The diverse profiles and variety of colors associated with timber architecture may have had a positive impact on the acceptance of wooden cladding also in an urban setting.

Nevertheless, the most preferred cladding material was stone/bricks, which is also a common city cladding material. This finding is in accordance with those of McManus and Baxter [24], Craig et al. [15], and National Association of Home Builders (NAHB) [11], who found bricks to be the most preferred outdoor cladding material. The high preference for stone/bricks, particularly for native Norwegians, might be related to attitudes connected to the upmarket status, since stone and brick claddings are more expensive than the other cladding materials. It might also be related to the high focus in Norway on the maintenance and durability of claddings [21] and that stone bricks are regarded to be the most durable [15], which also fits with the finding of increasing differences in preferences among cladding materials for respondents that are more concerned about outdoor cladding (Figure 4, row 2 and row 3).

Our findings show that there are other factors that have a stronger influence on respondents' material preferences in city buildings than if they come from a country where wood is an uncommon building material, or from a country where wood is extensively used. We found some significant differences between the two groups of dwellers studied. However, most of the differences with regard to material preferences were related to different attitudes, such as preferences regarding where the respondents wanted to live. Since increased preferences for city living increased the preferences for materials that are common in cities, individuals who prefer city living to a greater extent identify themselves with buildings made of materials that are common in cities rather than buildings made of materials that are more common outside cities. This finding is in accordance with those of Nasar and Kang [17] and Sadalla and Sheets [18], who say that the exterior of a house might convey a meaning about the owner to others, and Desprès [19], who found that people might use the house to define identity. Higher preferences for city living combined with higher preferences for common city building structural materials (Figure 3, row 1 and row 2) therefore fits well with the expected relationship between tradition and material preferences in a city context, personal tradition, and residential choice from a life style perspective [16], and other choices related to familiarity [1]. This finding is also

in accordance with our findings on residential choice, where we found that immigrants and native Norwegians inside the Oslo region prefer apartments in multistory buildings more than immigrants outside the Oslo region, who preferred apartments in multistory buildings the least.

Within the category of respondents who prefer to live in a city and said that the material that is used indoors is not important, the highest preferred indoor material was paint or wall paper on concrete, while for the respondents who said that indoor materials was important, paint or wallpaper on concrete was one of the least preferred materials. Our study therefore shows that there were different preferences for using concrete as a structural material and concrete used as an indoor wall and ceiling material, but that this difference depended to a large extent both on the respondent's attitudes regarding the importance of indoor material use and preferences for living in a city (Figure 5, row 2 and row 3 and Figure 3). The experience of concrete as a "cold" absorber of body heat radiation might be the reason why respondents who both prefer city living and said that indoor materials are important state low preferences for indoor concrete surfaces. Mechanical resistance and noise related to the boring of holes and simple interior modifications may also play a role. Our findings show that for concrete structures, inner surfaces other than paint or wallpaper on concrete should be considered.

It is logical that the same materials see different preferences for structural use and indoor surface use because each fulfills different needs. For visual surfaces, both visual and tactile properties are important. Brandt and Shook [25] found that consumers' quality attributes for forest products are usually visual or tactile. Consumer preferences for wood are found to depend on harmony, activity, and social status [26]. Harmony is related to homogeneity [27], while a positive relationship between visual homogeneity and preferences is found for decking materials [28]. For structural materials, physical properties such as strength properties, fire safety, and sound insulation are more important.

The correspondence of preferences may be attributed to the common features of all urbanizing regions and may also relate to the fundamental role of buildings as the stable framework for social life. In Norway, the functional and technological standards of buildings are homogenous and highly regulated on governmental and municipal levels. Rental housing constitutes a very small part of the housing market. Varieties of individual and shared ownership dominate, also among immigrants. The typical, cooperative housing associations in Oslo require participation in decisions regarding maintenance and investments, which may be a strong integrating factor that may influence attitudes towards the design and materiality of buildings.

## 5. Conclusions

Our findings provide a few primary insights into consumer preferences for city-based housing in Norway. First, with respect to material preferences in city housing, there are only minor differences between Norwegian natives who represent countries where wood is extensively used in houses outside cities and immigrants coming from a country where wood is hardly used at all. Differences that do exist between respondents are more related to where an individual would prefer to live. Second, despite the longstanding tradition of wood use in single-family houses in Norway, other materials that have traditionally been used in city buildings are more preferred. The preferences seem, therefore, to be more related to material traditions and to the context in which the materials are used. Individuals who prefer city living seem to a greater extent to identify themselves with buildings made of materials that are common in cities rather than with buildings made of materials that are more common outside cities. Since the material tradition and the context seem to be important factors for consumers, consumer information is important when a material is introduced in a new context. Landmark wooden city buildings for housing are a useful tool for developers to introduce, teach, and make wood more familiar in a city context.

## 6. Limitations

As our goal was not the generalization of a population, but rather to compare two groups of Norwegians, we did not attempt to obtain a pure random sample. With respect to immigrant



participants, our sample size was smaller than ideal. This made the result less robust and hindered our ability to validate the models. Additionally, the variation within the immigrant group was large since they come from different continents and countries. This large variation may have decreased the probability of finding significant effects.

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## References

1. Vasanen, A. Beyond stated and revealed preferences: The relationship between residential preferences and housing choices in the urban region of Turku, Finland. *J. Hous. Built Environ.* **2012**, *27*, 301–315. [CrossRef]
2. UN Department of Economic and Social Affairs Population Division. Available online: [http://www.un.org/en/development/desa/population/publications/pdf/trends/WPP2012\\_Wallchart.pdf](http://www.un.org/en/development/desa/population/publications/pdf/trends/WPP2012_Wallchart.pdf) (accessed on 19 October 2014).
3. UN Habitat. Available online: <http://mirror.unhabitat.org/content.asp?cid=5809&catid=206&typeid=6> (accessed on 19 October 2014).
4. Dunse, N.; Thanos, S.; Bramley, G. Planning policy, housing density and consumer preferences. *J. Prop. Res.* **2013**, *30*, 221–238. [CrossRef]
5. Price, M.; Benton-Short, L. Counting Immigrants in Cities across the Globe. Migration Policy Institute. Available online: <http://www.migrationpolicy.org/article/counting-immigrants-cities-across-globe> (accessed on 14 December 2007).
6. Price and Benton-Short. Available online: <http://www.migrationpolicy.org/article/counting-immigrants-cities-across-globe> (accessed on 13 November 2014).
7. Hernandez, P.; Kenny, P. Development of a methodology for life cycle building energy ratings. *Energy Policy* **2011**, *39*, 3779–3788. [CrossRef]
8. Robertson, A.B.; Lam, F.C.; Cole, R.J. A comparative cradle-to-gate life cycle assessment of mid-rise office building construction alternatives: Laminated timber or reinforced concrete. *Buildings* **2012**, *2*, 245–270. [CrossRef]
9. Ritter, M.A.; Skog, K.; Bergman, R. *Science Supporting the Economic and Environmental Benefits of Using Wood and Wood Products in Green Building Construction*; General Technical Report FPL–GTR–206; United States Department of Agriculture, Forest Service, Forest Products Laboratory: Washington, DC, USA, 2011; p. 9.
10. Mahapatra, K.; Gustavsson, L. Multi-storey timber buildings: Breaking industry path dependency. *Build. Res. Inf.* **2008**, *36*, 638–648. [CrossRef]
11. NAHB. Available online: <http://www.prnewswire.com/news-releases/new-nahb-study-shows-national-consumers-prefer-brick-197850191.html> (accessed on 28 November 2014).
12. Davies, I.; Walker, B.; Pendlebury, J. *Timber Cladding in Scotland*; ARCA Publications: Edinburgh, UK, 2002.
13. Tandberg, E.; Morstad, P. *Uttalelse Til Nasjonal Transportplan 2014–2023*; Byrådsavdeling for Miljø og Samferdse: Kirkegaten, Lillehammer, 2012; p. 7.
14. Statistics Norway. Available online: <http://www.ssb.no/boligstat> (accessed on 5 November 2014).

15. Craig, A.; Abbott, L.; Laing, R.; Edge, M. Assessing the Acceptability of Alternative Cladding Materials in Housing: Theoretical and Methodological Challenges. Available online: [http://www.researchgate.net/publication/27250534\\_assessing\\_the\\_acceptability\\_of\\_alternative\\_cladding\\_materials\\_inhousing\\_theoretical\\_and\\_methodological\\_challenges](http://www.researchgate.net/publication/27250534_assessing_the_acceptability_of_alternative_cladding_materials_inhousing_theoretical_and_methodological_challenges) (accessed on 16 December 2002).
16. Ærø, T. Residential choice from a lifestyle perspective. *Hous. Theory Soc.* **2006**, *23*, 109–130. [[CrossRef](#)]
17. Nasar, J.L.; Kang, J. House style preference and meanings across taste cultures. *Landsc. Urban Plan.* **1999**, *44*, 33–42. [[CrossRef](#)]
18. Sadalla, E.K.; Sheets, V.L. Symbolism in building materials. *Environ. Behav.* **1993**, *25*, 155–180. [[CrossRef](#)]
19. Desprès, C. The meaning of home: Literature review and directions for further research and theoretical development. *J. Archit. Plan. Res.* **1991**, *8*, 96–115.
20. Hauge, Å.L.; Kolstad, A. Dwelling as an expression of identity. A comparative study among residents in high-priced and low-priced neighbourhoods in Norway. *Hous. Theory Soc.* **2007**, *24*, 272–292. [[CrossRef](#)]
21. Høibø, O.; Hansen, E.; Nybakk, E. Building material preferences with a focus on wood in urban housing: Durability and environmental impacts. *Can. J. For. Res.* **2015**, *45*, 1617–1627. [[CrossRef](#)]
22. JMP, Version 10.0.0. Statistical Discovery, SAS Institute Inc.: Cary, NC, USA, 2012.
23. Store Norske Leksikon. Available online: <https://snl.no/h\T1\oyhus> (accessed on 25 November 2014).
24. McManus, B.R.; Baxter, D.O. Revealed preferences for building materials: A survey of low and moderate income households. *Hous. Soc.* **1981**, *8*, 45–51. [[CrossRef](#)]
25. Brandt, J.P.; Shook, S.R. Attribute elicitation: Implications in the research context 1. *Wood Fiber Sci.* **2007**, *37*, 127–146.
26. Broman, N.O. Means to Measure the Aesthetic Properties of Wood. Ph.D. Thesis, Luleå University of Technology, Luleå, Sweden, 2000.
27. Nyrud, A.Q.; Roos, A.; Rødbotten, M. Product attributes affecting consumer preference for residential deck materials. *Can. J. For. Res.* **2008**, *38*, 1385–1396. [[CrossRef](#)]
28. Høibø, O.; Nyrud, A.Q. Consumer perception of wood surfaces: The relationship between stated preferences and visual homogeneity. *J. Wood Sci.* **2010**, *56*, 276–283. [[CrossRef](#)]



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