buildings

MDPI

Article

Cognitive Bias in Perceptions of Industrialized Housing

María Luisa Nolé [1,*], Antoni Montañana [1], Robi Barranco-Merino [1], Juan Luis Higuera-Trujillo [2] and Carmen Llinares [1]

[1] University Institute for Human-Centered Technology Research (Human-Tech), Universitat Politècnica de València, 46022 Valencia, Spain; amonav@doe.upv.es (A.M.); rbarmer@doctor.upv.es (R.B.-M.); cllinare@htech.upv.es (C.L.)

[2] Department of Mechanical Engineering and Industrial Design, University of Cadiz, 11519 Puerto Real, Spain; juanluis.higuera@uca.es

* Correspondence: mlnole@htech.upv.es

Abstract: Industrialized housing offers potential benefits in efficiency and sustainability compared to traditional construction methods, but public perception often remains negative due to a lack of familiarity. This study explores how prior information and knowledge influence perceptions of industrialized versus traditional housing. An online survey with 267 participants evaluated stimuli composed of an image of a house and a label (industrialized or non-industrialized). Results indicated no significant differences in perception based on visual appearance alone; however, the "industrialized" label was rated less favorably. This effect was more pronounced among those without expertise in industrialized construction. The study also revealed that providing objective prior information improved perceptions of personal and emotional attributes (e.g., cozy, family-friendliness, comfortable, well-being), but did not affect views on construction-specific attributes (e.g., quick-to-build, automated, or modular). These findings underscore the need for neutral and informative communication to counteract negative biases and enhance acceptance of industrialized housing. For the construction industry and policymakers, it is crucial to promote unbiased information and education to overcome resistance due to misconceptions and foster a more positive perception of the product's features. Addressing concerns and clarifying benefits, these initiatives aim to shift public opinion toward recognizing the value of industrialized housing.

Keywords: industrialized housing; consumer perception; labeling bias; prior information; level of expertise

Citation: Nolé, M.L.; Montañana, A.; Barranco-Merino, R.; Higuera-Trujillo, J.L.; Llinares, C. Cognitive Bias in Perceptions of Industrialized Housing. *Buildings* **2024**, *14*, 2665. https://doi.org/10.3390/buildings14092665

Academic Editor: Pramen P. Shrestha

Received: 19 July 2024
Revised: 18 August 2024
Accepted: 26 August 2024
Published: 27 August 2024

1. Introduction

Industrialized construction, which encompasses methods such as prefabrication and modular construction, has experienced growing interest in the global construction industry over the past few decades [1]. This technology, characterized by the fabrication of building components in a controlled environment prior to their transport and installation on-site [2,3], has significant advantages compared to conventional construction methods [4].

The scientific literature has extensively documented these benefits, ranging from substantial reductions in construction time and costs [5,6], to notable improvements in the quality and durability of structures [6] and significant decreases in safety incidents and embodied energy [7,8]. In addition, industrialized construction has been shown to be more sustainable and efficient in terms of energy, emissions, and waste reduction [9–12] and to allow the use of innovative and industrial materials, or in the process, such as the use of monitoring and inventory tracking [13]. These findings highlight the significant potential for industrialized construction to contribute to more sustainable building practices and mitigate the environmental impact of industry.

However, despite these demonstrated advantages, the adoption of these technologies, understood as the process of acceptance, integration, and use of these technologies, has

experienced a slow progression. This phenomenon has been especially marked in the residential market [14] and is attributed to a combination of factors, including limited knowledge about these techniques and negative public perception toward the industrialization of construction. Consumers' purchase intention toward prefabricated housing is influenced by a number of psychological and cognitive factors, such as internal ethics and prosocial behaviors [14], as well as individual preferences, personal identity, and emotional baggage [15]. That is, the perceptions and beliefs of potential buyers play a fundamental role in whether or not they decide to purchase these types of housing solutions. Understanding the psychological factors that shape purchase intention is crucial to facilitating the adoption of industrialized construction. Misinformation about this technology has been shown to be a determinant factor that decreases purchase intention and adoption [16–18]. In turn, the lack of accurate and objective information about prefabricated housing can lead to misperceptions about its value [19,20], resulting in increased resistance, skepticism, and cultural bias [21,22]. Such negative public perception toward off-site construction methods is a major factor hindering the rapid development of these techniques worldwide [23]. This is why consumer perceptions toward industrialized housing emerge as a critical factor in the adoption of industrialized housing. And the lack of knowledge and the existence of prejudices about industrialized housing sustain such popular negative perceptions and constitute significant barriers to the industrialized housing market. Moreover, it is believed that the very nomenclature "industrialized" or "prefabricated" may evoke negative connotations causing attitudinal barriers to purchase intent [24–26]. These studies suggest that there is an underlying bias or prejudice toward "industrialized" or "prefabricated" in the minds of consumers. For example, Apaydin's [25] research shows how the mere mention of "manufactured home" decreases purchase intent, while Mazursky and Jacoby [26] identified that this type of terminology is sometimes associated with temporary shelter contexts for people in emergency or low-income situations. These studies suggest that there is an underlying bias or prejudice toward the "industrialized" or "prefabricated" in the minds of consumers. However, the question arises as to whether this rejection is due solely to the label used, or whether there is also a bias toward the inherent characteristics of the product with that label. Understanding whether the problem lies in the nomenclature, the design, or a combination of both, is crucial to developing effective communication strategies to encourage the adoption of industrialized construction.

However, it is noteworthy that there is still little research related to industrialized housing and most of the existing studies are old [25]. Moreover, most studies in this area have focused on technological aspects and have studied professional profiles in the sector, such as governments, developers, or promoters [27–30]. However, a significant gap has been left in understanding the perceptions and attitudes of end consumers. Little research has been conducted on the factors that influence the formation of potential buyers' purchase intention [14]. This gap in the literature is critical, as consumer acceptance and adoption are critical to the success of any innovation in the residential market.

The present study focuses on investigating the perception of industrialized housing, with special emphasis on the impact of prior information and specialized knowledge about the sector. Taking all of this into account, the objective of this work is to answer four specific questions: (Q1) Is there a negative bias toward industrialized housing either due to the design itself or the term 'industrialized'? (Q2) If this bias exists, is it general or specific to users not related to the construction sector? (Q3) Is the potential bias due to a lack of information? (Q4) If there is an effect of lack of information, does it also influence the assessment of other characteristics of the housing?

Thus, it aims to understand the general assessment and specific characteristics of industrialized housing, in order to better understand the factors affecting the acceptance and adoption of industrialized construction in the market.

2. Methodology

To address the stated objective, a protocol was designed in which participants had to evaluate a stimulus (composed of an image of a house and a label) presented through a questionnaire that also collected relevant sociodemographic information. The questionnaire was randomly presented in one of two conditions: (1) receiving prior information about industrialized housing or (2) not receiving such information.

2.1. Sample

A total of 450 responses to the online questionnaire were received from participants in Spain. To ensure data quality, incomplete responses were excluded [31,32]. Therefore, after this data refinement, the responses of 267 participants were finally analyzed: 135 women and 132 men (mean age = 41.61 years; σ = 10.06). Additionally, to control for the impact of prior knowledge about industrialized housing, respondents with very high knowledge of the subject and/or work experience or training in the industrialized housing sector were identified and considered (45 in total). Specifically, these participants were those who indicated in the questionnaire that they had a higher education related to the construction sector (engineering, architecture, or similar) and were performing duties in a specific company in the industrialized housing sector.

The remaining 222 participants, i.e., those unrelated to the sector, were randomly assigned to one of the two experimental conditions: receiving or not receiving prior information about industrialized housing before evaluating the stimulus. In contrast, data from 45 respondents related to the sector were only collected for the condition without prior information (Table 1), in order to assess the effect of familiarity with the sector without the influence of additional information.

Table 1. Distribution of participants across the different experimental groups (rows) is detailed, categorized by gender and relation to the industrialized construction sector (columns). The categories "Information" and "No information" indicate whether participants received prior information about industrialized housing. Meanwhile, the categories of "Industrialized" and "Non-industrialized" indicate the nature of the image and the label that composed the stimulus to be evaluated in each experimental group.

			Non-Sector Related		**Sector Related**	
Condition	**Label**	**Image**	**Female**	**Male**	**Female**	**Male**
Information	Industrialized	Industrialized	14	13	-	-
		Non-industrialized	15	16	-	-
	Non-industrialized	Industrialized	16	11	-	-
		Non-industrialized	17	12	-	-
Non-information	Industrialized	Industrialized	13	14	6	4
		Non-industrialized	12	15	3	5
	Non-industrialized	Industrialized	13	13	6	7
		Non-industrialized	14	14	6	8

2.2. Questionnaire

The questionnaire used in this study was developed and distributed using SurveyMonkey (https://uk.surveymonkey.com/), a widely used online platform for creating and administering questionnaires. The questionnaire was designed to collect detailed information on people's assessment of industrialized housing. The structure of the questionnaire encompassed 3 key sections to ensure a comprehensive understanding of participants' perceptions.

The first section aimed to establish two conditions: receiving prior information about industrialized housing or not receiving information. To this end, the first thing the participant observed after accessing the survey was the study presentation and an initial question about the self-reported level of knowledge of industrialized housing. Additionally, this

section randomly included an informative video showing the construction process of a real industrialized house. This allowed for evaluating the impact of prior information on perceptual assessments of industrialized housing.

The second section constituted the main part of the questionnaire. A visual stimulus was presented to the respondents. Each participant saw an image of a house, which could be industrialized or non-industrialized, accompanied by a label: "industrialized housing" or "non-industrialized housing". Both the image and the label were randomized to control for any bias in responses, resulting in congruent and incongruent stimuli. After the stimulus presentation, participants evaluated the house based on a series of statements using a Likert-type scale from −5 (strongly disagree) to 5 (strongly agree). Specifically, it was indicated: "Rate your level of agreement or disagreement with the following statements regarding the visualized house: This house seems to me quick-to-build/automated construction/warm/low-maintenance/modular/noisy/sustainable/flexible/versatile/safe/ innovative/original, creative/customizable/expensive/healthy/durable, stable/bright/luxurious, elegant/high-quality/family-friendly/cozy/aesthetic, beautiful/comfortable, well-being". These characteristics were selected to cover all relevant aspects of a house, based on previous studies on differential semantics in the residential context [33,34]. This approach allowed us to address perceptions of the physical design and form of the house, comfort, and overall livability. Finally, respondents were asked to make an overall assessment of the house with the statement "Overall, I like this house", using the same Likert scale from −5 to 5. This question allowed a general impression of the participant's likes or dislikes toward the presented house to be obtained.

In the third section, sociodemographic data of the respondents were collected, including age, gender, education, and work related to industrialized housing. This information allowed for contextualizing the responses and conducting more precise analyses, applying the second inclusion criterion.

2.3. Stimulus

Each participant was randomly presented with a stimulus of 24 different stimuli (2 labels × 12 images). The labels were 'industrialized housing' or 'non-industrialized housing'. The images were photographs of actual dwellings, six of which were of an interior living space and six of which were of a façade. All the exterior images showed a full front view of the dwelling, while the interior images presented a broad, representative view of the main living space (living room and/or kitchen) of the dwelling. Of each of these six indoor and outdoor spaces, two images were high-level dwellings, two were mid-level dwellings, and two were low-level dwellings. Of each of these pairs of images, one was an industrialized dwelling and one was a non-industrialized dwelling with similar characteristics to each other.

The photographs that made up each stimulus were obtained from a variety of reliable sources, including architects' databases, design magazines, and specialized construction and housing websites. The criteria for ranking the dwellings (low, medium, high) were based on factors such as estimated construction cost, materials used, architectural design, and overall size of the dwelling. Image selection was performed by ensuring that the visual characteristics were as similar as possible between each pair of images of industrialized and non-industrialized dwellings within each level category. This included aspects such as architectural style, quality of finishes, dimensions, and geometry of space, type and arrangement of furnishings, and the environment visible in the images. This ensured that there was variability in the type of dwellings presented.

Each housing photograph was standardized, with a resolution of 72 dpi, dimensions of 1200 × 800 pixels, color depth of 8 bpp in the sRGB profile, and a post-processed color adjustment. This color adjustment was performed to remove filters or other edits that altered the original state of the captured photographs. Each image includes a translucent black bottom skirt (4.8 cm wide) with the corresponding label: 'Industrialized Housing' or 'Non-Industrialized Housing'. This skirt not only serves to prominently display the label,

but also ensures that this information does not interfere with the visual perception of the architecture and design of the dwelling. This resolution ensures clarity and visibility of the architectural and design details, as well as the label. As a result, participants are able to focus their attention on both the details of the homes and the labels. These features were kept uniform across all images to avoid visual bias.

2.4. Data Analysis

The collected data were tabulated and analyzed using SPSS v.27.0 "https://www.ibm.com/es-es (accessed on 13 July 2024). To answer the four questions posed in our objective, 4 hypotheses were established, organized in two phases of analysis (see Table 2), in which the Mann–Whitney test was applied. This non-parametric statistical test allows for the comparison of medians between groups of continuous or ordinal variables, based on independent cases and without assuming a normal distribution of the data [35,36]. Each of these three assumptions was confirmed by (1) verifying that the nature of the data was appropriate for the test, as the Likert scale ratings from −4 to +4 established the ordinal variables used in the study; (2) monitoring the dates and times of survey submissions to ensure that the responses constituted independent cases; and (3) checking that none of the study variables followed a normal distribution using the Kolmogorov–Smirnov test (all $p < 0.000$). Additionally, the effect size was calculated using Rosenthal's r statistic [37,38]. This statistic measures the magnitude of the observed differences, facilitating a deeper interpretation of the results and providing a robust and reliable evaluation of the data.

Table 2. Specification of the statistical treatment carried out with the Mann–Whitney test, indicating the dependent and independent variables involved, independently for each proposed hypothesis.

Phase and Purpose	Hypothesis Proposed	Dependent Variable	Independent Variables
I. To know if there is a bias toward industrialized housing	Q1: (h1) There is a bias based on the term "industrialized"	Like Rating	• Label and type • Image type
	Q2: (h2) The bias is specific to people who are not experts in the sector	Like Rating	• Level of expertise • Label type • Image type
II. To know if the provision of prior information on industrialized homes influences their valuation	Q3: (h3) The bias toward industrialized housing is influenced by prior information.	Like Rating of non-experts	• Label/Image type
	Q4: (h4) Prior information affects the set of assessments of industrialized housing	Set of assessments of non-experts	• Label/Image type

3. Results

The results obtained from the analyses carried out are presented below following the two-stage structure outlined in the previous section.

3.1. Phase I: Existence of Bias toward Industrialized Housing

To find out if there is a negative bias toward industrialized housing due to the design itself or the term 'industrialized' the Mann–Whitney U test was used. The results with the whole sample showed that the image (U = 2631.5; $p = 0.280$) did not generate significant differences when they were industrialized (Mdn = 2; Rank = 10) or non-industrialized (Mdn = 2; Rank = 10 and Mdn = 3). Regarding the label, the rating was more positive for non-industrialized (Mdn = 3; Rank = 9) versus industrialized (Mdn = 2; Rank = 10), but these results did not show significant differences (U = 3364.5; $p = 0.980$). This validates our hypothesis that there are differences in the distributions depending on the label (h1). Despite this result, a more detailed analysis was carried out.

To find out whether the bias existed depending on the intrinsic characteristics of the subjects, the same analysis was carried out but independently for those who did and did not have knowledge/profession/training related to the industrialized construction sector. The results of the Mann–Whitney test determined the existence of differences. Specifically, for people related to the sector, there was no effect either for labels (U = 244; $p = 0.981$) non-industrialized (Mdn = 2; Rank = 9) vs. industrialized (Mdn = 2; Rank = 10) or for images (U = 196.5; $p = 0.196$) non-industrialized (Mdn = 1; Rank = 10) vs. industrialized (Mdn = 2; Rank = 9). The ratings of the non-industry respondents also did not differ according to the type of stimulus image (U = 1376; $p = 0.620$), where the scores for industrialized (Mdn = 2; Rank = 10) and non-industrialized (Mdn = 2; Rank = 10) images were similar. However, the label did influence the rating of this group of respondents (U = 1788; $p = 0.041$; r = 0.197), where scores for industrialized labels (Mdn = 2; Rank = 10) were lower than for non-industrialized labels (Mdn = 3; Rank = 9). Similarly, when analyzing the impact of prior knowledge or experience in the non-industrialized construction sector, the results were consistent with our second hypothesis, confirming that (1) the valuation of industrialized or non-industrialized housing was not different for experts or non-experts and (2) the valuation of housing with an industrialized or non-industrialized label was also not different for experts, but was for non-experts (h2). This suggests that the labels, and not the images themselves, influence the perceived liking of the dwellings (Figure 1).

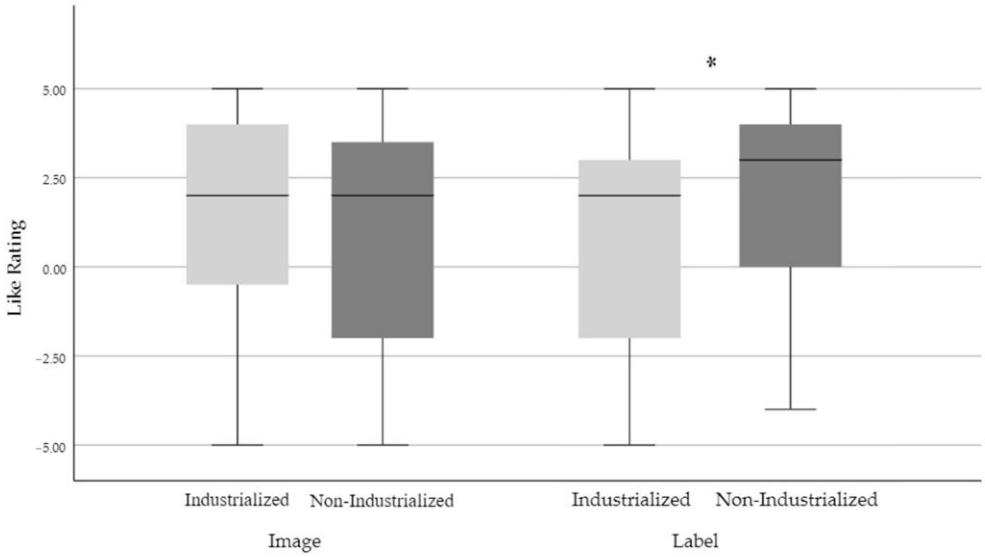

Figure 1. Graph of Like Rating levels according to image type and tag type. * Indicates statistically significant differences ($p < 0.05$).

3.2. Phase II: Effect of Prior Information on Industrialized Housing Bias

Because the results reported a bias coming from the label, a second analysis aimed only to find out whether giving prior information about industrialized housing influenced the rating of label-based stimuli. To do so, a Mann–Whitney U-test was applied comparing Like Rating between groups that received prior information and those that did not, independently for the industrialized and non-industrialized label. The results of the test found that the overall rating of the industrialized label stimuli was significantly improved (U = 713; $p < 0.001$; r = 0.478) when receiving prior information (Mdn = 3.5; Range = 3) compared to not receiving such information (Mdn = 2; Range = 10). Receiving (Mdn = 2; Rank = 9) or not receiving (Mdn = 3; Rank = 9) information had no effect on the rating of non-industrialized labeled stimuli (U = 1794; $p = 0.089$), being similar in both conditions (Figure 2). Therefore, when considering how prior information affects the evaluation of the dwellings, we found that it does not affect whether the dwelling has the non-industrialized label, but it does affect the evaluation of the dwellings with industrialized labels (h3).

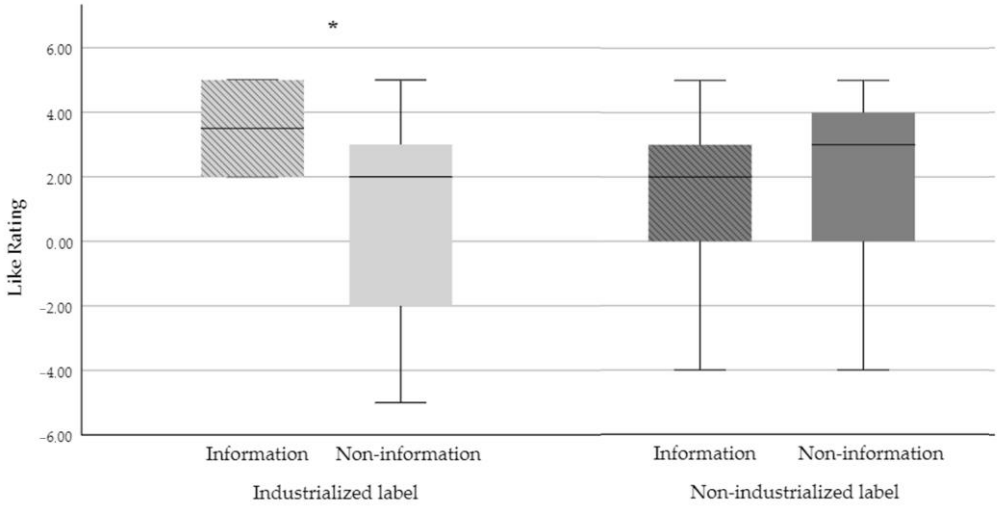

Figure 2. Graph of Like Rating levels according to the type of label and whether or not the information was received. The shaded patterns indicate different conditions: diagonal stripes represent the 'Information' condition, and solid gray represents the 'Non-information' condition. * Indicates statistically significant differences ($p < 0.05$).

Additionally, the Mann–Whitney U test was performed on the specific ratings of 23 different characteristics of the houses. The test results indicated that receiving prior information also increases the specific ratings of some of the 23 characteristics studied. Thus, the perception of Cozy (U = 843.5; $p < 0.000$; r = 0.401), Aesthetic, beautiful (U = 1046.5; $p = 0.002$; r = 0.289), Comfortable, well-being (U = 847.5; $p < 0.000$; r = 0.400), Noisy (U = 1931; $p = 0.032$; r = 0. 202), Luxurious, elegant (U = 1112.5; $p = 0.008$; r = 0.253), Expensive (U = 1175; $p = 0.022$; r = 0.217), High-quality (U = 950; $p = 0.000$; r = 0.343), Flexible, versatile (U = 1201.5; $p = 0.032$; r = 0.202), Family-friendly (U = 826. 5; $p < 0.000$; r = 0.411), Durable, stable (U = 1050; $p = 0.002$; r = 0.288), Original, creative (U = 1043.5; $p = 0.002$; r = 0.293), Healthy (U = 1170.5; $p = 0.020$; r = 0.220), Customizable (U = 1069.5; $p = 0.003$; r = 0. 277), and Bright (U = 1088.5; $p < 0.005$; r = 0.268) were significantly different when information was received than when it was not, but only in cases where the stimulus had an industrialized label. Of all these ratings, only the perception of Expensive (U = 1947.5; $p = 0.009$; r = 0.250) was also significantly different in the conditions with and without non-industrialized label information (see median values and ranges for each case in Figures 3 and 4). All other ratings were not affected by receiving or not receiving information on either type of label (all p-value > 0.05). Therefore, this partially supports our hypotheses about the differences in the valuation based on the information received for only some of the valued characteristics of the industrialized housing (h4) since the valuation of the rest of the characteristics was not affected by whether or not prior information was received.

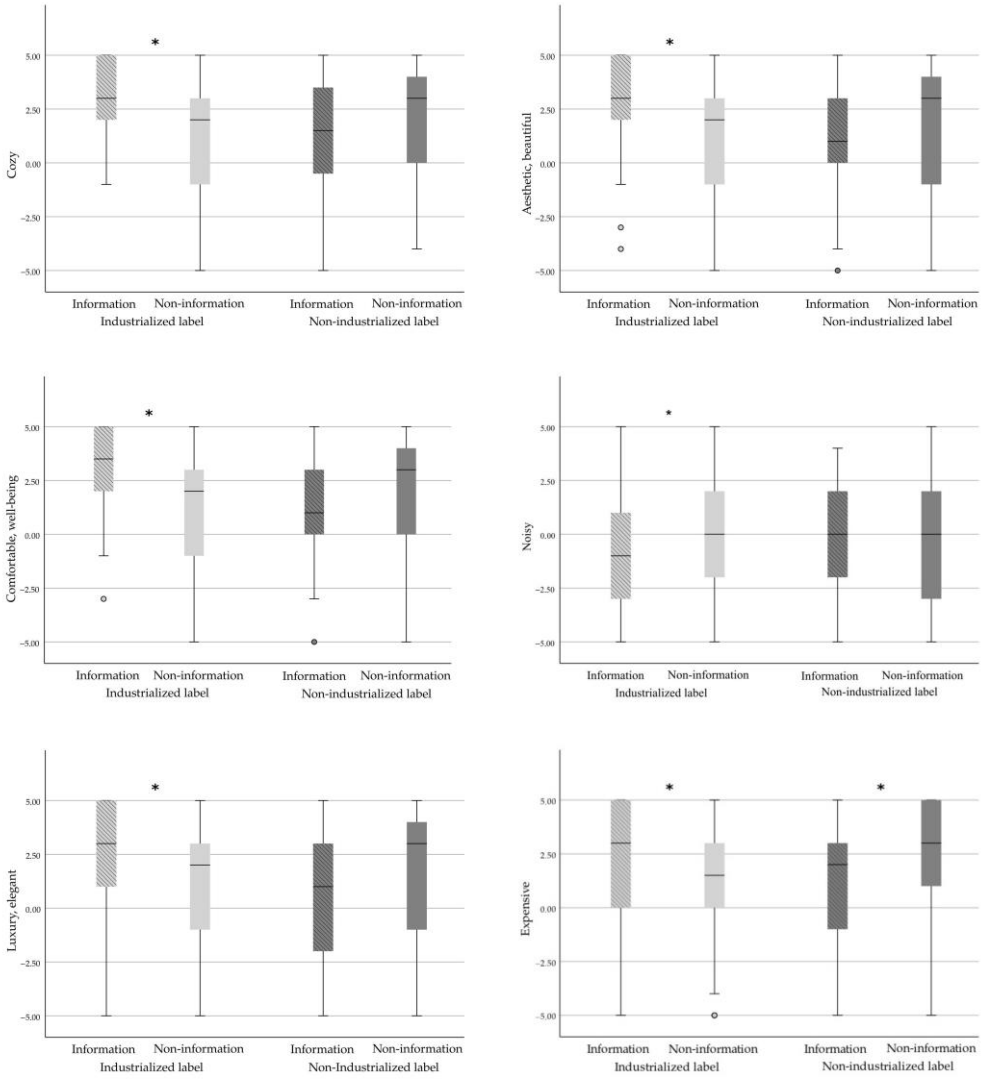

Figure 3. Graph of the specific ratings of dwellings (Cozy; Aesthetic, Beautiful; Comfortable, well-being; Noisy; Luxury, elegant; Expensive) according to the type of label and whether they have received information. The asterisk (*) indicates statistically significant differences ($p < 0.05$). The different shading patterns represent distinct experimental conditions: diagonal stripes indicate the 'Information' condition, solid gray represents the 'Non-information' condition. The circles represent outliers in the data.

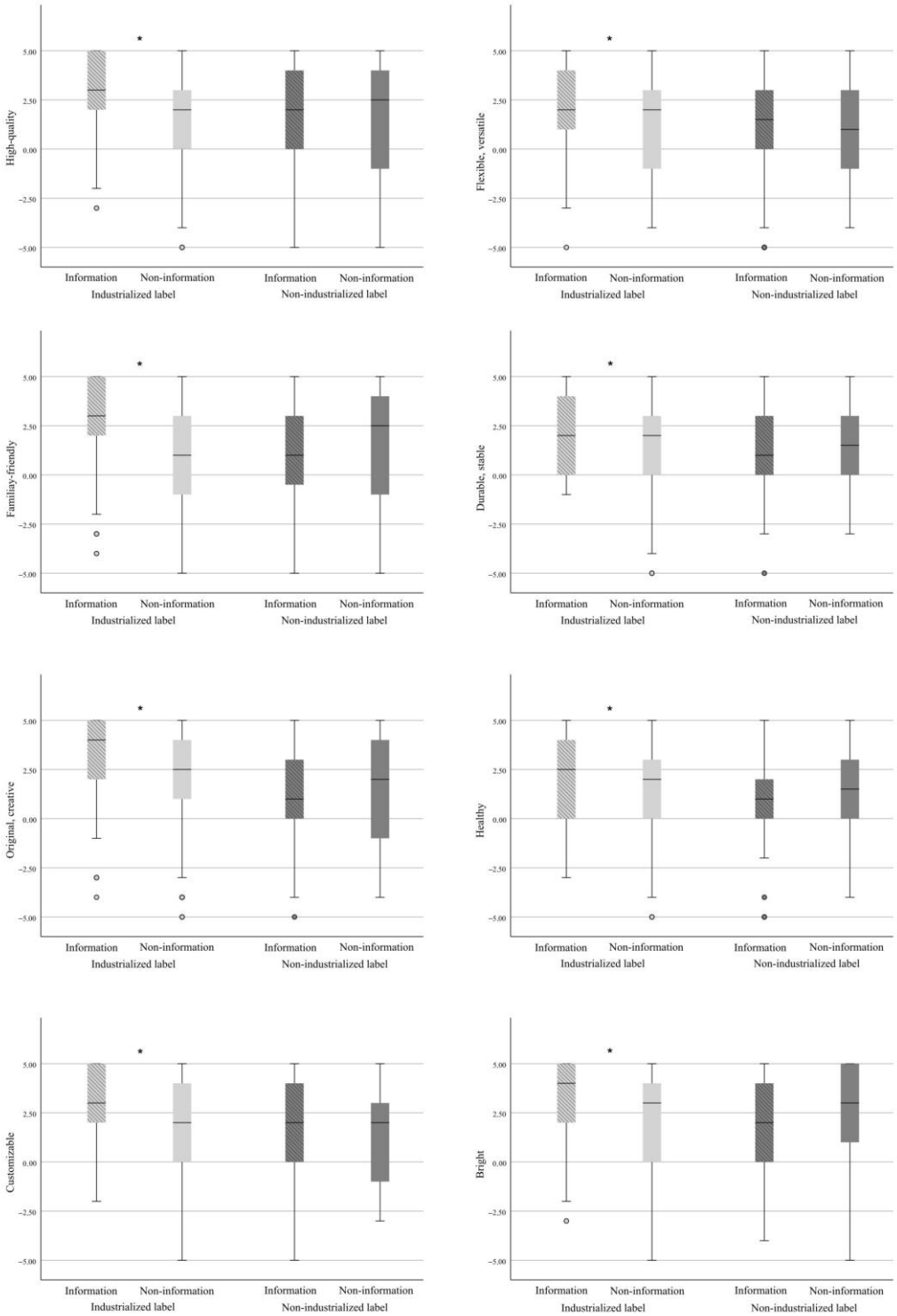

Figure 4. Graph of the specific ratings of dwellings (High-quality; Flexible, versatile; Family-friendly; Durable, stable; Original, creative; Healthy; Customizable; Bright) according to the type of label and whether they have received information. The asterisk (*) indicates statistically significant differences ($p < 0.05$). The different shading patterns represent distinct experimental conditions: diagonal stripes indicate the 'Information' condition, solid gray represents the 'Non-information' condition. The circles represent outliers in the data.

4. Discussion

This study investigates the perception of industrialized dwellings in comparison with dwellings carried out through a traditional construction process, exploring how

prior information and specialized knowledge about this type of construction influence these perceptions.

The findings indicate that the label 'industrialized' exerts a more significant impact on the perception of housing than its physical appearance. This observation is consistent with the prominence of text within a visual stimulus, where textual elements often attract a higher number of eye fixations, potentially driven by an innate inclination to read and comprehend the content [39]. Consequently, our study reveals that housing, irrespective of its industrialized status, tends to be perceived less favorably when designated as 'industrialized housing'.

A key aspect of the study is that the most negative perceptions of dwellings labeled as industrialized are mainly observed among people who are unfamiliar with the process of industrializing a dwelling. It may be that the very word industrialized has a connotation of novelty for inexperienced consumers, generating uncertainty due to the unknown and, as a consequence, rejection of the product due to resistance to change [40]. This explanation could be supported by other studies that have shown a generalized rejection of novel products by consumers [41,42], in sectors such as the food industry [43], e-book production [44], and e-banking [45]. However, this aversion to the new does not appear to be widespread. For instance, in sectors such as telecommunications, there is no resistance to the consumption of the latest and most up-to-date mobile phones [46].

In addition to this, the results may also suggest that the label 'industrialized' carries an intrinsic negative bias that may be generated by stereotypes and prejudices. In this regard, Richetin et al. [47] obtained consistent results, in which the product was perceived less favorably by consumers when accompanied by the industrial label compared to the traditional label. Nonetheless, this should be interpreted with caution, as the study focused on food products, which are inherently different from housing. Food products are consumed daily and ingested, making them more likely to be perceived as harmful to health. However, should an intrinsic negative bias exist, it might be attributable to stereotypes and prejudices. The issue of the influence of stereotypes and preconceived labels has been mainly analyzed from social psychology and can be extrapolated to the analysis of the perception of industrialized housing. Several studies have shown that stereotypes profoundly affect cognition and the way new information is processed. According to social perception theory, stereotypes have functionality in that they act as cognitive filters that speed up the processing of information [48,49]. However, this filtering can be detrimental as it distorts the interpretation of information leading to unsubstantiated bias. In the context of industrialized housing, the label 'industrialized' may trigger pre-existing negative associations, such as perceptions of lower quality or durability, thus influencing the overall assessment. What makes stereotypes complex is that they can operate automatically, affecting evaluations even in the absence of conscious intentions to discriminate [50]. Fazio et al. [51] added that the automatic activation of stereotypes can be difficult to control, and that initial evaluations can influence later judgments significantly. In either case, whether because of possible stigma toward the word itself or because of the uncertainty of not knowing it, lack of adequate information is a critical factor [16] in addressing the bias generated.

This implied that our research also analyzed how prior information or lack of information among non-experts about the industrialization process can have an effect on the perception of the dwelling itself. In this case, having prior information improves the overall assessment of dwellings labeled as industrialized, without negatively affecting non-industrialized dwellings. It is not entirely expected for informed individuals to make similar evaluations to those of experts regarding this type of housing. In this regard, studies such as Duboz et al. [52] demonstrate that being an expert on a subject does not exempt one from critical scrutiny and identifying weaknesses, such as those associated with autonomous vehicles. This suggests that it is not merely the information itself that influences evaluation but rather that industrialized housing possesses intrinsically positive qualities that become more apparent with a deeper understanding of the process. Thus, information enables a critical assessment of the product and recognition of its advantageous features.

In addition, it is noteworthy that prior information also has an effect on the assessment of specific characteristics of the dwelling. Some very relevant results can be extracted from this. For example, the perceived sustainability of an industrialized dwelling is improved when prior information is received. Accordingly, there is a current trend in the food sector toward a preference for environmentally friendly and sustainable products [18], which may justify an improvement in the general perception of this type of housing. However, the relationship of the results of these studies should be interpreted with caution as they were mainly developed in the context of the food sector. They have also found an improvement in the perception of Luxurious, elegant; High-quality; or Customizable, which is consistent with previous studies that found that the perception of a home as prestigious or luxury favors consumer acceptance [53]. In any case, these terms do not show differences with a strong magnitude of effect [54].

The terms that significantly improved in the face of previous information were Cozy; Family-friendly; or Comfortable, well-being, i.e., those more related to the user's own experience in the space. In light of this, it appears that emotional attributes show greater product approach-avoidance behavior [55]. In contrast, it is important to note that most of the characteristics closely related to industrialized construction, such as quick-to-build, automated construction, or modular, were not affected by prior information. This can be explained by the fact that these technical features are less visible to consumers and require a deeper technical understanding to be properly valued. In this sense, the theory of limited cognitive capacity suggests that consumers tend to simplify complex information and focus on attributes that are easier to understand and evaluate [56]. This suggests that basic prior information can improve general and more personal perceptions of the product, but its impact on the assessment of specific technical attributes is limited, possibly because lack of prior knowledge requires deeper information and even direct experience. According to Ericsson and Smith [57], the acquisition of expert knowledge is based on systematic and repeated practice that leads to the formation of more complex and accessible knowledge structures, thus improving the ability to evaluate and understand complex technical information.

Considering the discussion of our results, it appears that there is no consensus on the perception and prior information regarding industrialized products in general, and even less so with respect to the specific context of industrialized construction. Therefore, studies such as the present one on the perception of industrialized housing are crucial for understanding, at a theoretical level, the barriers to the acceptance of this technology and have important implications for the construction industry, public policy, urban planning, architectural design, and marketing strategies. Industrialized construction, which offers benefits such as cost and time efficiency [58] and environmental improvements [10–12], is growing, but its adoption may be constrained by limited knowledge [16] that favors the development of biases. The provision of neutral and objective information, as well as education and effective communication, is essential to overcome these biases and encourage the acceptance of sustainable and efficient building methods, promoting a built environment that is more valued by society and significantly improving the quality of life.

Finally, it is important to note that this study has several limitations that should be considered when interpreting the hypotheses based on the results obtained. First, the sample used was located in Spanish territory, which implies the influence of this particular culture on the responses. In this regard, it should be noted that perceptions of housing may vary significantly across different socio-cultural contexts and that survey-based methodology may be subject to socially desirable responses [59]. To address these limitations and advance the field, future research should focus on several key areas. Future research could focus on developing educational interventions that provide information about industrialized housing to counteract negative stereotypes. These interventions should be optimally designed for each profile, considering within-subject variables such as the level of education and the specific area of expertise, to ensure their effectiveness and relevance. It is essential that future research continues to explore these aspects, with

particular emphasis on how prolonged and direct exposure to industrialized housing can influence public perception and the sustainability of this change in the long term. Expanding this approach will contribute to a better understanding and acceptance of industrialized housing in different cultural and socio-economic contexts, promoting its integration as a viable and sustainable option in contemporary society.

5. Conclusions

In this study, we investigate the perception of dwellings that have been produced through a process of industrialization. Specifically, the investigation has explored the existence of bias toward the label 'industrialized' and the effect of prior objective information on this bias. It is concluded that (1) this bias is especially present in people without knowledge of the sector, nor with a related profession or training; and (2) moreover, prior information on this subject mitigates negative bias within this non-expert population, showed a significantly improved perception of these homes, especially in personal or emotional attributes. Therefore, it seems important to provide neutral prior information to consumers. This phenomenon indicates that education and the dissemination of impartial information can allow people to form opinions based on objective data rather than preconceived prejudices. These personal opinions are not solely based on functional or technical criteria; they also encompass experiential and emotional factors. This, in turn, may facilitate a greater acceptance of technological innovations in the construction sector. The implications of these findings are highlighted in two key areas: a theoretical contribution and a practical one.

Theoretically, this study opens a new line of inquiry by focusing on consumer perceptions of industrialized housing. This area is underexplored due to two factors: first, homes are purchased infrequently over a person's lifetime, which limits consumer interest in studying this sector; and second, industrialized housing is relatively novel and has not been subject to extensive analysis. Our findings provide an initial foundation for studying perceptions of industrialized housing, which can be further explored in future research. From a practical perspective, the results underscore the need for the industrialized construction industry to develop communication strategies that clarify and promote the tangible benefits of these homes.

From a practical perspective, the results are of interest to both the industrialized construction industry and governments. For the former, the need is highlighted for the sector to develop communication strategies that clarify and promote the tangible benefits of these homes. For the latter, it is important to consider that public policies should also promote education about the social and environmental advantages of industrialized housing to facilitate its acceptance. Implementing these recommendations could significantly enhance public perception and foster greater acceptance of innovations in the construction sector.

Author Contributions: Conceptualization, A.M., M.L.N., R.B.-M., J.L.H.-T. and C.L.; methodology, M.L.N., J.L.H.-T. and C.L; software, J.L.H.-T.; validation, J.L.H.-T., C.L. and M.L.N.; formal analysis, M.L.N.; investigation, M.L.N., C.L. and J.L.H.-T.; resources, C.L.; data curation, C.L., J.L.H.-T. and M.L.N.; writing—original draft preparation, M.L.N. and A.M.; writing—review and editing, M.L.N. and R.B.-M.; visualization, A.M., R.B.-M. and M.L.N.; supervision, C.L.; project administration, C.L.; funding acquisition, C.L. All authors have read and agreed to the published version of the manuscript.

Funding: This publication is funded by la Generalitat Valenciana, Vicepresidència Segona i Conselleria de Serveis Socials, Igualtat i Habitatge, Pla Irta, Innovació i Recerca per a la Transició Ecològica en l'Arquitectura (programa 3. Investigació, ref. HBIRT3-2023-7). The first author is supported by the Ministry of Science, Innovation, and Universities of Spain (FPU19/03531). The third author is supported by MCIN/ AEI/10.13039/501100011033 y FSE+ (PRE-2022).

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the risk that disclosure could jeopardize the privacy of the individuals involved in the study.

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

References

1. Wuni, I.Y.; Shen, G.Q. Barriers to the adoption of modular integrated construction: Systematic review and meta-analysis, integrated conceptual framework, and strategies. *J. Clean. Prod.* **2020**, *249*, 119347. [CrossRef]
2. Gibb, A.G. *Off-Site Fabrication: Prefabrication, Pre-Assembly and Modularisation*; John Wiley & Sons: Hoboken, NJ, USA, 1999.
3. Wuni, I.Y.; Shen, G.Q. Critical success factors for modular integrated construction projects: A review. *Build. Res. Inf.* **2020**, *48*, 763–784. [CrossRef]
4. Loizou, L.; Barati, K.; Shen, X.; Li, B. Quantifying advantages of modular construction: Waste generation. *Buildings* **2021**, *11*, 622. [CrossRef]
5. Bertram, N.; Fuchs, S.; Mischke, J.; Palter, R.; Strube, G.; Woetzel, J. Modular construction: From projects to products. *McKinsey Co. Cap. Proj. Infrastruct.* **2019**, *1*, 1–34.
6. Kamali, M.; Hewage, K. Life cycle performance of modular buildings: A critical review. *Renew. Sustain. Energy Rev.* **2016**, *62*, 1171–1183. [CrossRef]
7. Hammad, A.W.; Akbarnezhad, A.; Wu, P.; Wang, X.; Haddad, A. Building information modelling-based framework to contrast conventional and modular construction methods through selected sustainability factors. *J. Clean. Prod.* **2019**, *228*, 1264–1281. [CrossRef]
8. Lawson, R.M.; Ogden, R.G.; Bergin, R. Gibb Application of modular construction in high-rise buildings. *J. Archit. Eng.* **2012**, *18*, 148–154. [CrossRef]
9. Margherita, L.; Carlos, M.; Urban, P. Challenges Facing Components Reuse in Industrialized Housing: A literature review. *Environ. Sci. Sustain. Dev.* **2021**, *6*, 73–82. [CrossRef]
10. Monahan, J.; Powell, J.C. An embodied carbon and energy analysis of modern methods of construction in housing: A case study using a lifecycle assessment framework. *Energy Build.* **2011**, *43*, 179–188. [CrossRef]
11. Al-Hussein, M.; Manrique, J.D.; Mah, D. *North Ridge CO_2 Analysis Report: Comparison between Modular and On-Site Construction*; University of Alberta: Edmontom, AB, Canada, 2009.
12. Kim, D. Preliminary Life Cycle Analysis of Modular and Conventional Housing in Benton Harbor, Michigan. Ph.D. Dissertation, University of Michigan, Ann Arbor, MI, USA, 2008.
13. Kedir, F.; Hall, D.M. Resource efficiency in industrialized housing construction—A systematic review of current performance and future opportunities. *J. Clean. Prod.* **2021**, *286*, 125443. [CrossRef]
14. Zhou, Z.; Shen, G.; Xue, J.; Sun, C.; Liu, Y.; Cong, W.; Yu, T.; Wang, Y. The formation of citizens' intentions to purchase prefabricated housing in China: The integrating theory of planned behavior and norm activation model. *Eng. Constr. Archit. Manag.* **2023**. *ahead-of-print*. [CrossRef]
15. Koklic, M.K.; Vida, I. A Strategic Household Purchase: Consumer House Buying Behavior. *Manag. Glob. Transit. Int. Res. J.* **2011**, *7*, 74–96.
16. Shen, K.; Li, X.; Cao, X.; Zhang, Z. Prefabricated housing subsidy analysis in China based on an evolutionary game model. *J. Civ. Eng. Manag.* **2021**, *27*, 553–570. [CrossRef]
17. Kamar, K.M.; Alshawi, M.; Hamid, Z. Barriers to industrialized building system (IBS): The case of Malaysia. In Proceedings of the BuHu 9th International Postgraduate Research Conference (IPGRC), Salford, UK, 29 January 2009; Volume 30.
18. Cheng, C.; Shen, K.; Li, X.; Zhang, Z. Major barriers to different kinds of prefabricated public housing in China: The developers' perspective. In Proceedings of the ICCREM 2017—International Conference on Construction and Real Estate Management 2017, Guangzhou, China, 10–12 November 2017; pp. 79–88.
19. Pasquire, C.L.; Gibb, A.G. Considerations for assessing the benefits of standardisation and pre-assembly in construction. *J. Financ. Manag. Prop. Constr.* **2002**, *7*, 151–161.
20. Blismas, N.; Pasquire, C.; Gibb, A. Benefit evaluation for off-site production in construction. *Constr. Manag. Econ.* **2006**, *24*, 121–130. [CrossRef]
21. Lovell, H.; Smith, S.J. Agencement in housing markets: The case of the UK construction industry. *Geoforum* **2010**, *41*, 457–468. [CrossRef]
22. Shah, R.; O'Mahony, L.; Matipa, W.; Cotgrave, A. The public perception of prefabricated housing in the UK. *EPiC Ser. Built Environ.* **2020**, *1*, 266–273.
23. Mao, C.; Shen, Q.; Pan, W.; Ye, K. Major barriers to off-site construction: The developer's perspective in China. *J. Manag. Eng.* **2015**, *31*, 04014043. [CrossRef]
24. Craig, A.; Laing, R.; Edge, M. 21st Century: Cities, social life and sustainable development. In Proceedings of the 16th IAPS Conference, Paris, France, 4–7 July 2000; pp. 161–169.
25. Apaydin, F. Effectiveness of prefabricated house industry's marketing activities and Turkish consumers' buying intentions towards prefabricated houses. *Asian Soc. Sci.* **2011**, *7*, 267–276. [CrossRef]
26. Mazursky, D.; Jacoby, J. Forming impressions of merchandise and service quality. In *Perceived Quality*; Jacoby, J., Olson, J., Eds.; Lexington Books: Lexington, MA, USA, 1985; pp. 13–54.
27. Dou, Y.; Sun, X.; Ji, A.; Wang, Y.; Xue, X. Development strategy for prefabricated construction projects: A tripartite evolutionary game based on prospect theory. *Eng. Constr. Archit. Manag.* **2023**, *30*, 105–124. [CrossRef]

28. Ekanayake, E.M.A.C.; Shen, G.; Kumaraswamy, M.; Owusu, E.K.; Xue, J. Capabilities to withstand vulnerabilities and boost resilience in industrialized construction supply chains: A Hong Kong study. *Eng. Constr. Archit. Manag.* **2022**, *29*, 3809–3829. [CrossRef]
29. Song, Y.; Wang, J.; Liu, D.; Huangfu, Y.; Guo, F.; Liu, Y. The influence of government's economic management strategies on the prefabricated buildings promoting policies: Analysis of quadripartite evolutionary game. *Buildings* **2021**, *11*, 444. [CrossRef]
30. Wu, G.; Yang, R.; Li, L.; Bi, X.; Liu, B.; Li, S.; Zhou, S. Factors influencing the application of prefabricated construction in China: From perspectives of technology promotion and cleaner production. *J. Clean. Prod.* **2019**, *219*, 753–762. [CrossRef]
31. Groves, R.M.; Peytcheva, E. The impact of nonresponse rates on nonresponse bias: A meta-analysis. *Public Opin. Q.* **2008**, *72*, 167–189. [CrossRef]
32. Tourangeau, R.; Rips, L.J.; Rasinski, K. *The Psychology of Survey Response*; Cambridge University Press: Cambridge, UK, 2000.
33. Llinares, C.; Page, A. Application of product differential semantics to quantify purchaser perceptions in housing assessment. *Build. Environ.* **2007**, *42*, 2488–2497. [CrossRef]
34. Llinares, C.; Page, A.F. Kano's model in Kansei Engineering to evaluate subjective real estate consumer preferences. *Int. J. Ind. Ergon.* **2011**, *41*, 233–246. [CrossRef]
35. McKnight, P.E.; Najab, J. Mann-Whitney U Test. *Corsini Encycl. Psychol.* **2010**, 1. [CrossRef]
36. MacFarland, T.W.; Yates, J.M.; MacFarland, T.W.; Yates, J.M. Mann–whitney u test. In *Introduction to Nonparametric Statistics for the Biological Sciences Using R*; Springer: Cham, Switzerland, 2016; pp. 103–132.
37. Rosenthal, R. Effect sizes: Pearson's correlation, its display via the BESD, and alternative indices. *Am. Psychol.* **1991**, *46*, 1086–1087. [CrossRef]
38. Fritz, C.O.; Morris, P.E.; Richler, J.J. Effect size estimates: Current use, calculations, and interpretation. *J. Exp. Psychol. Gen.* **2012**, *141*, 2–18. [CrossRef]
39. Fang, Y.; Zhu, L.; Cao, X.; Zhang, L.; Li, X. Visual Saliency: How Text Influences. In *Social Computing and Social Media. Design, Ethics, User Behavior, and Social Network Analysis, Proceedings of the HCII 2020, Copenhagen, Denmark, 19–24 July 2020*; Meiselwitz, G., Ed.; Lecture Notes in Computer Science; Springer: Cham, Switzerland, 2020; Volume 12194. [CrossRef]
40. Claudy, M.C.; Garcia, R.; O'Driscoll, A. Consumer resistance to innovation—A behavioral reasoning perspective. *J. Acad. Mark. Sci.* **2015**, *43*, 528–544. [CrossRef]
41. Joachim, V.; Spieth, P.; Heidenreich, S. Active innovation resistance: An empirical study on functional and psychological barriers to innovation adoption in different contexts. *Ind. Mark. Manag.* **2018**, *71*, 95–107. [CrossRef]
42. Kleijnen, M.; Lee, N.; Wetzels, M. An exploration of consumer resistance to innovation and its antecedents. *J. Econ. Psychol.* **2009**, *30*, 344–357. [CrossRef]
43. Frewer, L.J. Consumer acceptance and rejection of emerging agrifood technologies and their applications. *Eur. Rev. Agric. Econ.* **2017**, *44*, 683–704. [CrossRef]
44. Chen, S.; Granitz, N. Adoption, rejection, or convergence: Consumer attitudes toward book digitization. *J. Bus. Res.* **2012**, *65*, 1219–1225. [CrossRef]
45. Laukkanen, T. Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking. *J. Bus. Res.* **2016**, *69*, 2432–2439. [CrossRef]
46. Mehra, A.; Rajput, S.; Paul, J. Determinants of adoption of latest version smartphones: Theory and evidence. *Technol. Forecast. Soc. Chang.* **2022**, *175*, 121410. [CrossRef]
47. Richetin, J.; Demartini, E.; Gaviglio, A.; Ricci, E.C.; Stranieri, S.; Banterle, A.; Perugini, M. The biasing effect of evocative attributes at the implicit and explicit level: The tradition halo and the industrial horn in food products evaluations. *J. Retail. Consum. Serv.* **2021**, *61*, 101890. [CrossRef]
48. Shapira, B.; Shoval, P.; Hanani, U. Stereotypes in information filtering systems. *Inf. Process. Manag.* **1997**, *33*, 273–287. [CrossRef]
49. Shapira, B.; Shoval, P.; Hanani, U. Experimentation with an information filtering system that combines cognitive and sociological filtering integrated with user stereotypes. *Decis. Support Syst.* **1999**, *27*, 5–24. [CrossRef]
50. Devine, P.G. Stereotypes and prejudice: Their automatic and controlled components. *J. Personal. Soc. Psychol.* **1989**, *56*, 5. [CrossRef]
51. Fazio, R.H.; Jackson, J.R.; Dunton, B.C.; Williams, C.J. Variability in automatic activation as an unobtrusive measure of racial attitudes: A bona fide pipeline? *J. Personal. Soc. Psychol.* **1995**, *69*, 1013–1027. [CrossRef] [PubMed]
52. Duboz, A.; Mourtzouchou, A.; Grosso, M.; Kolarova, V.; Cordera, R.; Nägele, S.; Raposo, M.A.; Krause, J.; Garus, A.; Eisenmann, C. Exploring the acceptance of connected and automated vehicles: Focus group discussions with experts and non-experts in transport. *Transp. Res. Part F Traffic Psychol. Behav.* **2022**, *89*, 200–221. [CrossRef]
53. Montañana, A.; Nolé, M.L.; Llinares, C. Strategic Design Approaches for Eliciting the Perception of 'Prestige' in Housing Consumers. *Buildings* **2024**, *14*, 853. [CrossRef]
54. Cohen, J. A power primer. In *Methodological Issues and Strategies in Clinical Research*, 4th ed.; Kazdin, A.E., Ed.; American Psychological Association: Worcester, MA, USA, 2016; pp. 279–284. [CrossRef]
55. Lee, S.; Ha, S.; Widdows, R. Consumer responses to high-technology products: Product attributes, cognition, and emotions. *J. Bus. Res.* **2011**, *64*, 1195–1200. [CrossRef]
56. Sweller, J. Cognitive load theory. In *Psychology of Learning and Motivation*; Academic Press: Cambridge, MA, USA, 2011; Volume 55, pp. 37–76.

57. Ericsson, K.A.; Smith, J. (Eds.) *Toward a General Theory of Expertise: Prospects and Limits*; Cambridge University Press: Cambridge, UK, 1991.
58. Steinhardt, D.A.; Manley, K. Adoption of prefabricated housing–the role of country context. *Sustain. Cities Soc.* **2016**, *22*, 126–135. [CrossRef]
59. Larson, R.B. Controlling social desirability bias. *Int. J. Mark. Res.* **2019**, *61*, 534–547. [CrossRef]