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Original Research Article

The Impact of Daylight on Emotional Responses in Residential Spaces of Tabriz City*

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Abstract

Problem statement: Light is the primary parameter in establishing a visual relationship between humans and their surroundings. Without it, many of our daily activities would not be possible in modern conditions. Studies indicate that daylight conditions in various indoor spaces influence the emotional responses of occupants. Since people today spend most of their time at home and in indoor environments, and they have both physical and psychological needs for daylight, architects must have the necessary knowledge about daylight and its relationship with emotional responses. However, studies in this field are limited, and existing research has been conducted in different geographic latitudes with varying lighting qualities.

Research objective: This study aims to identify the key daylight factors affecting the emotional responses of residents in Tabriz city, examining the influence of gender, age, and housing type. Additionally, it explores the impact of window orientation and dimensions on residents' emotional responses.

Research method: This study employed a survey research method and image processing of a sample residential unit in Tabriz using the Revit software in a simulated environment. The standardized Pratt and Russell questionnaire was used for assessment. Demographic characteristics, experimental conditions, and participant perceptions were then analyzed.

Conclusion: Results indicate that two factors—window size and orientation—significantly impact residents' emotional responses. In the north and east orientations, increasing window size generally enhances residents' vitality. However, in the south orientation, increasing window size tends to reduce overall vitality. Additionally, there is a minor significant relationship between gender, age, and emotional responses to daylight. The type of housing does not affect emotional responses to daylight.

Keywords: *Light, Emotional Response, Interior Space, Housing, Light Orientation.*

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Introduction

Lighting has been an inseparable part of human life throughout history. Visual communication accounts for approximately 80–85% of our interaction with our living environment. Vision is the result of the eye's function in the presence of light, and our perception of space depends on its level of illumination. This illumination factor includes various emotional qualities that can influence individuals' moods (Pourdeihimi et al., 2008).

Daylight quality is a dynamic and variable factor influenced by a building's geographical location, time (hour, day, season), sky conditions (clear or cloudy), and brightness. These factors impact residents' sensory perceptions, which manifest through their emotional responses, creating a distinctive and meaningful spatial experience (Rezaei & Sharghi, 2024). A major issue contributing to a lack of vitality among residents is the insufficient presence of proper daylight in indoor spaces. While national regulations specify minimum window sizes for daylight entry, they do not address the qualitative aspects of light or the effects of maximum window dimensions, which are more relevant to residents' vitality.

Therefore, architects and interior designers should consider the inherent potential of daylight and strive to design transparent building façades in a way that, in addition to addressing the physical needs and quantitative aspects of daylight, also takes into account its qualitative components and the psychological needs of residents. This includes the impact of daylight on sensory perceptions and emotional experiences. Furthermore, when designing façades, careful attention should be given to the orientation and dimensions of openings in each space.

Research background shows that although some designers have assessed the impact of window orientation and size on residents' emotional responses in certain geographic latitudes, no study has been conducted in the context of Iran and Tabriz, specifically examining the residents of this region.

This study, using image processing in a simulated environment via Revit software, aims to identify the daylight factors affecting residents' emotional responses, evaluate the impact of window orientation and dimensions, and examine the relationship between gender and age with these factors.

Thus, the research questions are as follows:

1. Which daylight factors influence residents' emotional responses?
2. How do window orientation and size affect residents' emotional responses?
3. Do gender and age impact residents' emotional responses?

Incorporating these research findings into the design process will enable architects to assess, compare, and analyze the perceptual effects of daylight in their proposed designs. This will encourage residents to make greater use of daylight in interior spaces, while the strategic design of building openings—considering appropriate dimensions and orientations—can contribute to enhanced psychological well-being and overall quality of life for residents.

Theoretical Foundations

• Light

Light is an architectural medium that influences other architectural elements. It can be considered the primary element that evokes emotions within a space. Light regulates human behavior; when architects design lighting specifically for a space, people undoubtedly experience a greater sense of well-being.

In Table 1, the previous studies that have been carried out in the field of light are summarized.

• The impact of light on emotional responses

Mehrabian and Russell, in their book An Approach to Environmental Psychology, identified pleasure, arousal, and dominance as

Table 1. Previous studies on daylight. Source: Authors.

Light components	Description	Sources
Light intensity	The amount of light received varies based on different times of the day, seasons, etc. The highest daylight intensity on a sunny summer day is 10,000 foot-candles.	Karlen, 2009
Direction of incoming light	The building's location on the site, orientation, and placement of light-transmitting surfaces affect the quality of daylight in interior spaces.	Mousavi et al., 2019
Sun elevation	The position of the sun in the sky is a key factor in the quality and amount of daylight entering the interior space.	Madan et al., 2024
Daylight	The percentage obtained from dividing the interior brightness by the exterior brightness, without considering direct sunlight exposure.	Mousavi et al., 2019
	From a physical perspective, daylight refers to a portion of the electromagnetic radiation spectrum emitted by the sun within the visible wavelength range.	Baker & Steemers, 2002
	Direct sunlight, clear sky, clouds, and reflections from the ground and surrounding buildings contribute to daylight entering through windows.	Lechner, 2014
Materials	The finishing materials of interior walls and the type of glass used for light-transmitting surfaces influence daylight quality in interior spaces.	Mousavi et al., 2019
Opening size	Increasing the brightness in the middle and back sections of a room is achieved by placing windows closer to the ceiling (higher from the floor).	Ghiabklou, 2016
	The size and position of light-transmitting surfaces, the ratio of glazed area to floor area, the geometrical proportions of the space, and the height of the skylight all affect daylight quality in indoor spaces.	Mousavi et al., 2019
Neighborhood context	In single-sided wall openings, if no obstacles are present, the useful depth of the room is approximately twice the height of the skylight. If obstructions exist, auxiliary lighting is required within the skyline-free zone of the room.	Tahbaz et al., 2022
	Considerations such as shading, sky view angle, and proximity to neighboring buildings influence the quality of daylight in indoor spaces.	Mousavi et al., 2019

the three fundamental emotional responses to environments. They developed a standardized questionnaire to measure these responses (Mehrabian & Russell, 1974).

In a subsequent study by Russell and Pratt in 1980, titled A Description of the Affective Quality Attributed to Environments, it was established that people attribute meaning to environments in both a cognitive-perceptual and emotional manner. The emotional meaning was conceptualized as a two-dimensional bipolar space, categorized into eight variables arranged circularly around the environment (Russell & Pratt, 1980).

Affect, in this context, is defined as the emotion expressed through language, while the affective quality of a molar physical environment (or, more simply, a place) refers to the emotion-stimulating quality that individuals verbally attribute to that place. In this study, the standardized Russell & Pratt questionnaire was used to assess the eight variables illustrated in Fig. 1.

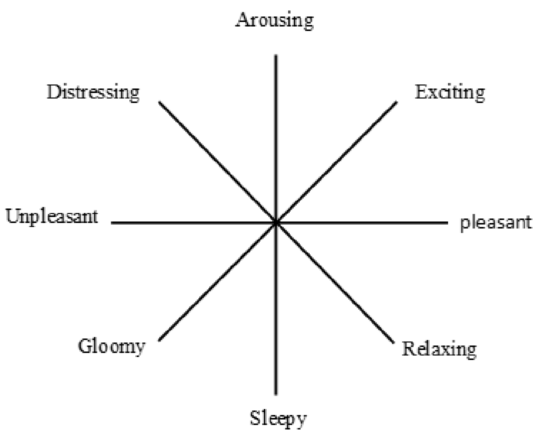

Fig. 1. Circular arrangement of eight emotional descriptors. Souse: Russell & Pratt, 1980.

Research findings indicate that lighting influences individuals in two fundamental ways:

Its direct effect results from changes in visual quality due to lighting, either by altering visual system stimuli or modifying the operating conditions of the visual system. In contrast, its indirect effect stems from light's ability to attract attention, influence mood and behavior, alter motivation, and regulate the body's hormonal balance. Lighting can impact both the physiological responses of the human body and visual perception (Pourdeihimi et al., 2008).

According to the research background (Table 2), the variables of daylight include the sun's altitude, time (day and hour), sky condition (clear or cloudy), distance of adjacent buildings, material color, direction of incoming light, window dimensions, window shape, and the presence or absence of shading devices. The indicators for measuring emotional responses, according to the Russell and Pratt questionnaire, consist of 12 bipolar factors, which are subsets of four bipolar factors in the diagram: Pleasant–Unpleasant (Satisfying–Dissatisfying, Beautiful–Inappropriate, Attractive–Repulsive), Exciting–Gloomy (Energizing–Gloomy, Stimulating–Dull, Diverse–Monotonous), Arousing–Sleepy (Inspiring–Uninspiring, Encouraging–Restraining, Active–Inactive), and Relaxing–Distressing (Coherent–Chaotic, Soothing–Distressing, Legible–Confusing).

Research Method

The present study adopts a positivist approach to precisely evaluate the proposed hypotheses. Accordingly, the research process was designed in an empirical and objective manner, such that each participant experiences the lighting quality of the simulated environment, influenced by varying window sizes (large and small) and

Table 2. Previous studies on daylight and emotional responses. Source: Authors.

Component	Description	Sources
Light intensity	Psychological stimulation and, consequently, stress increase if the light level in a space exceeds the optimal range. Strong preference for natural light over artificial light.	Tabatabaian & Tamannaei, 2014
	The impact of key factors such as light intensity and color on consumer reactions.	Nayebi et al., 2007
	Simply increasing brightness without adequate attention to spatial light distribution and visual comfort is not the best approach to achieving optimal lighting.	Peeters, 2021
Exposure duration	Limited evidence supports a positive relationship between light exposure duration and amount.	Böhmere et al., 2021
Daylight	One of the fundamental physical and psychological needs of humans—creates more comfortable and pleasant conditions, leading to increased well-being and productivity.	Pourdeihimi et al.,2008
	Unique emotional qualities—significant impact on mood and emotions—the perceptual aspect of light is more important than other aspects.	McCloud, 1995
	High-quality light—a combination of sunlight and skylight—best aligns with human visual response.	Robbins, 1986
	Effects of daylight on mental and psychological health—a key principle of green architecture—utilizing natural light for illumination reduces electric energy consumption, fossil fuel use, and greenhouse gas emissions.	Hansen, 2006
	Residents prefer access to daylight and outdoor views, even if artificial lighting is sufficient.	Wells, 1965
Light brightness	The greater the variation in brightness within a user's field of vision, the more pleasant the space is perceived. Specifically, variability in brightness levels (within a certain range) is more satisfying than intensity alone.	Parpairi et al., 2002

different orientations of daylight exposure. The data on participants' emotional responses were collected using a self-reporting method through a survey. Thus, the relationship between window dimensions and daylight orientation with residents' emotional responses has been assessed and analyzed. The following sections provide details on the study population, simulation process, studied variables, data collection methods, and their validity, as well as the statistical methods used for data analysis.

- **Case studies and population**

The residential space plans used in this study were obtained from the Tabriz Engineering Organization by randomly selecting nine plans of newly constructed residential buildings across different areas of Tabriz.

The target population of this research includes students from all academic levels (bachelor's, master's, and doctoral) at Tabriz Islamic Art University, totaling over 3,000 individuals. Based on Morgan's table and the research requirements, the sample size was determined to be 341 participants. The selection of the sample was conducted by distributing questionnaires among various university groups through the university portal and Telegram groups.

- **Simulation process**

The simulation of the sample residential spaces in Tabriz was conducted with high precision and professionalism using the Revit software, and the corresponding renderings were produced using the V-Ray plugin. The modeling was performed according to the geographic coordinates of Tabriz on December 21st at noon, under clear and cloudless weather conditions. This time was chosen based on prior research evidence, which indicates that major mood disturbances occur during this period, coinciding with the lowest sun altitude of the year.

The V-Ray plugin settings were configured to ensure the highest image quality, ranging across low, low+, medium, medium+, high, and high+ settings, with the final render set to the highest quality. The image resolution was set to 4000 × 3000 pixels with a DPI of 300. In this simulation, artificial lighting was deactivated, and only natural sunlight with an intensity of 10 and clear sky conditions was utilized. Additionally, the background color was set to gray with a brightness level of 40, and the rendering method was configured as Buckets with a size of 24. Other settings remained at their default values. The final rendered images were saved in PNG, JPG, and TIF formats, while in the questionnaire, only JPG format was used for image display.

- **Studied variables**

In this study, two independent variables—window dimensions and window orientation—were examined as key factors. The window orientation included three directions: north, east, and south; the west-facing orientation was excluded due to its unfavorable lighting conditions, which are typically designated for service areas and bathrooms.

The window dimensions were modeled in minimum and maximum sizes, in accordance with the regulations outlined in Iran's National Building Code (Topic 4). The dimensions of the primary living spaces in the sample residences were based on the average measured dimensions of the main spaces in nine newly constructed residences in Tabriz, derived from engineering organization maps (Fig. 2). The method for modeling minimum and maximum window sizes was calculated as follows:

Minimum window dimensions: Based on Topic 4 of the National Building Code, the minimum window area for kitchens and living rooms, considering a wall-to-wall distance of more than 4.5meters, is set at one-seventh of the floor area. In bedrooms, where the opposite wall distance is less than 4.5meters, the minimum window area is one-eighth of the floor area (Fig. 3). The lower edge of the window from the floor has been modeled at 1.1meters, adhering to the minimum regulatory requirements (Road, Housing and Urban Development Research Center, 2013, 104).

Maximum window dimensions: The maximum window area has been modeled with a 1.1-meter height for the lower edge from the floor, leaving a 10 cm gap from the left, right, and top edges to the ceiling (Fig. 4).

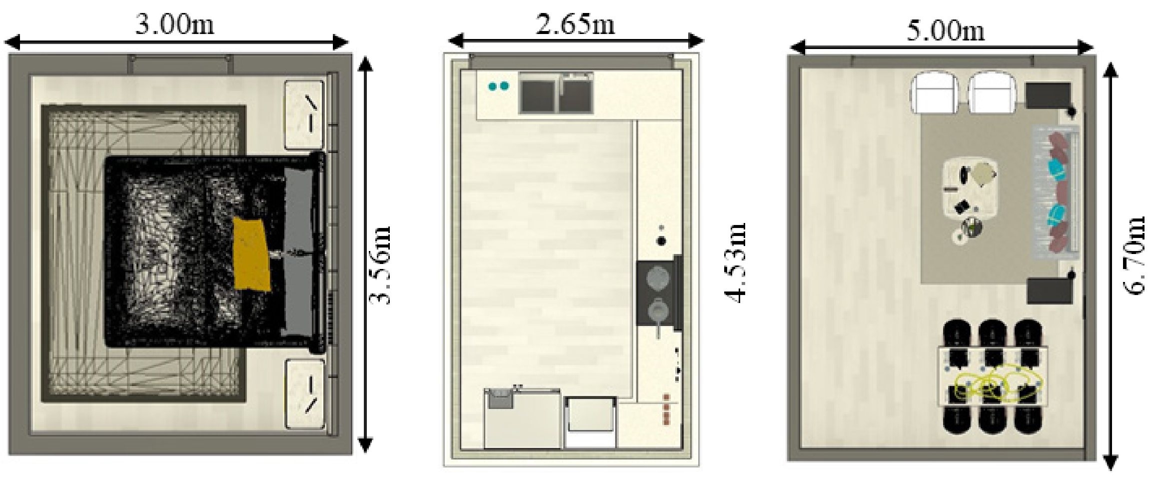

Fig. 2. Dimensions of residential spaces in the Tabriz case study. Source: Authors.

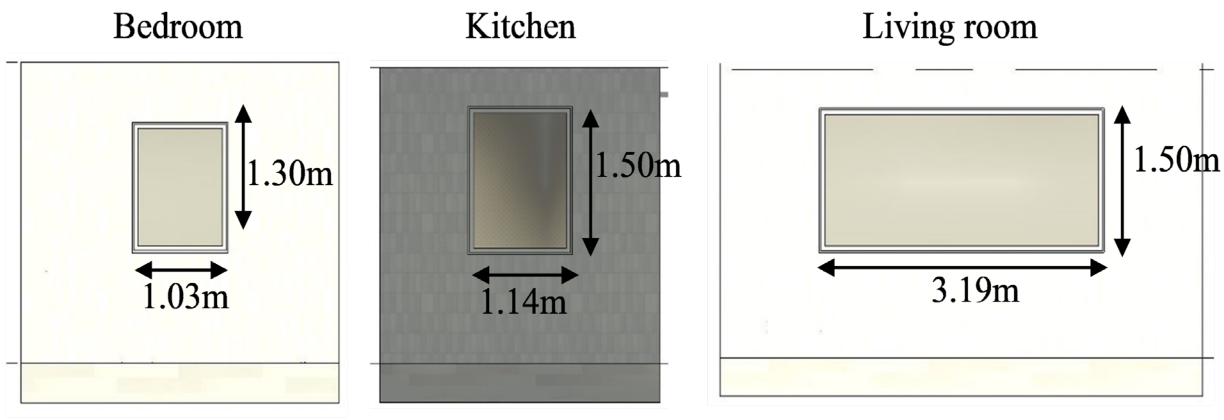

Fig. 3. Minimum window dimensions. Source: Authors.

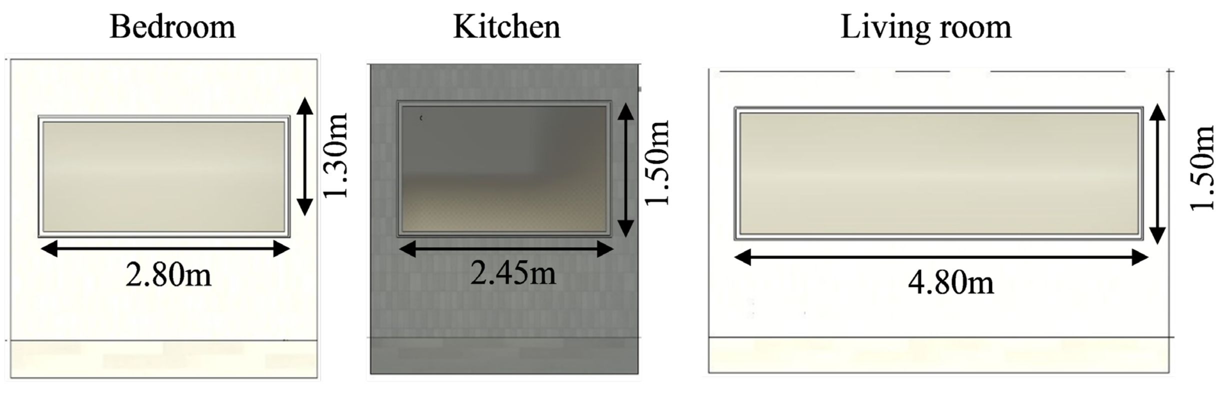

Fig. 4. Maximum window dimensions. Source: Authors.

• **Independent variable grouping**

To reduce participant fatigue, three images per space (totaling 12 images per sequence) were displayed to each participant within a one-minute time frame. The independent variables were categorized into two groups and presented in a way that ensured notable differences in lighting quality between the sequences. In the first group, large and small north-facing windows were positioned next to a small south-facing window (Table 3). In the second group, large and small east-facing windows were placed alongside a large south-facing window (Table 4). From the six designed sequences, each group was presented with three sequences, including kitchen, living room, and bedroom spaces.

The dependent variable in this study is participants' emotional responses. The following sections provide details on how this variable was measured and the study indices.

• **Emotional responses (self-reported data)**

In this study, six simulated sequences were shown to participants. Each participant responded to 12 questions per sequence, using a 7-point Likert scale. The questionnaire ranged from 1 (negative pole) to 7 (positive pole). The questions were derived from a translated and adapted version of Russell and Pratt's standard questionnaire, incorporating 12 bipolar word pairs, as follows: Satisfying– Dissatisfying, Beautiful– Inappropriate, Attractive– Repulsive, Energizing– Gloomy, Stimulating– Boring, Diverse– Monotonous, Inspiring–Uninspiring, Encouraging–Restraining, Active–Inactive, Coherent–Chaotic, Soothing–Distressing, Legible–Confusing. These word pairs represent the research indices in this study.

This study was primarily designed to evaluate the impact of window dimensions and orientations on residents' emotional responses. Therefore, based on previous studies, other potential influencing variables were controlled and kept neutral and constant. These variables are detailed in Table 5.

• **Obstacle distance from the window**

The solar altitude angle in Tabriz at the beginning of winter is 30 degrees relative to the ground. Since most residential buildings in Tabriz are mid-rise, with an approximate height of 10 meters, a 10-meter-high wall was positioned at the minimum distance required to allow sunlight to reach the interior. This wall simulates a neighboring wall in a residential area of Tabriz, and its distance was calculated using the formula $\tan 30 = 10/X = 10\sqrt{3}$ meters.

• **Data collection method and its reliability and validity**

The data collection process was conducted using a researcher-designed online questionnaire. To obtain valid and analyzable data, two types of questionnaires were used. At the beginning of each questionnaire, its purpose was clearly explained to participants, assuring them that their responses would remain completely confidential. Following this explanation, questions related to demographic characteristics—including gender, age, and housing type—were asked. Participants were also required to report recent stimulant consumption before proceeding.

After collecting demographic information, each participant was shown three simulated sequences, each lasting one minute. At the end of the presentation, participants responded to 12 questions to assess their emotional reactions to these sequences.

A total of 400 questionnaires were distributed and collected via an online platform. After collection, an initial analysis was performed to identify incomplete or invalid responses. Among the 400 received questionnaires, 50 were excluded due to stimulant consumption or failure to meet the survey conditions (such as repetitive or illogical responses). Ultimately, 350 valid questionnaires remained.

Considering a statistical population of 3,000 people, the Morgan Table was used to determine the minimum required sample size, which was

Table 3. Group 1. Source: Authors.

Room	Bedroom	Living room	Kitchen
Small window- north			
Large window- north			
Small window- south			

Table 4. Group 2. Source: Authors.

Room	Bedroom	Living room	Kitchen
Small window- east			
Large window- east			
Large window- south			

Table 5. Research variables. Source: Authors.

Simulation variables	
Variable	Type
Geographical location	Control (Tabriz City)
Visible light transmission coefficient of glass	Control (same glass material)
Observer's eye level	Control (standing eye level, fixed)
Observer's position & view angle	Control (same)
Sky conditions	Control (clear sky)
Time of simulation	Control (december 21st, 12:00 PM)
Light-transmitting facade	
Variable	Type
Orientation of opening	Independent (north, south, east) - west is usually for service areas and bathrooms
Size of opening	Independent (minimum size, maximum size)
Material color	Control (black and white colors)
Shape	Control (simple)
Protrusion & recession of opening	Control (no protrusion or recession)
External shading device	Control (no external shading)
Study context & surrounding environment	
Variable	Type
Space dimensions	Control (sample Tabriz housing dimensions)
Furniture & surfaces	Control, uniform (no color)
Space activities	Control (participants imagine light quality in the space)
Building floor	Control (first floor)
View & landscape	Control (no specific landscape view)
Daylight obstruction	Control (at a distance of 10√3, length 60m, height 10m)
Vitality (dependent variable)	
Measured through a questionnaire	

identified as 341 questionnaires for statistical analysis. Therefore, the remaining 350 valid questionnaires were sufficient not only to meet the statistical requirements but also to allow for detailed analysis and structural equation modeling (SEM).

This approach enabled researchers to conduct in-depth analyses of the data and present the findings as credible evidence regarding the impact of window dimensions and sunlight direction on human emotions in residential space design.

To evaluate the reliability of the research tools, Cronbach's alpha, Rho_A, and composite reliability were used. All Cronbach's alpha values fell within a satisfactory range, indicating the strong reliability of the research instruments. The Rho_A results also confirmed an acceptable level of correlation within the research constructs. Furthermore, the composite reliability values demonstrated the attainment of acceptable reliability levels for investigating the research variables.

In addition to reliability metrics, the Average Variance Extracted (AVE) was used to assess convergent validity at the construct level. The AVE values obtained for resident vitality and other research variables confirmed acceptable validity.

- **Data analysis methods**

For data analysis, Structural Equation Modeling (SEM) was employed using the Partial Least Squares (PLS) method in SmartPLS software. This software was selected for its advanced capabilities in data processing and modeling complex variable relationships. Additionally, Excel was used to visualize various charts.

In analyzing the conceptual model, the relationships between variables were first estimated. At this stage, Path Coefficients were calculated to indicate the strength and nature of the relationship between independent and dependent variables. The t-statistic was then used to assess the significance of path coefficients. The t-statistic calculations indicate a significant effect of independent variable changes on the dependent variable. At a 0.05% error level, t-values greater than 1. 96 are considered statistically significant.

To evaluate the significance of constructs and their relationships, t-statistics and their corresponding significance levels were examined. After analyzing the model using SmartPLS, Path Coefficients were extracted for all hypothetical relationships between constructs.

Initially, t-statistic values were calculated for each relationship. In accordance with statistical rules, at a 0. 05 significance level, a t-statistic above 1. 96 indicates a significant relationship between variables. The results confirmed that all constructs and hypothetical relationships had t-values above 1. 96 and p-values below 0.05, demonstrating their statistical significance. These findings indicate that window dimensions and orientations have a significant effect on residents' emotional responses.

Findings

In Table 6, the Path Coefficients for the north-facing window with a large opening are presented. Additionally, analysis results for the five other sequences (including east-facing large and small windows, south-facing large and small windows, and the small north-facing window) were extracted and are shown in Fig. 5 for comparison. The spider diagram in Fig. 5 visually represents the complex relationships between variables, enabling a more detailed analysis of the study's findings.

To examine the correlation between gender, age, and housing type with the criteria influencing residents' emotional responses, the Chi-square test was used. Table 7 presents the results for one of the 12 emotional response components across all orientations and studied window sizes. Similar findings were obtained for the remaining 11 components.

In Table 8, the influence of window orientation and size on perceived emotional responses was ranked based on factor loadings.

Table 6. Path coefficients and t-statistic for the north-facing large window. Source: Authors.

Window orientation & size	Emotional response component		Standardized factor loading	Impact coefficient (β)	t-statistic	Standard error
North light, large window	K1	Readable- confusing	0.817	0.795	20.184	0.000
	AR1	Relaxing- distressing	0.753			
	E1	Coherent- chaotic	0.816			
	F1	Active- inactive	0.869			
	V1	Encouraging- restraining	0.836			
	A1	Inspiring– uninspiring	0.802			
	T1	Diverse- monotonous	0.717			
	M1	Stimulating- boring	0.789			
	N1	Energizing- gloomy	0.753			
	J1	Attractive- repulsive	0.786			
	Z1	Beautiful- unattractive	0.772			
	D1	Satisfying- unsatisfying	0.760			

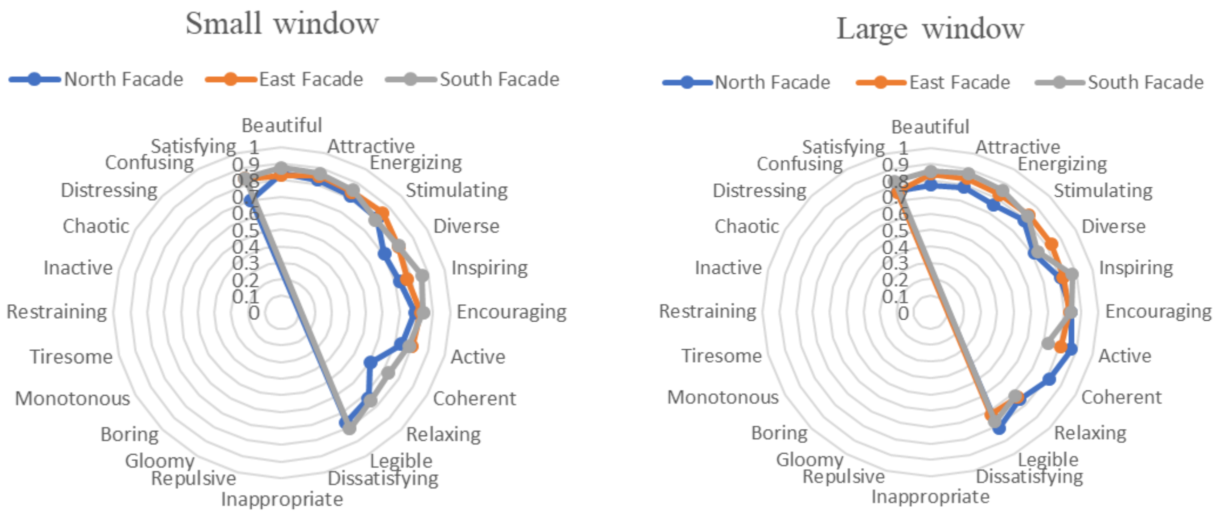

Fig. 5. Comparison of different orientations for small and large windows with factor loading values. Source: Authors.

Table 7. Analysis of the effect of gender, age, and housing type on the Energizing-gloomy component of emotional responses. Source: Authors.

Emotional response component	Window orientation & type	Gender relationship	Age relationship	Housing type relationship
Energizing- gloomy	North light- large window	Random	Significant	Random
	North light- small window	Random	Random	Random
	South Light- small window	Random	Random	Random
	East Light- large window	Significant	Random	Random
	East Light- small window	Significant	Random	Random
	South Light- large window	Random	Random	Random

Table 8. The impact of windows in three orientations (north, east, and south) and different sizes (small and large) on residents' emotional responses, ranked from most to least significant. Source: Authors.

Ranking	Impact score	Effect on emotional responses	Lighting condition
1	0.806	Strong positive effect on emotions, creating a bright and motivating space. However, .excessive light may lead to boredom and fatigue	South light- large window
2	0.796	Less impact on positive emotions due to limited light intensity, which may cause boredom.	South light- small window
3	0.795	Positive and stable impact, reducing stress and creating a calm and uniform atmosphere.	North light- large window
4	0.792	Helps create a dynamic space, but variations in light intensity and glare may cause mixed feelings and fatigue.	East light- large window
5	0.767	Less impact on positive emotions due to variations in light intensity and limited daylight, potentially leading to mixed emotions and boredom.	East light- small window
6	0.670	Limited positive emotional impact due to low light intensity, which may reduce overall quality of life.	North light- small window

Discussion

According to previous studies, window size plays a significant role in the perception and aesthetic judgment of a room. Research findings indicate that larger windows are essential for achieving satisfying, exciting, complex, legible, coherent, spacious, open, and well-defined rooms. These characteristics receive higher evaluations as window size increases. Keighley (1973) identified the preferred window height range as 5. 9 feet (1. 8 meters) to 7. 9 feet (2. 4 meters) and suggested that windows should be wider. In higher latitudes, larger windows are generally preferred by users (Moscoso et al., 2015).

Window size significantly affects perceived pleasantness, interest, excitement, complexity, spaciousness, and satisfaction with the view (Moscoso Paredes et al., 2020). Individuals exposed to more natural light experience higher vitality (Shishegar & Boubekri, 2016).

The present study aligns with previous research, confirming that window dimensions impact residents' emotional responses. In most emotional response indicators, larger windows have a positive effect on perceived emotions.

According to prior research, morning light from east-facing windows is preferred over north-facing light, while afternoon light from south- and west-facing windows is more desirable. East-facing windows provide high brightness in the morning, which gradually decreases throughout the day. Therefore, larger windows should be placed on the east facade (Tawfic & Adel, 2005). However, the findings of this study prioritize southern light for larger windows, followed by northern light, and finally eastern light. This means that for large window sizes, the results do not fully align with previous studies. For small windows, southern light remains the most preferred, followed by eastern light, and finally northern light, which partially aligns with previous research.

Studies indicate that with aging, eye efficiency declines, which can be compensated for by increasing brightness. Consequently, older individuals prefer higher light levels (Xue et al.,2014; Tawfic & Adel, 2005). The present study partially supports these findings, as only a few cases showed a significant relationship between age and emotional responses to daylight, possibly due to intervening factors.

Previous studies have found no statistical differences in gender preferences for lighting comfort (Xue et al., 2014). The present study confirms these findings for north and south orientations but does not align with them for east-facing windows.

The preference for larger windows, especially in east- and north-facing facades, suggests that the minimum window size requirements set by engineering regulations are not necessarily preferred by residents in Tabriz.

Conclusion

Regarding the first research question, findings indicate that window size and light direction significantly impact residents' emotional responses. Southern light has a converse effect, while eastern and northern light have positive effects. Across all three directions (north, south, and east), larger windows generate stronger emotional responses than smaller ones. Due to the negative numerical effect of southern-facing windows, residents' emotional responses decrease as window size increases in this orientation. Among both large and small window sizes, south-facing windows have the strongest impact, followed by north-facing windows, and east-facing windows have the weakest effect on residents' vitality.

Regarding the second research question, findings indicate that gender differences are significant due to the romantic lighting quality of Eastern light, causing different emotional responses between men and women. In terms of age, only a few cases showed a significant relationship between age and emotional response components. Housing type does not affect residents' emotional responses.

Based on the study's findings, the following architectural recommendations are proposed to enhance residential interior spaces:

Recommendation 1: Increase window size on the north and east facades as much as possible.

Recommendation 2: Increase window size on the south facade, preferably with shading devices.

Recommendation 3: When designing east-facing windows, consider gender and individual needs, as men and women have different emotional responses to eastern light.

This study is specific to the geographical location of Tabriz. Since geographical position and sun altitude affect daylight quality, future studies could replicate this experiment across diverse populations and geographic contexts. Additionally, this study used image-based simulations, but future research could employ virtual reality technology for a more immersive experience. This study also modeled daylight conditions for noon on December 21st under clear skies. Since time of day, season, and weather conditions may influence residents' emotional responses, future studies could further explore these factors.

References List

• Baker, N., & Steemers, K. (2002). *Daylight Design of Buildings.* James & James Science.

• Böhmer, M. N., Hamers, P. C., Bindels, P. J., Oppewal, A., van Someren, E. J., & Festen, D. A. (2021). Are we still in the dark? A systematic review on personal daily light exposure, sleep-wake rhythm, and mood in healthy adults from the general population. *Sleep Health, 7*(5), 610-630. https://doi.org/10.1016/j.sleh.2021.06.001

• Ghiabklou, Z. (2016). *Fundamentals of building physics.* Amir Kabir University of Technology Press.

• Garcia-Hansen, V. R. (2006). *Innovative daylighting systems for deep-plan commercial buildings* [Ph. D Thesis, Queensland University of Technology].

• Karlen, M. (2009). *Lighting design basics* (K. Mahmoodi, Trans.). Shahr-e Ab. (Orginal work published 2004)

• Lechner, N. (2014). *Heating, cooling, lighting: Sustainable design methods for architects.* John Wiley & Sons.

• Madan, Ö. K., Chamilothori, K., van Duijnhoven, J., Aarts, M. P., & de Kort, Y. A. (2024). Restorative effects of daylight in indoor environments–A systematic literature review. *Journal of Environmental Psychology, 97*, 102323. https://doi.org/10.1016/j.jenvp.2024.102323

• Mccloud, K. (1995). *Kevin McCloud's lighting book: the ultimate guide to lighting every room in the home.* Ebury Press.

• Mehrabian, A., & Russell, J. (1974). *An approach to environmental psychology.* M.I.T. Press.

• Moscoso Paredes, C. T., Chamilothori, K., Wienold, J., Andersen, M., & Matusiak, B. S. (2020). Window Size Effects on Subjective Impressions of Daylit Spaces: Indoor Studies at High Latitudes Using Virtual Reality. *The Journal of the Illuminating Engineering Society of North America.* http://dx.doi.org/10.1080/15502724.2020.1726183

• Moscoso, C., Matusiak, B., & Svensson, U. P. (2015). Impact of window size and room reflectance on the perceived quality of a room. *Journal of Architectural and Planning Research*, 294-306.

• Mousavi, F., Mahmodi, M., & Tahbaz, M. (2019). The Effect of Geometry and Area of Windows of Southview Rooms on The Depth of Daylighting (Case Study: Yazd's Traditional Houses). *Hoviatshahr, 12*(4), 5-18. https://dorl.net/dor/20.1001.1.17359562.1397.12.4.1.6

• Nayebi, B., Kateb, F, Mazaheri, M., & Birashk, B. (2007), تأثیر نور فضاهای داخلی بر کیفیت زندگی و رفتارهای اخلاقی انسان [The Impact of Interior Space Lighting on Quality of Life and Human Ethical Behaviors]. *Journal of Ethics in Science and Technology,* 2(3-4), 65-72. [in Persian]. https://sid.ir/paper/451283/fa

• Parpairi, K., Baker, N. V., Steemers, K. A., & Compagnon, R. (2002). The Luminance Differences index: a new indicator of user preferences in daylit spaces. *Lighting Research & Technology, 34*(1), 53-66. https://doi.org/10.1191/1365782802li030oa

• Peeters, S. T., Smolders, K. C., Vogels, I. M., & de Kort, Y. A. (2021). Less is more? Effects of more vs. less electric light on alertness, mood, sleep and appraisals of light in an operational office. *Journal of Environmental Psychology, 74,* 101583. https://doi.org/10.1016/j.jenvp.2021.101583

• Pourdeihimi, S., & Haji Seyyed Javadi, F. (2008). Daylight and the human being: perception and biopsychology of daylight. *Soffeh, 17*(1). https://dor.isc.ac/dor/20.1001.1.1683870.1387.17.2.10.6

• Rezaei, S., & Sharghi, A. (2024). Geometric Patterns of Daylight Distribution and Sensory Perceptions of Residents in Residential Buildings. *Bagh-e Nazar, 21*(134), 5-20. https://doi.org/10.22034/bagh.2024.451479.5587

• Road, Housing and Urban Development Research Center. (2013). *Iran's National Building Code, 4.* 104.

• Robbins, C. L. (1986). *Daylighting: Design and Analysis.* Van Nostrand Reinhold.

• Russell, J. A., & Pratt, G. (1980). A description of the affective quality attributed to environments. *Journal of Personality and Social Psychology, 38*(2), 311.

• Shishegar, N., & Boubekri, M. (2016). Natural light and productivity: Analyzing the impacts of daylighting on students' and workers' health and alertness. *International Journal of Advances in Chemical Engineering and Biological Sciences, 3*(1), 1-6.

• Tabatabaian, M., & Tamannaee, M. (2014). Investigation the effect of built environments on psychological health. *Armanshahr Architecture & Urban Development, 6*(11), 101-109.

• Tahbaz, M., Djalilian, S., Fatemeh, M., & Kazemzadeh, M. (2022). Natural day lighting in traditional houses in Kashan, case study of Ameri House. *Journal of Iranian Architecture Studies, 2*(4), 87-108.

• Tawfik, M. A., & Adel, W. M. (2005). *Natural Lighting as a Factor in Providing a Healthy Environment in Buildings* [Master's Thesis, Cairo University Giza].

• Wells, B. W. P. (1965). Subjective responses to the lighting installation in a modern office building and their design implications. *Building Science, 1*(1), 57-68. https://doi.org/10.1016/0007-3628(65)90006-X

• Xue, P., Mak, C. M., & Cheung, H. D. (2014). The effects of daylighting and human behavior on luminous comfort in residential buildings: A questionnaire survey. *Building and Environment, 81*, 51-59. https://doi.org/10.1016/j.buildenv.2014.06.011

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