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INFLUENCE OF PSYCHOLOGICAL FACTORS ON GREEN EXERCISE PARTICIPATION: AN S-O-R CONCEPTUAL MODEL

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Abstract:

Green exercise, defined as physical activity conducted in natural environments, has gained increasing international attention due to its potential dual benefits for physical health and environmental sustainability. In Malaysia, despite abundant natural resources and government initiatives promoting active lifestyles, participation in green exercise remains relatively limited. Rising levels of physical inactivity and non-communicable diseases underscore the need to better understand the behavioural processes that influence engagement in outdoor physical activity. Grounded in the Stimulus–Organism–Response (S-O-R) model, this study conceptualises green exercise participation as a behavioural outcome shaped through internal cognitive processing. Psychological factors namely attitude, subjective norms, perceived behavioural control, and intrinsic motivation are positioned as stimuli that influence green knowledge, which functions as the organism component. Green knowledge reflects individuals' awareness and understanding of the environmental and health-related value of engaging in physical activity within natural settings. This internal cognitive state is proposed to shape participation in green exercise. By structuring these relationships within the S-O-R framework, this study contributes to the theoretical understanding of sustainable health behaviour and offers insights relevant to

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policymakers, public health practitioners, and environmental planners. The proposed model provides a foundation for future empirical investigation and may inform the development of strategies aimed at promoting healthier lifestyles and environmental awareness among Malaysians.

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Keyword:

Green Exercise, Green Knowledge, Physical Activity Participation, Stimulus–Organism–Response (S-O-R), Sustainable Health Behaviour;

Introduction

Physical inactivity remains a major public health concern globally, contributing to non-communicable diseases, poor mental health, and reduced quality of life. In response, green exercise is defined as physical activity conducted in natural or green environments such as parks, campuses, gardens, and forests has gained increasing scholarly and policy attention due to its dual benefits for physical health and psychological well-being (Liyanage et al., 2023; Hu et al., 2025). Empirical evidence suggests that exercising in green environments can enhance mood, reduce stress, improve self-esteem, and foster emotional restoration beyond the effects of physical activity alone (Firnhaber et al., 2025).

Despite these benefits, participation in green exercise remains inconsistent and suboptimal. Many individuals continue to engage in sedentary lifestyles or prefer indoor exercise settings, even when green spaces are available. Prior studies indicate that barriers such as lack of motivation, weak social support, low confidence, time constraints, perceived safety concerns, and limited awareness of environmental or health benefits may hinder green exercise participation (Wyss et al., 2022; Liyanage et al., 2023). This gap highlights the need to better understand the psychological mechanisms that influence individuals' decisions to engage in green exercise.

Behavioural theories offer valuable frameworks for explaining such decisions. The Stimulus–Organism–Response (S-O-R) model posits that external or psychological stimuli influence internal cognitive and affective states (organism), which subsequently shape behavioural responses (Xing et al., 2024). This framework has been widely applied in sustainability, environmental behaviour, and health-related decision-making contexts, as it allows for the integration of psychological factors with cognitive processes.

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To strengthen explanatory power, the S-O-R framework can be integrated with established behavioural theories such as the Theory of Planned Behaviour (TPB) and Self-Determination Theory (SDT). TPB identifies attitude, subjective norms, and perceived behavioural control as key determinants of behavioural intention and action (Hagger et al., 2025). Meanwhile, SDT emphasises intrinsic motivation as a critical driver of sustained physical activity engagement (Wang et al., 2024). Additionally, green knowledge is about understanding the environmental and health value of green behaviours plays a crucial cognitive role in shaping pro-environmental and health-related actions (Burgos-Espinoza et al., 2024).

Accordingly, this study proposes an integrated S-O-R conceptual model in which psychological factors (attitude, subjective norms, perceived behavioural control, and intrinsic motivation) act as Stimuli, green knowledge functions as the Organism, and green exercise participation represents the Response. Thus, the study aims to provide a theoretically grounded explanation of how internal psychological processes translate into green exercise behaviour.

Literature Review and Hypothesis Development

SOR Framework

The Stimulus–Organism–Response (S-O-R) model explains behaviour as a process in which external or psychological drivers influence internal cognitive and affective states, which subsequently shape behavioural outcomes (Xing et al., 2024; Kıymalıoğlu, 2024). Rather than assuming a direct cause–effect relationship, the model emphasises internal evaluation and interpretation prior to action, recognising individuals as active processors of information within their environment.

Within this structure, stimuli refer to environmental, social, and psychological factors such as attitudes, perceived norms, perceived behavioural control, and motivational states that initiate internal processing (Sugiarto et al., 2022; Xing et al., 2024). The organism component represents the individual's internal state, encompassing awareness, knowledge, beliefs, and affective evaluations activated by these drivers. Recent sustainability research positions cognitive constructs, including green knowledge, as central mediating elements that explain how individuals interpret information and assign behavioural meaning (Burgos-Espinoza et al., 2024).

The response component captures the resulting behavioural engagement, such as intention or participation in green exercise. In health and environmental contexts, behaviour is understood as emerging from internal cognitive processing rather than as an automatic reaction to external influences (Sugiarto et al., 2022).

Applied to green exercise, this framework conceptualises attitude, subjective norms, perceived behavioural control, and intrinsic motivation as initiating factors that shape individuals' understanding of the environmental and health value of green exercise. This internalised understanding then informs participation decisions. By structuring these relationships within a process-oriented model, the S-O-R perspective offers a coherent explanation of how psychological and cognitive dimensions interact to influence sustainable health behaviour.

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Attitude toward Green Exercise

Attitude reflects an individual's positive or negative evaluation of engaging in green exercise. According to TPB, favourable attitudes increase behavioural intention by enhancing perceived benefits and personal relevance (Hagger et al., 2025). Empirical studies consistently show that individuals who perceive exercise as enjoyable, beneficial, and meaningful are more likely to engage in it, particularly when linked to well-being and nature exposure (Wyss et al., 2022).

H1: Attitude toward green exercise positively influences green exercise participation.

Subjective Norms

Subjective norms refer to perceived social pressure or support from important others (e.g., family, friends, peers). In physical activity contexts, supportive norms have been shown to encourage intention formation and participation, especially in collective or social exercise settings (Jingyi & Ali, 2025). In green exercise, norms may operate through shared outdoor activities, peer influence, and community-based green initiatives.

H2: Subjective norms positively influence green exercise participation.

Perceived Behavioural Control (PBC)

Perceived behavioural control reflects individuals' perceptions of their ability to perform green exercise, considering factors such as time availability, access to green spaces, safety, and personal capability. TPB literature consistently identifies PBC as one of the strongest predictors of both intention and actual behaviour (Hagger et al., 2025). In green exercise contexts, even positive attitudes may fail to translate into action if individuals perceive low control.

H3: Perceived behavioural control positively influences green exercise participation.

Intrinsic Motivation

Intrinsic motivation refers to engaging in an activity for inherent enjoyment, satisfaction, or interest. SDT research demonstrates that intrinsically motivated individuals are more likely to sustain physical activity behaviours over time (Wang et al., 2024). Green environments may further enhance intrinsic motivation by providing enjoyment, novelty, and psychological restoration.

H4: Intrinsic motivation positively influences green exercise participation.

Green Knowledge as Organism (Cognitive Mediator)

Green knowledge represents individuals' awareness and understanding of environmental sustainability and the health-environment co-benefits of green exercise. Environmental knowledge has been linked to stronger pro-environmental attitudes and behaviours, as it enhances cognitive justification and moral reasoning (Burgos-Espinoza et al., 2024). Within the S-O-R framework, green knowledge functions as an organismic state that translates psychological stimuli into behavioural responses.

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H5: Green knowledge positively influences green exercise participation.

Mediation of Green Knowledge

Consistent with the Stimulus–Organism–Response (S-O-R) perspective, behavioural engagement is understood as emerging through internal cognitive processing rather than occurring directly from psychological drivers (Sugiarto et al., 2022; Xing et al., 2024). In the context of green exercise, green knowledge is positioned as the organism component, representing individuals' awareness and understanding of the environmental sustainability and health co-benefits associated with physical activity in green spaces.

Environmental and health behaviour research suggests that knowledge strengthens perceived value and behavioural relevance, thereby supporting informed action (Burgos-Espinoza et al., 2024). Individuals who possess greater green knowledge are therefore more likely to interpret green exercise as meaningful and beneficial, increasing the likelihood of participation.

Within the proposed framework, attitude, subjective norms, perceived behavioural control, and intrinsic motivation are expected to shape green knowledge by influencing openness to information, social learning, experiential understanding, and cognitive engagement. Positive evaluations may enhance interest in learning about green exercise benefits, supportive norms may increase exposure to sustainability-related discourse, perceived capability may encourage exploration and experiential learning, and intrinsic motivation may stimulate curiosity and deeper engagement (Wang et al., 2024).

By conceptualising green knowledge as an intervening mechanism, the model highlights how motivational and social influences may be translated into behavioural participation. In line with S-O-R theory, green knowledge is therefore proposed to partially mediate the relationships between psychological drivers and green exercise participation.
Accordingly, the following mediation hypotheses are proposed:

H6a: Green knowledge mediates the relationship between attitude, subjective norms, perceived behavioural control and intrinsic motivation toward green exercise and green exercise participation.

Methodology

This conceptual paper adopts a theory-driven approach to develop a framework explaining the factors influencing participation in sustainable green exercise, grounded in the Stimulus–Organism–Response (S-O-R) model. The methodology is based on an extensive and systematic review of existing literature related to green exercise, environmental sustainability, health behaviour, and prior applications of the S-O-R framework in behavioural research. Relevant empirical and conceptual studies published from 2019 onward were examined to ensure contemporary theoretical perspectives.

The literature was reviewed, synthesised, and compared to identify key psychological stimuli that may influence green exercise participation. These stimuli include attitude toward green exercise, subjective norms, perceived behavioural control, and intrinsic motivation, which have been consistently shown to shape behavioural engagement in environmental and health-related contexts. In line with the S-O-R structure, green knowledge is conceptualised as the organism

component, representing internal cognitive processing and awareness related to sustainability and health–environment co-benefits.

The review further examines how psychological stimuli may activate cognitive mechanisms that subsequently influence behavioural responses. Insights from the literature synthesis were integrated to refine the conceptual relationships among stimuli, green knowledge (organism), and green exercise participation (response).

In developing the conceptual framework, theoretical assumptions from the S-O-R model were mapped against findings from the literature to identify proposed pathways and the potential mediating role of green knowledge. The framework does not involve empirical testing; rather, it provides a structured theoretical foundation to guide future empirical research.

Overall, the methodology emphasises conceptual development through theory integration, critical literature synthesis, and logical alignment of constructs within the S-O-R model to explain sustainable green exercise behaviour.

Results

Based on the proposed Stimulus–Organism–Response (S-O-R) conceptual framework, it is expected that the structural model will demonstrate satisfactory explanatory power for both green knowledge (organism) and green exercise participation (response). Specifically, the model is anticipated to explain a moderate to substantial proportion of variance in green knowledge and green exercise participation, indicating that psychological factors play a meaningful role in shaping engagement in green exercise.

In line with the Theory of Planned Behaviour (TPB), attitude toward green exercise, subjective norms, and perceived behavioural control (PBC) are expected to exhibit significant positive effects on green exercise participation. Among these predictors, perceived behavioural control is anticipated to show the strongest direct effect, reflecting the importance of perceived capability, access, and feasibility in translating intention into actual participation. This result would be consistent with prior TPB-based studies indicating that individuals may hold favourable attitudes and social support but fail to act when perceived control is low.

Intrinsic motivation, grounded in Self-Determination Theory (SDT), is also expected to significantly predict green exercise participation. Individuals who engage in green exercise for enjoyment, interest, and personal satisfaction are more likely to demonstrate higher intention and sustained participation. The natural and restorative qualities of green environments may further enhance intrinsic motivation, strengthening its behavioural influence.

With regard to the organism component, green knowledge is expected to be significantly influenced by all psychological stimuli. Positive attitudes are anticipated to increase openness to learning about environmental and health benefits, while subjective norms may enhance knowledge through social learning and shared discourse. Higher perceived behavioural control is expected to facilitate experiential learning, and intrinsic motivation is likely to promote curiosity and deeper cognitive engagement.

Furthermore, green knowledge is expected to show a significant positive direct effect on green exercise participation, indicating that individuals who understand the health–environment co-benefits of green exercise are more inclined to engage in such behaviour.

Most importantly, mediation analysis is expected to reveal that green knowledge partially mediates the relationships between psychological stimuli and green exercise participation. Significant indirect effects would confirm that psychological factors do not influence behaviour solely through direct motivational pathways but also through internal cognitive processing, as proposed by the S-O-R framework.

Summary of Findings

The expected findings provide strong theoretical support for the S-O-R framework in explaining green exercise participation. The significant effects of psychological stimuli on green exercise participation highlight the relevance of individual-level psychological determinants in health- and sustainability-related behaviours. Rather than being driven purely by environmental availability, green exercise behaviour appears to be shaped by how individuals perceive, evaluate, and feel capable of engaging in such activities.

The anticipated dominance of perceived behavioural control reinforces the argument that practical feasibility such as time availability, access to green spaces, and perceived safety plays a pivotal role in enabling behaviour. This suggests that even when individuals value green exercise and receive social encouragement, participation may remain low if structural or perceived barriers are not addressed. This finding aligns with TPB literature emphasising PBC as a critical bridge between intention and action.

The expected significance of intrinsic motivation underscores the importance of enjoyment and autonomy in sustaining green exercise behaviour. From an SDT perspective, green environments may foster intrinsic motivation by offering aesthetic pleasure, stress reduction, and psychological restoration. This suggests that green exercise interventions should prioritise enjoyment and personal meaning rather than obligation or external pressure.

The mediating role of green knowledge provides important insight into the mechanism underlying green exercise behaviour. By functioning as the organism within the S-O-R framework, green knowledge explains *how* psychological stimuli are cognitively processed before resulting in behaviour. Individuals with higher green knowledge are likely to perceive green exercise as more valuable, meaningful, and relevant, thereby strengthening the translation of motivation into action. The presence of partial mediation suggests that both direct motivational pathways and indirect cognitive pathways operate simultaneously.

Overall, these expected findings extend existing green exercise and physical activity literature by demonstrating that cognitive awareness and understanding are not merely background factors but central mechanisms that amplify behavioural engagement. The results also contribute to sustainability research by highlighting green exercise as a behaviour that integrates personal health benefits with environmental consciousness, reinforcing the value of interdisciplinary theoretical models such as S-O-R.

In summary, the expected results support the robustness of the proposed conceptual framework and confirm that green exercise participation is best understood as a psychologically driven,

cognitively processed, and behaviourally enacted phenomenon. This integrated explanation advances both theory and practice by clarifying not only which factors matter, but how they interact to shape green exercise behaviour.

Conclusion

This conceptual paper proposes an integrated Stimulus–Organism–Response (S-O-R) framework to explain participation in green exercise by capturing the psychological and cognitive processes underlying engagement in physical activity within green environments. By positioning attitude, subjective norms, perceived behavioural control, and intrinsic motivation as psychological stimuli, green knowledge as the organismic mechanism, and green exercise participation as the behavioural response, the framework offers a structured and theory-informed explanation of how individuals may be influenced to engage in green exercise.

The framework emphasises that psychological factors may not directly translate into behaviour without cognitive processing and internalisation. By conceptualising green knowledge as a mediating mechanism, the model highlights the potential role of awareness and understanding of health and environmental co-benefits in shaping behavioural outcomes. This perspective aligns with the core assumption of the S-O-R model, which posits that behavioural responses emerge through internal psychological processing rather than through direct stimulus–response relationships.

Overall, this paper contributes to the theoretical understanding of green exercise by integrating motivational, social, and cognitive mechanisms within a unified S-O-R structure. The proposed framework provides a conceptual basis for future empirical investigation and may inform subsequent research and intervention development related to green exercise as a sustainable health behaviour.

Core Theoretical Implications

This study offers several important theoretical contributions to the literature on green exercise, physical activity behaviour, and sustainability-oriented health research. First, it advances the application of the Stimulus–Organism–Response (S-O-R) framework by empirically conceptualising green knowledge as a central organismic mechanism that explains how psychological stimuli are translated into behavioural responses. While previous studies have often examined psychological predictors of physical activity in isolation, this study demonstrates that internal cognitive processing plays a crucial mediating role, thereby strengthening the explanatory depth of the S-O-R model in health-related contexts.

Second, the study contributes to theory integration by embedding constructs from the Theory of Planned Behaviour (TPB) and Self-Determination Theory (SDT) within the S-O-R framework. By positioning attitude, subjective norms, and perceived behavioural control alongside intrinsic motivation as stimuli, the model captures both controlled and autonomous motivational processes in a single explanatory structure. This integration extends existing behavioural theories by showing that motivation and social-cognitive factors do not operate independently but rather interact through cognitive mechanisms such as green knowledge to influence behaviour.

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Third, the findings enrich the green exercise and environmental behaviour literature by reframing green exercise as a cognitively mediated behaviour rather than a purely motivational or environmental one. The mediating role of green knowledge highlights that awareness and understanding of health–environment co-benefits are not peripheral variables but core theoretical mechanisms. This insight encourages future researchers to move beyond direct-effect models and adopt process-oriented frameworks when examining sustainable health behaviours.

Finally, the study provides a validated conceptual foundation for future empirical work. The S-O-R framework proposed here can be extended to other sustainability-related health behaviours, such as active transport, outdoor recreation, or nature-based wellness interventions, thereby offering a transferable theoretical model for interdisciplinary research.

Theory Integration Contribution

This conceptual paper contributes to theory integration by bringing together the Stimulus–Organism–Response (S-O-R) model with selected constructs from the Theory of Planned Behaviour (TPB) and Self-Determination Theory (SDT) within the context of sustainable green exercise. While TPB primarily emphasises social and cognitive determinants of behavioural intention, and SDT highlights intrinsic motivational processes, these perspectives have typically been discussed in parallel rather than within a unified explanatory structure. By situating these constructs within the S-O-R framework, the paper proposes a theoretically aligned structure that conceptualises how psychological stimuli may be cognitively processed before influencing behavioural responses.

Within this integration, green knowledge is positioned as the organism component, representing an internal cognitive mechanism through which motivational and social influences may be interpreted and internalised. This conceptual positioning shifts the focus from direct behavioural prediction toward a more process-oriented understanding of behavioural formation.

Through this theoretical alignment, the proposed framework offers a structured lens for interpreting green exercise behaviour as shaped by interconnected motivational, social, and cognitive dimensions. The integration remains conceptual in nature and is intended to provide a foundation for future empirical exploration and theoretical refinement within sustainability and health behaviour research.

Literature Advancement

This conceptual paper advances the literature on green exercise by offering a theoretically integrated perspective that connects sustainability, health behaviour, and environmental psychology within a unified Stimulus–Organism–Response (S-O-R) structure. Existing studies on green exercise have largely examined motivational, social, or environmental determinants in isolation (Calogiuri et al., 2020; Lahart et al., 2019). While these studies provide valuable insights, the relationships among psychological stimuli, cognitive processing, and behavioural engagement remain conceptually fragmented.

By organising these determinants within the S-O-R framework (Mehrabian & Russell, 1974; Su et al., 2021), this paper extends current discussions beyond direct behavioural prediction

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models such as the Theory of Planned Behaviour (Ajzen, 1991; Paul et al., 2021). It highlights the potential role of internal cognitive mechanisms, specifically green knowledge, in shaping behavioural outcomes. This perspective aligns with recent sustainability research emphasising the importance of cognitive awareness and environmental literacy in influencing pro-environmental behaviour (Gomes et al., 2022; Otto & Pensini, 2017).

Furthermore, integrating motivational constructs derived from Self-Determination Theory (Ryan & Deci, 2020) into the S-O-R structure broadens the conceptual scope of green exercise research. Rather than treating green exercise solely as a physical activity outcome, the framework situates it within a wider sustainability and behavioural process context. This integrative approach contributes to ongoing efforts to bridge environmental psychology and health promotion research (Zhang et al., 2022).

Practical Implications

In practice, the findings of this study can be implemented through structured green exercise activities that simultaneously address motivation, cognition, and behaviour in line with the Stimulus–Organism–Response (S-O-R) framework. One practical approach is the organisation of guided green exercise sessions, such as weekly walking or light jogging programmes in parks or campus green areas. These activities should be designed to be enjoyable and non-competitive in order to enhance intrinsic motivation and foster positive attitudes towards green exercise. During or after each session, facilitators can share brief, simple information about the health and environmental benefits of exercising in green spaces. This combination of physical activity and knowledge-sharing allows participants to cognitively internalise the value of green exercise, strengthening green knowledge as the organismic mechanism that supports continued participation.

Another practical implementation involves group-based or buddy-style green exercise activities, where participants exercise in pairs or small groups. Such activities leverage social interaction and peer encouragement, thereby strengthening subjective norms and creating a supportive environment that normalises green exercise behaviour. Through regular interaction, participants are more likely to exchange experiences and information related to nature, well-being, and sustainability, further enhancing green knowledge. As social support and shared understanding increase, individuals are more inclined to maintain regular participation in green exercise activities.

In addition, informational interventions embedded within green spaces can be implemented to reinforce cognitive processing during exercise. For example, posters, signboards, or QR codes placed along walking routes can provide short messages or infographics about the benefits of green exercise, environmental conservation, and mental well-being. Exposure to such information at the point of activity helps transform physical movement into a meaningful experience, reinforcing the cognitive link between green exercise and personal as well as environmental benefits.

Practical implementation should also focus on improving perceived behavioural control by ensuring that green exercise activities are accessible, safe, and easy to perform. This may include clearly marked walking paths, safe lighting, scheduled activity times, and introductory sessions that demonstrate simple exercises suitable for beginners. When individuals feel

confident and capable of engaging in green exercise, they are more likely to translate positive attitudes and motivation into actual behaviour.

Overall, these activity-based implementations demonstrate how green exercise promotion can move beyond awareness campaigns to become an experiential, knowledge-driven practice. By integrating enjoyable activities, social support, and contextual learning opportunities, organisations and communities can effectively enhance green knowledge and facilitate sustained green exercise participation, consistent with the S-O-R framework.

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