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A Multi-Aspect Assessment of Experiences of People Engaging in Recreational Physical Activity in Real Life as well as Immersive and Non-Immersive VR

Abstract. The aim of the article is to identify — taking into account several dimensions described in the literature — experiences of people undertaking recreational physical activity (PA) in the form of cycling in natural conditions and riding a stationary bicycle in three settings: without any visualisations, in non-immersive visual reality (nIVR) and IVR. The empirical assessment of such experiences was carried out on a sample of 40 students, using a research questionnaire developed by the authors. Results of Friedman's analysis of variance indicate that the conditions of cycling significantly affect cyclists' experiences in the following systems: internal/external ($\chi^2 = 61.42(40;3)$; $p < 0.001$), physical/emotional ($\chi^2 = 11.90(40;3)$; $p < 0.05$), utilitarian/hedonistic ($\chi^2 = 29.38(40;3)$; $p < 0.001$), passive/active ($\chi^2 = 48.28(40;3)$; $p < 0.001$), immersion/absorption ($\chi^2 = 11.71(40;3)$; $p < 0.05$), unpleasant/pleasant ($\chi^2 = 77.14(40;3)$; $p < 0.001$), boring/stimulating ($\chi^2 = 47.70(40;3)$; $p < 0.001$). The conditions in which the participants rode a bike significantly influenced their overall experience profile, resulting from the distribution of categories within the systems indicated above. However, similarities were found in two pairs of scenarios: (1) cycling in natural conditions and in IVR, and (2) riding a cycle ergometer without any visualisation and in nIVR.

Keywords: experience, physical activity, recreation, cycling, virtual reality

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1. Introduction

Among various factors influencing opportunities and practices related to people's free time, the development of technology plays a special role. The relevance of technology can be exemplified by the growing interest of consumers in practicing physical activity (PA) in an artificial reality created using information technology, known as virtual reality (VR). The virtual environment is not only used to create original forms of PA but also digital representations of real ones. As a result, consumers have a broader choice and can decide whether they want to practice PA in the real world (real life, RL) or in a virtual environment. The latter option can additionally be accompanied by different degrees of immersion (NIVR or IVR). By analysing the relationship between the conditions in which PA is undertaken and the way people experience it one can expect to arrive at a better understanding of consumer preferences with respect to modern technologies. The following study seeks to determine whether practicing recreational PA in RL and VR differentiates user experiences defined as the overall perception of the activity itself and the resulting impressions. The authors attempt to answer this question using results of an empirical study of PA in the form of cycling.

2. Literature Review

There are many theoretical concepts developed in various fields of science that can be used to analyse experience derived from recreational PA. One concept that we refer to in this article is the idea of experience economy, which is based on the assumption that experience, like raw materials, goods and services, can also be the subject of market exchange. When such experience is staged for the consumer, it is characterised by being memorable and personal and is revealed over a certain period of time and through specific sensations (Pine II & Gilmore, 1999, p. 6).

From the perspective of the above-mentioned concept, experience as a "product" is not only the object of exchange between the seller and the buyer but is also a theoretical construct that can be used to present any means that serve to satisfy people's needs and desires (Szczechowicz, 2012). Thus, although physical activities are usually undertaken in certain conventional forms, in practice, they can be implemented in various spatial, natural, cultural, social, economic and technological conditions. Consequently, there are various ways in which physical activity can be staged.

PA can be implemented in natural conditions (RL) or in completely artificial ones (VR). In both types of reality, a person can be completely immersed in the

scenery (immersion) or can perceive the created scenery incompletely. In the case of VR, the virtual world is visualised on a classic flat screen (NIVR) or a person is fully immersed in it (IVR) thanks to a head-mounted display (HMD) device (Garay-Sánchez et al., 2021). Similarly, in real life, a person can either be engaged in a full experience (cycling in natural conditions) or a partial one when using a cycloergometer. It should be noted that from a strictly functional point of view, these different settings do not differ from each other in principle. Nonetheless, there may be differences in terms of broadly understood sensations, experiences, emotions, feelings, etc.

There are at least a dozen different interpretations regarding the concept of "experience" (Schmitt, 2010). In this study, experience is broadly defined as a way of perceiving an object of consumption or a subjective reaction to what is consumed. This definition is similar to the one formulated by Stephan H. Haeckel, Lewis P. Carbone and Leonard L. Berry (2004, quoted in Skowronek, 2012, p. 130) with respect to the concept of "total experience", and to what Iwona Skowronek (2012) describes as "holisticity of experiences".

There are also many categorisations of consumer experiences (Schmitt, 2003). For example, Morris B. Holbrook and Elizabeth C. Hirschman (1982) describe utilitarian experiences as oriented towards specific practical goals, and hedonistic experiences as oriented towards pleasure understood in terms of the 3 F's, i.e. fantasy, feelings and fun. Experience can also be external — resulting from sensory perception, and internal — resulting from rational or intellectual awareness and understanding of one's own feelings (Dziewanowska & Kacprzak, 2013, p. 93). Bernd Schmitt (2003, p. 105) describes consumer experience as a construct consisting of several dimensions, each constituting a certain type of experience: cognitive, sensory, affective, social and physical. Colin Shaw (2005, p. 64–68) distinguishes between experiences in which the physical aspect dominates, and those in which the emotional aspect plays the key role. From the buyer's point of view and taking into account the degree of involvement, experiences can be classified into oblivious, dispersed, engaging and captivating.

There are also typologies of experiences with a higher degree of complexity. For example, Joseph B. Pine II and James H. Gilmore (1999, p. 30–31) argue that consumers can be involved in creating their experiences in two basic dimensions: participation (active, passive) and connection with the environment (absorption, immersion). By combining the values of these dimensions, one obtains four realms of experience: entertainment (passive, absorption), aesthetics (passive, immersion), education (active, absorption) and escapism (active, immersion) (Pine II & Gilmore 1999, p. 31). When consumer behaviour is analysed in terms of emotions, it is possible to identify two key dimensions,

namely pleasure and arousal, whose interactions results in four states within the emotional experience module: stress (a state of unpleasant arousal), stimulation (a state of pleasant arousal), depression (a state of unpleasant sleep) and relaxation (a state of pleasant sleep) (Solomon, 2013, quoted in Kacprzak, 2017, p. 56–57). In addition to these classifications, certain specific types of experiences can also be described, most notably, peak experiences (Maslow, 1954) and "flow" (Csikszentmihalyi, 1990).

Although there are many scientific reports regarding experiences of buyers and consumers of various products, there are relatively few studies containing theoretical reflections and, above all, results of empirical research on experiences arising as a result of undertaking PA, including recreational PA. While there are studies looking into specific aspects of experiences associated with PA, particularly, regarding the state of "flow" (Kawabata & Mallett, 2011; Ross & MacIntyre, 2020), out-of-body experiences (Alvarado, 2016) and satisfaction with PA (Baldwin et al., 2013) — there is a research gap concerning multidimensional analyses of experiences of people undertaking PA that account for the conditions in which it is performed.

The problem of experiences arising as a result of undertaking PA becomes even more interesting when one considers the fact that various forms of a given activity can be performed not only in a traditional way (in a natural environment or a deliberately staged physical space), but also in VR. Research on active video games (AVGs) enabling physical exercise in VR indicates that this form of recreation is assessed positively in both its immersive and non-immersive versions (Baños et al., 2016; Dębska et al., 2019; Polechoński et al., 2020, 2022, 2023). The few studies which identify differences in the feelings of people using VR applications in immersive and non-immersive modes suggest that the use of AVG in the immersive mode is associated with more intense impressions (Pallavicini et al., 2018, 2019; Tan et al., 2015).

In view of the above, the authors decided to empirically compare experiences of people undertaking recreational PA in real life and non-immersive and immersive VR. The study focused on PA in the form of cycling, which is one of the most available and most common forms of PA (Uczestnictwo..., p. 76). More importantly, in addition to natural conditions (RL), cycling can also be performed in immersive and non-immersive VR.

The aim of the empirical study can be expressed in the form of the following research question: How do people engaged in recreational cycling in different conditions (RL, VR) experience this activity taking into account various dimensions of experience? Two research hypotheses were also formulated with respect to this question:

HB1) Experiences of people engaged in recreational cycling differ significantly depending on whether the activity is carried out in RL or VR.
HB1) Experiences of people engaged in recreational cycling differ significantly depending on their sex.

3. Method

The purpose of the study was to identify experiences of people engaged in recreational cycling in two basic settings: 1) in a natural environment using a typical bicycle, and 2) using a cycloergometer. There were three variants of the latter setting: (a) without any visualisations, (b) in NIVR and (c) in IVR.

The research procedure consisted of the following seven stages:

1. Participants were presented with general information about the research project.
2. A participant completes "questionnaire No. 1" (cycling in natural conditions).
3. The participant completes "questionnaire No. 2" (riding a cycloergometer without visualisation).
4. The participant takes part in activity session No. 1 (riding a cycloergometer in NIVR).
5. The participant rests and completes "questionnaire No. 3" (riding a cycloergometer in NIVR).
6. The participant takes part in activity session No. 2 (riding a cycloergometer in IVR).
7. The participant rests and completes "questionnaire No. 4" (riding a cycloergometer in IVR).

It was assumed that the participants were sufficiently familiar with the first two activities ("cycling in natural conditions" and "riding a cycloergometer without any visualisations") that they could express their opinions regarding these experiences without having to perform these activities during the study. Since the other two activities ("riding a cycloergometer in NIVR" and "riding a cycloergometer in IVR") were considered to be much less common, the participants were asked to perform them in two sessions during the study. "Activity session No. 1" involved riding a cycloergometer using NIVR, during which the image of the virtual world was displayed on the screen located in front of the participant. During "Activity

session No. 2" participants rode a cycloergometer wearing VR goggles to create the experience of immersion. To eliminate the possible influence of the order in which the sessions were conducted, the order was changed for each subsequent participant.

To ensure the recreational nature of both cycling sessions, it was decided that the physical activity would be carried out at a moderate intensity level, which, according to the classification developed by the *American College of Sport Medicine*, corresponds to a heart rate ranging from 64 to 77% HR_{max} (Riebe et al., 2018). Therefore, the maximum heart rate (HR_{max}) was calculated for each participant using the formula: 208 – 0.7 × age (Tanaka et al., 2001). Activity sessions lasted 10 minutes, and after each session there was a break of several minutes to allow the participants' heart rate to stabilise at the resting level.

The participants were asked to complete a questionnaire with the same set of questions about each of the four PA settings described above: riding a standard bike in natural conditions, riding a cycloergometer without any visualisations, riding a cycloergometer in NIVR, and riding a cycloergometer in IVR.

The literature does not provide examples of research tools to identify experiences of people undertaking PA that were to be examined in this study. Such tools have only been reported for specific types of experiences, such as the feeling of "flow" (Jackson et al., 2008) or the experience of "pleasure" (Mullen et al., 2011). Therefore, the authors developed a questionnaire consisting of seven sets of opposing statements relating to the classifications of experiences described in the previous section. The participants were asked to indicate the degree of agreement with these statements using a seven-point ordinal ranging from "–3" (maximum agreement with the statement on the left) to "+3" (maximum agreement with the statement on the right side, with "0" representing the middle (neutral) value (Table 1).

The study was carried out between June-July 2023 at University of Physical Education in Katowice (AWF) in a certified Laboratory of Research on Pro-Health Physical Activity (PN-EN ISO 9001: 2015, certificate validity: 7/12/2021-16/12/2024). The laboratory has a room with a stationary bike with a separate space in which the participants could fill in the questionnaires. All cycling sessions were conducted using a cycloergometer (Kettler — Ergo C10), with an external cadence sensor (Wahoo Cadence) installed on its crank mechanism. The height of the cycloergometer seat and the settings of the headband securing the VR goggles were adjusted for each participant. In addition, the cycloergometer was set to adjust the load for each participant in such a way so that their heart rate reached and maintained the moderate level of intensity at (64–77% HR_{max}).

Table 1. Statements representing different dimensions of experience described in the literature (a fragment of questionnaire No. 1)

During cycling in natural conditions …									
… I am fully concentrated on only how my body is carrying out the physical activity, not paying attention to the surroundings in which it is taking place.	o	o	o	o	o	o	o	… I am fully concentrated only on my surroundings in which I am undertaking the physical activity, not paying attention to how my body performs it.	**Internal** experience vs. **external** experience
… I absorb the world as it is only through the senses and I do not undertake any mental effort in order to realise or understand my own experiences.	o	o	o	o	o	o	o	… I undertake mental effort in order to realise and understand my own experiences and I do not restrict myself to reception of the world only through the senses.	Experience in which the **physical aspect** dominates vs. experience in which the **emotional aspect** dominates
… my attitude is passive in nature: apart from the obvious fact that "I am cycling", I have no sense of influence on the course of my activity and the experiences resulting from it.	o	o	o	o	o	o	o	… my attitude is active in nature: I do not only "cycle", but I also have a sense of influence on the course of my activity and the experiences resulting from it.	Configuration of the 4 features given here (**passive** vs. **active** and **immersion** vs. **absorption**) allows us to classify experiences as: • **entertainment** (passive + absorption), • **education** (active + absorption), • **aesthetics** (passive + immersion) • **escapism** (active + immersion)
… I totally immerse myself in the undertaken activity and the environment in which this activity is carried out — due to this, I myself become a natural, inseparable part of the reality surrounding me.	o	o	o	o	o	o	o	… I absorb the ambience of the undertaken physical activity and the environment in which I realise it, somehow, from a distance — due to which I myself am rather an observer of what I am doing and what surrounds me.	
… I am geared towards achieving tangible and real practical objectives — and not only the pleasure derived from the undertaken activity.	o	o	o	o	o	o	o	… I am geared towards only the pleasure derived from the undertaken physical activity — and not achieving objectives with are real, tangible or practical.	**Utilitarian** experience vs. **hedonistic** experience
Cycling in natural conditions …									The configuration of the 4 features given here (**unpleasant** vs. **pleasant** and **boring** vs. **stimulating**) allows us to classify experiences into the following categories: • **stress** (unpleasant, stimulating), • **excitement** (pleasant, stimulating), • **depression** (unpleasant, boring), • **relaxation** (pleasant, boring)
… I perceive as unpleasant.	o	o	o	o	o	o	o	… I perceive as pleasant.	
… I perceive as boring.	o	o	o	o	o	o	o	… I perceive as stimulating.	

Source: Based on: Dziewanowska & Kacprzak (2013); Shaw (2005); Pine II & Gilmore (1999); Holbrook & Hirschma (1982); Solomon et al. (2013), quoted in Kacprzak (2017, p. 56–57)

Both activity sessions were conducted at the same station (Fig. 1). During the first one, the VR image was displayed on a screen (image diagonal: 200 cm; distance from the participant: 250 cm). During the second session, the participants wore Oculus Quest 2 VR goggles to create the experience of immersion.

The experience of riding a bike in VR was simulated using the vzfit app (https://www.vzfit.com/) on one of the routes available in the application, which is called Iceland Sunset Ride (author: KenOhBee) (Fig. 2).

Fig. 1. A participant riding a stationary bike in nIVR and IVR.
Source: Own materials

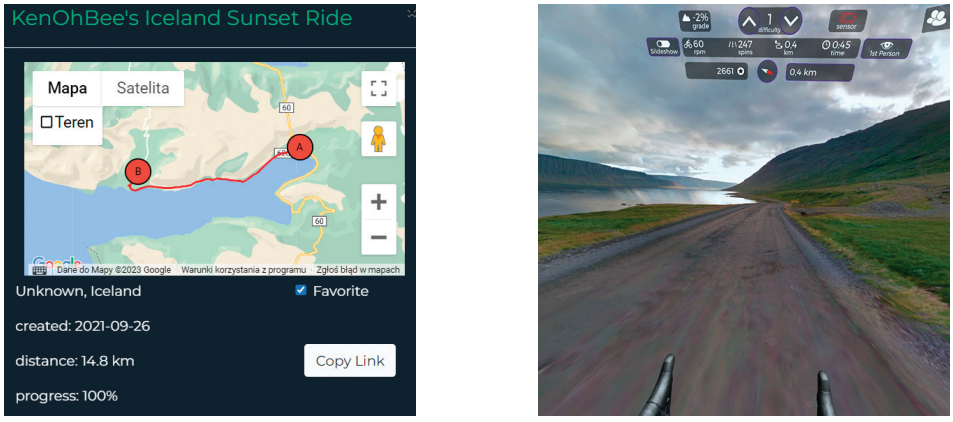

Fig. 2. The route "covered" by the participants: the map and the view from the perspective of the participant.
Source: Screenshot from VZfit app user account (https://www.vzfit.com) and from Oculus Quest 2 goggles from VZfit app

A group of 40 students from the University of Physical Education in Katowice (AWF) took party in the study (Tab. 2).

Study participants had to meet the following criteria: be healthy and physically fit, be able to ride a bicycle and practice this form of PA, including a stationary bike. Candidates who were sensitive to flashing lights, who suffered from epilepsy, had a history of motion sickness or balance disorders were disqualified from participa-

tion. Participation in the study was voluntary and it was possible to resign at any stage. The study was approved by the Research Ethics Committee of University of Physical Education in Katowice (AWF) and complied with the guidelines of the 1964 Declaration of Helsinki.

Table 2. Study group by sex and age

Study participants		*N*	Age	
			$\bar{x}$	*SD*
Total		40	22.65	2.25
Including:	women	20	22.35	2.32
	men	20	22.95	2.19

Legend: *N*: number of study participants; $\bar{x}$: arithmetic mean; *SD*: standard deviation
Source: Own elaboration

Statistical analysis, performed using Statistica and Statgraphics software, involved the calculation of the arithmetic means ($\bar{x}$) and standard deviations (*SD*), the median (M_e) and the interquartile range (*IQR*). The Shapiro-Wilk test was used to assess the normality of the distribution. Differences in the relationships between the four different settings and the nature of the participants' experiences were measured using Friedman's ANOVA and Kendall's W coefficient. In order to make intra-group comparisons, Friedman's analysis of variance was supplemented with post-hoc tests comparing absolute differences between rank means. The medians observed between women and men were compared using the non-parametric Mann-Whitney U test, supplemented with Glass's rank-biserial correlation coefficient (r_{rb}).

4. Results

Questionnaire results are presented in Table 3 (for all participants) and in Table 4 (for men and women).

Table 3. A comparison of cycling experiences in four settings taking into account different dimensions of experience (all participants)

Dimension of experience	PA settings																			
	Cycling in field				Bicycle ergometer				Bicycle ergometer in nIVR				Bicycle ergometer in IVR							
	$\bar{x}$	*SD*	M_e	*IQR*	$\bar{x}$	*SD*	M_e	*IQR*	$\bar{x}$	*SD*	M_e	*IQR*	$\bar{x}$	*SD*	M_e	*IQR*	χ^2	*df*	*p*	*W*
internal/ external	0.93	1.40	1	2	−0.75	1.19	−1	0	−0.35	1.25	−1	1	1.83	0.96	2	1.25	61.42	3	<0.001	0.51
physical/ emotional	0.93	1.40	1	2	0.45	1.69	0.5	3	−0.28	1.20	−1	2	0.65	1.89	1	3	11.90	3	<0.05	0.10
utilitarian/ hedonistic	0.35	1.55	0	3	−0.80	1.45	−1	1	−0.30	1.49	0	3	0.85	1.76	1	3	29.38	3	<0.001	0.24
passive/ active	1.83	1.30	2	2	0.18	1.80	0	3	−0.78	1.12	−1	0.5	1.45	1.54	2	2	48.28	3	<0.001	0.40
immersion/ absorption	−0.53	1.38	−1	2	0.05	1.63	0	2.5	0.48	1.55	0	3	−0.60	1.50	−1	0.25	11.71	3	<0.05	0.10
unpleasant/ pleasant	2.20	0.97	2	1	0.20	1.36	0.5	2	0.60	1.26	1	1	2.40	0.71	2.5	1	77.14	3	<0.001	0.64
boring/ stimulating	1.78	0.89	2	1	1.18	1.13	1	1	0.53	1.28	1	1	2.05	0.93	2	1	47.70	3	<0.001	0.40

Legend: $\bar{x}$: arithmetic mean; *SD*: standard deviation; M_e: median; *IQR*: interquartile range; χ^2: test statistics of Friedman's test; *df*: degrees of freedom; *p*: p value; *W*: Kendall's W coefficient.
Source: Own elaboration

4.1. "Internal" vs "External" Experience

The questionnaire results indicate that the participants paid relatively much attention to their surroundings ("external" experience) when cycling in IVR (1.83 ± 0.96 points) and in the natural environment (0.93 ± 1.40 points). They tended to pay more attention to "internal" experience while cycling in nIVR and without any visualisation. Friedman's ANOVA indicates that cycling conditions significantly influence this particular dimension of experience ($\chi^2 = 61.42(40;3)$; $p < 0.001$; $W = 0.51$), and the size of the associated effect is strong. Extended post-hoc analyses indicate that:

- the experience of cycling in natural conditions does not differ significantly from the experience of cycling in IVR, but is rated significantly higher ($p < 0.05$) than the experience in riding a cycloergometer without visualisation and cycling in nIVR;

Table 4. A comparison of cycling experiences in four settings taking into account different dimensions of experience by sex

PA setting	Dimension of experience	Women		Men				
		M_e	*IQR*	M_e	*IQR*	*U*	*p*	r_{rb}
Cycling in field	internal / external	1.5	2	1.0	3	155.5	0.220	0.22
	physical / emotional	1.0	2.25	1.0	1.25	178.5	0.561	0.11
	utilitarian / hedonistic	0.5	3	0.0	3	187.5	0.741	0.06
	passive / active	2.0	1	2.0	1.25	134.0	0.063	0.33
	immersion / absorption	−1.0	2	−1.0	1.25	187.5	0.737	0.06
	unpleasant / pleasant	2.0	1	2.0	1	182.0	0.607	0.09
	boring / stimulating	2.0	0	2.0	1	159.5	0.237	0.20
Bicycle ergometer	internal / external	−1.0	0.25	−1.0	1	152.5	0.149	0.24
	physical / emotional	0.0	3	1.0	3	190.5	0.804	0.05
	utilitarian / hedonistic	−1.0	2.5	−1.0	1	155.0	0.196	0.23
	passive / active	1.5	4	−1.0	1.25	120.0	0.028*	0.4
	immersion / absorption	0.5	3	−1.0	3	153.0	0.200	0.24
	unpleasant / pleasant	1.0	1.5	−1.0	2	135.0	0.071	0.33
	boring / stimulating	1.5	1.25	1.0	0.25	157.0	0.230	0.22
Bicycle ergometer in nIVR	internal / external	−1.0	1	0.0	1	171.5	0.430	0.14
	physical / emotional	−1.0	1	0.0	2	160.5	0.271	0.20
	utilitarian / hedonistic	0.0	2	−0.5	2	163.5	0.318	0.18
	passive / active	−1.0	1.25	−1.0	0.25	183.0	0.630	0.09
	immersion / absorption	0.0	2.25	1.0	2.25	170.0	0.417	0.15
	unpleasant / pleasant	1.0	2	1.0	0	171.0	0.408	0.15
	boring / stimulating	1.0	1	1.0	1.5	192.0	0.829	0.04
Bicycle ergometer in IVR	internal / external	2.0	1.25	2.0	1	128.5	0.041*	0.36
	physical / emotional	1.5	3.25	1.0	3.25	180.0	0.589	0.1
	utilitarian / hedonistic	1.5	3.25	1.0	3	164.5	0.335	0.18
	passive / active	2.0	2.25	2.0	1	155.0	0.214	0.23
	immersion / absorption	−1.0	1	−1.0	2	153.0	0.170	0.24
	unpleasant / pleasant	3.0	1	2.0	1	176.0	0.477	0.12
	boring / stimulating	2.5	1	2.0	1	131.0	0.048*	0.35

Legend: M_e: median; *IQR*: interquartile range; *U*: Mann-Whitney U test value; *p*: p value; *: statistically significant dependence; r_{rb}: Glass rank biserial correlation coefficient.
Source: Own elaboration

- the experience of cycling in IVR is rated significantly higher ($p < 0.05$) than the experience of riding a cycloergometer without visualisation and in NIVR.

Median ratings of cycling in IVR given by men and women are significantly different ($p = 0.041$) at the 95.0% confidence level but the effect size is moderate (r_{rb}=0.36).

4.2. "Physical" vs "Emotional" Experience

In the case of cycling in the natural environment (0.93 ± 1.40 points) and in IVR (0.65 ± 1.89 points), but also without any visualisation (0.45 ± 1.69 points), the emotional aspect is slightly more important than the physical one. The reverse relationship exists in the case of cycling in NIVR (−0.28 ± 1.20 points). Friedman's ANOVA reveals that cycling conditions significantly influence this dimension of experience (χ^2 = 11.90(40;3); $p < 0.05$; $W = 0.1$), but the effect size is weak. Extended post-hoc analyses indicate that the experience in natural conditions is rated significantly ($p < 0.05$) higher than the experience in NIVR. The significance level of the difference between the experience of cycling in IVR and in NIVR only slightly exceeds the significance level of the test.

4.3. "Utilitarian" vs "Hedonistic" Experience

Participants' answers indicate that the experience of cycling in IVR (0.85 ± 1.76 points) and in the natural environment (0.35 ± 1.55 points) tends to be perceived as "hedonistic". In contrast, cycling in NIVR (−0.30 ± 1.49 points), especially without any visualisation (−0.80 ± 1.45 points), is treated more in utilitarian terms. Friedman's ANOVA indicates that cycling conditions significantly influence this dimension of experience (χ^2 =29.38(40;3); $p < 0.001$; $W = 0.24$), but the effect size is weak. Extended post-hoc analyses indicate that:

- cycling in natural conditions is rated significantly ($p < 0.05$) higher than riding a stationary bike without visualisation;
- cycling in IVR conditions is rated significantly ($p < 0.05$) higher than riding a stationary bike without visualisation and in NIVR.

4.4. "Entertaining", "Educating", "Aesthetic" or "Escapist" Experience

The participants tended to described their attitude to cycling as "active" when riding a bike in the natural environment (1.83 ± 1.30 points) and in IVR (1.45 ± 1.54 points), while the "passive" attitude was more likely to be chosen when cycling in NIVR (−0.78 ± 1.12 points). Attitudes associated with riding a cycloergometer without any visualisations can be considered "neutral". Friedman's ANOVA suggests that the conditions of cycling significantly influence this dimension of experience (χ^2 = 48.28(40;3); $p < 0.001$; $W = 0.40$), although the effect size is moderate. Extended post-hoc analyses indicate that:

- cycling in natural conditions does not differ significantly from cycling in IVR, but is associated with significantly ($p < 0.05$) higher values than riding a cycloergometer without visualisation and in NIVR;
- cycling in IVR conditions is associated with significantly ($p < 0.05$) higher values than riding a cycloergometer without visualisation and in NIVR.

When one compares the ratings of men and women regarding riding a cycloergometer without any visualisation, the difference between the medians is statistically significant ($p < 0.05$) at the confidence level of 95%. The size of the associated effect is moderate.

The feeling of "immersion" was more likely to be reported when cycling in IVR (−0.60 ± 1.50 points) and in the natural environment (−0.53 ± 1.38 points), while the feeling of "absorption" when riding a cycloergometer in NIVR (0.48 ± 1.55 points). Riding a stationary bike without visualisation tended to be characterized as "neutral" (0.05 ± 1.63 points). Friedman's ANOVA indicates that cycling conditions significantly influence this dimension of experience ($\chi^2 = 11.71(40;3)$; $p < 0.05$; $W = 0.1$), but the size of this effect is weak. Extended post-hoc analyses indicate cycling in NIVR is associated with significantly ($p < 0.05$) higher values than the cycling in natural conditions and IVR.

The results of the above analysis can be represented graphically (Fig. 3). Thus, cycling in the natural environment and cycling in IVR tended to be described as an "escapist" experience, cyclying in NIVR was perceived as "entertaining", and riding a cycloergometer without any visualisation was perceived as "neutral".

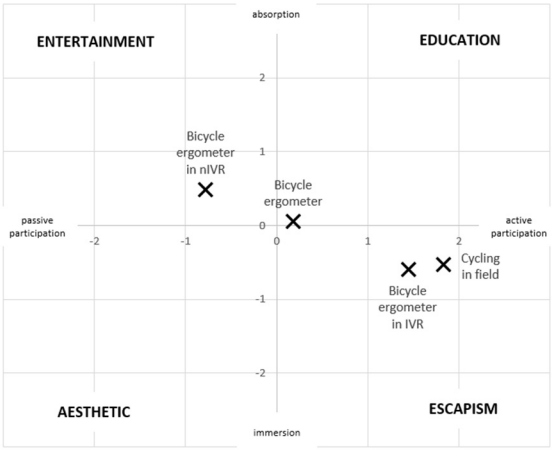

Figure 3. Four cycling settings within the space of four dimensions of experience: "passive" vs "active" participation and "immersion" vs "absorption" (according to arithmetic mean).
Source: Own elaboration based on Pine II & Gilmore (1999) and research results

4.5. "Stressful", "Exciting", "Depressing" or "Relaxing" Experience

When the cycling experience is analysed in terms of another set of dichotomies ("unpleasant" vs "pleasant" and "boring" vs "stimulating"), the results are quite clear.

Regardless of the setting, the participants rated their experience as "pleasant", although by far the highest values were reported when cycling in IVR (2.40 ± 0.71 points) and in the natural environment (2.20 ± 0.97 points). The ratings for the two remaining settings ranged from 0.20 to 0.60. Friedman's ANOVA indicates that the conditions of cycling significantly affect these dimensions of experience ($\chi^2 = 77.4(40;3)$; $p < 0.001$; $W = 0.64$) and the size of this relationship is strong. Extended post-hoc analyses lead to the following conclusions:

- the degree of pleasure derived from cycling natural conditions does not differ significantly from that experienced when cycling in IVR, but is associated with significantly ($p < 0.05$) higher values than in the case of riding a cycloergometer without visualisation and in NIVR;
- the degree of pleasure derived from cycling in IVR is rated significantly ($p < 0.05$) higher than in the case of riding a cycloergometer without visualisation and in NIVR.

Relatively small differences in the participants' ratings were observed in relation to the second pair of dimensions of experience (stimulating vs boring). All four settings were considered to be "stimulating", although in this case, the highest values were observed for cycling in IVR (2.05 ± 0.93 points) and in the natural environment (1.78 ± 0.89 points), and relatively high compared to riding a cycloergometer without visualisation (1.18 ± 1.13 points). Friedman's ANOVA suggests that the conditions of cycling significantly influence this dimension of experience ($\chi^2 = 47.70(40;3)$; $p < 0.001$; $W = 0.40$), while the size of this effect is moderate. Extended post-hoc analyses indicate that:

- the perceived level of stimulation when cycling in natural conditions is significantly ($p < 0.05$) higher than in the case of cycling in NIVR;
- the perceived level of stimulation when cycling in IVR conditions is significantly ($p < 0.05$) higher than in the case of riding a cycloergometer without visualisation and in NIVR.

When one compares the ratings of men and women regarding cycling in IVR, the difference between the medians for the two groups is statistically significant ($p < 0.05$) at the confidence level of 95%. The associated effect size is moderate.

As can be seen in Figure 4, while all four cycling settings were described as "stimulating", this assessment was particularly strong in the case of cycling in IVR and in the natural environment. Cycling in nIVR was perceived as more pleasant than stimulating, and cycling without any visualisations was assessed as more stimulating than pleasant.

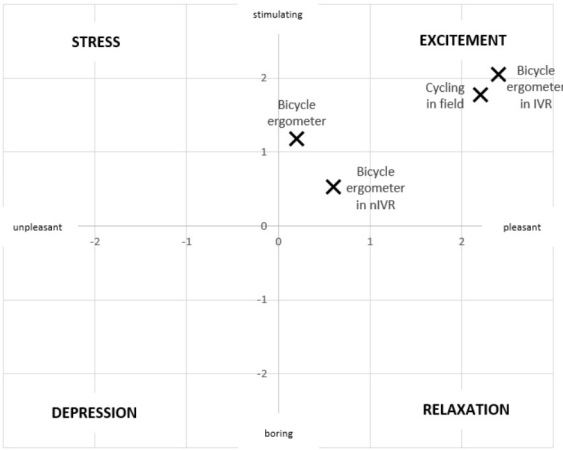

Figure 4. Four cycling settings within the space of four dimensions of experience: "pleasant" vs "unpleasant" and "boring" vs "stimulating" (according to arithmetic mean).
Source: Own elaboration based on Solomon (2013), quoted in Kacprzak (2017, p. 56–57) and research results

4.6. An Overall Comparison of Different Dimensions of the Cycling Experience

All dimensions of the cycling experience in the four settings are presented in Figure 5.

As can be seen, the degree of similarity between the patterns of relationships along the seven dimensions of experience is strongest for cycling in natural conditions and in IVR.

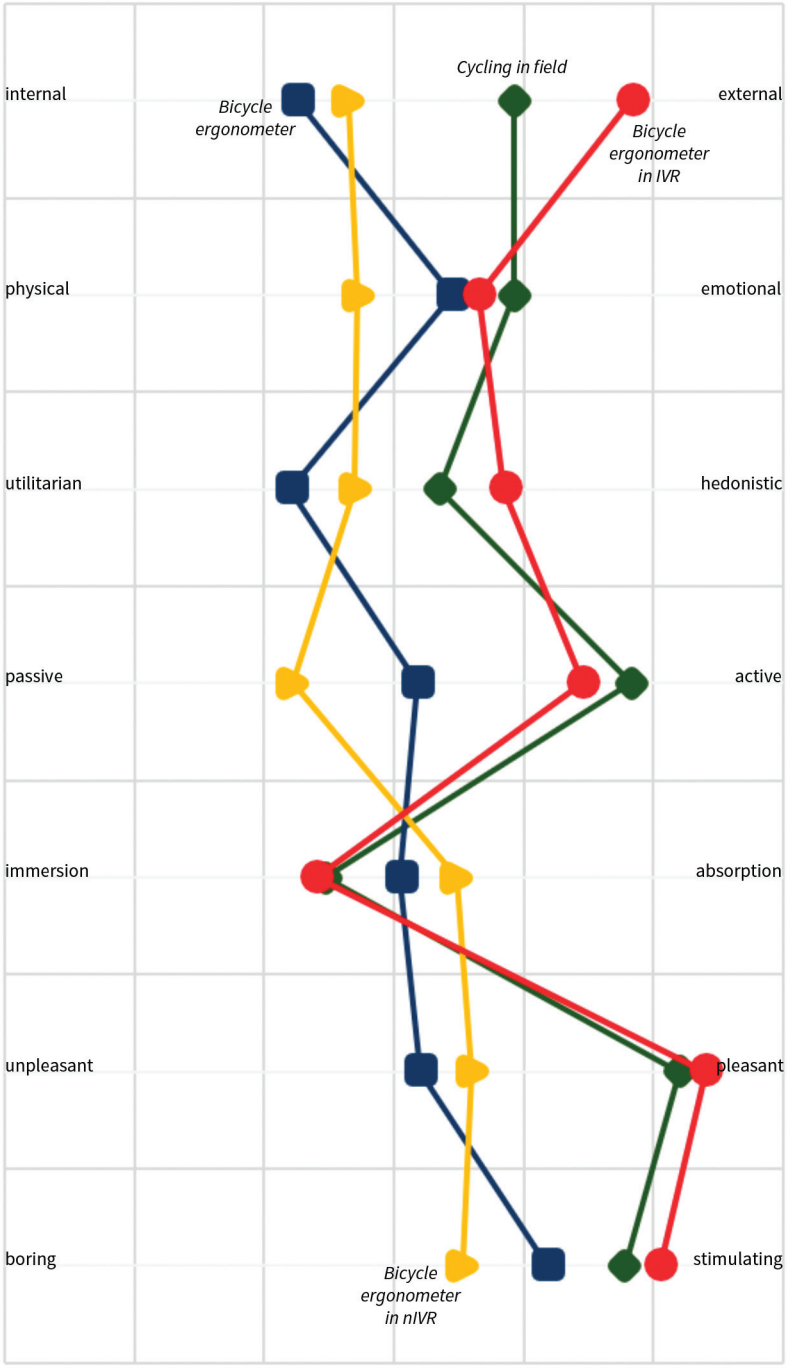

Figure 5. Dimensions of the cycling experience in the four settings (according to the arithmetic mean)
Source: Own elaboration

5. Discussion

The results presented above provide an interesting material for discussion and comparison with findings emerging from other studies into certain dimensions of experiences of people undertaking PA in various contexts. It must be remembered, however, that the results presented in this article refer to cycling undertaken by a specific group of people (students of physical education). Moreover, the study was conducted on a relatively small, non-random sample, which means that the results cannot be regarded as representative and should be interpreted with great caution.

5.1. General Nature of the Cycling Experience

As can be seen from the results in section 4, the participants experiences of cycling considering in the four different settings varied and in most cases, this variation was found to be statistically significant. It is worth emphasising that there was a great degree of similarity in the participants' assessments regarding cycling in natural conditions and in IVR.

This high degree of consistency of experiences associated with cycling in natural conditions and in IVR suggests that these two settings are largely equivalent. This is confirmed by the fact that no statistically significant differences were observed between cycling in natural conditions and in IVR for any of the seven dimensions of experience, represented by the seven questionnaire items. This observation is important not only from a theoretical point of view, but has practical significance as well — it shows that the IVR technology can provide similar experiences to traditional forms of PA, as evidenced by the fact that it is becoming an increasingly popular way of spending free time.

Let us now compare the results with the findings from other studies. For example, Kai Israel et al. (2023) concluded that the acceptance of the VR experience as a substitute for real experience is higher in the case of passive VR experiences (i.e. those in which the user is only an observer without a direct impact on the experience itself), than in the case of active VR experiences (i.e. those that require the user's participation). In that study, the researchers compared feelings of people taking a virtual walk and watching a theatre performance. Another study that investigated the relationship between VR and RL was conducted by Yoh Myeung-Sook (2001), who argued that VR is "real" and although it involves the use of information technologies, it does not create a "false" world, which stands in opposition to the "true" world, but rather expands the "ordinary" world that we are familiar with.

Statistically significant differences in the participants' assessments were observed between women and men with regard to cycling in IVR and two dimensions

of experience: "external" vs "internal" and "boring" vs "stimulating". While cycling in IVR, women tended to be more focused on their surroundings, while men were more focused on themselves; the experience of cycling in IVR was assessed as more "stimulating" by women. Therefore, it can be assumed that women were more engaged when cycling in IVR than men.

5.2. Assessment Concerning Individual Dimensions of Experiences

The participants found cycling in IVR and in natural conditions to be the most pleasant, while cycling in NIVR turned out to be slightly more pleasant than cycling without visualisation (the differences between the first and last two settings was found to be statistically significant). It can therefore be concluded that an image displayed on the screen in front of the cyclist is a factor that increases the pleasure of cycling. This finding is consistent with research results indicating that the pleasure associated with exercising can be increased by audio-visual stimuli (Bigliassi et al., 2019; Bird et al., 2019; Jones et al., 2014). The experience of doing physical exercise in VR could also motivate students to undertake PA in VR in the future (Lee et al., 2020).

As already noted, cycling in IVR and in natural conditions was found to be more stimulating than cycling without visualisation and in NIVR (although not all observed differences were statistically significant). This could imply that an image displayed on the screen in front of the cyclist attracts their attention, thereby reducing their involvement in motor activities. This could explain why cycling without any visualisation was assessed as more stimulating and exciting. In a survey regarding the idea of exergaming, Aung Pyae (2021) found that people using IVR were more engaged in exercising than people performing exercises in a conventional form. This issue is addressed in more detail in the review by Brendan Mouatt et al. (2020), although their conclusions are not unambiguous.

In view of the above it can be concluded that the experience of cycling can generally be described in terms of "stimulation", especially when it is undertaken in IVR and in natural conditions. It is also appropriate to classify an experience as exciting, for example, in the case of a stay in an amusement park (Boguszewicz-Kreft, 2013, p. 239). In a somewhat similar context, a study related to cycling was also conducted by Larissa Müller et. al. (2015). They performed an experiment which demonstrated that people riding bicycles in a VR environment not only expressed certain emotions (surprise, joy, fear, disgust), but these emotions could even be provoked through technical means.

The participants in our study indicated the highest level of immersion when cycling in IVR and in natural conditions. Their assessments were neutral with respect

to cycling without visualisation, and the lowest level of immersion was observed when cycling in NIVR (statistically significant differences were found between NIVR and natural conditions and IVR). It is worth noting that research conducted over the last few years confirms this assertion, which was considered controversial until recently. In particular, studies have shown that the perceived level of "flow" was higher in the case of PA undertaken in VR compared to PA done in natural conditions. This fact was demonstrated by Yu-Min Fang and Yen-Jung Huang (2021) with respect to physical exercises, by Chul Ho Bum et al. (2022), who analysed the game of golf, and in the study by Hyun Suk Lee and Junga Lee (2021) regarding football activities carried out in primary schools. The results of our study indicating a significantly higher level of perceived immersion in the case of cycling in IVR compared to that in NIVR are also consistent with observations of people playing video games (Kim & Ko, 2019; Pallavicini, Pepe & Minissi, 2019; Rutrecht et al., 2021).

When the cycling settings are ranked according to participants' assessments on the scale from the most "active" to the most "passive", cycling in natural conditions and in IVR are ranked higher than cycling without any visualisation and in NIVR (differences between the first two and the last two settings turned out to be statistically insignificant).

In view of the above it can be concluded that the experiences of cycling in natural conditions and in IVR can be described in terms of "escapism". It is worth noting that escapism is the basic motivation for many types of activity, including physical (Stenseng et al., 2023), although it can also lead to excessive loneliness (Siricharoen, 2019). Tal Laor (2020) found that escapism was one of the main needs satisfied by participating in the Pokémon Go urban game using the technology of augmented reality (AR). Interestingly, what escapism, understood as a social phenomenon, and VR have in common is the existence of "another world", which the user escapes to (Okorokova, 2018). Cycling in NIVR was also described as "entertaining". It can therefore be concluded that making PA more attractive by displaying an image on the screen introduces an element of fun for the participants (Huizinga, 1949).

When participants' assessments are ranked on the scale between "utilitarian" and "hedonistic" axis, the four settings can be arranged in the following order: no visualisation, NIVR, natural conditions, IVR (however, not all differences were found to be statistically significant). Therefore, riding a stationary bike without visualisation is treated as the most pragmatic option and is associated with a certain form of training, which does not necessarily have to be enjoyable as such. In contrast, cycling in VR and in natural conditions tends to be the most pleasant. Although motivations and feelings connected with cycling in the natural environment, including recreational activities, are already well-recognised (Kesenheimer et. al., 2023), little is still known about cycling in VR.

The results regarding the perception of different PA settings raise some interpretative difficulties. While the participants reported that it required some mental effort to become aware and understand their own experiences regarding riding a bicycle in natural conditions, in IVR and without visualisation, they said that in the case of cycling in NIVR the perception through the senses played the dominant role (the only statistically significant difference was observed between cycling in natural conditions and in NIVR). It can therefore be concluded that this last form of presenting artificially-generated content is attractive, but it is absorbed quite unconsciously, without deeper reflection about one's own experience.

The results regarding the dichotomy between "internal" and "external" system are clearer. The participants tended to concentrate on the surroundings when cycling in IVR and in natural conditions, while in the other two settings (in NIVR and without visualisation) thy tended to focus more on the cycling setting (the differences between the first two and last two settings were found to be statistically significant). In other words, the experience of artificial immersive reality and natural conditions are the type of environments that absorb participants' attention to the largest and similar degree.

5.3. Multi-dimensional Assessment of PA Experience

It seems that the multi-dimensional approach to identifying experiences of people undertaking PA can provide valuable insights that can be combined into a broad, comprehensive description of what sort of needs are satisfied when a person is engaged in PA. However, for the purpose of future research a standardised questionnaire would have to be developed that meets rigorous requirements of empirical research, especially with respect to validity and reliability.

6. Summary

Existing studies regarding experiences arising as a result of undertaking PA, also in VR, focus on very specific impressions or feelings reported by people performing physical activity. Although detailed indications are provided regarding specific types of consequences resulting from undertaking PA, these studies do not provide a complete and internally consistent description of such experiences. To bridge this research gap, the authors of this study decided to investigate experiences of people taking up PA from a multi-dimensional perspective. Rather than trying to undermine the current state of knowledge, the results of the study provide new

insights into the issue, which raise questions about the relationships between various dimensions of experiences associated with PA. The authors believe that research involving the multi-aspect assessment of experiences associated with PA is well worth continuing in order to obtain a holistic view of how PA is experienced in various conditions — including the use of VR technology, which is likely to become an increasingly attractive alternative to traditional forms of PA. At the same time, it is necessary to continue work aimed at developing standardised research tools that could provide reliable and comparable empirical data about experiences of people engaged in various forms of PA.

7. Conclusions

The findings presented above indicate that experiences of young students engaged in recreational cycling in natural conditions and in IVR can be characterised as "external", "emotional" and "hedonistic", can be described as a form of "escapism", and are associated with a feeling of "stimulation". The students' experiences of riding a cycloergometer without any visualisation and in NIVR were somewhat different, although not all observed differences were found to be statistically significant. As hypothesised, the students' experiences associated with in recreational cycling differ significantly depending on the conditions in which this activity is undertaken (HB1) and on the person's sex (HB2) and these differences are associated with specific dimensions of experience.

7.1. Theoretical and Methodological Conclusions

In general, the cycling setting significantly influenced the overall experience profile of the participants. However, similarities between these experiences were found to exist in two settings: (1) cycling in natural conditions and in IVR, and (2) riding a cycloergometer without any visualisation and cycling in NIVR.

The proposed multi-dimensional approach to identifying the nature of experiences associated with PA can provide valuable insights. However, it requires the development of a standardised research questionnaire.

7.2. Practical Conclusions and Implications for Further Research

The strong similarity in the students' experiences of cycling in natural conditions and in IVR could be of interest to people and organisations offering products based

on the immersive VR technology, especially when one considers future developments in this technology. Given the exploratory nature of the study, it would be a good idea to conduct similar analyses for other forms of PA and develop appropriate tools for this purpose, especially taking into account differences between demographic cohorts (generations) and other socio-demographic groups. It is worth noting that the use of VR may offer new possibilities for implementing PA in forms that will be considered attractive and, at the same time, safe for individuals with limited mobility (seniors, people with disabilities, athletes struggling with injuries, etc.).

Limitations

The main limitations of the study is the fact the sample was small and non-random. Furthermore, the participants completed the same questionnaire four times, in very short time intervals, which could have introduced a certain degree of randomness into the results. The questionnaire items were based on a set of simple measurement scales, which were developed using classifications of consumer experiences described in the literature, which in their current form do not create a complete and internally coherent multidimensional system; therefore, the reliability and validity of the questionnaire can be considered rather low. In view of the above, the results should be treated as preliminary. More reliable empirical data on this subject could be obtained by means of a more refined questionnaire.

CRediT Authorship Contribution Statement

Bartosz Szczechowicz: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, software, supervision, validation, visualization, writing — original draft, writing — review & editing.

Jakub Ryśnik: conceptualization, data curation, formal analysis, investigation, methodology, resources, software, validation, writing — original draft, writing — review & editing.

Jacek Polechoński: conceptualization, data curation, investigation, methodology, resources, software, supervision, writing — original draft, writing — review & editing.

Rajmund Tomik: conceptualization, methodology, project administration, resources, supervision, writing — review & editing.

Declaration of Competing Interest

The authors report there are no competing interests to declare.

The authors have no relevant financial or non-financial interests to disclose.

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Wieloaspektowa ocena doświadczeń osób podejmujących rekreacyjną aktywność fizyczną w rzeczywistości realnej oraz immersyjnej i nieimmersyjnej rzeczywistości wirtualnej

Streszczenie. Celem artykułu była identyfikacja — w kilku opisywanych w literaturze wymiarach — doświadczeń osób podejmujących rekreacyjną aktywność fizyczną w formie jazdy na rowerze w warunkach naturalnych oraz jazdy na rowerze stacjonarnym (cykloergometrze) bez jakichkolwiek wizualizacji oraz w rzeczywistości wirtualnej nieimmersyjnej (nIVR) i immersyjnej (IVR). Empirycznej oceny doświadczeń dokonano na próbie 40 studentów, wykorzystując do tego autorski kwestionariusz badawczy. Na podstawie przeprowadzonej analizy wariancji Friedmana można stwierdzić, że warunki uprawiania kolarstwa istotnie wpływają na charakter doświadczeń w układach: wewnętrzne — zewnętrzne (χ^2 = 61,42(40;3); p < 0,001), fizyczne — emocjonalne (χ^2 = 11,90(40;3); p < 0,05), utylitarne — hedonistyczne (χ^2 =29,38(40;3); p < 0,001), postawa pasywna — postawa aktywna (χ^2 = 48,28(40;3); p < 0,001), zanurzenie — absorpcja (χ^2 = 11,71(40;3); p < 0,05), nieprzyjemne — przyjemne (χ^2 = 77,14(40;3); p < 0,001), usypiające — pobudzające (χ^2 = 47,70(40;3); p < 0,001). Warunki, w jakich podejmowana jest jazda na rowerze, istotnie wpływają na ogólny profil doświadczeń rowerzystów, powstający jako rezultat rozkładu kategorii w ramach wskazanych wyżej układów. Doświadczenia te okazują się jednak podobne do siebie w dwóch przypadkach: (1) jazdy w warunkach naturalnych i jazdy w IVR oraz (2) jazdy na cykloergometrze bez jakiejkolwiek wizualizacji i jazdy w nIVR.

Słowa kluczowe: doświadczenie, aktywność fizyczna, rekreacja, jazda na rowerze, rzeczywistość wirtualna