

Exploring user preferences for lighting and spatial conditions and the impact on atmospheric qualities of Catholic churches

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ARTICLE INFO	ABSTRACT
<p><i>Article history:</i> Received March 13, 2024 Received in revised form July 14, 2024 Accepted August 19, 2024 Available online December 01, 2024</p> <p><i>Keywords:</i> Church Interior space Lighting Preference Religious building</p> <p>*Corresponding author: Adira Damai Reforma Department of Architecture, School of Architecture, Planning and Policy Development, Institut Teknologi Bandung, Indonesia Email: damai.adira@outlook.com</p>	<p><i>The transformations in the design of Catholic church architecture, partly influenced by the Second Vatican Council, have led to notable changes in spatial and lighting conditions. This study aims to uncover user preferences for lighting and spatial characteristics in Catholic churches. The study employs a mixed-methods strategy that is performed in two phases. The data collection process uses online surveys with non-random/non-probability sampling. The principal component, factor, and correlation analyses are included in subsequent data analysis. The user's preferences are determined by methodically analyzing each independent variable. The research results indicate that various elements, such as color, contrast, lighting hierarchy, visual richness, perceived building shape, age of the building, verticality, symmetry, and private space, can affect the generation of positive and spiritual experiences. The research sheds light on the intricate interplay between architectural elements and user perceptions in terms of Catholic church design, providing valuable insights for further considerations in sustainable and meaningful architectural practices.</i></p>

Introduction

The role of lighting in church buildings is of paramount significance, contributing significantly to spatial perception and visual effects within a provided environment (Ozorhon and Uraz 2014; Abrianti and Salura 2019; Damayanti and Salura 2022). Both natural and artificial light instrumentally create the desired atmosphere (Kreuz 2008) and possess a profound impact on emotional states (Kayhan, Şahin, and Erkan 2021; Sholanke, Fadesere, and Elendu 2021). In church architecture, artificial lighting is particularly influential in crafting a sacred expression (Lukman, Mandala, and Utamalieu 2022).

Furthermore, light in church buildings owns symbolic significance, representing truth, holiness, and the presence of God (Ayudyah et al. 2020). The deliberate use of light, whether artificial or natural, affects not only the space's aesthetic qualities but also its deeper symbolic implications, which enhance worshippers' entire spiritual and aesthetic experience. Architects and designers must comprehend the subtle functions of lighting in churches if they are to create surroundings that complement the sacred and symbolic aspects of places of worship.

The architectural styles of Gothic, Romanesque, and Baroque are extensively regarded as the norm for church buildings (Stegers 2008). In Indonesia, numerous Catholic churches specifically embrace the Gothic architectural style (Richard and Roosandriantini

2022). Neo-Gothic architecture, which is a variation of Gothic architecture, has been implemented with multiple modifications and simplifications (Soelistyo and Sutanto 2023). The ability of Gothic architecture to manipulate natural light is one of its unique features. Larger buildings and broader apertures have been created possible by structural advances, which are responsible for this potential. Furthermore, the church's intentional use of stained glass plays an essential function in filtering incoming light and incorporating color to the area. Medina et al. (2017) and contributing to the creation of a divine atmosphere (Warbung, Soedarso, and Carina 2020).

In contemporary times, the architectural style of church buildings has experienced a notable transformation, embracing increased diversity. This transition can be attributed, in part, to the influence of the Second Vatican Council (Farah 2009; Stegers 2008) which advocated for the Catholic Church to adapt to local contexts (Kusbiantoro 2009). Environmental concerns, technical developments, economic reasons, and cultural influences are just a few of the aspects that this adaptation encompasses (Laurens 2013).

Significant changes in the spatial and lighting conditions of churches have been brought about by the development of their architectural styles. A sense of God's presence was initially the primary objective of church interior design. There has been a change over time toward establishing an inviting atmosphere that encourages members to assemble and engage in communal worship (Kieckhefer 2004). This transformation is evident in the architectural features of Gothic churches emphasizing vertical elements and monumental spatial proportions.

Furthermore, the original linear configuration of church building layouts has evolved, to providing diverse floor plan configurations, encompassing centralized layouts (Stegers 2008). Particularly in the context of Catholic churches in Indonesia, the alteration in design reflects an effort by the church to integrate into the local cultural and environmental context (Kusbiantoro 2009). This modification exemplifies a larger pattern in modern church architecture, which emphasizes the creation of welcoming and communal spaces for worship in addition to spiritual themes.

Research into user preferences in religious spaces has been conducted by scholars such as Manning, Nicholas J. Watkins, and Kathryn H.

Anthony (2009) and Herzog et al. (2013). Manning, Nicholas J. Watkins, and Kathryn H. Anthony (2009) delved into the satisfaction of parishioners concerning the design features of both modern and traditional Romanesque architecture in Catholic churches. The study unveiled four design characteristic factors: environmental quality, spatial quality, and a preference for sacramental design features. Similarly, Herzog et al. (2013) examined factors influencing preferences in houses of worship. Their research revealed that individual decisions in the environment of religious places are significantly affected by factors such as age, architectural style, visual richness, and building maintenance. These studies provide significant novel perspectives on the complex dynamics of user preferences in religious architecture, providing foundations for comprehending the factors influencing worshipers' preferences and levels of satisfaction.

Research on lighting in houses of worship and its impact on perception has been conducted by scholars such as Kayhan, Şahin, and Erkan (2021); Wardono and Wibisono (2013); Matracchi and Sadeghi habibabad (2021); Mansour (2022). Kayhan, Şahin, and Erkan (2021) examined people's moods in response to different light sources, revealing that natural light has the most positive mood effect. In a study by Wardono and Wibisono (2013), in prayer rooms, the effects of different wall openings were investigated. Based on the research, it is possible to generate a meditative mood by utilizing thin openings for daylighting.

Furthermore, Mansour (2022) demonstrated that light intensity plays a role in evoking spiritual and positive/negative emotions. Furthermore, Matracchi and Sadeghi habibabad (2021) uncovered light intensity, suggesting that an intensity around 250-260 lux received the highest score based on expert opinions. These studies provide crucial novel viewpoints on the complex relationship between architectural features, illumination, and people's spiritual and emotional experiences in places of worship.

Architectural design plays a crucial role in establishing the sacredness of a Catholic church building, as noted by Estika et al. (2017). Additionally, church buildings can evoke positive emotions (Kindermann and Riegel 2018) and spiritual feelings (Novita and L. Lukman 2023). Studies on Indonesian church design preferences are scarce, despite the acknowledged importance

of lighting and architectural design modifications in Catholic churches. To bridge this gap, this study investigates user preferences for lighting and spatial arrangements in Catholic churches both modern and neogothic. Furthermore, an investigation is conducted into the atmosphere that these churches create. It is expected that the results will be a useful resource for architects designing Catholic churches in Indonesia, offering perspectives that can enhance the process of designing and more effectively meet the needs of worshippers.

Methods

This study employs a mixed-method approach (Creswell 2012) conducted in two stages, employing a non-random/ non-probability sampling method with purposive and snowball sampling techniques (Kumar 2011). There was a significant relationship discovered between preferences obtained from photographic images and those from the original sites, with the author capturing the images utilized in both stages. Stamps (1990), thereby corroborating the validity of this approach. Furthermore, the use of photographs is recognized for its capacity to evoke emotional responses (Baberini et al. 2015; Gorini et al. 2010; Hamann et al. 2002) and has been successfully implemented in various studies.

This study's initial phase is qualitative and attempts to investigate user preferences for space and illumination in church environments. The objective of the quantitative second stage is to examine at the relationships between the dimensions that have been identified. This two-phase method enhances the study's comprehensiveness by enabling an in-depth investigation of user preferences and the quantitative examination of the dimensions that were discovered afterward.

The qualitative stage

In the qualitative stage, data collection was conducted through an online questionnaire designed for Catholics. There are three sections to the questionnaire. An overview of the study and personal data collection are provided in the first section. This form requests for your age, gender, email address, and city of residence. Respondents are permitted to decline to reveal their email addresses.

Open-ended questions constitute the second and third sections of the survey. Respondents are presented with two images in the second section which display the interior of the same church, which is decorated in a neo-Gothic style and has both artificial and natural illumination. Then, depending on which of the two images best represents them as they reach mass, they are prompted to select. Respondents are then asked to explain their decision. The final section of the questionnaire addresses similar questions, but this time employs images of contemporary churches in various lighting settings.

This structured questionnaire design enables the collection of nuanced responses. It also enables participants to express their preferences and provide insightful explanations for their choices. Thus, it is possible to enrich the qualitative data collected during this stage of the study.

This research utilizes photographs of Saint Peter Cathedral Bandung (figure 1, images number 1 and 3) as a representation of a neogothic church and Saint Laurent Catholic Church Bandung (figure 1, images number 2 and 4) as a representation of a modern church. Both sets of church images were captured in both natural light and artificial light conditions.

Saint Peter Cathedral in Bandung was photographed in the morning under natural lighting, and Saint Laurent Catholic Church in Bandung was captured in the afternoon under bright sunshine. On the other hand, to reduce the impact of natural light, photos with artificial lighting were captured at night. To guarantee accuracy and consistency that accurately depicts the actual conditions during the photographic sessions, the white balance value was manually determined and applied to each of the four photographs.



Figure 1. Images used in the questionnaire

The questionnaire distribution spanned seven days, commencing on February 16, and concluding on February 24, 2023. During this period, a total of 122 respondents were acquired. The majority of participants were younger than 26 years old, with a gender distribution of 54% female and 46% male. 11% (n=13) of respondents

live in Bandung, the city where the church is located. 2% (n=3) of respondents live abroad, while 4% (n=5) living outside Java. The distribution of respondents' domiciles from the qualitative stage can be seen in figure 2.

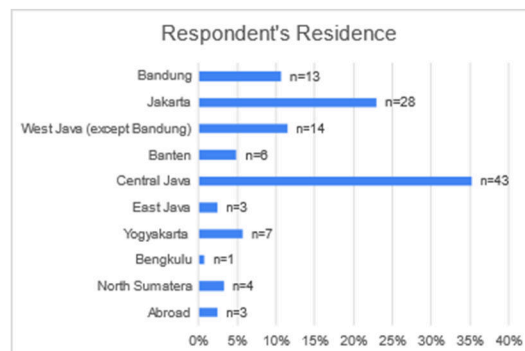


Figure 2. Respondent's residence in the qualitative stage.

Open coding and axial coding techniques were particularly employed in content analysis for examining the data collected from 122 respondents. Three primary classifications emerged from the qualitative stage questionnaire responses: lighting condition (n = 195), spatial condition (n = 11), and respondents' perception of the atmosphere (n = 173). This methodical categorization enhances the breadth of knowledge obtained from the study by rendering it less difficult to comprehend the preferences and perspectives of the participants.

The respondent's answer for lighting condition consists of optimal lighting condition (n=73), natural lighting condition (n=23), visual comfort (n=19), lighting aesthetics (n=7), visual hierarchy (n=7), and color (n=66) categories. Examples of the respondents' answers from those four categories are "sufficient lighting", "natural lighting", "visible daylight", "light help to support worship", "colorful", "no glare", "light helps to stay focused", "warm colors", "dramatic lighting", and "soft lighting condition".

The respondent's answer for spatial condition consists of the physical condition (n=11) category. Examples of the respondents' answers from the physical condition category are "aesthetic design", "placement of furniture", "not dull", "modern design", "old building", and "open space conditions".

Meanwhile, the respondents' answers for an atmosphere that the respondent felt consisted of affective impression (n=88) and spiritual

impression (n=74) categories. Examples of the respondents' answers from those two categories are “lively”, “pleasant”, “fresh”, “modest”, “comfortable”, “peaceful”, “serene”, “homely”, “joyful”, “solemn”, “mystical”, “full of hope”, “sacred”, and “calm”.

The quantitative stage

In the quantitative stage, data collection was conducted through an online questionnaire featuring closed-ended questions aimed at Catholics. Social media platforms including Facebook, Instagram, and WhatsApp were employed to help distribute the questionnaire. Participants' email addresses that were gathered during the preceding qualitative phase were additionally employed for distributing the questionnaire. The diverse participation and broad dissemination of this multi-channel approach resulted in an effective dataset that was suitable for quantitative analysis.

The questionnaire in the quantitative stage is structured into five parts. The initial section introduces the study and gathers personal information, including age, gender, and city of residence. The subsequent four parts labeled second to fifth, encompass twelve questions focusing on lighting conditions, six questions addressing spatial conditions, and an additional six questions exploring the atmosphere perceived by the respondent.

A relevant image is supplied for every section of the questionnaire; the image sequence is denoted by numbers in line with figure 1. The quantitative stage's questions originated from the qualitative stage and associated literature. Respondents were prompted to rate their thoughts and preferences on a five-point Likert scale. Table 1 provides a sample questionnaire question for reference. This methodical technique guarantees a thorough and methodical evaluation of participant responses, which supports the study's quantitative analysis.

Table 1. Sample questions used in the qualitative stage

Group question	Question	Scale						
Lighting condition	The lighting conditions based on the image are interesting	Strongly disagree	1	2	3	4	5	Strongly agree
	The lighting conditions based on the image are	Strongly disagree	1	2	3	4	5	Strongly agree

Group question	Question	Scale						
Atmosphere that has been felt	comfortable to look at	Strongly disagree	1	2	3	4	5	Strongly agree
	When I saw this picture, I felt a peaceful atmosphere	Strongly disagree	1	2	3	4	5	Strongly agree

In the quantitative stage, a total of 110 respondents were collected, with 51% identifying as male and 49% as female. Age distribution among respondents was as follows: 51% were under 26 years old, 33% fell between 27-42 years old, 14% were within the 43-58 years old bracket, and the remainder were over 59 years old. A total of 11% (n=12) of respondents live in Bandung, 16% (n=16) live outside Bandung in West Java province. The distribution of respondents' domiciles from the quantitative stage can be seen in figure 3.

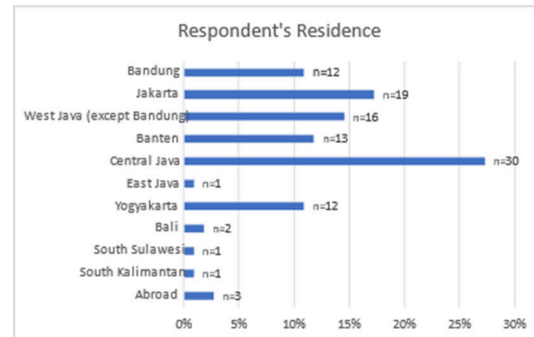


Figure 3. Respondent's residence in the quantitative stage

Principal component analysis (PCA) and factor analysis (FA) were employed to examine the acquired data. These analytical techniques were implemented to distinguish between the measured variables' latent variables. To reveal the relationships between these latent variables and provide a comprehensive understanding of the interactions between the various elements examined in the study, a multivariate analysis was additionally performed. This analytical method enables a more thorough investigation of the patterns and correlations discovered in the dataset which contributes to a nuanced interpretation of the quantitative data.

Results and discussion

The analytical results from factor analysis (FA) and principal component analysis (PCA) are presented in [table 2](#). For each of the three question groups, PCA was performed separately to expedite the process of naming the latent variables. The three categories of questions are atmosphere sensed, lighting condition, and spatial condition. Only one principal component had an eigenvalue greater than one for each question group. For each question group, two main components were therefore employed. Every dimension in these groups had Cronbach's Alpha values higher than 0.7. This indicates that every measurement is dependable and consistent, following ([Lavrakas 2008](#)). The robust reliability of the dimensions enhances the credibility of the derived latent variables and their subsequent interpretation within the study.

Two latent factors, "visual attractiveness" and "visual hierarchy," were identified through the lighting condition group's Factor Analysis (FA) to account for a cumulative percentage of 73%. The measured variables associated with the respondent's evaluation of lighting conditions make up the latent variable "visual attractiveness". Meanwhile, the latent variable "visual hierarchy" incorporates measured lighting-related variables that can direct the

respondent's visual attention. Concerning the components of visual appeal and hierarchical significance that affect respondents' impressions, this distinction provides a clear grasp of the underlying causes within the lighting condition group.

For the spatial condition group, two latent variables described as "space according to preference" and spatial openness" with a total variance of 73,29% were obtained. Open space latent variable encompasses one question, namely space has an open atmosphere. On the other hand, the measured variable about respondent's preference space condition hence the name of latent variable space according to preference.

Meanwhile, the atmosphere felt group resulted in two latent variables which were then named "spiritual impression" and "positive impression". The total variance for this group is 84,65%. The name of the spiritual impression latent variable was used because of the use of transcendence references, such as sacred, tranquil, intimate, and peaceful. Moreover, the name of the positive impression latent variable was utilized because the measured variables contained positive impressions but did not have transcendence reference. This result is by [Kindermann and Riegel \(2018\)](#) which emotion evoked in the church can either be a spiritual, religious, positive, or negative emotion.

Table 2. Factor analysis result from the qualitative stage

Measured variable	Mean	Factor loading	Eigen value	% of variance	Cum. %	Cronbach's alpha
Lighting condition group questions						
Factor 1: Visual Attractiveness	3,72		7,81	40,20	40,20	0,93
[Attractive] lighting	3,66	0,84				
[Beautiful] lighting	3,72	0,83				
Lighting [has appropriate color]	3,75	0,79				
Lighting [is visually comfortable]	3,79	0,76				
Lighting [aids concentration]	3,70	0,67				
Lighting [is glare free]	3,88	0,66				
Lighting [support worship]	3,81	0,63				
Lighting [has optimal brightness level]	3,44	0,61				
Factor 2: Visual Hierarchy	3,67		0,95	32,80	73,00	0,91
Lighting [helps focus on symbol]	3,70	0,88				
Lighting [helps focus on the altar]	3,73	0,87				
Lighting [is directing my gaze]	3,72	0,76				
Lighting [has suitable dark-light effect]	3,52	0,70				
Spatial condition group questions						
Factor 1 Space According to Preference	3,64		3,67	47,18	47,18	0,87
Space [has a design that suits your preference]	3,52	0,91				
Space [has furniture arrangement according to your preference]	3,64	0,86				
Space [has an attractive design]	3,59	0,83				
Space [is well-maintained]	4,07	0,54				
Space [has a complex design]	3,35	0,49				
Factor 2 Spatial Openness	3,53		0,73	26,11	73,29	0,87

Measured variable	Mean	Factor loading	Eigen value	% of variance	Cum. %	Cronbach's alpha
Space [has an open space atmosphere]	3,53	0,93				
Atmosphere felt group questions						
Factor 1 Spiritual Impression	3,89		4,48	51,31	51,31	0,93
Feeling [sacred atmosphere]	3,95	0,87				
Feeling [tranquil atmosphere]	3,99	0,85				
Feeling [intimate atmosphere]	3,77	0,85				
Feeling [peaceful atmosphere]	3,86	0,70				
Factor 2 Positive Impression	3,73		0,59	33,34	84,65	0,83
Feeling [joyful atmosphere]	3,58	0,93				
Feeling [positive mood]	3,89	0,71				

Multivariate correlation analysis was then employed to examine the FA result and determine how the latent variables related to one another. As was already established, research has demonstrated that religious spaces may stimulate strong feelings. Thus, the dependent variable was the group inquiry about the atmosphere felt. However, because the author is unable to establish a causal relationship between lighting and spatial condition, both are treated as independent variables. The multivariate correlation analysis between the independent and dependent variables is displayed in table 3. The significant probability of each variable is less than 0,0001.

The multivariate correlation analysis results demonstrate that each independent variable owns a similar correlation value for each dependent variable. The correlation value between spiritual impression and positive impression is 0,76. This result is under the study conducted by Mansour (2022) which illustrates that there is a positive correlation between positive emotion and spiritual feeling.

Space according to preference has the highest correlation value for spiritual impressions while visual attractiveness has the highest correlation value for positive impressions. This indicates that there are different lighting and spatial design requirements for a church building to evoke spiritual and positive impressions. Therefore, this study will attempt to analyze each independent variable concerning the dependent variable based on the images that were administered.

Table 3. Multivariate correlation analysis of lighting and spatial condition towards atmosphere felt. Signif. Prob. <,0001

Independent variable	Dependent variable	
	Spiritual impression	Positive impression
Visual attractiveness	0,686	0,684
Visual hierarchy	0,625	0,575
Space according to preference	0,693	0,677
Spatial openness	0,316	0,450

The mean score for each image between visual attractiveness with positive impression and spiritual impression can be seen in figure 4 and figure 5. Figure 4 illustrates a linear relationship between excellent perception and visual appeal. Figure 5 demonstrates that images can have a high mean score of spiritual influence even while their mean score of visual attractiveness is insignificant. This result implies that these two different impressions are influenced by observable variations in lighting. These figures illustrate the complex interplay of visual features, impressions, and the effect of lighting conditions on the perceived ambiance in a church environment through their complicated relationships.

The factors of color, luminance ratio or uniformity, light source location, light intensity, and light distribution have been identified as influential in psychology (Dilaura et al. 2011). Warm colors are appreciated for their visual appeal and can elicit both positive and spiritual feelings, as illustrated in figures 4 and 5. While modern churches utilize artificial lighting to provide this warm color, Gothic architecture frequently employs stained glass. This result is consistent with (Gordon 2015), who highlights those warm colors are associated with a calm and comfortable atmosphere, thereby rendering them appropriate for worship. Warm light has a crucial function in shaping the psychological experience in church surroundings because of its impact on perceptions and impressions.

In figure 4, image number 3 scored the lowest in both visual attractiveness and positive impression. A prominent difference among the four images is that in image number 3, the artificial light source is visible, potentially perceived as discomfort glare by respondents. This observation is consistent with (Altomonte et al. 2016), who discovered that discomfort glare can indeed affect mood.

Figure 5 illustrates that light intensity and luminance ratio, or contrast, play significant factors in eliciting feelings of spirituality. Compared to the other three photographs, the lighting in image number two is highly consistent or lacks contrast. Even if image number three is not very visually appealing, it nonetheless has the power to evoke a spiritual feeling. Compared to image number 2, images 1, 3, and 4 exhibit strong contrast, which perhaps explains why their spiritual impression scores are so high. This finding aligns with (Gordon 2015), who asserted that luminance ratio or contrast is essential in creating an emotional impact. These observations emphasize the nuanced role of lighting factors in shaping not only visual attractiveness but also the emotional and spiritual responses within the church environment.

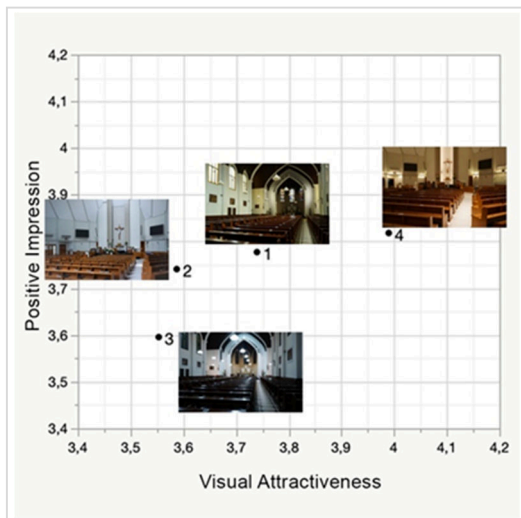


Figure 4. Mean value of each image between positive impression (y) and visual attractiveness (x)

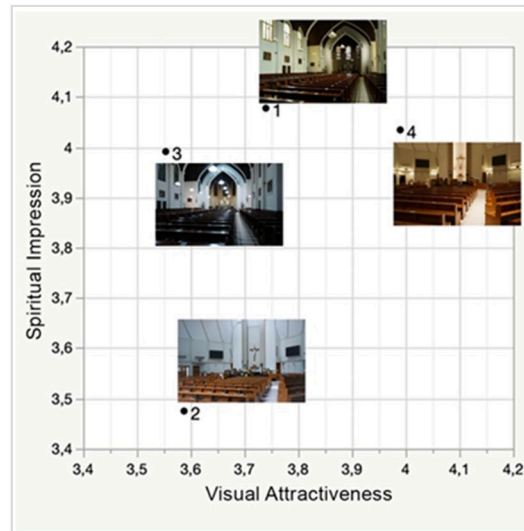


Figure 5. Mean value of each image between spiritual impression (y) and visual attractiveness (x)

In figures 6 and 7, images number 4 and number 3 exhibit the highest and second-highest scores for visual hierarchy. Both images utilize artificial light to establish a visual hierarchy. The primary focal point in image number 4 is the cross, which is illuminated by an indirect wall lamp utilized to generate accent lighting. This assists in establishing a visual hierarchy. In contrast, the second image's visual hierarchy is accomplished by varying the lighting colors in the nave and sanctuary.

The sanctuary, or the area surrounding the altar, holds significant importance as the most sacred space in church buildings. Therefore, directing the congregation's focus toward the sanctuary is crucial (Mandala 2020). Furthermore, artificial light offers greater control (Warbung, Soedarso, and Carina 2020), making it a preferred choice for creating a visual hierarchy. Artificial lighting has a crucial part in enhancing the entire spatial experience inside the church environment, as demonstrated by its effective usage in establishing visual hierarchy and guiding attention.

In image number 1, it is apparent that the illumination in the sanctuary is lower than in the nave area. In addition, it is difficult to observe religious symbols surrounding the sanctuary, such as the altar and tabernacle. As a result, the first image has the lowest score. The illumination between the sanctuary and nave in image number 2 is approximately the same, despite the sanctuary and religious symbols being visible. It emphasizes the significance of contrast and light dispersion in

establishing visual hierarchy. This finding aligns with the assertions of [Trisno and Fermanto Lianto \(2018\)](#); [Antonakaki \(2007\)](#), who emphasized that lighting plays a pivotal role in directing focus by creating higher illuminance in the sanctuary.

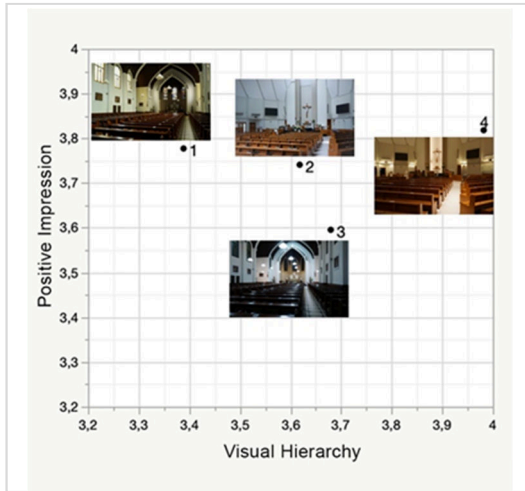


Figure 6. Mean value of each image between positive impression (y) and visual hierarchy (x)

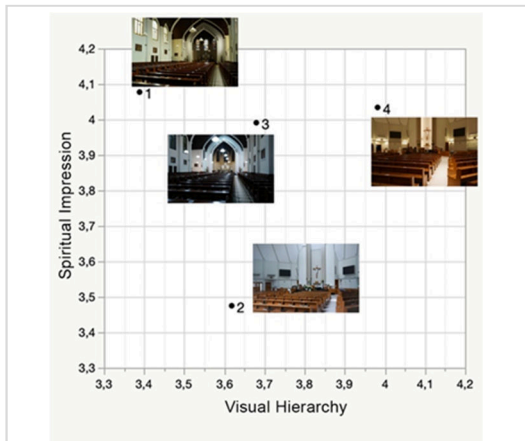


Figure 7. Mean value of each image between spiritual impression (y) and visual hierarchy (x)

Figures 8 and 9 depict the mean scores between "space according to preference" with positive and spiritual impressions. It is evident from the two sets of photographs that neogothic church architecture has priority over modern church architecture. Even though this conclusion has to be confirmed by another research employing a more varied sample, significant details on user preferences for church space conditions can still be obtained.

One reason modern churches are less preferred than neogothic churches is that modern

churches tend to possess less visual richness ([Herzog et al. 2013](#)). Buildings with more visual richness, such as decoration, articulated walls, and the use of natural materials, are generally more favored ([Herzog and Shier 2000](#)). Furthermore, the perceived age of worship buildings with a 'traditional' architectural style, such as Gothic, is often preferred ([Herzog et al. 2013](#)). Neogothic churches frequently employ natural earth tones, such as brown, ochre, umber, gray, brick red, and dark green ([Milleni and Sudianto Aly 2023](#)).

In comparison to modern churches, neogothic churches emphasize building height and verticality. A study conducted by [Costa and Bonetti \(2016\)](#) demonstrates that vertical and tall shapes are more preferred and perceived as sacred, capable of evoking positive and spiritual impressions. On the other hand, figures 8 and 9 indicate that, although being less favored, modern churches can nevertheless arouse spiritual and favorable feelings. This can also be explained by the religious symbols and symmetry apparent in churches, which heighten feelings of holiness and hence generate favorable emotions ([Costa and Bonetti 2016](#); [Estika et al. 2021](#)). Meanwhile, the mean scores of images 2 and 4 exhibit a noticeable difference in space according to preference compared to images number 1 and 3. It recommends that proper lighting design can significantly influence spatial preference in a church setting.

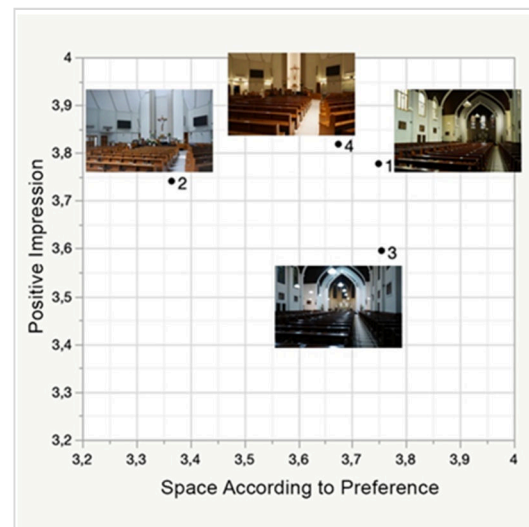


Figure 8. Mean value of each image between positive impression (y) and space according to preference (x)

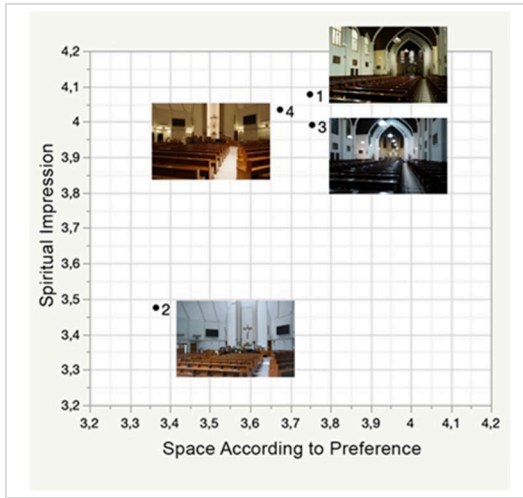


Figure 9. Mean value of each image between positive impression (y) and space according to preference (x)

The perception of the modern church is that it is more open than the neogothic church, as demonstrated in figures 10 and 11. The reality that the neogothic church images include walls may have a profound effect on this perspective. Modern churches are considered to be more open because of their architecture, which emphasizes a horizontal shape that promotes a pleasant ambiance (Kieckhefer 2004). Interestingly, the neogothic church, which is perceived as less open, elicits higher spiritual and positive impressions. It aligns with the findings of Costa and Bonetti (2016), who demonstrated that secluded spaces are perceived as more attractive and sacred.

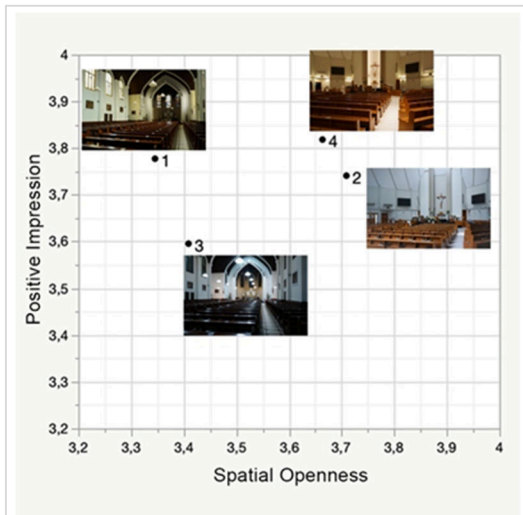


Figure 10. Mean value of each image between positive impression (y) and spatial openness (x)

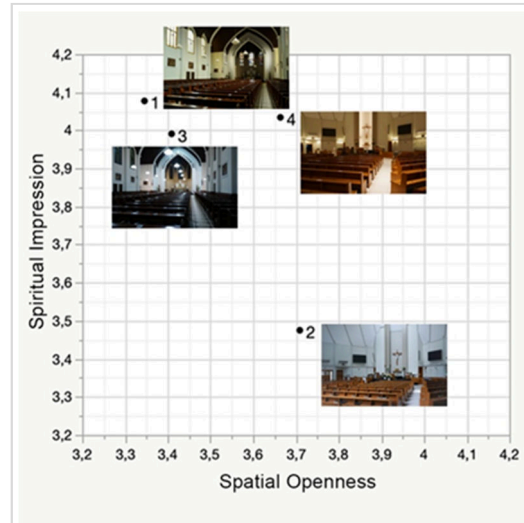


Figure 11. Mean value of each image between spiritual impression (y) and spatial openness (x)

In summary, the lighting and spatial characteristics of the two churches to evoke positive and spiritual impressions based on user preference are summarized in table 3. Despite the clear difference between Gothic and modern architecture in churches, both styles demonstrate the capacity to evoke a positive and spiritual atmosphere within the congregation. The analysis emphasizes the significance of warm colors created by artificial lighting and stained glass in church settings. Another important factor in church lighting design is the purposeful use of contrast and strategic lighting distribution to direct human focus. To generate a sanctified perception among the congregation, it is necessary to simultaneously incorporate building articulation, symmetry, height, religious symbols, ornamentation, natural materials, and solitary spaces.

A person's background plays a crucial role in shaping their perceptions and preferences (Calvillo Cortés and Falcón Morales 2016; Bodrogi et al. 2017). Both questionnaires were aimed at Catholics. Consequently, the preference for lighting and spatial characteristics found in this study were only limited to Catholics. However, the majority of the respondent's residences are outside Bandung, where the church is located. It can be assumed that the majority of the respondents were not familiar with the church buildings that were utilized in this study. Therefore, there is an indication that the preferences and spiritual impressions found are universally applicable to Catholics in Indonesia.

Table 4. User's preference of lighting and spatial characteristic

Lighting condition	<ol style="list-style-type: none"> 1. Light with warm color temperature produced from filtering natural light using stained glass or artificial lighting. 2. The use contrasts. 3. Light distribution which can direct the user's focus towards the most sacred part of the building.
Spatial condition	<ol style="list-style-type: none"> 1. The use of ornament, articulation, religious symbol, and natural material. 2. Symmetrical space with high room height. 3. Secluded space to evoke sacred impression.

Architects and designers who specialize in religious spaces especially churches will discover this overview to be instructive. Creating a setting that may convey a spiritual feeling is a challenge for architects and designers that extends beyond straightforward duties like designing pleasant lighting and spaces. Moreover, this study provides valuable insights by examining lighting and spatial factors that influence users' perception of the atmosphere. Creating sacred places in religious contexts is ultimately important because it may provoke good and spiritual feelings, which will enhance the congregation's quality of worship.

Conclusions

This research explores user preference for a Catholic church based on images of the neogothic style and modern-style church. Furthermore, we analyze the correlation between lighting condition and spatial condition with positive impression and spiritual impression. The correlation analysis performed has a significant probability of less than 0,0001. The analysis demonstrated that visual attractiveness can influence both spiritual impressions and positive impressions with similar correlation values of 0,686 and 0,684. In spatial conditions, space according to preference has a higher correlation value to evoke spiritual and positive impressions with correlation values of 0,693 and 0,677. Furthermore, correlation analysis shows that visual hierarchy is more influential in eliciting spiritual impressions with a correlation value of 0,625 compared to positive impressions with a correlation value of 0,575. Each independent variable is then analyzed to explore the user's preference based on the images that were used. The results showed that color, contrast, visual comfort, lighting hierarchy visual

richness, building age, building shape, verticality, symmetry, and secluded space can influence the stimulation of positive and spiritual impressions.

Further research needs to be carried out with a more extensive set of images with various lighting and spatial conditions to further validate the findings in this study and to comprehensively assess the preference for lighting and spatial conditions in Catholic churches. Additionally, most of the respondents in this research were under 26 years old. Therefore, the results of this research might not fully represent the preference for lighting and spatial conditions among respondents from different age groups.

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Author(s) contribution

Adira Damai Reforma contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

Dewi Larasati contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.

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