



EVALUATING VOLUNTEER SATISFACTION WITH SUSTAINABILITY INITIATIVES AT THE PARIS 2024 OLYMPICS

Abstract - This study examined volunteers' evaluations of sustainability initiatives implemented during the Paris 2024 Olympic Games using psychological constructs derived from the Theory of Planned Behavior (TPB) as an exploratory theoretical framework. Rather than testing the original TPB model, the study investigated whether attitudes, subjective norms, and perceived behavioral control were associated with volunteer satisfaction across seven sustainability dimensions: Carbon Neutrality, Renewable Energy, Public Transport, Waste Management, Sustainable Architecture, Social Inclusion, and Economic Sustainability. A questionnaire survey was conducted among 205 volunteers recruited through convenience sampling within the Olympic Village during the Games. Correlation analyses and multiple regression analyses were used to examine the associations between the three TPB-derived constructs and satisfaction with each sustainability initiative. The regression models explained 8.9% to 21.7% of the variance in satisfaction. Perceived behavioral control showed the most consistent pattern, with significant positive associations with satisfaction across six of the seven sustainability dimensions. Subjective norms also showed significant positive associations across several dimensions, whereas attitudes were generally not significantly associated with satisfaction and showed significant negative associations with Waste Management and Economic Sustainability. Sensitivity analyses using HC3 heteroscedasticity-robust standard errors produced substantively similar results, although the association between subjective norms and Public Transport satisfaction was no longer statistically significant at the .05 level. These findings suggest that perceived behavioral control and subjective norms may provide useful perspectives for understanding volunteers' evaluations of sustainability initiatives, while the relatively modest explanatory power of the models indicates that additional contextual and experiential factors should also be considered. The findings should be interpreted as exploratory associations rather than as a test of the original TPB model or evidence of causal relationships.

Keywords: Theory of Planned Behavior; volunteer satisfaction; sustainability; Olympic Games; Olympic Agenda 2020+5.

EVALUACIÓN DE LA SATISFACCIÓN DE LOS VOLUNTARIOS CON LAS INICIATIVAS DE SOSTENIBILIDAD EN LOS JUEGOS OLÍMPICOS DE PARÍS 2024

Resumo - Este estudo examinou as avaliações dos voluntários sobre as iniciativas de sustentabilidade implementadas nos Jogos Olímpicos de Paris 2024, utilizando construtos psicológicos derivados da Teoria do Comportamento Planejado (TPB) como referencial exploratório. Em vez de testar o modelo original da TPB, investigou-se se atitudes, normas subjetivas e controle comportamental percebido estavam associados à satisfação dos voluntários em sete dimensões: Neutralidade de Carbono, Energia Renovável, Transporte Público, Gestão de Resíduos, Arquitetura Sustentável, Inclusão Social e Sustentabilidade Econômica. Foi realizada uma pesquisa por questionário com 205 voluntários recrutados por amostragem por conveniência na Vila Olímpica durante os Jogos. Análises de correlação e regressão múltipla examinaram as associações entre os três construtos derivados da TPB e a satisfação com cada iniciativa. Os modelos explicaram entre 8,9% e 21,7% da variância da satisfação. O controle comportamental percebido apresentou o padrão mais consistente, com associações positivas significativas em seis das sete dimensões. As normas subjetivas também mostraram associações positivas significativas em várias dimensões. As atitudes, em geral, não foram significativamente associadas à satisfação e apresentaram associações negativas com a Gestão de Resíduos e a Sustentabilidade Econômica. Análises de sensibilidade com erros-padrão robustos à heterocedasticidade HC3 produziram resultados semelhantes, embora a associação entre normas subjetivas e satisfação com o Transporte Público deixasse de ser significativa ao nível de 0,05. Os resultados sugerem que o controle comportamental percebido e as normas subjetivas podem contribuir para compreender as avaliações dos voluntários sobre iniciativas de sustentabilidade. Contudo, o poder explicativo moderado dos modelos indica a relevância de fatores contextuais e experienciais adicionais. Os achados devem ser interpretados como associações exploratórias, não como teste da TPB original ou evidência de causalidade.

Palavras-chave: Teoria do Comportamento Planejado; satisfação dos voluntários; sustentabilidade; Jogos Olímpicos; Agenda Olímpica 2020+5.

MÁS ALLÁ DE LA NEUTRALIDAD PASIVA: PROTEGIENDO LA ARENA OLÍMPICA Y RECHAZANDO LAS SANCIONES COLECTIVAS

Resumen Este estudio examinó las evaluaciones de los voluntarios sobre las iniciativas de sostenibilidad implementadas en los Juegos Olímpicos de París 2024, utilizando constructos psicológicos derivados de la Teoría del Comportamiento Planificado (TPB) como marco exploratorio. En lugar de poner a prueba el modelo original de la TPB, se investigó si las actitudes, las normas subjetivas y el control conductual percibido estaban asociados con la satisfacción de los voluntarios en siete dimensiones: Neutralidad de Carbono, Energía Renovable, Transporte Público, Gestión de Residuos, Arquitectura Sostenible, Inclusión Social y Sostenibilidad Económica. Se realizó una encuesta mediante cuestionario con 205 voluntarios reclutados mediante muestreo por conveniencia en la Villa Olímpica durante los Juegos. Los análisis de correlación y regresión múltiple examinaron las asociaciones entre los tres constructos derivados de la TPB y la satisfacción con cada iniciativa. Los modelos explicaron entre el 8,9% y el 21,7% de la varianza de la satisfacción. El control conductual percibido mostró el patrón más consistente, con asociaciones positivas significativas en seis de las siete dimensiones. Las normas subjetivas también mostraron asociaciones positivas significativas en varias dimensiones. En general, las actitudes no se asociaron significativamente con la satisfacción y presentaron asociaciones negativas con la Gestión de Residuos y la Sostenibilidad Económica. Los análisis de sensibilidad, realizados con errores estándar robustos a la heterocedasticidad HC3, produjeron resultados similares, aunque la asociación entre las normas subjetivas y la satisfacción con el Transporte Público dejó de ser significativa al nivel de 0,05. Los resultados sugieren que el control conductual percibido y las normas subjetivas pueden contribuir a comprender las evaluaciones de los voluntarios sobre las iniciativas de sostenibilidad. Sin embargo, el poder explicativo moderado de los modelos indica la relevancia de considerar factores contextuales y experienciales adicionales. Los hallazgos deben interpretarse como asociaciones exploratorias, no como una prueba de la TPB original ni como evidencia de causalidad. "neutralidad activa y funcional" prepara el camino a seguir, la tarea para el futuro es consolidar este paradigma a través de criterios operativos claros. Este artículo propone dichos criterios para asegurar la aplicación universal de los reglamentos, con vistas a los futuros ciclos olímpicos, comenzando por Los Ángeles 2028.

Palabras-clave: Teoría del Comportamiento Planificado; satisfacción de los voluntarios; sostenibilidad; Juegos Olímpicos; Agenda Olímpica 2020+5.

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Introduction

The Paris 2024 Olympic Games were held against a backdrop of growing global awareness and commitment to sustainable development. As the world faces unprecedented environmental challenges such as climate change, biodiversity loss, and resource depletion, the need for large-scale events to incorporate sustainability principles has never been more pressing. The International Olympic Committee (IOC) has recognized this imperative, making sustainability a key component of its strategic framework, the Olympic Agenda 2020 and its extension, the Olympic Agenda 2020+5. These agendas emphasize the importance of embedding sustainability into all aspects of the Olympic Games and ensuring lasting benefits for host communities¹.

Focusing specifically on the Paris 2024 Olympic Games, this event was positioned as a landmark in demonstrating how a major international sports gathering can align with the goals of environmental, social, and economic sustainability. The Paris 2024 Olympic Games committed to achieving carbon neutrality by implementing a range of initiatives designed to minimize the carbon footprint of the Games. This included the use of renewable energy sources, extensive public transportation options to reduce emissions, and innovative waste management systems to ensure minimal environmental impact. Additionally, sustainable building practices were employed, utilizing eco-friendly materials and energy-efficient designs. These efforts reflect a broader trend towards green construction and urban planning, which is critical for reducing the environmental impact of urban areas.

Social sustainability was another pillar of the Paris 2024 Olympic Games' vision. The Games aimed to promote social inclusion by ensuring that the benefits of hosting the Olympics are shared widely across different segments of society. This included engaging local communities, providing opportunities for underrepresented groups, and fostering a sense of collective ownership and pride. The involvement of volunteers, the creation of accessible venues, and initiatives to promote health and well-being among residents are all integral to this approach. Economic sustainability was equally prioritized, with the Paris 2024 Olympic Games designed to deliver lasting economic benefits. This involved stimulating local economies through infrastructure investments, creating job opportunities, and boosting tourism. By fostering partnerships with local businesses and

leveraging the global visibility of the Olympics, Paris aimed to create a sustainable economic legacy that extends well beyond the duration of the Games.

A key focus of this study was the engagement of volunteers in the Paris 2024 Olympic Games. Volunteers are crucial to the success of the Games, playing vital roles in various operational aspects and serving as ambassadors of sustainability practices. Understanding how these sustainability initiatives are perceived and evaluated by volunteers is essential for future event planning and the development of sustainability initiatives. Volunteers' experiences and feedback can provide valuable insights into how these measures are perceived and evaluated and highlight areas for improvement. The International Olympic Committee (IOC) emphasizes that “volunteers are the lifeblood of the Olympic Games and play a vital role in making the Games happen (w/p)”¹³. By focusing on volunteers, this study aims to examine how sustainability initiatives are perceived and evaluated by those who are integral to the operational success of the Olympics.

This study adopted the Theory of Planned Behavior (TPB) as a theoretical lens for understanding how volunteers evaluate sustainability initiatives implemented during the Paris 2024 Olympic Games. Rather than testing the original TPB model, the present study examined whether the three psychological constructs of TPB—attitudes, subjective norms, and perceived behavioral control—were associated with volunteers' satisfaction with sustainability initiatives. By conducting correlation and multiple regression analyses between attitudes, subjective norms, perceived behavioral control, and satisfaction with the sustainability initiatives, this study aimed to provide insights and recommendations for improving the communication and implementation of sustainability initiatives in future Olympic Games and other large-scale events. This, in turn, may inform efforts to enhance volunteer engagement with sustainability initiatives and contribute to a lasting positive legacy for the host cities and their communities, in alignment with the principles of sustainable development.

Literature Review

The integration of sustainability into the Olympic Games has evolved significantly over recent decades. Historically, the focus was primarily on economic gains and international prestige, often at the expense of environmental and social

considerations. However, the growing recognition of the environmental impacts of large-scale events and the need for sustainable development have prompted a shift in how the Olympics are planned and executed.

Sustainability of Past Olympic Games

Evaluating the sustainability of past Olympic Games provides a critical framework for assessing the effectiveness of current and future initiatives. This historical analysis offers valuable insights into the successes and challenges faced by previous host cities, allowing for the refinement and improvement of sustainability practices.

Müller and Wolfe² conducted a comprehensive evaluation of the sustainability of the Olympic Games from 1992 to 2020, focusing on three primary dimensions: economic, social, and ecological. Their study highlights the multifaceted nature of sustainability and underscores the necessity of a balanced approach that addresses all three dimensions simultaneously.

Economic sustainability involves creating lasting economic benefits for the host city and region. This includes infrastructure development, job creation, and boosting local businesses through tourism and global exposure. The Salt Lake City 2002 Winter Olympics exemplify successful economic sustainability. The event not only generated significant economic activity during the Games but also left a legacy of improved infrastructure and increased tourism. Investments in transportation and sports facilities continued to benefit the region long after the Games concluded². In contrast, the Sochi 2014 Winter Olympics faced criticism for excessive spending and corruption, which overshadowed the potential long-term economic benefits. The cost of the Sochi Games was the highest in Olympic history, raising questions about the financial prudence and sustainability of such expenditures².

Social sustainability refers to the inclusive benefits provided to the community, including social cohesion, public health, and accessibility. The London 2012 Olympics are often cited as a benchmark for social sustainability. The London Organizing Committee of the Olympic and Paralympic Games (LOCOG) focused on creating a positive social legacy by promoting inclusivity and community engagement. Initiatives included the development of affordable housing, improved public spaces, and programs to increase local participation in sports and physical activities. The Games also prioritized accessibility, ensuring that facilities were inclusive for people with disabilities³.

Conversely, the Beijing 2008 Olympics faced criticism for the displacement of residents and the suppression of dissent, highlighting the challenges of achieving social sustainability in the face of political and economic pressures².

Ecological sustainability involves minimizing environmental impacts through the use of renewable resources, reducing emissions, and implementing effective waste management practices. The Vancouver 2010 Winter Olympics made significant strides in this area by incorporating green building standards and renewable energy sources. The Games were praised for their commitment to reducing greenhouse gas emissions and protecting natural habitats⁴. In contrast, the Sochi 2014 Olympics were marred by environmental degradation due to large-scale infrastructure projects that damaged local ecosystems and wildlife habitats. Despite initial promises of sustainability, the environmental cost of the Sochi Games highlighted the challenges of balancing development with ecological preservation².

The most successful examples of Olympic sustainability have been those that effectively integrated economic, social, and ecological dimensions. The London 2012 Olympics, for example, demonstrated a holistic approach by simultaneously addressing economic growth, social inclusion, and environmental protection. This integrated strategy not only enhanced the immediate success of the Games but also ensured a lasting positive legacy for the city and its residents³.

While progress has been made in integrating sustainability into the Olympic Games, significant challenges remain. These include managing the high costs associated with hosting the Games, ensuring genuine community engagement, and balancing the environmental impacts of large-scale infrastructure projects. Future host cities can learn from the successes and shortcomings of past Games to develop more effective and sustainable practices. For instance, the emphasis on community engagement and social inclusion seen in London can be adopted by future hosts to enhance social sustainability. Similarly, the environmental lessons from Vancouver can inform greener infrastructure and energy practices.

The evaluation of past Olympic Games reveals the complexity and importance of achieving sustainability across economic, social, and ecological dimensions. The experiences of cities like Salt Lake City, London, Vancouver, and Sochi offer valuable lessons for Paris 2024 Olympic Games and beyond. By learning from these precedents,

future Olympic hosts can enhance their sustainability efforts, ensuring that the Games contribute positively to the host cities and the global community.

Paris 2024 Olympic Games

The Paris 2024 Olympic Games were positioned as a groundbreaking event in terms of sustainability, building upon lessons learned from previous Olympic Games and aiming to set new standards for future events. The focus on sustainability was multifaceted, encompassing environmental, social, and economic dimensions. This comprehensive approach was designed to ensure that the benefits of the Games extend far beyond the event itself, with the aim of creating a lasting positive legacy for the host city and its inhabitants.

Paris 2024 Olympic Games committed to substantially reducing the carbon footprint of the Games, a significant step in reducing the environmental impact of the Games⁵ (5). According to Monica and Sabina⁴, carbon neutrality is achieved by minimizing greenhouse gas emissions and compensating for any remaining emissions through activities that absorb carbon dioxide, such as reforestation projects. According to the Paris 2024 Sustainability & Legacy Post-Games Report, the final carbon footprint of the Games was approximately 1.595 million tonnes of CO₂ equivalent, representing a 54.6% reduction compared with the average of the London 2012 and Rio 2016 Games⁶.

The Paris 2024 Organizing Committee implemented measures to supply the Games with renewable electricity⁵. This approach not only sought to reduce the carbon footprint but also demonstrated the potential for renewable energy in large-scale events. Paris 2024 connected Games venues to the public electricity grid, and 98.4% of electricity requirements were covered by the grid. The electricity supplied via the grid to power the Games was 100% renewable electricity produced in France⁶. Additionally, the Games promoted public transportation as a primary means of transport for athletes, volunteers, and spectators. By enhancing and expanding public transport infrastructure, Paris aimed to reduce reliance on private vehicles, thereby cutting emissions and easing urban traffic congestion⁵. All competition venues were served by public transport, and 87% of spectators used public transport or other forms of active mobility to travel to events⁶.

Sustainable architecture and infrastructure planning were also important components of the Paris 2024 sustainability strategy. To reduce the environmental impact

associated with construction, Paris 2024 relied extensively on existing and temporary infrastructure, which accounted for 95% of Games sites. Permanent infrastructure incorporated low-carbon construction technologies, while temporary venues applied circular-economy principles, including rental and the use of reused, recycled, and recyclable materials⁶.

Waste management was another critical component of the environmental sustainability strategy. Paris 2024 Olympic Games implemented measures to reduce waste generation and recycle waste that could not be avoided. Initiatives included reducing single-use plastics, promoting the use of reusable materials, and encouraging waste sorting and circular use of materials⁵. The amount of waste generated during the Games was reported to be almost 60% lower than at London 2012, while 78.6% of waste during the operational phase was recovered or avoided. The use of single-use plastic for drinks supplied by Paris 2024 was also reduced by 52% by weight compared with London 2012⁶.

A key focus of the Paris 2024 Olympic Games was social sustainability, achieved through robust community engagement and social inclusion initiatives. Learning from the successes and challenges of past Games, Paris 2024 Olympic Games sought to ensure that the benefits of hosting the Olympics were broadly distributed across the local population, fostering social cohesion and with the aim of creating a lasting positive legacy⁵.

One of the primary methods for achieving social sustainability was through extensive community engagement. The Paris 2024 Organizing Committee actively involved local communities in the planning and preparation stages of the Games. This included public consultations, community meetings, and partnerships with local organizations to ensure that the voices and needs of residents were heard and addressed. By fostering a sense of ownership and participation, these efforts aimed to build stronger, more connected communities⁵.

The Games also focused on inclusivity, ensuring that opportunities created by the Olympics were accessible to all segments of society. Universal accessibility was incorporated into Paris 2024's strategy from the bid phase, with objectives including enabling full participation, providing an obstacle-free Games experience, and promoting the social participation of people with disabilities. Such initiatives were designed to promote social inclusion, reduce inequalities, and enhance participation in the Games⁵.

Furthermore, the Paris 2024 Olympic Games implemented programs aimed at promoting health and well-being among the local population. These programs sought to leverage the excitement and engagement generated by the Games to encourage increased participation in sports and physical activities. By promoting active lifestyles, the Games aimed to improve public health outcomes and foster a culture of health and fitness in the host city.

Economic sustainability was another cornerstone of the Paris 2024 Olympic Games' strategy. Paris 2024 sought to generate economic and social value through employment, responsible procurement, and opportunities for very small, small, and medium-sized enterprises and organizations in the social and solidarity economy. Aligning with the findings of Monica and Sabina⁴ on the importance of economic sustainability in Olympic planning, Paris 2024 Olympic Games were designed to support long-term economic benefits that extend well beyond the duration of the Games⁵. Among the 4,700 suppliers mobilized by Paris 2024, 88% were French suppliers, 83% were VSEs or SMEs, and 10% were social economy organizations. More than 800 social and solidarity economy structures were mobilized across Games contractors⁶.

Employment was also a significant component of the Games' economic and social strategy. Post-Games reporting indicated that approximately 181,000 jobs were directly mobilized by the Games, alongside more than 1.5 million hours of social integration activity⁶.

The Paris 2024 Olympic Games represented a comprehensive effort to integrate sustainability into the planning and execution of the Games. By focusing on environmental sustainability, social inclusion, and economic development, Paris aimed to create a lasting positive legacy that benefits the host city and its residents. The commitment to sustainability at Paris 2024 Olympic Games addressed the immediate impacts of the Games and also provides a reference point for considering how large-scale events may contribute to broader sustainable development goals.

The Paris 2024 Olympic Games were planned and delivered in alignment with the recommendations from the Olympic Agenda 2020+5, which emphasize sustainability, inclusivity, and legacy. Recommendation 2 from the Olympic Agenda 2020+5 specifically calls for fostering sustainable Olympic Games by integrating sustainability into all aspects of the event⁷. This includes achieving climate-positive Games by 2030,

developing strategies to address climate change impacts, and ensuring no permanent construction occurs in protected areas. Additionally, the agenda highlights the importance of delivering lasting benefits to host communities, which Paris 2024 Olympic Games aimed to achieve through its comprehensive sustainability initiatives¹. Importantly, the sustainability measures implemented by Paris 2024 and the outcomes reported by the Organizing Committee should be distinguished from participants' perceptions of those measures. While official post-Games reporting documents the implementation and selected outcomes of Paris 2024's sustainability strategy, the present study does not independently assess their objective effectiveness. Rather, it examines how volunteers perceived and evaluated seven sustainability initiative areas—Carbon Neutrality, Renewable Energy, Public Transport, Sustainable Architecture, Waste Management, Social Inclusion, and Economic Sustainability—based on their experiences during the Games.

Theoretical Foundations and Key Components

The TPB posits that an individual's attitude towards a behavior significantly influences their intention to perform that behavior⁸. Positive attitudes towards sustainability initiatives at the Olympics, such as renewable energy use or waste reduction, are likely to enhance participants' support and engagement. Studies have shown that favorable attitudes towards environmental actions are correlated with higher levels of pro-environmental behavior⁹. In the present study, attitude was operationalized as volunteers' overall evaluations of sustainability-related practices across the seven initiative areas, based on the mean of seven sustainability-related items, rather than as a general measure of environmental attitudes.

Subjective norms refer to the perceived social pressure to perform or not perform a behavior⁸. In the context of the Olympics, this could involve the expectations of peers, family, and the broader community regarding the adoption of sustainable practices. Research has indicated that when individuals believe that important others value sustainability, they are more likely to engage in pro-environmental behaviors¹⁰.

Perceived behavioral control involves an individual's perception of their ability to perform a given behavior⁸. This concept is particularly relevant in the context of the Olympics, where participants might face various barriers to engaging in sustainable

practices, such as lack of knowledge or resources. Higher perceived control is associated with stronger intentions to act sustainably and actual behavior change¹¹.

Although the original TPB explains behavioral intention and actual behavior, recent studies have extended the TPB framework by incorporating additional constructs such as satisfaction into models originally developed to explain behavioral intention and behavior¹². Building on this broader use of TPB-derived frameworks, the present study adopted attitudes, subjective norms, and perceived behavioral control as an exploratory theoretical lens for examining volunteers' satisfaction with sustainability initiatives. However, because satisfaction is not an outcome variable in the original TPB, the present study should not be interpreted as a test or extension of the original TPB model. In addition, the three TPB-derived constructs were operationalized across multiple sustainability practices rather than with reference to a single, specifically defined behavior.

Methods

This study employed a structured questionnaire survey method to evaluate volunteers' perceptions and attitudes towards the sustainability initiatives implemented at the Paris 2024 Olympic Games. This method enabled the collection of quantifiable data, allowing for systematic analysis of trends and insights concerning volunteers' views and experiences regarding the Games' sustainability efforts.

Participants and Data Collection

The target population for this study comprised volunteers participating in the Paris 2024 Olympic Games. Volunteers were selected as the study's focus because, according to the International Olympic Committee (IOC), they are integral to the success of the Games. The IOC highlights that “volunteers are the lifeblood of the Olympic Games and play a vital role in making the Games happen (w/p)”¹³. Understanding volunteers' perceptions is crucial to embedding the sustainability concept deeply into the event. This study aimed to examine how sustainability initiatives are perceived and evaluated by these essential participants.

Participation in the survey was voluntary, with responses collected anonymously to ensure confidentiality. Participants were recruited through convenience sampling using

in-person outreach within the Olympic Village. The survey was conducted from 26 July to 11 August 2024. This approach resulted in a sample size of 205 respondents.

Questionnaire Design

The questionnaire comprised four sections. Section 1 (General Questions) collected demographic and background information, including age, gender, nationality, role during the Games, previous attendance at the Olympic Games, interest in sustainability and environmental issues, awareness of the Paris 2024 sustainability initiatives, and sources of such awareness. Section 2 (Environmental Knowledge) consisted of six multiple-choice questions assessing knowledge of environmental issues, including climate change and water pollution. Section 3 (Sustainability Initiatives) contained 40 statements addressing sustainability-related perceptions and experiences. Among these, seven items assessed attitudes, seven items assessed subjective norms, and seven items assessed perceived behavioral control in relation to sustainability practices. These measures were developed with reference to the three core constructs of the TPB and operationalized for the sustainability context of Paris 2024, rather than as behavior-specific measures designed to test the original TPB model. These items were rated on a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). For each of the three TPB-derived constructs, the mean score of the seven corresponding items was calculated and used in the subsequent analyses. Higher scores indicated more positive attitudes, stronger subjective norms, and greater perceived behavioral control, respectively. Section 4 (Sustainability Initiatives Satisfaction) assessed satisfaction separately for seven sustainability initiative areas: Carbon Neutrality, Renewable Energy, Public Transport, Waste Management, Sustainable Architecture, Social Inclusion, and Economic Sustainability. Each initiative was assessed using a single item rated on a five-point scale ranging from 1 (not at all satisfied) to 5 (very satisfied), with higher scores indicating greater satisfaction. Environmental knowledge and other questionnaire items that were not included in the three TPB-derived constructs or the seven initiative-specific satisfaction outcomes were not included in the statistical analyses reported in the present study.

In this study, satisfaction with sustainability initiatives was conceptualized as volunteers' evaluative response to the sustainability measures implemented during the

Paris 2024 Olympic Games. Specifically, it reflects the extent to which volunteers positively evaluated each sustainability initiative based on their perceptions and experiences during the Games. Satisfaction was examined as an evaluative outcome rather than as behavioral intention or actual behavior. Accordingly, the study explored the associations between the three TPB-derived psychological constructs—attitudes, subjective norms, and perceived behavioral control—and volunteers' satisfaction with each sustainability initiative, rather than testing the original TPB model.

Data Analysis

The data analysis included descriptive statistics, reliability analysis, correlation analysis, and regression analysis.

Descriptive statistics, including frequencies, means, and standard deviations, were calculated to summarize the demographic characteristics of the participants and their responses to the study variables.

Cronbach's alpha was calculated to assess the internal consistency of the questionnaire items measuring attitudes, subjective norms, and perceived behavioral control.

Correlation analyses were conducted to examine the relationships between volunteers' attitudes, subjective norms, perceived behavioral control, and their satisfaction with the seven key sustainability initiatives (Carbon Neutrality, Renewable Energy, Public Transport, Sustainable Architecture, Waste Management, Social Inclusion, and Economic Sustainability).

To examine the associations between the three psychological constructs derived from the TPB and volunteers' satisfaction with sustainability initiatives, a series of multiple regression analyses were conducted. For each of the seven sustainability initiatives, the mean scores for attitudes, subjective norms, and perceived behavioral control were entered simultaneously as predictor variables, with satisfaction with the respective initiative as the outcome variable. Unstandardized regression coefficients (B), *t*-values, *p*-values, and coefficients of determination (R^2) were used to evaluate the associations and explanatory power of each model.

Because the purpose of the present study was not to test the original TPB model, behavioral intention and actual behavior were not included as outcome variables. Instead,

the analyses explored the associations between the three TPB-derived psychological constructs and volunteers' satisfaction as an evaluative response to sustainability initiatives.

Regression diagnostics were conducted to assess multicollinearity, independence of residuals, and heteroscedasticity. Variance inflation factors ranged from 1.528 to 1.713 and tolerance values ranged from 0.584 to 0.655, indicating no substantial multicollinearity. Durbin–Watson statistics ranged from 1.975 to 2.210. Because evidence of heteroscedasticity was observed in some models, sensitivity analyses were additionally conducted using HC3 heteroscedasticity-robust standard errors.

Sample Size

To conduct regression analyses that yield meaningful and reliable results, it is essential to determine an appropriate sample size. The required sample size for regression analysis depends on factors such as the desired statistical power, the expected effect size, and the significance level (α).

Tabachnick and Fidell¹⁴ suggest that, to achieve reliable results in behavioral and social sciences, the sample size should be sufficient to detect even modest relationships between variables. They recommend using a minimum of 50 participants plus 8 for each predictor variable in regression analyses to ensure robustness and generalizability of the findings. Given the three TPB components used as predictors in this study, this suggests a minimum sample size of 74 participants. However, considering the complexity of the analysis and to enhance the power to detect medium to large effects, a sample size of around 205 participants, as obtained, is deemed adequate to ensure reliable results in this context.

The determination of an appropriate sample size is crucial for conducting reliable regression analyses, particularly when assessing the relationship between multiple predictors and an outcome variable. In this study, a sample size of 205 was obtained, which is sufficient for detecting medium to large effect sizes in multiple regression analysis, according to Cohen¹⁵ guidelines.

Cohen¹⁵ provides a framework for understanding effect sizes in regression analysis using the measure of f^2 , which relates to the proportion of variance explained by the predictors (R^2). Specifically, f^2 is calculated as:

$$f^2 = \frac{R^2}{1 - R^2}$$

For a medium effect size, Cohen recommends an R^2 value of approximately 0.13. This value is obtained by solving the equation for $f^2 = 0.15$, which represents a medium effect size:

$$R^2 = \frac{0.15}{1 + 0.15} \approx 0.13$$

Given the sample size of 205, the study is well-positioned to detect medium effect sizes ($R^2 \approx 0.13$) with adequate statistical power (0.80) at the conventional alpha level of 0.05. This level of R^2 suggests that the model would need to explain approximately 13% of the variance in the dependent variable to achieve a medium effect size, which is a typical threshold in social and behavioral sciences.

Accordingly, the obtained sample size of 205 was considered adequate for the multiple regression analyses conducted in this study, particularly for examining associations of moderate magnitude among the three TPB-derived predictors and volunteer satisfaction. However, the study was not specifically powered to detect small effects, and nonsignificant associations should therefore be interpreted with caution.

Ethical Considerations

This study adhered to ethical standards in research, ensuring voluntary participation, informed consent, and confidentiality of responses. Participants were informed about the purpose of the study, the anonymity of their responses, and their right to withdraw from the survey at any time without any consequences. Data were stored securely and used solely for academic research purposes. The study was reviewed and approved by the Ethics Committee of the researcher's affiliated institution (No. 2B0051).

Results

Descriptive Statistics

The descriptive statistics provided an overview of the demographic characteristics of the respondents, including gender, age, and nationality. The majority of the participants were aged between 18 and 24 years (39.0%), with a slightly higher representation of

female volunteers (53.7%) compared to male volunteers (43.4%). The sample included volunteers from 41 different nationalities, ensuring a diverse distribution of cultural backgrounds. Additionally, respondents showed a strong interest in sustainability and environmental issues, with 74.1% indicating that they were ‘very interested’ or ‘extremely interested’. The participants represented a total of 41 different nationalities (Algeria, Australia, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Egypt, France, Germany, Greece, Guatemala, Hong Kong, Indonesia, Ireland, Italy, Japan, Kazakhstan, Kenya, Macedonia, Malaysia, Mauritius, Mexico, Morocco, Peru, Philippines, Poland, Portugal, Romania, Serbia, South Korea, Spain, Switzerland, Thailand, Togo, USA, Ukraine, United Kingdom). The most represented nationality was French, with 109 participants (53.2%).

Table 1. The demographic characteristics of the participants.

Demographic Variable	Frequency (n)	Percentage (%)
Gender		
Male	89	43.4%
Female	110	53.7%
Other	6	3.0%
Age		
18-24	80	39.0%
25-34	53	25.9%
35-44	25	12.2%
45-54	21	10.2%
55-64	18	8.8%
65 or older	8	3.9%
Interest in Sustainability and Environmental Issues		
Not at all interested	0	0.0%
Slightly interested	7	3.4%
Moderately interested	46	22.4%
Very interested	98	47.8%
Extremely interested	54	26.3%
Total	205	100.0%

Source: the author.

Reliability Analysis

The reliability analysis indicated strong internal consistency for the three TPB-derived predictor scales, with Cronbach’s alpha coefficients as follows: Attitude ($\alpha = 0.911$, $M = 4.23$, $SD = 0.78$), Subjective Norms ($\alpha = 0.930$, $M = 3.56$, $SD = 0.978$), and Perceived Behavioral Control ($\alpha = 0.882$, $M = 3.69$, $SD = 0.815$). All alpha values

exceeded the generally accepted threshold of 0.70¹⁶.

Correlation Analysis

The correlation analysis examined the relationships between the components of the TPB and satisfaction with the seven key sustainability initiatives implemented at the Paris 2024 Olympic Games: Carbon Neutrality, Renewable Energy, Public Transport, Waste Management, Sustainable Architecture, Social Inclusion, and Economic Sustainability. The results revealed several significant correlations, particularly highlighting that Subjective Norms showed significant positive correlations with satisfaction across several initiatives, especially with Economic Sustainability ($r = 0.352$, $p < .001$) and Carbon Neutrality ($r = 0.417$, $p < .001$). Perceived Behavioral Control also showed strong positive correlations, notably with Social Inclusion ($r = 0.390$, $p < .001$) and Sustainable Architecture ($r = 0.389$, $p < .001$). In contrast, Attitudes had generally weaker correlations, with the lowest observed in Waste Management ($r = 0.082$, $p = .242$), which was not statistically significant. Overall, subjective norms and perceived behavioral control showed positive correlations with satisfaction across several sustainability initiatives, whereas the correlations between attitudes and satisfaction were generally weaker and less consistent.

Table 2. Result of Correlation Analysis.

	Attitudes	Subjective Norms	Perceived Control	Behavioral
Carbon Neutrality	0.272***	0.417***		0.380***
Renewable Energy	0.261***	0.401***		0.373***
Public Transport	0.230***	0.277***		0.229***
Waste Management	0.082	0.271***		0.361***
Sustainable Architecture	0.240***	0.394***		0.389***
Social Inclusion	0.195*	0.286***		0.390***
Economic Sustainability	0.069	0.352***		0.382***

*** $p < .001$, * $p < .005$

Source: the author.

Regression Analysis

The multiple regression analyses across the seven sustainability initiatives

revealed varying patterns of association between the TPB-derived constructs and volunteer satisfaction, with the models explaining between 8.9% and 21.7% of the variance in satisfaction.

For Carbon Neutrality, Subjective Norms ($B = 0.280, p < .001$) and Perceived Behavioral Control ($B = 0.235, p = .013$) were significantly and positively associated with satisfaction ($R^2 = 0.202$). Similarly, for Renewable Energy, both Subjective Norms ($B = 0.260, p = .001$) and Perceived Behavioral Control ($B = 0.236, p = .011$) showed significant positive associations with satisfaction ($R^2 = 0.190$). For Public Transport, only Subjective Norms were significantly and positively associated with satisfaction ($B = 0.191, p = .039$), while Attitudes and Perceived Behavioral Control were not significant predictors ($R^2 = 0.089$). For Waste Management, Perceived Behavioral Control showed a significant positive association with satisfaction ($B = 0.465, p < .001$), whereas Attitudes showed a significant negative association ($B = -0.252, p = .019$). Subjective Norms were not statistically significant ($R^2 = 0.159$). For Sustainable Architecture, Subjective Norms ($B = 0.252, p = .002$) and Perceived Behavioral Control ($B = 0.287, p = .002$) were significantly and positively associated with satisfaction ($R^2 = 0.194$). For Social Inclusion, only Perceived Behavioral Control was significantly and positively associated with satisfaction ($B = 0.439, p < .001$), whereas Attitudes and Subjective Norms were not significant predictors ($R^2 = 0.158$). Finally, for Economic Sustainability, Subjective Norms ($B = 0.307, p < .001$) and Perceived Behavioral Control ($B = 0.439, p < .001$) were significantly and positively associated with satisfaction, whereas Attitudes showed a significant negative association ($B = -0.350, p = .001, R^2 = 0.217$).

Overall, Perceived Behavioral Control showed significant positive associations with satisfaction across six of the seven sustainability initiatives, while Subjective Norms were significantly associated with five initiatives. Attitudes were generally not significant, except for their negative associations with Waste Management and Economic Sustainability.

Table 3. Multiple regression analysis predicting volunteer satisfaction with sustainability initiatives.

Sustainability Initiative	Predictor	B	t	p	R	R ²
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Carbon Neutrality	Attitude	0.014	0.150	0.881	0.450	0.202
	Subjective Norms	0.280	3.531	< .001		
	Perceived Behavioral Control	0.235	2.519	0.013		
Renewable Energy	Attitude	0.008	0.089	0.930	0.436	0.190
	Subjective Norms	0.260	3.314	0.001		
	Perceived Behavioral Control	0.236	2.552	0.011		
Public Transport	Attitude	0.125	1.141	0.255	0.299	0.089
	Subjective Norms	0.191	2.078	0.039		
	Perceived Behavioral Control	0.093	0.853	0.395		
Waste Management	Attitude	−0.252	−2.360	0.019	0.399	0.159
	Subjective Norms	0.169	1.880	0.062		
	Perceived Behavioral Control	0.465	4.380	< .001		
Sustainable Architecture	Attitude	−0.034	−0.358	0.720	0.441	0.194
	Subjective Norms	0.252	3.177	0.002		
	Perceived Behavioral Control	0.287	3.063	0.002		
Social Inclusion	Attitude	−0.051	−0.483	0.630	0.398	0.158
	Subjective Norms	0.107	1.207	0.229		
	Perceived Behavioral Control	0.439	4.207	< .001		
Economic Sustainability	Attitude	−0.350	−3.430	0.001	0.466	0.217
	Subjective Norms	0.307	3.560	< .001		
	Perceived Behavioral Control	0.439	4.320	< .001		

Source: the author.

Sensitivity analyses using HC3 heteroscedasticity-robust standard errors produced substantively similar results. The statistical significance of the main associations was retained, except for the association between subjective norms and Public Transport satisfaction, which was no longer statistically significant at the .05 level ($B = 0.191$, $HC3\ SE = 0.099$, $p = .054$).

Discussion

This study aimed to explore the associations between three TPB-derived psychological constructs and volunteer satisfaction with seven sustainability initiatives implemented during the Paris 2024 Olympic Games. Although the original TPB was developed to explain behavioral intention and behavior, the present study explored whether its three core psychological constructs were associated with volunteers' evaluations of sustainability initiatives. By doing so, the research sought to provide a deeper understanding of the relationships between these psychological constructs and volunteers' evaluations of sustainability initiatives in the context of a global sporting event.

Interpretation of key findings

Subjective norms were significantly associated with volunteer satisfaction across several sustainability initiatives, including Carbon Neutrality, Renewable Energy, Public Transport, Sustainable Architecture, and Economic Sustainability. These findings suggest that perceived social expectations may be relevant to how volunteers evaluate sustainability initiatives. Previous studies on episodic volunteering in sports events highlight that social pressures and expectations from others play a critical role in shaping volunteer behavior and satisfaction¹⁷. Specifically, the desire for social interaction and the sense of connection with others through volunteer activities have been identified as key factors that enhance volunteer satisfaction and future volunteer intentions¹⁸. Additionally, the need for social approval and recognition has been shown to significantly account for volunteer motivation¹⁹. Thus, the consistent positive associations between subjective norms and satisfaction observed in this study suggest that perceived social expectations may be relevant to how volunteers evaluate sustainability initiatives. This underscores the importance of considering social influence and community recognition

in the design of volunteer management strategies and sustainability programs, as these factors may be relevant to volunteer engagement and satisfaction. However, the association between subjective norms and Public Transport satisfaction was not statistically significant in the HC3 sensitivity analysis ($p = .054$), indicating that this particular finding should be interpreted cautiously.

Perceived behavioral control was significantly associated with volunteer satisfaction across six of the seven sustainability initiatives, including Carbon Neutrality, Renewable Energy, Waste Management, Sustainable Architecture, Social Inclusion, and Economic Sustainability. This finding suggests that volunteers who perceived greater capacity or opportunity to engage with sustainability-related practices tended to evaluate these initiatives more positively. From the perspective of TPB, perceived behavioral control reflects individuals' perceptions of their ability and available resources to perform a behavior. In the context of Paris 2024, volunteers who felt that sustainability-related practices were accessible and within their capacity may therefore have evaluated the corresponding initiatives more favorably. For volunteers, such perceptions may have reflected practical aspects of the Games environment, such as the accessibility of sustainability-related practices, opportunities to participate in them, the availability of necessary resources or information, and the perceived ease of incorporating these practices into their volunteer activities. Thus, the association between perceived behavioral control and satisfaction may reflect not only volunteers' individual sense of capability but also how readily sustainability initiatives could be encountered or engaged with in the operational environment of the Games.

Although the present study did not examine the behavioral mechanisms underlying this association, the consistent pattern across six sustainability dimensions suggests that perceived behavioral control may be particularly relevant to understanding volunteers' evaluations of sustainability initiatives. Previous research has also suggested that opportunities for learning and personal development are relevant to sport-event volunteering²⁰; however, these mechanisms were not directly examined in the present study.

Attitudes were negatively associated with satisfaction regarding both Waste Management and Economic Sustainability. One possible explanation, although not directly tested in the present study, can be drawn from Expectation–Disconfirmation

Theory²¹, which proposes that satisfaction is determined by the discrepancy between prior expectations and perceived performance. Volunteers with stronger pro-sustainability attitudes may have held higher expectations regarding the sustainability initiatives implemented at the Paris 2024 Olympic Games. If the implementation of these initiatives was perceived as falling short of such expectations, volunteers with stronger pro-sustainability attitudes may have evaluated them more critically. However, the present study did not directly measure either prior expectations or perceived discrepancies between expectations and implementation.

During the Games, the first author observed waste collection at the different locations used by volunteers. Within the residential buildings of the Olympic Village, waste was separated into two categories, whereas three-category waste separation was commonly observed at competition venues. Some waste collection stations provided up to four categories (Figure 1). While this observation cannot be generalized to all Paris 2024 venues, it provides contextual evidence of the waste-management practices encountered by volunteers in the Olympic Village. Volunteers with stronger pro-sustainability attitudes may have evaluated these practices against higher expectations regarding waste management; however, this interpretation remains speculative because neither volunteers' expectations regarding waste separation nor their evaluations of the observed waste stations were directly measured. For Economic Sustainability, the mechanism underlying the negative association with attitudes is less clear. Although the result may similarly reflect differences between volunteers' expectations and their perceptions of the initiative, the present study provides no direct evidence for this explanation. The negative association should therefore be regarded as an exploratory finding requiring further investigation.

Figure 1. Waste separation station observed in the Paris 2024 Olympic Village. Photograph taken by the first author during the Games.



Source: the author.

Limitations of the Study

While this study offers valuable insights into the factors associated with volunteer satisfaction with sustainability initiatives at the Paris 2024 Olympic Games, several limitations should be noted. Although the sample size of 205 participants was adequate for detecting medium effect sizes at the conventional significance level of 0.05, the R^2 values varied across models, ranging from 0.089 to 0.217. The explanatory power was particularly limited for Public Transport ($R^2 = 0.089$), for which the model accounted for less than 10% of the variance in satisfaction. The explanatory power for Social Inclusion was also relatively modest ($R^2 = 0.158$), although higher than that observed for Public Transport. These results indicate that substantial variance in volunteer satisfaction remained unexplained by the three TPB-derived constructs. Variables such as infrastructure quality, personal convenience, and social context, which were not included in the model, may represent additional factors relevant to volunteer satisfaction.

First, an important theoretical limitation is that satisfaction is not an outcome variable in the original TPB, which was developed to explain behavioral intention and behavior. Therefore, the present study should not be interpreted as a test or validation of the original TPB model. Rather, it represents an exploratory application of TPB-derived psychological constructs to volunteers' evaluations of sustainability initiatives. This highlights the need to explore additional theoretical perspectives or incorporate other relevant factors in future research. In addition, the TPB-derived constructs were measured across multiple sustainability practices rather than with reference to a single, specifically defined behavior. Although the three predictor scales demonstrated strong internal consistency, this operationalization differs from conventional behavior-specific TPB measurement. Future research should employ behavior-specific measures of attitudes, subjective norms, perceived behavioral control, behavioral intention, and behavior to more directly examine the TPB framework in the context of sustainability initiatives at mega-sport events.

Second, the relatively modest explanatory power of the regression models suggests that the three TPB-derived constructs captured only part of the factors associated with volunteers' satisfaction with sustainability initiatives. This indicates that volunteers' evaluations may also be associated with contextual and experiential factors not included in the present study, such as the accessibility and visibility of sustainability practices, the availability of relevant information and resources, and volunteers' direct experiences with these initiatives. Future research should therefore incorporate a broader range of contextual and experiential variables to develop a more comprehensive understanding of volunteers' evaluations of sustainability initiatives and to reduce the potential for omitted variable bias. In addition, because multiple associations were examined across seven initiative-specific outcomes, the possibility of Type I error due to multiple testing should be considered when interpreting individual *p*-values.

Third, participants were recruited through convenience sampling within the Olympic Village. Therefore, although the sample included volunteers from diverse national backgrounds, it should not be considered statistically representative of the entire Paris 2024 volunteer population. This sampling approach limits the generalizability of the findings.

Finally, the cross-sectional design of this study limits the ability to establish causal relationships between the TPB-derived psychological constructs and volunteer satisfaction. The observed associations should therefore not be interpreted as evidence that attitudes, subjective norms, or perceived behavioral control caused changes in satisfaction. Future research employing longitudinal or experimental designs could provide further insight into the direction and causal mechanisms of these relationships.

Conclusion

The findings of this study suggest that the TPB-derived psychological constructs may provide a useful exploratory perspective for understanding volunteers' evaluations of sustainability initiatives, although volunteer satisfaction, rather than behavioral intention or behavior, was examined as the outcome in the present study. Perceived behavioral control showed the most consistent pattern, with significant positive associations with satisfaction across six of the seven sustainability dimensions, while subjective norms were also positively associated with satisfaction across several dimensions. Attitudes showed a less consistent pattern and were negatively associated with satisfaction with Waste Management and Economic Sustainability.

These insights contribute to the broader sustainability objectives of the Olympic Agenda 2020+5 by providing practical implications for the design and communication of sustainability initiatives within volunteer programs. These findings suggest that future volunteer programs may benefit from communication strategies that make sustainability-related actions accessible and understandable while also considering the role of social expectations. This approach may help to foster a stronger sense of ownership and engagement among volunteers, thereby supporting the long-term sustainability goals of the Olympic Movement.

However, the study also highlights several limitations, particularly in terms of the explanatory power of the models, as indicated by the relatively modest R^2 values for some initiatives. This suggests that additional contextual and experiential factors associated with volunteer satisfaction, such as cultural context, infrastructure quality, and event logistics, may need to be considered. These findings highlight the need to examine these relationships across different event contexts and participant populations.

Moving forward, future research should focus on addressing these limitations by exploring a broader range of variables and incorporating more diverse samples. Moreover, longitudinal studies could provide deeper insights into how volunteers' sustainability-related perceptions and satisfaction evolve over time and help clarify the direction of the relationships observed in the present study. By doing so, future studies could enhance the theoretical understanding of volunteer engagement and inform future efforts aligned with the sustainability objectives outlined in the Olympic Agenda 2020+5.

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