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Selected dimensions of the self-esteem and a kinematic effect of the intentional target at taekwondo athletes

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B Data Collection
C Statistical Analysis
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Dorota Ortenburger[1ABCDE], Jacek Wąsik[1ABCDE], Tomasz Góra[1BDE]

Institute Physical Education, Tourism and Physiotherapy, Jan Dlugosz University, Czestochowa, Poland

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Abstract

Background & Study Aim: Failing to use simplifications in science of martial arts is connected with the necessity of interdisciplinary approach in conducting research, gathering and interpreting scientific data. The considerations of this paper included herein constitute the stage of the conducted research, leading towards a fuller understanding of a role of particular factors that influence on kick kinematics. The aim of this paper is the new knowledge concerning: the role of an intentionally indicated target in front kick kinematics, and the impact of selected aspects of the feeling of personal competence on kicking kinematics.

Material & Method: Six women training ITF (International Taekwon-do Federation) taekwondo were analysed (age: 19.8 ±3.8 years; body mass: 167.7 ±6.4 kg; height: 57.7 ±6.5 cm). For the purpose of this research motion analysis lab HML (Human Motion Lab) was used. Indicators registered structure of spatial-temporal motion marker, that was placed on the foot. Questionnaires used in health psychology and health promotion (*Inventory Sense of Personal Competence Scale*) and own questionnaire were applied.

Results: The registered speed during the execution of front kick was 11.06 ±1.49. The speed during the execution of kicking without a physical target (into the air) was 8.984 ±1.485 m/s for the left leg; 8.581 ±1.146 m/s for the right leg. While during the kick into the ball was 7.194 ±1.562 for the left leg and 7.506 ±0.988 m/s for the right leg. The research indicated that there is a statistically valid dependency ($p<0.01$) between the obtained maximum velocity of a front kick and the feeling of own competence (IA aspect). The relation between the persistence in continuing activities and obtained maximum velocity was not observed.

Conclusions: We can observe that during front kick performed by the examined taekwondo athletes the intentionally indicated physical target of a kick influenced on the movement kinematics. The performed research reveals that the maximum velocity of a front kick performed by woman, taekwondo athletes is influenced by a physical target. This may be associated with the concept of resource sharing, if action has a higher ceiling of difficulty, it is followed by extended reaction time and the mechanism of the speed-accuracy trade off. No lateralisation differences have been found in the group. It has been noticed that a bigger ability to initiate demanding activity strength positively affects the obtained velocity of the kicks. Such a dependency is not observed in the case of persistence in continuing activities.

Key words: front kick • kicks kinematics • martial arts • movement kinematic • performance • psychological factor • sense of personal competence • velocity

Martial arts – *plural noun* any of various systems of combat and self-defence, e.g. judo or karate, developed especially in Japan and Korea and now usually practised as a sport [30]

Motion marker – the reflective indicator facilitating to analyse the kinematics of the human body.

Marker noun 1. in games such as football and hockey, a player who stays close to an attacking player in the opposing team to prevent him or her from receiving the ball or scoring **2.** a substance which reveals the use of a banned substance, found in drugs testing [30]

Kinematics – *noun* the scientific study of motion [30].

Taekwondo – a Korean martial art and combat sport where it uses kicks and punches with a heavy emphasis on kicks. The fights are individual and standing.

Ap chagi – is the front kick in traditional taekwon-do.

Sport psychology – is often defined as the study of behaviour in sport. More broadly, the field is a scientific discipline focused on examining how thoughts, feeling, behaviour and environmental [7].

Self-confidence – self-confidence focused on athletes perceptions about their abilities to achieve success [7].

Sport exercise – for many years professionals considered sport and exercise psychology to be a single field in which psychological principles were applied to competitive sport, physical activity and exercise domain. As the field developed, professionals have been able to specialize, studying topics. Whereas sport psychology addresses thought, feeling and behaviours in competitive sporting context [7].

Introduction

It can be observed that in the research over the effectiveness of tasks connected with extreme sport challenges, the aspects of biomechanics, psychology and other fields run through each other. In martial arts science and in sport psychology more and more frequently the research concentrates on the connections at the level of the body, emotions, feeling own competence, and cognition in the search for fuller solutions within these fields [1-4].

Reflective, academic approach to the realisation of specified tasks connected with competing in martial arts is related to the analysis of not easy situation that spreads from the dimension specified by conditionings and the rules of biomechanics, kinematics as well as the psychological, social and others dimension [2, 3].

Taekwondo is a Korean martial art, the name of which is composed of three words: ***tae*** – meaning a foot, kick, ***kwon*** – fist, fist hit, ***do*** – road, philosophy of life [5]. The role that is played by psychological factors in shaping the body kinematics makes a considerable and constantly developing field of scientific martial arts research. Under the subject literature, psychological factors, including emotional and cognitive factors, due to complicated dependencies within nervous system, have an impact on muscles tension [6]. Sport psychology is often defined as the study of behaviour in sport. More broadly, the field is a scientific discipline focused on examining how thoughts, feeling, predisposition, psychological skills behaviour and environmental factors interact [7].

In the light of the literature on health and sport psychology one of the factors, having impact on the performance of various tasks, including the tasks of a high performance, is self-assessment of the personal skill of concentrating on a continual and effective activity despite the factors distracting attention. Researchers have conducted a large number of studies examining the relationship between selected aspects of self-confidence and performance [4, 5, 7].

The aim of this paper is the new knowledge concerning: the role of an intentionally indicated target in front kick kinematics (the impact on the maximum velocity) and the impact of selected aspects of the feeling of personal competence on kicking kinematics.

Material and methods

Six women training ITF (International Taekwon-do Federation) taekwondo were analysed (age: 19.8 ±3.8 years; body mass: 167.7 ±6.4 kg; height: 57.7 ±6.5 cm). During tests they were performing front kicking (according to taekwondo terminology: *ap chagi*) from lateral standing posture (according to taekwondo terminology: *niunja sogi palmok debi maki*): without physical shield (into the air), a table tennis ball hanging on a line and a shield typical for strikes (and used in martial arts). Each kick was performed 3 times for each of these aims. In total 72 attempts have been registered.

Taekwondo athletes after biomechanical research filled questionnaires used in health psychology and health promotion. *The Inventory Sense of Personal Competence Scale* and our own questionnaire were applied [8].

The Human Subjects Research Committee of the University scrutinized and approved the test protocol as meeting the criteria of Ethical Conduct for Research Involving Humans. All subjects in the study were informed of the testing procedures and voluntarily participated in the data collection. The obtained results were analysed statistically.

Protocol

Kinematic measures. For the purpose of this research motion analysis lab HML (Human Motion Lab, Poland) was used. The facility included ten NIR Vicon MX-T40 (Vicon, USA) cameras with the resolution of 4 MP (2352 x 1728 px) as well as 10-bit grayscale. The system allows to capture up to 370 frames per second at full resolution.

Psychological measures. The following psychological factors were examined: *ability to initiate demanding activity* (SA aspect) and *stamina in continuing activities* (SA aspect). Two subscales were measured (range of scores possible: from 6 to 24) *sense of personal competence* (IA aspect). Participants were asked to indicated how they felt in relation to each item. Each item was scored on 4 point Likert scale.

Statistical analysis

For all registered maximum velocities a median and standard deviation have been indicated. Normality was checked with Shapiro-Wilk's test. The differences between comparable groups have been assessed on the basis of t-test. In order to identify basis dependencies that exist between the most important

variables (from the point of view of research goals), the ANOVA analysis was applied. Statistical significance was adopted at the level of $p<0.01$. All calculations were made using IBM SPSS Statistics 20.

Results

The registered average maximum velocity of a front kick performed by women is between 8.58 to 8.98 m/s without a physical target and 7.19 to 7.50 m/s when aimed at a table tennis ball. There are no statistically valid differences in the maximum velocity of a front kick between a left and right foot (Table 1).

Figure 1 shows a sample graph of the changes in the speed differing in intentionally indicated target in kicking kinematics (physical target).

There is a statistically valid dependency ($p<0.01$) between the obtained maximum velocity of a front kick and the feeling of own competence: IA aspect (Figure 2). Such a dependency is not observed in the case of "persistence in continuing activities": SA aspect, $p = 0.159$ (Figure 3).

Discussion

The assessment of the dependency between the target kick and the observed movement kinematics was obtained due to the quantity test of the impact of different aims of a kick (table tennis ball or the air) on the observed kinematic indicator in the shape of a kick (velocity). In this experiment we registered average maximum velocity of a front kick performed by women between 8.58 to 8.98 m/s (without a physical target) and 7.19 to 7.50 m/s (table tennis ball). Men obtain higher velocity of a *ap chagi* i.e. 10 to 14 m/s [9].

The research indicated that the interaction between the aspect of the feeling of personal competence,

Extreme sports (EFPA) – "extreme form of physical activity are extreme sports, often classified according to the environment in which they are performed (water, land, air), extreme form of physical recreation as well as gainful activity or voluntary service, and all varieties of physical activity that meet at least one classification criterion of the feature associated either with extreme risk of injury or death, or extreme body burden with high level of effort, or extreme coordination difficulty" [31, p. 19, see also 32]

A Likert scale – is a psychometric scale commonly involved in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research, such that the term (or more accurately the **Likert-type scale**) is often used interchangeably with *rating scale*, even though the two are not synonymous [33].

Table 1. Speed of front kick and intentionally indicated target (total 72) by taekwondo female athletes (n = 6) in different circumstances.

Leg	Circumstances leg strike				*p*-value
	without a physical target (into the air)		into the small ball		
	mean	SD	mean	SD	
left	8.984	1.485	7.194	1.562	0.000
right	8.581	1.146	7.506	0.988	0.002
p-value	0.368		0.420		

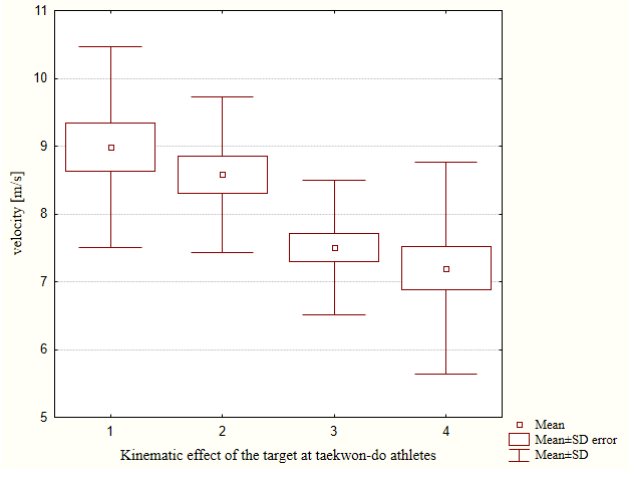

Figure 1. The role of an intentionally indicated target in kicking kinematics (kinematic indicator: velocity front kick, $p = 0.000$) by taekwondo female athletes (n = 6) – legend: 1 left leg without physical target; 2 right leg without physical target; 3 left leg into the small ball; right leg into the small ball.

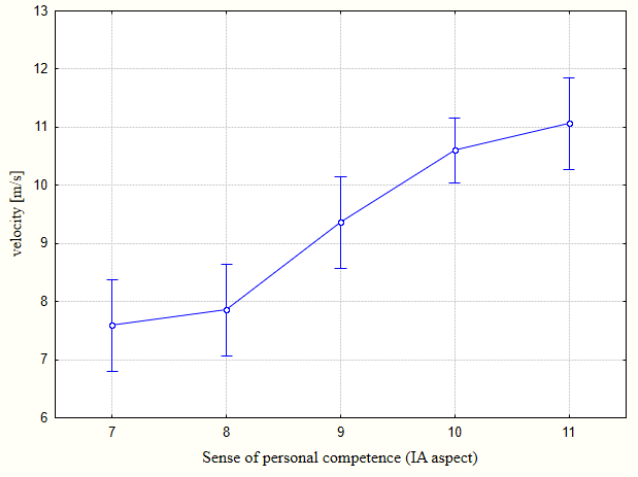

Figure 2. The relationship of selected aspects of the sense of personal competence (IA) on kicking kinematics ($p = 0.028$) by taekwondo female athletes (n = 6). IA aspect – first aspect of the feeling of personal competence, specified as "ability to initiate demanding activity".

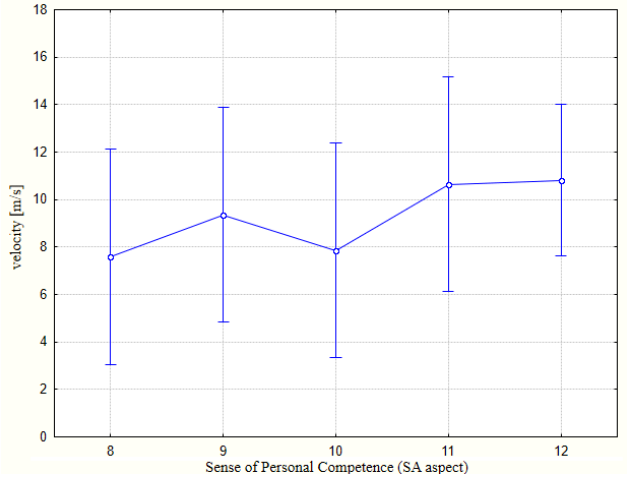

Figure 3. Selected aspects of the sense of personal competence (SA) and kinematic indicator (velocity, p = 0.159) by taekwondo female athletes (n = 6). SA aspect – second aspect of the feeling of competence, specified as "stamina in continuing activities".

specified as "ability to initiate demanding activity" (Figure 2) and the type of performed kicking technique (Figure 1) refers to kinematic indicator that is velocity. We may assume that a kick to a little target lowered the maximum velocity of a kick. The difference was statistically valid ($p<0.01$). Such a mechanism is referred to in psychology as „the speed-accuracy trade off" [10]. It reveals that the fastest kicks cause disorders in control. Thus, the competitors for whom it is important to aim at the target precisely, in order to control movement in full, do not fully use the maximum energy they are able to obtain. A similar dependency was referred to in other research [11]. Maybe these activities go along with the concept of sharing resources [12].

The obtained data can inform us about a considerably balanced development of both left and right foot in the case of sample taekwondo competitors. There are studies that indicate that the increase of condition of a non-dominating joint is accompanied with the beneficial changes in some brain structures [13].

Based on empirical data of our experiment, we can assume that a higher confidence in one's own power reflects positively on obtaining velocities of the examined kicks. Such a dependency is not observed in the case of "persistence in continuing activities". Other researchers have also noticed that a high self-assessment of abilities makes a factor that has an impact on a high level of performance [7, 14]. It allows to concentrate on effort and continue it, despite disturbing factors [15].

To a considerable degree this subjective self-assessment is based on own experience [9]. Maybe the connection of the kinematics of movement and competence will make the element testing "man's self-assessment" [16]. In the light of the literature on sport psychology it's very justified as indicated by existing research on psychosocial factors lowering performance sports. However, the precise mechanism that underline changes in motor control performance under psychological pressure remain a source of debate [17, 18].

Athletes and coaches have beliefs about the role of confidence in sport performance. Elite athletes report higher levels self-esteem than non-elite athletes. On the other hand, increasing self-confidence can sometimes also lead to drop in performance. If very high self-confidence leads to big reduce their effort, allow their minds to wander off task or engage in unnecessary risk, then their performance may decrease [7].

More and more often we talk about a holistic approach in the assessment of human behaviour [13, 19-23]. What is important, the whole system makes the sum of psyche and body. Failing to use simplifications, such as reductionist divisions, is very difficult and is connected with the inscribed in martial arts necessity of interdisciplinary approach in conducting research, gathering and interpreting scientific data [3]. Building the status of science about martial arts, connected with effective solving of the methodological problems is visible in scientists' works who, on one hand, represent an objective approach and, on the other, are highly qualified practitioners of martial arts [2, 3, 24].

The accessible literature does not present many biomechanical research concerning the measurements of women who practice martial arts. We hope that this paper will partially fulfil this gap. The considerations included herein constitute the stage of the conducted research, leading towards a fuller understanding of a role of particular factors that influence on punch/kick kinematics [24-28] and psychological conditionings of man's movements in martial arts [20, 29].

Our research should be interpreted in light of some methodological limitations. Future research should examine more different psychological self-reported tools and observations. The results and considerations presented here may constitute the empirical argumentation for comparisons for other researchers and may indicate the path for further research of an interdisciplinary character.

Conclusions

The performed research reveals that:

- the research revels statistically valid impact of an intentionally indicated target in kicking at taekwondo athletes. The maximum velocity of a front kick performed by women is influenced by a physical target.
- No lateralisation differences have been found in the group.
- It has been noticed that a bigger first aspect of the feeling of personal competence, specified as *ability to initiate demanding activity* has a positive relationship with the obtained velocity of the kicks. Such a dependency is not observed in the case of *stamina, persistence in continuing activities*. Stamina in continuing activities leading towards obtaining the assumed aim, as the second aspect of the feeling of competence has not influences on kicking velocity.

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