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THE IMPACT OF FAMILIAR IMPLEMENTATION AND UNUSUAL ARTISTIC IMPLEMENTATION OF RECYCLED MATERIALS IN BUILDING DESIGN ON PEOPLE'S EXPERIENCE AND MENTAL HEALTH

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ABSTRACT

Building design can impact people's mental health. Waste negatively affects the environment by polluting the air, water, and soil. Recycling waste in building construction was encouraged to support sustainability. The aim is to provide information about how different ways of executing recycled materials in building design can impact users' experience and mental health. 173 study participants watched two videos of a house built from recycled materials, which were noticeable as recycled waste in the structure of the building (building A), and a house built from recycled materials but not pronounced as recycled waste (building B). After watching the videos, the participants rated statements in a questionnaire using a 5-point Likert scale (quantitative measure) and answered open-ended questions (qualitative measure). Data were analyzed based on percentages and cross-tabulated to assign qualities to design environments. Descriptive data were organized in tables and figures. Most visitors (81.3%) claimed that touring building B decreased their anxiety and was a relaxing experience compared to what they felt when they were touring building A. Most study participants experienced positive emotions in building B compared to building A. To encourage people to use recycled waste in the construction of their buildings, the final execution of the building should look familiar and avoid giving the feeling that what was used is waste.

Keywords: Recycling, Architecture, Design, Users, Health

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INTRODUCTION

Construction and demolition waste includes all types of waste produced during the assembly or demolition of buildings. Construction and demolition waste lead to a negative impact on the environment by polluting the air, water, and soil, leading to disastrous consequences, including global warming (Butera et al., 2015: 44, Kabirifar et al., 2020: 263). Building construction contributes to 35 percent of the overall global industrial waste (Polat et al., 2017: 196, Solís-Guzmán et al., 2009: 29). In 2014, according to Menegaki and Damigos, building construction and demolition in China produced 1.13 billion tons of waste, 534 million tons in the United States, and over 58 million tons in the United Kingdom (Menegaki and Damigos, 2018: 13).

Another type of waste is solid waste which consists of everyday public-disposed items, including cans, bottles, papers, plastic, and food. Controlling the amount of solid waste is fundamental to supporting resource management and the environment (Vergara and Tchobanoglous, 2012: 37). Furthermore, people are generating, and dumping huge quantities of solid waste, and its removal is extremely difficult (Das et al., 2019: 228). In 1990, the annual worldwide disposal of solid waste was 17 billion tons and it is estimated to reach 27 billion tons in 2050 (Karak et al., 2012: 42, Tang et al., 2020).

Due to the negative link between waste and the environment, it is encouraged to recycle waste in building construction. Multiple recycled materials are used in new construction. These include recycled plastic, metals, wood, glass, paper, gypsum, concrete, fixtures such as doors and appliances such as sinks. It is well established that building design and final execution can have a significant impact on people's mental health by triggering or mitigating mental disorder symptoms (Aljunaidy and Adi, 2021: 14). It is well established, too, that people do not share the same experience when they are exposed to different environmental settings (Adi and Aljunaidy, 2021: 3, Aljunaidy and Adi, 2021: 14). A previous study showed the architectural students' willingness and feelings towards using recycled waste in building design (Adi and Aljunaidy, 2021: 3), and to what degree those students are trained to incorporate recycled waste in their studio design. However, people's experiences and attitudes regarding integrating recycled materials in building design were not evaluated. Psychological well-being is still needed.

Aims

The aim of the study is to evaluate people's design preferences after experiencing two types of implementing recycled waste in the design of buildings. The first type means recycled materials are noticeable as recycled waste in the structure of the building, and the second type means recycled materials are not pronounced as recycled waste in the structure of the building. A previous manuscript showed how the design of a building can significantly impact the psychological wellness of people (Aljunaidy and Adi, 2021: 14). Therefore, the current study aims to evaluate the effect of recycling in the construction of buildings on people's perceptions and on provoking positive feelings, including happiness and optimism. The hypothesis is that the final execution of building design using recycled materials as a pronounced recycled waste or in a familiar way that is invisible as recycled waste will have a different impact on users' experience, emotions, and mental well-being.

METHODS

Ethical Approval and Data Collection

The study ethics (numbered: 2021_03_08_04) were reviewed and approved by the Office of the Vice-Rector for Academic Affairs at Bilkent University on the 8th of March 2021. Researchers in interior design and human psychology implemented a questionnaire that contained a total of 27 statements and questions. The participants rated statements in the questionnaire using a 5-point Likert scale (quantitative measure) and answered open-ended questions (qualitative measure). The questions and the statements in the questionnaire were related to the study participants' demography, the study participants' emotions and mental

health as related to the physical environment design, and expectations and suggestions towards using recycled waste in building design and construction. The questionnaire was adapted from previously published questionnaires related to physical environmental design and people's emotions and mental health (Adi and Aljunaidy, 2021: 3, Frontczak et al., 2012: 22, Graham, 2015, Thomson et al., 2003: 31). The questionnaire was made available online using the "Google Forms" link which was spread through the email lists of academic institutions, and through social media platforms (WhatsApp and Facebook). The participants were informed that the questionnaire was confidential and that they could withdraw from it without giving any justification. Before filling in the questionnaire, the study participants watched two video recordings. The first video recording was about a house built using solid waste materials, including newspapers, magazines, marble waste, carbon papers, plastic and glass bottles, cans, milk cartons, clothes, and compact discs (Renewable Home by SBS Australia, 2020), (Figure 1, a). The recycled waste was used in an artistic way and was clearly visible as recycled waste in the structure of building A. The second video recording was about a house built almost completely from recycled construction and demolition waste, including wood, metal, and glass (Penn, 2020), (Figure 1, b). However, recycled materials used in building B's structure were not clearly visible as recycled wastes. Researchers wanted to neutralize the fact that building A and building B were made from recycled materials to evaluate the visitors' genuine experience and preferences in these two different styles of building design. Because of that, study participants (visitors of the virtual building tours) were not informed that recycled waste was the main constructing material for building B until the very end of the questionnaire. After informing the study participants about the source of construction materials for building B, they were asked if they changed their mind regarding what building they prefer (building A or building B), and if they changed their minds about its reason.

Researchers in this study did not include any opinion or information in the survey about the sources of building materials so that they would not influence the decisions and preferences of the study participants. To encourage deeper thoughts, a wide range of words that describes human feelings were made available for the study participants to choose from while they are filling in the questionnaire (Graham, 2015). Those 19 words were listed in Table 1.

Analysis

Those who participated in the study rated statements in the questionnaire based on a 5-point Likert scale. The scale ranged from "strongly agree" (five points) to "strongly disagree" (one point). The higher the score was, the more satisfied they were with their virtual tour experiences. Using Microsoft Excel Worksheet and "Google Forms", descriptive data were organized in tables and figures. The main method of analysis was calculating the percentages of the answers given to each question. Furthermore, certain words were cross-tabulated to know which design qualities were associated with the preferred environmental design features.

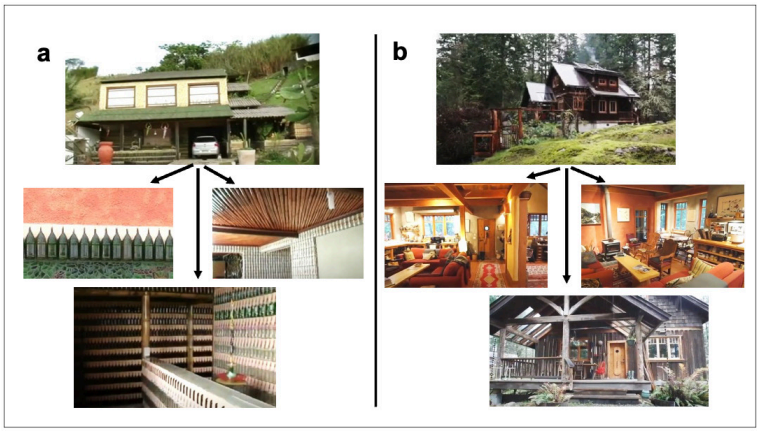

Figure 1. Buildings A & B
a: Building A was constructed using recycled solid waste which was pronounced as recycled waste in the final execution. b: Building B was constructed using recycled construction and demolition waste but not pronounced as recycled waste.

RESULTS

Demography of Participating People

173 people participated in the study. 58.1 percent of those people were females, 37.8 percent were males, and 4.1 percent did not specify. 57.3 percent of the virtual tour visitors were between 18 to 29 years old, 26.9 were between 30 to 49 years old, 10.5 percent were between 50 to 64 years old, and 5.3 percent were 65 years old or more. As the invitation to participate in the study was available publicly through social media (Facebook and WhatsApp groups), participation in the study was received from 14 countries including Turkey (82.14 percent), Canada (4.17 percent), Saudi (3.57 percent), United States (2.98 percent), Syria (1.19), Belgium, Germany, Jordan, Qatar, Slovenia, Spain, Sweden, United Arab Emirates and United Kingdom (0.60 percent each).

Impact of Different Design Implementations on Visitors' Experiences and Mental Well-being

Most of the participants (82.44 percent) preferred building B over building A (17.56 percent). People justified their preference for building B by explaining that building B felt cozy, familiar, and natural while building A felt crowded and more like a "waste place" (Figure 2). However, people justified their preference for building A by referring to its creative and artistic value compared to building B.

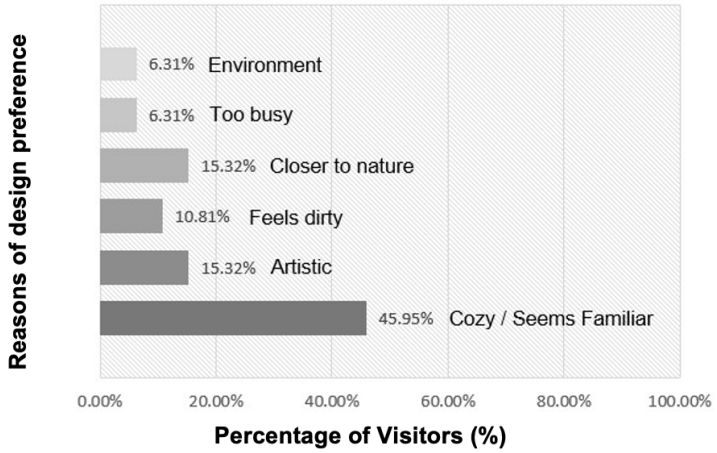

Figure 2. Reasons indicated by visitors justifying their preferences of buildings A or B

People who participated in the study were given the 19 adjectives that are listed in the first column of (Table 1) to select from the best that reflected their emotions in the virtual tours (no adjective pairs were used). The most common emotions regarding the visit to building A were feeling tired or interested while feeling happy, interested, or special were the most reported emotions regarding visiting building B (Table. 1).

Table 1. The feelings that study participants chose to describe their experiences after touring buildings A and B

Visitors' emotions	Percentage of visitors (%) building A	Percentage of visitors (%) building B
Happy	2.4	**23.5**
Sad	1.8	0
Bored	9.4	7.1
Fascinated	7.6	8.8
Excited	2.9	3.5
Scared	1.8	0.6
Amazed	7.1	5.9
Fantastic	1.2	2.9
Proud	7.1	0
Special	2.4	8.8
Marvelous	0	1.8
Buzzing	4.1	0
Fed up	5.9	0
Silly	4.7	0
Strong	0	1.8
Tired	**12.4**	3.5
Interested	**11.2**	**25.3**
Surprised	8.2	0
Curious	10	6.5

When filling in the survey, people who were exposed to buildings A or B, were asked whether they experienced any positive emotions including enjoyment and hope. Most study participants strongly did not agree about experiencing positive emotions in building A compared to what they experienced in building B (Figure 3).

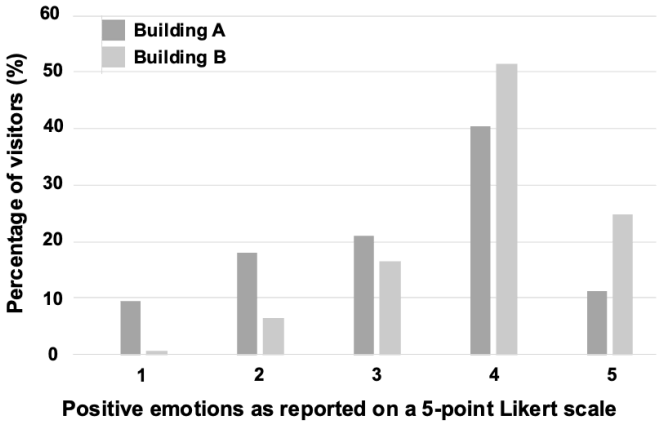

Figure 3. Positive feelings including enjoyment, hope, or optimism as indicated by visitors after seeing buildings A and B. A 5-point Likert scale ranging from "strongly agree" (5 points) to "strongly disagree" (1 point), was applied for the positive emotion evaluation.

Furthermore, most visitors reported that the tour in building B provided them with a calming experience and decreased their anxiety compared to the tour in building A (Figure 4, a). Most of the visitors indicated that they would recommend the tour of building B and A to other people. However, many visitors strongly did not agree about advocating building A tour to others (Figure 4, b).

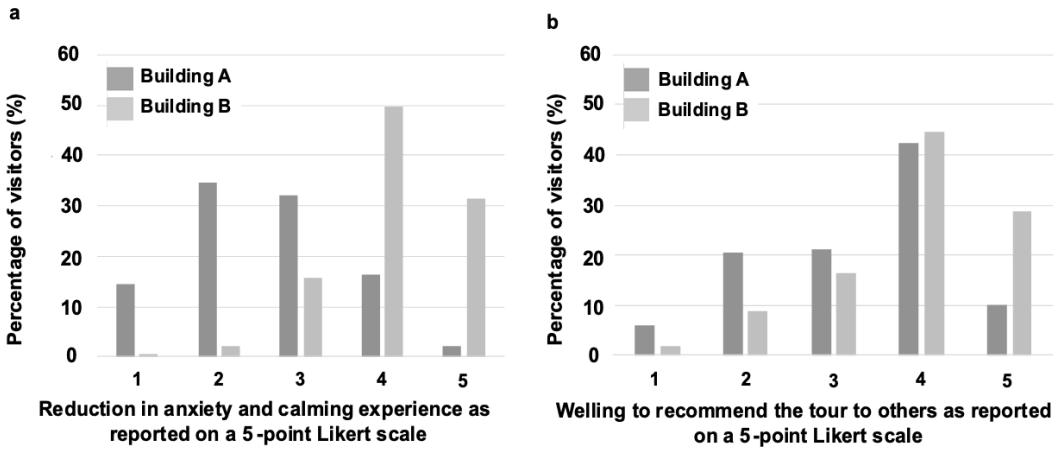

Figure 4. Effects of building design implementations on visitors' preference and mental well-being

A 5-point Likert scale, ranged from "strongly agree" (5 points) to "strongly disagree" (1 point), was implemented in the survey to assess people's experiences.

People's Attitude towards the Idea of Using Recycled Waste in the Core or as a Decoration of their Buildings

When visitors were asked what they think the focus of houses built from recycled materials should be, the majority (63.2 percent) mentioned sustainability (caring about the environment), 22.8 percent affordability (reasonably priced so people can afford to buy), and 14 percent indicated other reasons including authenticity, quality, and safety. In the survey, visitors had a question about their willingness to incorporate recycled materials in the core construction and/or as a decoration of their future houses/buildings. More people indicated that they would prefer to integrate recycled waste as decoration only in their buildings but not in the core of the construction (Figure 5).

To encourage people to consider the usage of recycled waste in building construction, most people who filled in the study survey suggested that the best ways were to provide a familiar and nice design of a building that was constructed using recycled materials and to communicate the crucial role of waste recycling on the environment (Figure 6). Fewer study participants supported the usefulness of talking to people about recycled waste as a more affordable option than using unrecycled materials (Figure 6).

When visitors were asked if they think that managers of big-budget projects will agree on adding recycled materials in the construction of buildings rather than using unrecycled materials, the agreement and disagreement were similar (36.3 percent agreement and 38.6 percent disagreement), while 25.1 percent of the visitors neither agreed nor disagreed. After informing the study participants that both buildings (A and B) were constructed using recycled waste, 90.6 percent of the visitors did not change their design preferences. However, few visitors (9.3 percent) changed their mind regarding what design they liked the most, 7 percent indicated that their design preference changed to become building B over building A, and 2.3 percent of the visitors changed their design preference to building A over building B. These changes in preferences, mainly towards building B, emphasized that the apparent design quality was a major attracting aspect in people's design choices.

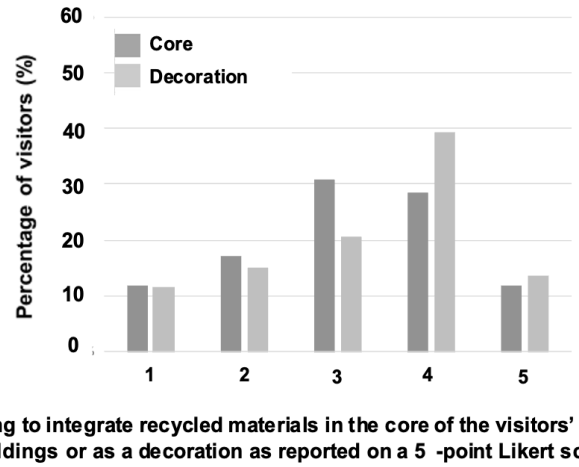

Figure 5. Visitors' willingness to integrate recycled waste in the construction of their future homes

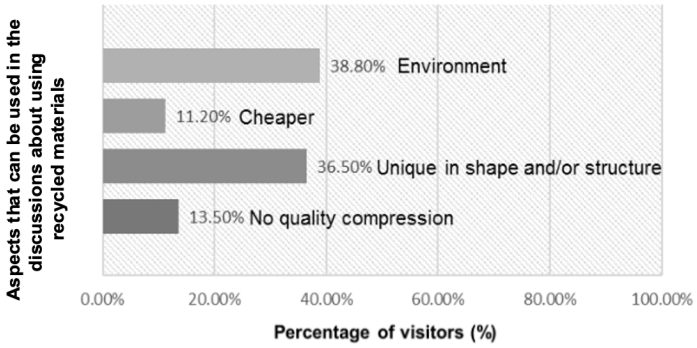

Figure 6. Different aspects that can be used in discussions to convince people to use recycled materials in the design of their buildings as suggested by the study participants

DISCUSSION

This study aims to evaluate the impact of different implementations of recycled waste in buildings on users' experience and mental health. The second aim of the study is to address people's attitudes towards using recycled material in buildings which provides data for architects and interior designers to shape a better understanding of people's references regarding using recycled materials in design. People participating in the study watched two different styles of recycled material applications in buildings. One of the buildings had recycled materials clearly shown as recycled materials in its structure; in the other building, recycled materials were not pronounced as recycled waste. The results were that people's choice of a building was predominantly centered on familiarity with the design rather than the source of the materials that were used in the construction. Building B, which seemed familiar and like a usual home, was a calming experience and reduced the level of anxiety of the visitors compared to building A, where the implantation of recycled waste was pronounced in its structure. More people indicated that they would prefer to use recycled waste only as a decorative and supplementary feature of their buildings compared to people who indicated that they would prefer using recycled materials in the core of their buildings. To encourage people to use recycled waste in the construction of their buildings, most study participants suggested talking to people about how crucial recycling is to save the environment and about creating a unique and familiar shape of buildings. Fewer study participants supported the usefulness of explaining to the clients that implementing recycled materials in building construction could be a more affordable alternative than using unrecycled materials.

The current paper highlights how important design quality is in people's assessment of a building. Generally, people felt that being in Building B was a calming experience as it seemed familiar while people did not express the same level of relaxation in building A and described it as being crowded. Quality in a building is judged by the final execution of a project in a way that meets the standards and fulfills the purpose of a product (Thomson et al., 2003: 31). The results herein agree with previous studies regarding the great demand for design quality by inhabitants (Frontczak et al., 2012: 22, Thomson et al., 2003: 31, Watson et al., 2016: 25). Therefore, architects and interior designers are encouraged to integrate recycled materials in their projects in ways that feel warm, familiar, and livable and try to focus on showing that the design of a building is based on recycling waste.

The effect of physical environmental design on people's mental well-being has already been established (Aljunaidy and Adi, 2021: 14). The most reported emotion of people visiting building A was "tired", while the most reported emotion of people visiting building B was "interested". People justified their "interested" feeling in building B by emphasizing that building B seemed familiar. Feeling "interested", though, is not a strong positive word to express feelings compared to the word "happy" but is still considered as a positive emotion that came very close to the percentage of people who expressed being "happy", feelings which were emphasized by the familiarity and coziness of building B. This means that implementing recycled materials in a familiar way can support people's positive feelings. These results agree with a previous study that showed architects should create their design for belongingness to increase people's happiness and satisfaction with the design of a building (Sääksjärvi and Hellén, 2013: 29). Building A did not seem like an ordinary home and some study participants had the feeling of "tiredness" when visiting it which was justified by feeling it as a "crowded" place. The results herein provide information for designers and architects when making decisions about possible ways to use recycled materials in building design and how people can react to them.

Reaching a solid agreement between customers and designers about using recycled materials or not in a project is necessary at the very early stages. Forming a general idea about customers' points of view and the way they look at using recycled materials in design is essential for interior designers and architects to effectively communicate with their clients and establish solid agreements with them. Researchers suggested that clear communication with the clients is key to a successful designer-client relationship (Norouzi et al., 2015: 172, Siva and London, 2011: 7). When the building design project starts and proceeds, clients usually become more satisfied as they start to understand the reasons behind using special techniques and special materials gradually (Norouzi et al., 2015: 172, Siva and London, 2011: 7). A previous study showed that architectural and interior design students believe that to convince their clients to accept using recycled materials in building construction, the architect or designer should underline the financial aspect of including recycled materials and should clarify that implementing recycled materials in construction does not necessarily mean that the quality of the final product will be compromised (Adi and Aljunaidy, 2021: 3). However, more studies were needed to assess people's opinions and what they like the most about using recycled materials in physical design projects. Considering people's opinions, the questionnaire results herein showed that many people thought that the best ways to convince clients to use recycled material in their buildings were to create a familiar design for the structure of the building and to clarify how important recycling is for the environment. This study is particularly important for creating a database for architects and interior designers to use for more effective and successful communication with their clients. Holistic studies are still needed to assess the best and most efficient, effective, and satisfactory ways to use each type of recycled material in building design.

Recycling in construction is essential to lessen the serious effect of waste on the environment. As using recycled materials in building design is mainly the decision of the clients, both architects and interior designers need to understand

people's perceptions and feelings about using recycled materials in building design and what aspects can encourage them to integrate recycled materials in the core or as a decoration of their buildings. In general, people's design preferences and feelings when exposed to different styles of recycling waste in buildings were mainly driven by the final execution, which was more accepted when it felt familiar and cozy than when it seemed artistic and pronounced as waste recycling. Many people mentioned that they would not mind implementing recycled materials in their buildings. Those findings are important for architects and interior designers as they create a database to support communication with clients regarding using recycled materials in building design and ultimately saving the environment and supporting people's mental health.

Contributions of Authors

The contribution of authors to the study was equal.

Conflict of Interest

The authors have no conflict of interest to declare.

Ethical Committee Declaration

The study ethics (numbered: 2021_03_08_04) were reviewed and approved by the Office of the Vice-Rector for Academic Affairs at Bilkent University on the 8th of March 2021.

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Figure References

Figure 1a: Buildings A. Renewable home by SBS Australia, Journeyman TV. [Video]. YouTube. https://youtu.be/_yahMHzbGn4 (04.11.2020).

Figure 1b: Buildings B. Penn, B. (2020). *Mat and Danielle of exploring alternatives, and Mat of exploring alternatives* [Video]. Youtube. https://youtu.be/6Hzs9_1ynE0 (04.11.2020).