Validating a perceptual framework of physical eSports participation intentions

Chantel Muller[1,*], Anita Lennox[2]

[1]School of Management Sciences, North-West University, Vanderbijlpark, South Africa, Orcid: 0000-0002-8830-1080

[2]School of Management Sciences, North-West University, Vanderbijlpark, South Africa, Orcid: 0000-0002-0409-1478

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Abstract

The eSports market is expected to generate $1.87 billion in global revenue for 2023 and was recognised as an official Olympic-level sport in the same year. This market will likely expand even further given the rapid growth of physical eSports, which includes, among others, virtual cycling, dancing and taekwondo – electronic sports requiring physical bodily movement from the user to play a virtual game. Despite this imminent success, there is a dearth of research investigating this topic, specifically consumers' perceptions and behaviour. As a departure point, this study was the first to clarify the concept of physical eSports, provide insights into South African consumers' perceptions and validated a perceptual framework to predict adoption intentions. A descriptive research design and cross-sectional approach were followed, where a purposive non-probability sample was targeted. Data were collected via a computer-administered survey and the reported sample comprised 474 general South African adult consumers aged 18 to 56. Statistical analyses, executed using SPSS and AMOS V28, included descriptive statistics, significant tests, reliability and validity analyses and confirmatory factor analysis via a structural equation model. Academics, physical eSports software and equipment developers, resellers and marketing professionals can use this tool to understand consumers' perceptions and possibly predict future adoption behaviour based on awareness, permanence, facilitating conditions, attitude and participation intentions. Subsequent implications and recommendations were provided.

*Corresponding Author

[1*]Chantel.Muller@nwu.ac.za

[2] Anita.Lennox@nwu.ac.za

1. Introduction

This study forms part of a larger project that pioneers the concept of physical eSports. While many readers might be familiar with virtual reality games or exergames based on traditional sports, such as running, cycling, golf, tennis and dancing, among others, there is no official umbrella term as is the case with console-based eSports – the commonly known format of eSports (Filchenko, 2018). Given the expansion of eSports, which now includes virtual games necessitating the users' physical movement to play the game, it is essential to separate virtual physical play from controller/keyboard play behaviour – which this series of studies intends to do. With virtual cycling, among other formats, as a type of physical eSports already a sanctioned sport (Union Cycliste Internationale – UCI), fast becoming an Olympic sport (IOC, 2023), paired with the overall eSports market expected to generate an expected $1.87 billion in global revenue for 2023 (Gough, 2021b), this current study addressed a significant gap in the literature, namely access to a validated perceptual framework of physical eSports participation intentions for understanding and predicting consumers' behaviour in this context. Such a framework is vital for brands offering physical eSports products and services, those who aim to enter this new market, and explicitly enabling marketers to target consumers more effectively by clearly understanding their perceptions of this new form of eSports. While some sports consumption models are available (Cranmer *et al*., 2021; Trail, 2012), no framework is available to understand physical eSports perceptions internationally, nor for the South African context. A foundational behavioural-based framework is crucial for physical eSports game and software developers, equipment and connected technology manufacturers, resellers, marketing professionals and academics to understand consumers' behaviour in this context and provide them with a behavioural prediction tool to grow this market globally.

Guiding this investigation and the consequent layout of this paper is the overview of important concepts to provide context and the rationale for the study by stating the problem and objective, which is then supported by the subsequent discussion of the theoretical framework guiding the development of the framework with the factors justified for inclusion. The execution of the empirical portion is detailed in the methodology section, which contains the typical discussion points. After that, the findings from the statistical analysis are interpreted and a concluding modelled framework is presented, backed by subsequent implications and recommendations. The paper concludes with limitations and future research suggestions.

2. Literature overview

2.1 Study context

Electronic Sports defined and market overview

Electronic sports, or eSports in short, as it is well known worldwide, refers to any video game competition where players or teams compete under controlled conditions (Riatti & Thiel, 2021). Like any other sport, eSports draw spectators (Janas, 2019) to varying degrees across various platforms, such as digitally and in person. As the concept progressed, Sjöblom and Hamari (2017) provided an updated definition of eSports, which is "a form of sports where electronic systems facilitate the primary aspects of the activity; the input of players and teams, as well as the output of the eSports system, are mediated by human-computer interfaces". As this study's title suggests, eSports is seen as a digitised form of traditional sports where participants participate against other players in the virtual digital world (Gough, 2021a; Sjöblom & Hamari, 2017) while using cognitive abilities (Martin-Niedecken & Schättin, 2020). Console-based eSports are played using a mobile device, hand-held controllers, keyboards, mice, joysticks, steering wheels, and more advanced equipment like various simulators.

Categorising eSports can be complex due to the diverse range of games and gameplay experiences. Moreover, Cranmer *et al*. (2021) discern three scales in the categorisation of eSports, which include physical activity (passive-active), the role of technology (technology-driven-enhanced) and virtuality (physical-virtual environment). To contextualise the theme of this study, namely physical eSports, it is essential to refer to a foundational framework that categorises and describes the diverse types of eSports. Cranmer *et al*. (2021) developed a framework or matrix comprising four quadrants delineating four distinct types of eSports. These types include *digitisation* (depiction of commercial physical sports-FIFA eWorld Cup, NBA 2K League, F1 eSport Series); *competitive multiplayer computer games* (traditional/multiplayer game experience-Streetfighter, StarCraft II, League of Legends); *digitally enhanced sport* **(**adjust existing sport and player rules and setups through digital developments-basketball, football, F1); and *immersive reality sport* (new types of immersive eSports integrating VR technologies- Echo Combat, Space Junkies with the most prominent game, namely Fortnite).

ESports, as per the above depiction, is rapidly developing in South Africa, as seen by the predicted revenue generation probability of R8.2 million by 2023 (Gough, 2021b) compared to the global revenue expected of $1.87 billion (Gough, 2021b). This provides substantial business development and marketing opportunities for international, specifically South African entities, to enter this lucrative and fast-evolving market. Consequently, growing this market might lead to economic stimulation, job creation and enable South Africa to be recognised as a technologically innovative country regarding augmented, virtual, simulated and integrated technologies.

One of the driving factors behind this growth is the increasing interest and demand among consumers to be a part of global social communities that participate in various eSports games. Furthermore, the

growth of modern digital society has also played a significant role in fuelling the popularity of eSports. For that reason, eSports has become an Olympic-level sport by being internationally sanctioned through various committees and sporting bodies. That is, on June 23-25, 2023, the inaugural Olympic eSports series was held in Singapore. Types of eSports played at the event included console/mobile/pc-based eSports such as digital archery, sailing, baseball, chess, tennis, shooting, motorsport and physical eSports, namely virtual cycling and triathlon, dance and taekwondo. Although these ten sports are not the only eSports types being played worldwide, their representation at an Olympic level indicates that they are established sports with remarkable income potential.

Rocket League was the most popular event, with 22 334 viewers during this Olympic eSport series (Iyer, 2023). During this event, 130 players worldwide participated in ten final rounds before a winner was determined, with 20,000 tickets sold (Anon, 2023). Only three of the ten eSports categories, totalling five official sporting codes, namely virtual cycling, running and triathlon via Zwift, dancing via Just Dance and Taekwondo via Virtual Taekwondo, comply with the extent and definition proposed by this research project. However, the International Olympic Committee (IOC) (2023) terms this series as "a global virtual and simulated sports competition", where this study imparts a clear definition of physical eSports.

Clarifying the concept: physical eSports

The introduction of physical eSports, such as Just Dance, a Nintendo Wii-based game, in 2009 marked a significant development within the eSports industry. The player had to "mimic the motions of an on-screen dancer's choreography for a particular song" and use the Wii remote. A specially designed dance pad registered the players' moves and assessed the accuracy, whereafter, game-play accuracy points determined the result of the performance. This main physical eSport research project clearly distinguishes console-based from physical eSports; some exceptions must be noted. For one, although a console-based game, Just Dance emanates from an official traditional sport, that is, several styles of dance, the need for specific equipment to play and, most crucially, the physical bodily movement needed to play the game (Hernandez, 2010) and is therefore appropriately categorised as physical eSports. Being foundational work, and as mentioned, lacking a universal term and classification, this hybrid eSport is suggested to belong on the physical eSports continuum. Nonetheless, this eSport has progressed remarkably over the last twenty years, drawing millions worldwide players (Yin-Poole, 2011).

After five years, in 2014, the first virtual cycling and running game from Zwift Inc. with the same name (Zwift, 2015) was introduced. Various comparable running and cycling-based games followed with one of the most recent categories, Virtual Taekwondo, established in 2018 (Gordon, 2021). In contrast to console-based games, physical eSports combines full-body motion tracking and excursion tracking through specific sensors, virtual video games, and live interaction with other players using special devices (Von Bromley, 2022; Janas, 2019).

From the numerous definitions in the literature, this study describes physical eSports as "virtual video-based gaming, requiring participants to use full-body movements to compete in recreational and competitive virtual and digital environments integrated with an application/game and specialised equipment while simultaneously being able to track their progress and interact with other human participants worldwide." The purview of physical eSports is outlined in Figure 1 to avoid uncertainty.

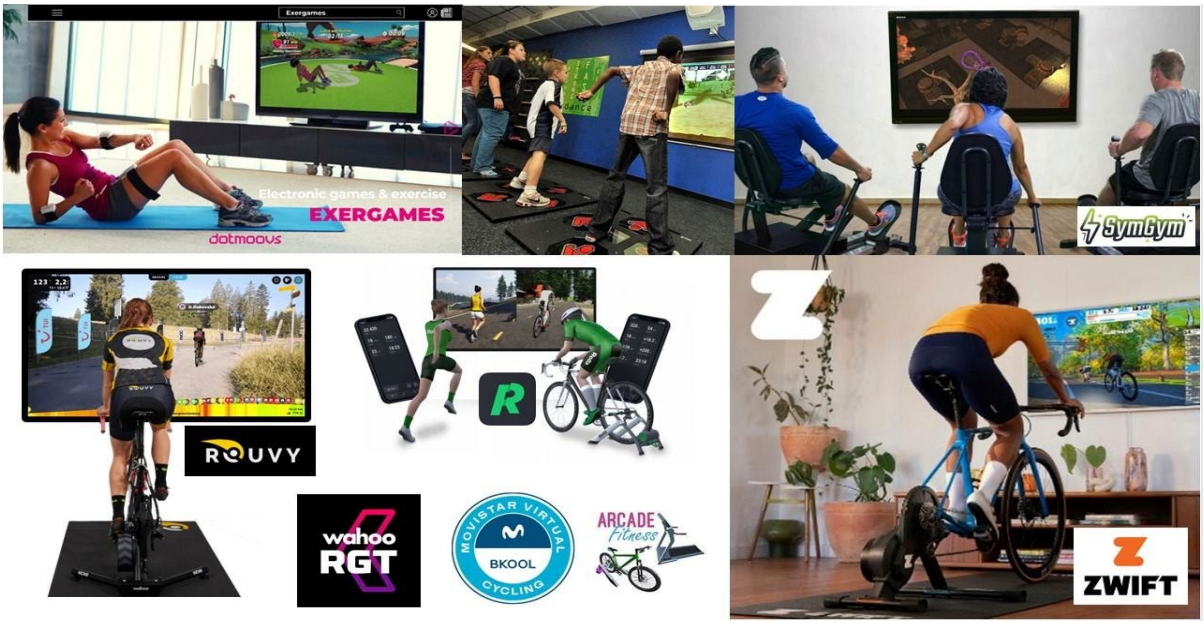

Figure 1. An illustration of physical eSports
Source: Authors' construction

This type of eSports stems from traditional sports and is essential for the user to physically move their body to play a virtual game based on famous sports codes. Players need additional equipment to take part in and view the results of their recorded activity or session. The level of physical eSports participation ranges from recreational/enjoyment purposes to training as a platform or for competitive reasons. Physical eSports include Exergaming, running apps like MyWoosh, Zwift, Wahoo RGT, Rolla World, Arcade Fitness and virtual marathon races, indoor cycling apps like Zwift, Rouvy, Wahoo RGT, BKool and Rolla World, and strength training solutions like SymGym. The sessions recorded by these apps can be synchronised to performance monitoring apps such as Strava or fitness tracker and smartwatch companion apps from brands such as Garmin, Fitbit, Polar, Samsung and Apple. It excludes at-home sports simulators like golf, baseball, and soccer, online or DVD-based at-home fitness programs and sports integrated with console or PC-based video game eSports like FIFA or Tiger Woods Golf, as it does not comply with physical eSports, as the definition and scope of this study.

Physical eSports are diverse, allowing players to interact socially and become part of global communities (Allenbey, 2022). Additionally, players can participate in structured training programmes (Hurley, 2023) that manage performance (Dunn, 2017). These characteristics are what make physical

eSport distinctive. The applications, games, and equipment utilised in this type of eSports further demonstrate the distinctiveness of physical eSports. Programs (applications) for indoor eSports training for cycling include Zwift, Wahoo X (Wahoo SYSTM and RGT), TrainerRoad, Rouvy, BKool, Kinomap, FulGaz, Kinetic Fit, Tacx Training, and Peloton (Von Bromley, 2022), for running includes Peloton, Zwift (Sayer *et al*., 2023), Arcade Fitness and RollaWorld, where full-body training games include SymGym (Esquada, 2016) and Exergaming (Benzing & Schmidt, 2018; Cataldo *et al*., 2019). Types of equipment used for indoor training and performance monitoring include bikes, smart trainers, treadmills, fitness mirrors, fitness and smart watches (Moscaritolo, 2022). Streaming live sessions and communicating with eSports social communities and clubs are essential to participating in physical eSports, and the top streaming and interaction platforms include Twitch, Discord and YouTube (Esports, 2023).

2.2 Problem Statement and research objective

Against the study's context, it is evident that there is a need to investigate the concept of physical eSports and grow this sporting format internationally and in South Africa. However, to achieve this, a perceptual and behaviour prediction framework is necessary to understand consumers' behaviour in this context – a framework specifically for physical eSports globally and particularly the South African context not available in the literature up to this point. This framework will assist the various physical eSports stakeholders understand the significance of brand awareness, perceived permanence, facilitating conditions, and attitude as contributors to South African consumers' physical eSports participation intentions. Access to the findings gives esports stakeholders a competitive advantage and the ability to adapt their marketing strategies for effective targeting. Owing to the traditional console-based eSport dominated by Generation Y consumers (VS Gaming, 2021), no evidence suggests which generation currently dominates the physical eSport market. To guide physical eSport brands, resellers and marketing professionals to segment and target the market for maximum market growth, it is essential to report on the appropriate age group. This study followed clear descriptions and inclusion criteria to report on the demographic profile.

Thus, the following research objective was addressed: validate a perceptual framework of physical eSports participation intentions by establishing the significance of perceived awareness, permanence, facilitating conditions and attitude.

3. Theoretical framework: extended theory of planned behaviour

The theory of planned behaviour suggests that consumer behaviour directly results from a person's intention to perform that particular behaviour and is determined by three conceptually independent variables: attitude, subjective norms and perceived behavioural control (Kim *et al*., 2013; Taylor & Todd, 1995). In the case of physical eSports games, equipment and the like, this suggests that a

consumer's attitude toward physical eSports, the normative influences they experience from significant individuals in their lives, and their perceived behavioural control over using the associated technology will ultimately determine their intent to participate in physical esports, which should predict their actual participation in future.

This theoretical framework has been investigated in various contexts but specifically in understanding wearable technology use (Muller & Bevan-Dye, 2023; Nam *et al*., 2017; Song *et al*., 2017; Zhu *et al*., 2017; Turhan, 2013), which is often used when playing physical eSports. Therefore, this theory was deemed suitable for this current study's purpose. It should be considered that since the concept of physical eSports is largely unknown and not yet played by most South African consumers, the social factor (subjective norms) does not form part of this foundational framework. Although two critical factors, awareness and permanence, were included based on their timely relevance, further factors should be added to this initial behavioural framework as the concept becomes mainstream. The five factors used to build this perceptual, physical eSports framework include awareness, permanence, facilitating conditions, attitude and behavioural intentions.

3.1 Awareness

Brand awareness can be characterised as the degree to which a consumer can remember and recognise a specific brand. This refers to the level at which a consumer has knowledge of a brand and can easily recall it when thinking about products in a specific category (Du Toit & Erdis, 2013). When consumers are aware of a brand, it becomes a part of their consideration set when purchasing decisions (Macdonald & Sharp, 2003). Besides its effect on purchases, brand awareness forms the basis of brand equity (Kotler & Keller, 2012) and is the foundation for all other links with the brand (Jooste *et al*., 2012). Moreover, brand placement is crucial in creating brand awareness among consumers. By strategically placing a brand, companies can ensure consumers see and hear about it frequently, leading to recognition and brand awareness (Keller, 2013). This means that when consumers evaluate different options, the brand they know is more likely to be included in their final choices.

Brand awareness plays a crucial role in consumer decision-making, increasing the likelihood of a brand being considered and ultimately chosen (Conradie *et al*., 2014; Huang & Sarigöllü, 2014). Furthermore, brand awareness significantly impacts market performance and a company's success. Brands with higher levels of awareness generally perform better in the market than brands with lower awareness. A better understanding of the brand and its offerings enhances brand recall and recognition, resulting in more favourable brand associations (Aaker, 1996). The most critical departure point is determining brand awareness's significance and statistical relevance in physical eSports. If a consumer is unaware of the games, equipment and ultimate benefits, these brands will not prosper in any market. Awareness of physical eSports will likely increase consumers' participation intentions and spending behaviours.

3.2 Permanence

Despite the dictionary definition of permanence, which relates to "the state or quality of lasting or remaining unchanged indefinitely", the term has a different meaning and interpretation in the context of this research area. That is, Lee *et al*. (2010) developed a 14-factor eSports consumption motives scale, which was subsequently validated by Lee and Schoenstedt (2011). These studies infer that permanence relates to participating or playing a game being readily available, convenient to play at any given time and for as long as the user wants. This notion is closely related to the "availability" factor reported on in works by Shin (2007; 2012) and Kim and Shin (2015), which is defined as "the degree to which users believe that their devices offer real-time connectedness to information and services (Shin, 2012), reflecting mobile technology's "anytime" -ness. Kim and Shin (2015) found that availability, referred to as permanence in this current study, has a significant indirect influence on consumers' attitudes and smartwatch adoption intention through its strong association with perceived ease of use. Shin (2007) found that permanence significantly influences consumers' mobile internet adoption, while Hattingh and Muller (2022) found that the availability of health features proved significant for smartwatch users. Preliminary eSports (console-based) research revealed no statistically significant link between permanence and US college students' eSports consumption (Lee & Schoenstedt, 2011). Given the inconsistent findings and the topic's novelty, investigating consumers' view of physical eSports permanence is vital.

3.3 Facilitating conditions

As a general principle, perceived behavioural control refers to a person's perception of whether it is easy or difficult to perform a particular behaviour (Ajzen, 1991) and is affected by both control beliefs and perceived facilitation. Mathieson (1991) indicates that a control belief refers to the perceived availability of skills, resources, and opportunities. In contrast, perceived facilitation refers to an individual's judgement of the importance of these resources to achieving an outcome, namely the behaviour, which can be accomplished using a specific technology. As part of the theory of planned behaviour, these factors that make up the perceived behaviour control variable are thought to be directly responsible for influencing consumers' behavioural intent and subsequent behaviour (Ajzen, 1991). This study focused on the latter part of this theory, namely whether certain facilitating conditions attract or detract from South African consumers' eSports participation intentions. Thus, it was necessary to determine respondents' belief that they have the necessary knowledge and resources to participate in physical eSports. It is proposed that this belief will influence their attitudes regarding physical eSports acceptance and their actual physical eSport intentions, in that positive perceived behavioural control will certainly facilitate participation.

3.4 Attitude

Attitude is a person's positive or negative feelings or predisposition about an object, individual or situation based on previous knowledge and beliefs (Kurniawan *et al*., 2019). Attitude rises from a set

of more specific, notable behavioural beliefs that reflect the perceived results associated with the targeted end behaviour (Kim *et al*., 2013), where, in consumer-related behaviour, a positive attitude could result in the purchase of a product, strengthening the likelihood of brand preference (Rahman *et al*., 2018). Venkatesh *et al*. (2003) indicates that attitude regarding using technology can be described as 'an individual's overall affective reaction to using a system', and for this study, it will be the participation or non-participation in physical eSport. Establishing South African consumers' attitudes towards physical eSports will provide the relevant stakeholders a departure point since attitude is a prelude to intention and subsequent behaviour.

3.5 Participation intentions

Behavioural intention refers to a consumer's readiness to perform a specific behaviour (Chan & Bishop, 2013) and is based on the person's positive value of performing the end behaviour (Ajzen, 1991). It is theorised that the stronger the consumers' intent to execute the behaviour, the more likely its actual performance will transpire. In the context of this study, the stronger a participant's intent to engage with physical eSports, the more likely they will participate and acquire the equipment needed. Behavioural intentions as per the TPB will be contextualised to participation intentions, which suggest that participants may adopt and engage in physical eSports derived from their intent, which links with this study's purpose – validating a behaviour prediction model.

4. Research Methodology

4.1 Research design, sampling method, and data collection

This study used a descriptive research design and a cross-sectional approach. The target population consisted of adult consumers aged 18 to 56 years in 2022 residing in South Africa. A generational cohort was defined by Markert (2004) using the age groups 18-36 and 37-56, representing Generation Y and Generation X, respectively. Being a quantitative study, data were collected from 500 general South African consumers at the end of 2022 by implementing a computer-administered survey. The online survey was distributed using a reputable South African research company with access to thousands of panel members who adhere to ethical standards and POPI Act regulations to ensure a 100 percent response rate. Furthermore, it was considered that the responses might be biased because the research company awards participants with points that can be redeemed for vouchers. Despite this, no prior evidence of biased responses using this company was reported.

As per purposive sampling, quotas were set before distribution to ensure data collection from a specific target population. In addition, these quotas, particularly the equal gender, cohort and age distribution, were crucial to restrict the skewness of the results and the possible distortion of an average physical eSports participant. To report a profile of South African physical eSports participants, the country of domicile was a strict requisite where this study targeted adult participants within the two stated

generations.

The following quotas were relevant when the online questionnaire was compiled:

- 500 responses
- 50 percent gender distribution [male: female]
- Representation from Generation Y [18-36] and Generation X [37-56]
- Respondents had to be aged 18 to 56 years in 2022
- Respondents had to be South African nationals domiciled in the country at the time of the survey

Due to these criteria, no data beyond the study's target population were gathered. The data were sent back to the researchers in the form of data files directly after the quota of 500 was reached. The turnabout time was three days, which is one reason for using this research company.

4.2 Research instrument

The electronic research instrument used in this study consisted of four sections, the first being the cover page that included the study's information, a precise definition, and graphical depictions of physical eSports and types to clarify the scope of the research. The second section sought demographic information, including gender, age, province of residence, highest qualification, and individual monthly income before tax. The third section was aimed at understanding respondents' background in terms of traditional sport, but more purposely, physical eSports-related questions and the perceived barriers associated with participating in physical eSports. The last section included the scaled-response items from previously validated and published research. These scales included the six-item awareness scale adapted from Yoo *et al*. (2000); the three-item permanence scale adapted from Lee and Schoenstedt (2011); the four-item facilitating conditions scale adapted from Venkatesh *et al*. (2012); and the four-item attitude and four-item intentions scale, both adapted from Kim and Shin (2015) and Venkatesh *et al*. (2003). The responses to these 21 scaled items, as outlined in Table 5, were measured on a six-point Likert-type scale (1=strongly disagree to agree 6=strongly).

4.3 Data analysis

Data analysis procedures, using Version 28 of IBM's Statistical Package for Social Sciences (SPSS) comprised a Mahala Nobis Distance Test to eliminate outliers (Tabachnick & Fidell, 2013), frequency analysis to display the sample profile and background information, principal components analysis (EFA) to determine data factorability and variance explained, Cronbach alpha calculation to establish the factors' internal-consistency and composite reliability, descriptive statistics and a one-sample t-test to determine data significance, Pearson's product-moment correlation analysis and collinearity diagnostics for nomological validity analysis. IBM's Analysis of Moment Structures (AMOS) Version 28.0 was then used to perform confirmatory factor analysis (CFA) using the maximum likelihood method, internal-consistency and composite reliability analysis, convergent and discriminant validity analyses, and model fit assessment to validate the final framework. The covariance-based (CB-SEM)

approach, as the dominant multi-variant technique (Hair *et al*., 2019), was deemed appropriate for this study.

The level of statistical significance was set at $p < 0.01$ and $p < 0.05$ where appropriate, and since these items were measured on a six-point scale, the one-sample t-test test value was set at 3.5.

4.4 Ethical considerations

This study adhered to stringent ethical considerations. First, before distributing the survey, ethical clearance was obtained from the institution's Faculty of Economic and Management Sciences Research Ethics Committee (EMS-REC), ethics number NWU - 01879-22-A4. Furthermore, the cover page concluded with an informed consent statement, emphasising that this was a minimal-risk study based on voluntary participation and that respondents could withdraw at any point without penalty. The respondents acknowledged the information and were advised that the results would only be reported in aggregate form. The data for this project is stored in an encrypted Microsoft OneDrive folder, and only the four-member team has access to the files.

5. Results and Discussion

With the quota set at 500 responses, a 100 percent response rate was achieved. Although, after performing a Mahala Nobis distance test (Tabachnick & Fidell, 2013), 26 outliers had to be removed, resulting in a 94.8 percent success rate. Furthermore, given the novelty of the concept of physical eSports at the time of data collection, various efforts were put in place to mitigate possible misunderstandings of the topic. This included a detailed definition of physical eSports and the graphical depiction shown in Figure 1. However, it is possible that some respondents misinterpreted it with console-based eSports. That is, after reviewing the responses, three categories of eSports participants emerged: physical eSports participants (24.9%), console-based eSports players (11.4%) and non-users (63.7%). As a result, it is most appropriate that a perceptual framework is validated that considers the views of all types of eSports consumers, which lends itself to careful interpretation by the reader.

Furthermore, some considerations when interpreting the results are as follows. The cohorts were reported as per the definitions by Markert (2004). While the respondents had to indicate their age at their last birthday, this study reports the results as they align with the cohort definitions, whereby 18-26 and 27-36 represent the two upper and lower portions of the Generation Y cohort, respectively and 37-46 and 47-56 the same, conversely for Generation X. The income brackets were derived from a South African study (Maphupha, 2018) that outlined the nation's income classes and the coinciding annual income of residents. This study divided these annual income values by 12 and requested respondents indicate their gross monthly income. Table 1 outlines the total study sample's profile.

Table 1: Study sample profile

Variable	Response	Frequency (*f*)	Percentage (%)
Cohort	Gen Y	289	61
	Gen X	185	39
Age	18-26	120	25.3
	27-36	169	35.7
	37-46	137	28.9
	47-56	48	10.1
Gender	Male	235	49.6
	Female	238	50.2
	Other	1	0.2
Province	E-Cape	27	5.7
	Free State	15	3.2
	Gauteng	226	47.7
	KZN	71	15
	Limpopo	24	5.1
	Mpumalanga	21	4.4
	N-Cape	7	1.5
	North-West	10	2.1
	W-Cape	73	15.4
Qualification [a]	<Grade 12	126	26.6
	Certif./Dipl.	138	29.1
	U-degree	122	25.7
	P-degree	85	17.9
	MBA	3	0.6
Income [b]	R0-4500	78	16.5
	R4501-12500	122	25.7
	R12501-30000	158	33.3
	R30001-52500	72	15.2
	R52501-72000	22	4.6
	R72001-110000	7	1.5
	R110001+	15	3.2
Subscription spend [c]	R0	51	10.8
	R1-100	144	30.4
	R101-300	180	38
	R301-R500	71	15
	R500+	28	5.9

Notes for the table:
n=474
[a] Qualification – highest | undergraduate and postgraduate degrees
[b] Income – monthly before tax (gross)
[c] Subscription spend – willing to spend on a monthly esports subscription

For the total sample, an almost equal gender distribution was achieved, with slightly more female (50.2%) than male (49.6%) respondents. As for cohort and age, 61 percent of respondents represented the Generation Y cohort (25.3% aged 18-26 | 35.7% aged 27-36). Generation X was represented by 39 percent of the sample (28.9% aged 37-46 | 10.1% aged 47-56). Moreover, most respondents resided in the Gauteng province (47.7%), followed by Western Cape (15.4%) and KwaZulu-Natal (15%). The other 21.9 percent of the respondents represented the Eastern Cape (5.7%), Limpopo (5.1%),

Mpumalanga (4.4%), Free State (3.2%), North-West (2.1%) and the Northern-Cape (1.5%). The reason for most respondents residing in the Gauteng province might be due to the province being the most densely populated of the other eight (Statistics SA, 2022).

Contrary to the national average, where only seven percent of South African adults are reported to have a tertiary education (Organisation for Economic Co-operation and Development (OECD), 2019), 44.2 percent of this study's sample had obtained an undergraduate degree (25.7%), a post-graduate degree (17.9%) and an MBA (0.6%). However, most of this study's sample had a certificate or diploma (29.1%), and 26.6 percent did not complete Grade 12. Regarding income classes, a third of the respondents (33.3%) earned a gross income between R12,001 and R30,000 per month. This aligns with a South African employee's average monthly salary, which in 2023 stood at R26,032 (Business Tech, 2023). A total of 25.7 percent of respondents earned between R4,501 and R12,500, 16.5 percent between R0 and R4,500 and 15.2 percent between R30,001 and R52,500. The remaining 9.3 percent of the sample earned between R52,501 and R72,00 (4.6%), R72,001 and R110,000 (1.5%) and more than R110,001 (3.2%).

The amount of money the respondents were willing to spend on a monthly subscription to access physical eSports games is somewhat related to their income level. That is, 42.2 percent of respondents earned between R0-R12,500, and 41.2 percent were willing to spend only between R0-R100 monthly. The logical explanation could be that these consumers have less disposable income and must prioritise other expenses. A promising finding for physical eSports- game developers specifically is that 58.9 percent of the respondents were willing to spend between R101-R300 (38%), R301-R500 (15%) and more than R500 (5.9%) on a monthly subscription.

The second section of the questionnaire dealt with obtaining physical eSports-related background information. Since the responses are only relevant to the verified physical eSports (p-eSp) participants. To understand the current South African physical eSports market, this study asked respondents who confirmed their physical eSports participation to respond to specific background questions. This necessitates isolating 118 or 24.9 percent of the sample, as outlined in Table 2.

There are two main reasons for participating in physical eSports, namely for recreational purposes, which include simply playing the game, socialising, staying healthy or completing a structured training program, or competing against other participants in structured events such as e-racing. Of the 118 respondents, 108 or 91.5 percent of South African participants do so for recreational purposes, whereas only 20 or 16.9 percent, actively compete in e-racing. Targeting South Africans by emphasising that physical eSports games have several recreational benefits might increase their participation intentions. Per the definition of physical eSports, participants must use their bodies to play a game. As such, respondents had to indicate the type of eSport game they played, where they could indicate all applicable types, meaning for some, there were multiple types. From the data, 22 or 18.6 of the respondents

participated in full-body games, 53 or 44.9 percent in indoor cycling games and 60 or 50.8 percent in indoor running games.

Table 2: Physical esports participants' background information

Variable	Response	Frequency (*f*)	Percentage (%)
Reason [a]	Recreation	108	91.5
	Competitive	20	16.9
eSport-type [b]	Full body	22	18.6
	Indoor cycling	53	44.9
	Indoor running	60	50.8
Application/Game [c]	Arcade Fitness	6	5.1
	Exergaming	3	2.5
	Peloton	1	0.8
	SymGym	4	3.4
	Rouvy	1	0.8
	Zwift	46	39
	Not specified/other	57	48.3
Platform [d]	Mobile	54	45.8
	Tablet	16	13.6
	PC/Laptop	45	38.1
	Smart TV	61	51.7
Equipment	Bike-related	24	20.3
	Bike trainer	30	25.4
	Foot pod	24	20.3
	Treadmill	60	50.8
	Other	5	4.2
Period [e]	A week-month	26	22
	3-6 months	33	28
	6 months – 1 year	27	22.9
	1-2 years	17	14.4
	2 years +	9	7.6
	Missing	6	5.1

Notes for the table:
n=118
[a] Reason for participation | The responses overlap since some participants had dual motives for participating.
[B] eSport-type – since respondents were not limited to one response, it is likely that some participate in more than one type of eSport
[c] Application or game – respondent had to select their primary preference
[d] Platform – respondents could select all applicable platforms, and overlaps are likely
[e] Period pertains to how long respondents have been participating in physical eSports

Knowing which applications or games respondents use will enable pointed industry recommendations. A limitation of the findings presented is that 48.3 percent of the respondents did not specify the application or game they used, or others were identified. Further, besides the findings of this study showing slightly higher participation in indoor running (50.8%) as opposed to indoor cycling (44.9%), the latter is the globally preferred eSports type. Additionally, the most popular indoor cycling application is Zwift (Von Bromley, 2022), and this is reflected by this study's eSports sample, with a recorded 39 percent being Zwift users. As one of the longest-standing physical eSports games, the Zwift

app went commercial at the end of 2014 or early 2015 (Zwift, 2015) and has since reached a market value above $1 billion (Christovich, 2023). This game alone had a reported 3 million users worldwide in 2021 (Reed, 2021), and the opportunity should be taken to target and increase user rates among South African consumers. Better yet, South African software developers are challenged to develop their own apps and games.

Reporting the platforms used in physical eSports is vital since game and application developers can optimise the games for these platforms. For example, an app should work seamlessly on smart TVs, more so on Tablets, ensuring improved accessibility to these games and apps. The most preferred platforms were smart TVs (51.7%), followed by mobile devices such as smartphones (45.8%), personal computers or laptops (38.1%) and tablet devices (13.6%). As such, apps and games must be optimised primarily for smart TVs and mobile devices while ensuring high functionality on personal computers/laptops. Similarly, game and app developers, specifically eSports equipment manufacturers, can benefit significantly if they have data reporting the equipment used by physical eSports participants. There was 24 or 20.3 percent of the 118 cases that used bike-related equipment, including speed and cadence sensors attached to a bicycle that serves as the input to control the game. Dedicated bike trainers, whether dumb or smart trainers, were used by 30 or 25.4 percent of the respondents. As for indoor running apps or games, 24 or 20.3 percent used a foot pod and whether in collaboration with or independently, 60 or 50.8 percent used a treadmill. These findings align with the eSports types identified. However, future research should include smart wearables, including activity trackers as input sensors to control these apps and games. Lastly, this study aimed to determine how long respondents had participated in physical eSports. The findings affirm that physical eSports is a new concept among South African consumers, where only 53 had been engaging with these apps and games for more than six months and 59 between a week and six months.

Tables 1 and 2 provide context for the five-factor perceptual framework, whereas Table 3 shows the results of the exploratory factor and descriptive statistical analysis combined with a one-sample t-test.

Table 3: EFA, descriptive statistics and one-sample t-test results

	EFA		Descriptive statistics			
Latent factors	**Loadings**	**Communalities**	**Mean**	**Std. dev.**	**t-value**	***p***
Awareness	0.716 - 0.806	0.687 - 0.780	4.656	± 1.006	25.021	0.001
Permanence	0.718 - 0.851	0.757 - 0.849	4.974	± 0.836	38.427	0.001
Facilitating conditions	0.667 - 0.776	0.719 - 0.744	4.346	± 1.049	17.564	0.001
Attitude	0.675 - 0.771	0.746 - 0.786	5.019	± 0.873	39.491	0.001
Participation intentions	0.669 - 0.796	0.796 - 0.844	4.905	± 0.981	31.165	0.001

For this framework to have scientific rigour, several statistical analysis techniques were employed to assess the data, starting with principal components analysis to ensure the factorability of the items. From the initial results, five factors were extracted, explaining 72.10 percent of the variance. However, it was concluded that four items had to be removed due to not loading on the correct factor, thereby ensuring

construct and discriminant validity of the remaining items in the affected constructs (awareness, facilitating conditions and permanence).

The removed items are indicated in Table 5 and were likely a result of the physical eSports concept being mainly unfamiliar to the respondents, who could not clearly state their agreement or disagreement with the statements about the broader factor. As such, principal components analysis, using the varimax rotation, was performed on the 17 remaining items again, from which five latent factors were extracted. The Kaiser-Meyer-Olkin (KMO) test and Bartlett's sphericity test returned satisfactory values [KMO = 0.950, chi-square Bartlett test = 5753.755 (df = 136), p = 0.000]. The resulting five factors explain 77.51 percent (an increase of 5.4%) of the total variance in physical eSports participation intentions. The factor loading and communality values are outlined in Table 3 and range between 0.667 to 0.851 and 0.687 to 0.849, respectively. Furthermore, the five factors were deemed valid, and subsequent tests were executed, including descriptive statistical analysis and a one-sample t-test. For a one-sample t-test to be confirmed to be statistically significant, the factor mean value must surpass the pre-set value of 3.5 with a p-value smaller than 0.01.

As per Table 3, all five factors measured on a six-point Likert scale recorded statistically significant ($p < 0.01$) mean values above 3.5. Promising for the diffusion of physical eSports is that, at a minimum, South African consumers showed an elevated level of awareness of this type of sport (4.656 ± 1.006). However, the relevant stakeholders must ensure this awareness level increases. Furthermore, the sample associated physical eSports with a high level of permanence (4.974 ± 0.836), meaning that they feel this eSports format is readily available. The more positive findings are that South African consumers, albeit the sample, have an overwhelmingly positive attitude towards physical eSports, with the highest mean score recorded (5.019 ± 0.873) and have a high likelihood of participating in this sport in the future (4.905 ± 0.981). The lowest mean score was recorded for the facilitating conditions factor (4.346 ± 1.049), suggesting South African consumers did not have the required resources (finances, equipment, device, internet), knowledge and compatible technologies to participate in physical eSports. This finding is not surprising and aligns with expectations given the novelty of the sport and its relevant devices, games, equipment, and the like needed to play. Nonetheless, all five factors are statistically significant, enabling the following analysis to be reported.

Screening for multicollinearity issues using collinearity diagnostics was executed to ensure the latent factors do not display excessively high correlation among the rest, as this would have negative implications for the remainder of the data analysis and reporting (Hair *et al*., 2019). This analysis calculated the tolerance values (TV) and the variance inflation factors (VIF) to ensure that the latent factors are unique and independent. Tolerance values above 0.10 and average VIF below ten are required to confirm the absence of multicollinearity issues in the dataset (Pallant, 2020). After that, a matrix of Pearson's Product-Moment correlation coefficients was generated to assert the nomological validity of the data, which requires, according to Hair *et al*. (2019), the presence of statistically

significant relationships in the theoretically correct direction between the sets of latent factors to be included in the framework. The findings are presented in Table 4.

Table 4: Bivariate correlation analysis and collinearity diagnostic results

Latent factors	AW	PERM	FC	ATT	TV	VIF
Awareness (AW)					0.473	2.115
Permanence (PERM)	0.493*				0.575	1.738
Facilitating conditions (FC)	0.677*	0.530*			0.501	1.996
Attitude (ATT)	0.631*	0.626*	0.602*		0.310	3.224
Participation intentions (PI)	0.605*	0.569*	0.668*	0.788*	0.327	3.055
*Significant at $p < 0.01$						

Table 4 concludes the nomological validity of the latent factors as there were statistically significant (p <0.01) positive relationships recorded between all the pairs of latent factors planned for inclusion in the perceptual framework of physical eSport participation. The relationships between the five latent factors range between r= 0.493-0.788, which constitute these relationships being moderately strong (± 0.41-0.60) to strong (± 0.61-0.80) (Hair *et al*., 2019). Furthermore, the calculated tolerance values range between 0.327 and 0.575 and an average VIF of 2.426, thus confirming the absence of 2.426 multicollinearity issues.

The scientific rigour of the data had been established up to this point, thereby justifying the execution of confirmatory factor analysis using drafting a measurement model. The maximum likelihood method was selected, and a five-factor model containing the 17 items was specified for testing. The first loading on each of the five latent factors was fixed at 1.0, resulting in 170 distinct sample moments and 61 distinct parameters to be estimated, equating to 109 degrees of freedom (df) based on an overestimated model and a chi-square value of 274.467, with a probability level equalling 0.000. While the chi-square statistic forms the basis for most other goodness-of-fit indices in a model (Hair *et al*., 2019), a statistically significant chi-square value would be indicative of poor model fit since this statistic is sensitive to sample size and the number of observed variables (Malhotra *et al*., 2012). As such, other model fit indices were calculated and reported to confirm model fit.

The model fit indices that were calculated to validate the model for this study consisted of the goodness-of-fit index (GFI), the incremental-fit index (IFI), the Tucker-Lewis index (TLI), the standardised root mean square residual (SRMR) and the root mean square error of approximation (RMSEA). According to Hair *et al*. (2019), GFI, IFI and TLI values above 0.90 and SRMR and RMSEA values below 0.08 indicate acceptable model fit. Convergent validity is established with latent factor loading estimates and average variance extracted (AVE) values of 0.50 or higher, whilst discriminant validity necessitates that the square root of the AVE values exceeds the correlation estimates between the relevant latent factors (Hair *et al*., 2019) and the heterotrait-monotrait ratio of correlations (HTMT) values be significantly smaller than 1 (Henseler *et al*., 2016). Reliability was tested using Cronbach's alpha (a) and composite

reliability (CR), where values of 0.70 and above are indicative of acceptable reliability (Malhotra *et al*., 2012). The validity and reliability were computed using an AMOS plugin developed by Gaskin *et al*. (2023). The level of statistical significance was set at $p < 0.01$ throughout.

Table 5 outlines the latent factors and items for each of the five factors, the coinciding code in the modelled framework (Figure 2), the standardised regression weights, the error variance terms (squared multiple correlations), the Cronbach alpha, composite reliability, AVE, the square root of the AVE values and the relationships between each of the latent factors.

The modelled framework shown in Figure 2 can conclusively be validated according to the measurement model (CFA) findings. That is, the model fit indices met the required thresholds, where the GFI = 0.938, NFI = 0.953, IFI = 0.971, TLI = 0.964, CFI = 0.971, SRMR = 0.031, RMSEA = 0.057 were computed. The framework was also confirmed to be highly reliable, with an overall Cronbach alpha value of 0.946 and alpha and CR values ranging between 0.74-0.93, exceeding the suggested 0.70 (Malhotra *et al*., 2012). As for validity, convergent validity was concluded since all factor loadings and AVE values were above the required 0.50 threshold. This framework's discriminant validity was scrutinised in terms of two suggested criteria. First, the AVE squared was required to exceed the correlation estimates between the relevant factors. In this regard, Table 5 shows that the square root for ATT and FC is lower than the correlation with participation intentions and awareness, respectively. Consequently, to confirm the discriminant validity of the framework, authors (Henseler *et al*., 2015; Henseler *et al*., 2016) suggest that the HTMT ratios can be computed as an alternative measure to confirm the discriminant validity. The HTMT values are outlined in Table 6.

Table 5: Estimates for the measurement model

Latent factors & items	**Code**	**SE**	**Err. var.**	**α**	**CR**	**AVE**	**√AVE**
Awareness (AW) **Yoo *et al.* (2000:203)**				0.89	0.88	0.65	0.80
"I know what physical eSports look like."	eSp_AW_1	0.803	0.645				
"I can recognise physical eSports among other video game-based eSports."	eSp_AW_2	0.828	0.685				
"I am aware of physical eSports."	eSp_AW_3	0.819	0.671				
"Some characteristics of physical eSports come to my mind quickly."	eSp_AW_4	0.763	0.582				
"I can quickly recall the symbol or logo of physical eSports games/apps."	*eSp_AW_5*						
"I have difficulty imagining physical eSports in my mind."	*eSp_AW_6*						
Permanence (PERM) **Lee & Schoenstedt (2011:42)**				0.74	0.74	0.59	0.77
"I think physical eSports are readily available."	*eSp_Perm_1*						
"I think physical eSports can be played at your convenience (any time of day)."	eSp_Perm_2	0.815	0.664				
"I think you can play physical eSports for as long as you want."	eSp_Perm_3	0.717	0.515				
Facilitating conditions (FC) **Venkatesh *et al.* (2012:178)**				0.80	0.80	*0.57*	*0.76*
"I have the resources (finances, equipment, device, internet) necessary to participate in physical eSports."	eSp_FCon_1	0.724	0.524				
"I have the knowledge necessary to participate in physical eSports."	eSp_FCon_2	0.828	0.686				
"Physical eSports games/apps are compatible with other technologies I use."	eSp_FCon_3	0.712	0.506				
"I can get help from others when I have difficulties using physical eSports games/apps."	*eSp_FCon_4*						
Attitude (ATT) **Kim & Shin (2015:553) Venkatesh *et al.* (2003:460)**				0.90	0.90	*0.69*	*0.83*
"Participating in physical eSports is a good idea."	eSp_ATT_1	0.804	0.646				
"I have a positive attitude towards physical eSports in general."	eSp_ATT_2	0.865	0.747				
"I like the idea of participating in physical eSports."	eSp_ATT_3	0.857	0.734				
"Overall, I think participating in physical eSports is beneficial."	eSp_ATT_4	0.792	0.628				
Participation intention (UI) **Kim & Shin (2015:553) Venkatesh *et al.* (2003:460)**				0.93	0.93	0.76	0.97
"I would like to participate in physical eSports in the near future."	eSp_INT_1	0.861	0.741				
"I intend to participate in physical eSports in the near future."	eSp_INT_2	0.883	0.779				
"I predict I will participate in physical eSports in the near future."	eSp_INT_3	0.868	0.753				
"I plan to use physical eSports equipment and games in the near future."	eSp_INT_4	0.884	0.781				
**Items removed | SE: Standardised regression weights*							
Correlations: p<0.001	AW ↔ ATT: 0.709; AW ↔ PI: 0.668; AW ↔ FC: *0.773*; AW ↔ PERM: 0.611; FC ↔ PERM: 0.624						
	ATT ↔ PI: *0.865*; ATT ↔ FC: 0.665; ATT ↔ PERM: 0.763; PI ↔ FC: 0.716; PI ↔ PERM: 0.687						

Table 6: HTMT values of the measurement model

Factors	AW	PERM	FC	ATT
AW				
PERM	0.494			
FC	0.643	0.480		
ATT	0.631	0.627	0.556	
PI	0.606	0.571	0.617	0.788

Accordingly, all HTMT ratios fell significantly below 1, ranging between 0.494 and 0.788; thus, discriminant validity can be concluded (Henseler *et al*., 2016). With the model fit, reliability and validity of the measurement model confirmed, Figure 2 illustrates the validated perceptual framework of physical eSports participation within the South African context.

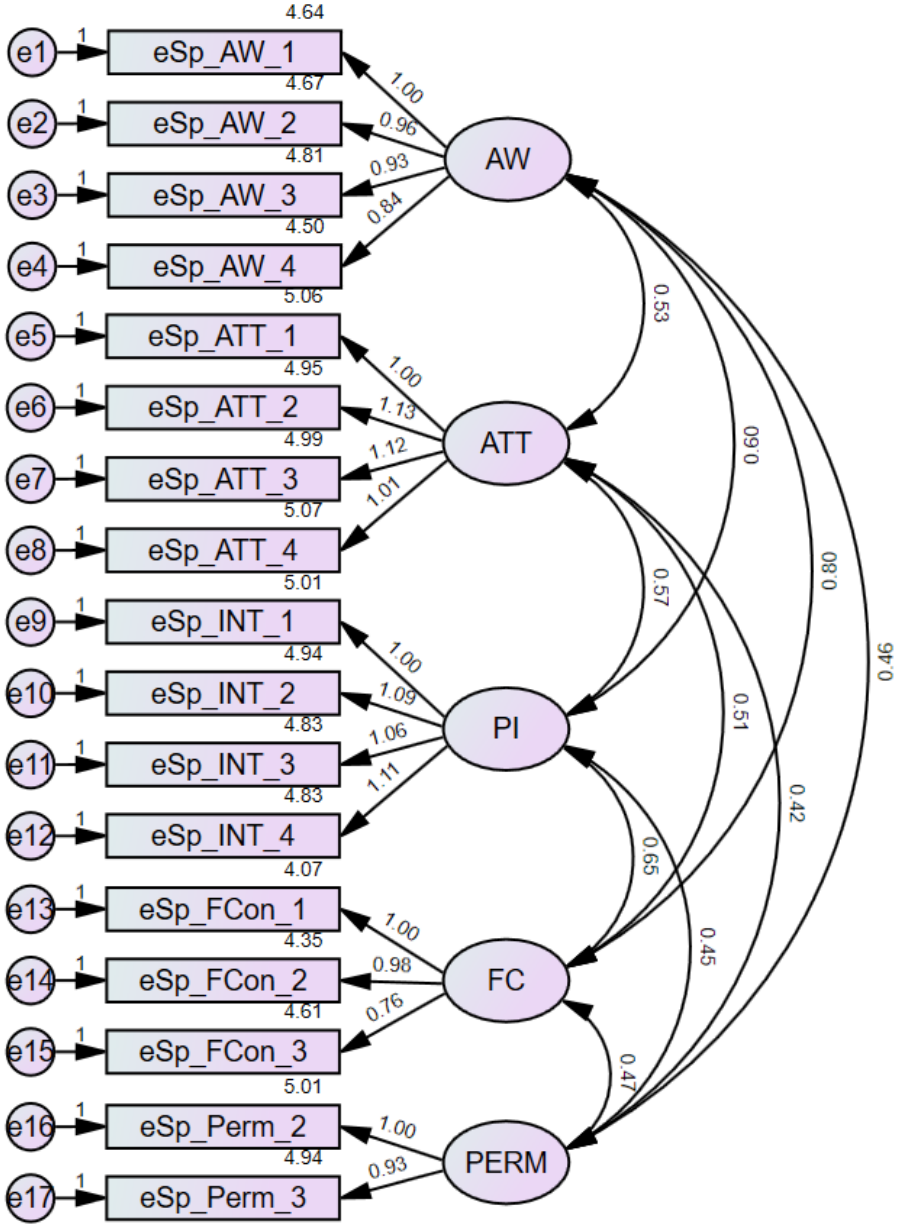

Figure 2: Perceptual modelled framework of physical eSports participation
Source: Authors' construction from AMOS.

6. Implications

6.1. Theoretical implications

This study was the first to validate a perceptual framework of physical eSports participation intentions, comprising five specific factors: awareness, permanence, facilitating conditions, attitude and participation intentions. This framework, though validated in the South African context, can nonetheless be applied to an international context, given the applicability of the five variables. Moreover, this framework provides a solid foundation for future expansion and inclusion of other important factors to understand consumers' perceptions of and predict their behaviour relating to the new format of electronic sports, namely physical eSports.

6.2. Practical and managerial implications

As part of the process to validate the perceptual framework in this study, the investigation simultaneously revealed pointed findings that need to be addressed by various stakeholders. In sum, South African consumers are somewhat aware of physical eSports, assuming the respondents did not misinterpret the concept of console-based eSports. Further, consumers strongly agree that physical eSports can be played at the user's convenience for as long as they want, which positively relates to their attitude and participation intentions of this electronic sport. Physical eSports stakeholders can be confident that, although this form of eSports is still in its infancy as a mainstream sport globally, South Africans have an overwhelmingly positive attitude towards and intend to participate in physical eSports soon. The caveat to the prior findings is that South African consumers, albeit the sample, did not seem to have the required resources (finances, equipment, device, internet), knowledge and compatible technologies to participate in physical eSports.

In accordance, the following recommendations are proposed to eSports brands, software and equipment developers, resellers and marketing professionals who, to their benefit, can target consumers effectively:

1. These stakeholders must improve awareness of their games and equipment on a larger, nationwide scale, not only targeting existing amateur or professional athletes. Consumers can be targeted with uniquely designed ads on activity tracking applications such as Strava and Endomondo, free-to-stream platforms such as YouTube and social media sites including the various popular social media sites.
2. Awareness, permanence, attitude and participation intentions can be increased significantly and facilitating conditions (i.e., access to resources) mitigated if the most frequented health centres, including gymnasiums, partner with physical eSports game and equipment developers, to either replace the conventional equipment (i.e., spinning bikes and treadmills) with smart bike trainers and treadmills or to integrate their games with the centres' existing infrastructure. This could be a mutually beneficial partnership, increasing memberships due to the gamified exercise experience and increased physical eSports participation. The ultimate achievement would be to establish open-access facilities for any member of the public to enjoy.

3. These stakeholders, specifically marketers, should emphasise the benefits of physical eSports and follow the same advertising and exposure channels mentioned under points 1 and 2. With the benefits emphasised, perhaps more consumers will be willing to spend a premium on a monthly subscription.

4. Physical eSports stakeholders should partner with professional athletes who have a presence in these eSports games, where local consumers can be targeted by South Africa's James Barnes and Ashleigh Moolman Pasio, the former who represented the country at the inaugural Olympic eSports series in June 2023 (IOC, 2023), and the latter taking the 2020 female UCI Zwift eSports World Championship title. These two athletes are prime ambassadors and influencers of this type of sport.

These recommendations provide a sound departure point in increasing physical eSports participation in the country and beyond.

7. Conclusions, Limitations and Future Research

The validated eSports participation framework produced in this study provides a valuable departure point for future research by adding additional variables that can be contextualised for other countries. Common limitations experienced in this study were the small sample size, not having qualitative feedback, the use of non-probability sampling, and, more notably, the possible response errors made given the respondents' unfamiliarity with the concept of physical eSports and the possible misinterpretation with console-based eSports. Instead, Data should be collected from existing players; the questionnaire brief should include video material or be done in person. Nonetheless, this area of research should receive and gain attention in the next few years internationally.

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