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A NOTATIONAL ANALYSIS ON WKF WORLD SENIOR KARATE CHAMPION, RAFAEL AGHAYEV OF AZERBAIJAN.

(Dissertation submitted under the Performance Analysis area)

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ABSTRACT

The aim of this study was to develop a notational analysis system to examine the WKF World Senior Karate Champion, Rafael Aghayev of Azerbaijan. A hand notation study examined 20 fights in order to determine the most predominant scoring technique and the tactical preparations for technique execution; mat territory (Dominant, Neutral, Defensive), hand techniques, foot techniques, place of contact (head and body), left/right execution and offensive/defensive pressure. To detect strategy changes within the bout, the intensity and type of actions in the last 30 seconds were also monitored and compared to the first 2.30 minutes duration. Results showed strategy change within the last 30 seconds. From notating techniques into two separate bout durations, this made results specific to bout duration; providing understanding for tactical decision making in relation to the remaining duration. A total number of 266 techniques executed were executed by the athlete, being awarded 58 techniques (18% success rate). This study explored how the athlete was effective, examining variables used within technique execution, presenting mean data and standard deviation along with non-parametric statistical procedures. For related variables, data was analysed using the Wilcoxon test. For analysing 3 or more samples, the Friedman test was used. The opponents' executed a total number of 321 techniques, being awarded 5; attaining a low success rate of 2%. Results established the athlete's most predominant scoring technique, Gyaku Tsuki accounting for 54% of all scores. The most frequent place of contact for all executions was the head; calculating as a mean value of 10 to the head and 3 to the body (occurring; 76% to the head, 24% to the body). Results for offensive/defensive pressure showed, executions were significantly offensive (mean value of 8); defensive mean value of 5. Percentage of execution pressures calculated 64% offensive and 36% defensive. The athlete predominantly executed techniques within a Neutral position, (Mean value =7), Dominant position, (mean value =5), Defensive (mean value=1). There were closer distribution (58:42%) between the athletes left (8 ±SD) and right (6±SD) executions. Due to the most predominant scoring technique being Gyaku Tsuki, this influenced hand techniques to be the most executed techniques, percentage of total hand techniques calculated as 57%; foot techniques was 43%. The athlete increased the frequency of execution rate within the last 30

seconds increased, executing a mean value of 4.4 techniques p/min within in the first 2.30 minutes, and 4.8 techniques p/min in the last 30 seconds.

INTRODUCTION

Karate is a form of martial art, a sport and a system of self-defence (Nakayama, 1978). Karate can be associated to the term 'empty-hand', simply referring to a practitioner utilising hands and feet in order of delivering attacking and blocking strikes against an attacker (Critchley et al., 1999). Karate exceeds 8 million practitioners worldwide, since originating from the 17th Century in Okinawa by Master Gichin Funakoshi (Zetaruk et al., 2005). Critchley (1999) states that Karate training incorporates three disciplines, Kata (Forms), Kumite (Sparring) and Kihon (Basics). However participation in traditional tournaments organised by the World Karate Federation (WKF) includes only the two main disciples, Kata and Kumite.

Kihon

Kihon is the basic fundamentals undertaken without an opponent, demonstrating movements and techniques until they become second nature, this discipline underpins Kata and Kumite.

Kata

Kata is a set of prearranged techniques combined into a sequence, demonstrating offensive/defensive blocking and attacking combinations without an opponent. In Kata competition the competitor's technical performance is assessed by judges to determine the winner.

Kumite

Kumite is used to execute bursts of consecutive techniques, transitioning techniques from Kata and Kihon to apply against an opponent in a real life situation in a controlled manner. Within Kumite competition, athletes will have 3 minutes of combat to perform consecutive techniques using variations of technique and intensity to apply against an opponent. A Kumite match is conducted under guided a set of rules (WKF Competition Rules, 2013). Referees and officials follow Nakayama's (1978), Best Karate Series for a technique to be awarded, based upon the series technical guidelines.

In 2000 the World Karate Federation (WKF) published a new set of rules. The aim of the new set of rules were to promote the sporting side of Karate, rather than the traditional. The new rules developed Karate into becoming more attractive and compelling for the public to watch. Originally techniques were awarded by judges that contacted with high intensity whilst following technical guidelines. The new rules have changed how Kumite is conducted. Judges no longer put as much emphasis on the technical execution of techniques; in modern events techniques are rewarded only when executed with control and following the basic technical guidelines. All techniques rewarded by the chief official must follow the WKF competition criteria. The new set of rules has been implemented in order to qualify for Olympic, Commonwealth and European Games recognition. Making Kumite more compelling for the public to watch and easier to understand how a match is conducted (Macan et al., 2006).

In order for a technique to be awarded, executions must be controlled and satisfy all six scoring criteria. WKF (2013) states, techniques must only be rewarded if there is good sporting attitude, vigorous application, correct timing of execution, correct distance from competitor, awareness of opponents' potential to counteract, good technical form. Scoring tariffs for Kumite have also been updated. Rewarding 3 points (Ippon) for all kicks to the head, and take downs countered with an attack. Rewarding 1 point (Waza-ari) for all kicking techniques to the truck and punches to the trunk and head. 2 points (Yuko) are rewarded for punches to the back of head. The winner of a bout is the athlete that has the most points and the end of 3 minutes, although the limit for a single bout is 8 points. If an athlete reaches 8 points the bout will be stopped and the athlete will be declared as the winner. For illegal techniques and disrespectful behaviour, officials can choose depending on severity a warning or penalty. The introduction of protection pads were introduced later to promote this rule change and limits injuries from being sustained (Macan et al., 2006). All competitors are allocated to the Kumite event which is suitable to their weight class in order of reducing injuries. The purpose of this study was to provide knowledge of an athlete's most predominant scoring technique, identifying the offensive/defensive pressure commonly chosen before the technique execution. Mat (tatami) territory determined to be an important factor to examine, in order to understand why the

athlete has chosen an offensive/defensive pressure, whilst clarifying whether the athlete within a dominant, cornered, or neutral position on the mat before executing.

LITERATURE REVIEW

Koropanovski and Jovanovic (2007) examined Men's Kumite characteristics to determine the most predominant techniques used, to construct strategies for training. A wide number of subjects were used to gain a wide range of data, examining 110 subjects using 55 fights throughout 2 WKF World and 3 European Championships. Due to a wide range of subjects, this presented a high amount of data and made the results more accurate to identify the most predominant scoring technique. Results showed that the most predominant scoring technique was Gyaku Tsuki (punch to the body), occurring 35%; following Gyaku Tsuki to the head (32%). This technique was the overall most predominant technique for contact to the head and body. Data collection was made specific in many areas of the study, such as collecting data on competitors at the same performance level; findings of results were made reliable and based on elite performance level.

There were many variables used for examining the techniques; posture, guard, motion, zone, point value, type of point, fight outcome. This enabled understanding for a competitor's tactical decision making, to identify technique characteristics used for an execution. The data collection could be more specific in order to understand how a technique was delivered; identifying more specific tactical variables on the technique's delivery (e.g. left/right executions, offensive/defensive execution). Notating unsuccessful techniques could have been used to examine the relationship of successful/unsuccessful techniques. The data collection determined the most predominant scoring technique, whilst examining separate weight categories. Data collection presented reliable results, due to each weight division being pooled separately, rather than examining the whole Men's Kumite discipline as a single population. This provided specific findings on the techniques executed and characteristics used in relation to each weight division (up to 60kg, 61-65kg, 66-70kg, 71-80kg, 81-80kg, 81kg and above). It's important to separate variables such as weight divisions, as depending on somatotype may influence executed scoring technique. Koropanovski and Jovanovic (2007) could have examined offensive/defensive executions to counteract their 'zone' variable. Gaining

knowledge on the tactical offensive/defensive pressure used for specific executed techniques in relation to mat zone.

McLeod and Laird (2009) collected data to establish the predominant scoring technique for Men's Kumite. The study examined male/female competitors, taking into consideration individual belt grade, weight category, point value, winners/losers and age. Due to the methodology being logically structured, this made results more specific to the hypothesis. Data was collected for both winners and losers, and used to compare and contrast relationships. However, there were limitations within the data analysis, as there were not enough data collected for losers. The study was unable to identify an accurate predominant scoring technique for losers, due to losers undoubtedly not executing as many techniques as the winners. However, this could possibly relate to losers not having high ability or technique variation. In comparison with the previous study, unsuccessful techniques could have been recorded in order to identify relationships between successful/unsuccessful techniques. A limitation is that both studies were undertaken within 'open' championships, where subjects are various 'styles'. This is a limitation, as depending on an athlete's 'style' will depend on technical variations used to deliver a technique, or the choice of technique executed. This limitation affected the reliability of results for frequency of executed techniques, and predominant characteristics.

A study by Tabben and Coquart et al (2014) examined 60 elite karate athletes, through the use of a time-motion structure and notational analysis. This study examined many variables such as, gender, match outcome, and weight divisions. Due to separating these variables, results were made more reliable and used for comparison. Data collection on elite athletes was collected from the historic WKF World Championship, Paris 2012. The objective was to advance knowledge and information to the elite athletes on their combat activity profiles. For both genders, a significant difference was observed for the frequency of punching techniques in relation to kicks. Also establishing the most predominant place of contact was to the head. The most predominant scoring technique for both genders was Gyaku Tsuki (to the head), closely matched between both genders (Male = 35%, Female = 34%). The most predominant kicking technique for both genders was Mwashi Geri (to the body), this occurred 24%. In agreement, Chaabene and Franchini, et al (2014)

discovered that Mwashi Geri (to the body) in their study occurred 44%. Research suggests, females tend to execute higher more lower limb (kicking techniques) compared to male counterparts, due to the assumption that females present more hip flexibility (Tsolakis and Bogdanis, 2012). The World Karate Federation (2013) implies, competitors seem to execute more head kicks rather than to the body. Claiming this is due to the higher scoring tariff given when targeting this place of contact. Although, kicking techniques have a much slower execution rate, contributing to being more vulnerable for an opponent to block and counteract (Imamura and Yoshimura et al., 2003). Tabben and Coquart (2014) states, punching techniques may be more predominantly executed due to being performed much faster, with less chance of an opponent counteracting.

Comparison of literature shows it's crucial to make the methodology specific to the aim of the study. In order to gain specific results there must be specific variables to the hypothesis; e.g. gender, age, weight division, upper limb compared to lower limb, place of contact etc. It's important to have a wide range of data in order to identify the most predominant scoring technique, and to obtain enough data to underpin the tactical execution. McLeod and Laird (2009), was unable obtain enough results to discover the most predominant scoring technique for losers. Data collection has to be made specific, in order to clarify underpinned reason for results while comparing variations. A similarity for all studies show the most predominant scoring technique was Gyaku Tsuki. In agreement, McLeod and Laird (2009), Koropanovski and Jovanovic (2007) discovered, Gyaku Tsuki (body) was the most predominant scoring technique. Similarly, Tabben and Coquart et al (2014) discovered Gyaku Tsuki was the most predominant technique; however the most predominant place of contact was the body. More tactical evaluation was needed to establish participant's decision making, understanding the type of technique executed depending on various fighting situations. E.g. first 2.30 minutes in comparison to the last 30 seconds. Techniques executed in the last 30 seconds, comparison to being within a winning and losing state. Furthermore, building on the knowledge of what technique an athlete uses depending on the opponents' characteristics. A limitation with these studies is that they identify what characteristics are used within technique execution. But, does not explore how bout variables (e.g. time duration, mat positioning) can influence the type of technique executed. Mat position influences whether a technique is executed

offensively/defensively. Another limitation with these studies is that only the successful techniques were notated. More knowledge could have been gathered if unsuccessful techniques were also notated, as results could have been used to compare and contrast the relationships of successful/unsuccessful techniques.

METHODOLOGY

Sample

A hand notation system was developed to explore critical aspects within a series of 20 fights, through the process of systematic observation. The study examined the WKF World Senior Kumite Champion, Rafael Aghayev from Azerbaijan. The athlete's current accolades include six World titles and eleven European titles, whilst currently holding the record for obtaining two Gold medals at one WKF World Championship. This study identifies his most predominant scoring technique, whilst providing knowledge of tactical intentions used for technique preparation. All bouts analysed consisted of high level international competitors, comprising of each bout being three minutes in duration.

Procedure

Collecting data for systematic observation required all videos from a public domain to be stored for future accessibility; stored videos have all taken place during the past 3 years. To ensure reliability, all videos were observed to ensure the footage included the complete fight and showed the time duration. All videos analysed have high quality resolution, showing the entire tatami and the chief referee rewarding a score. The hand notational method consisted of two computers, one used to observe bouts, and the other to input notations into a system. The notational system was designed using Microsoft Excel, specifically structured to collect tactical intentions when recording a single technique (Figure 1). The notational system was designed to record left execution, right execution, offensive/defensive execution, individual technique, hand technique, foot technique, monitor bout periods (first 2.30 minutes, last 30 seconds) and mat territory. The system was designed into three sub-categories; Defensive (Cornered), Neutral (Equal pressure) and Dominant (Pressuring the opponent). Collecting data on an athlete's mat territory was used to enable understanding for why the athlete chose to use a specific technique, in

relation to the fighting characteristics he's within (Figure's 1,2,3,). Once data collection was completed for the athlete, the same process was undertaken for the opponent's. By examining the opponents' this gave an overall indication for an average competitor, to use as a comparison against the athlete. After each bout the notations generated was summarized onto a 'master spreadsheet', which showed all notations within a single notation system. Once completed, results were transferred to a statistical software package (SPSS). The mean and standard deviation were calculated for the selected Kumite variables. Analysing the athlete and opposition enabled data analysis, aiding comparison of results.

Data Collection

Each technique was assigned a primary symbol when recording executed techniques. Whilst using a secondary representation (colour) for whether the technique was successful/unsuccessful or draw (both competitors contacting at the same time). An underline was assigned for the final 30 seconds in order to analyse whether fighting tactics have changed. Techniques were only notated if confirmed by the referee. Awarded scores were the result of contacting the opponent with controlled accuracy and being technically correct. Whilst gathering data within the final 30 seconds, this presented underpinned knowledge on technique execution, in relation to remaining time duration (Figure 4). The notational analysis system was designed to collect a wide range of Kumite variables with a single notation. Notating a single technique allowed notations to record whether selected variables were; left/right, dominant/neutral/defensive territory, offensive/defensive execution, part of body contacted, kick/punch, first 2.30 minutes and last 30 seconds.

Whilst observing a technique, to ensure reliability it was important to distinguish differences between offensive and defensive execution. A notation for defensive execution was recorded for, intercepting an incoming technique, blocking to counteract and intercepting a technique. Offensive techniques were notated when executed in four different ways, by single attack, placing a block whilst moving into an attack, or tactically setting up the attack in relation to mat territory positioning. Tactical profile and the pressure placed on the athlete depended on whether the notation was offensive/defensive. Once all bouts for the athlete was notated, the same procedure was undertaken for the opponent's. To verify reliability, a bout was

chosen by random to re-analyse for comparison to previous analysis. This was undertaken once notational analysis for the athlete and opponent's had been completed. Once the notational analysis was completed using Microsoft Excel and the reliability test had been undertaken, all data was transferred into a Statistical Package (SPSS) to undertake statistical analysis.

Reliability test

To ensure reliability of notations, one fight was chosen at random to retest and compare results of first observation against second observation. (Hughes and Franks, 1997) The method of testing reliability was using intra-observation, where a notation is repeated to demonstrate levels of consistency and accuracy. Validity of the notational system enabled each technique to be recorded upon its true value, whilst indicating the tactical preparations. Validity of the system enabled a true value of the technique and tactical preparations to be notated, providing reliable results of what occurred within a bout. A percentage of agreement score was calculated for each individual variable; left/right, punch/kick, offensive/defensive pressure, mat territory, place of contact. Percentage of agreement for all variables calculated as 100%, this showed reliable notations were made due to maximum agreement. Due to the validity of the notational analysis system and a high strength of reliability, the system was able to record many variables of a techniques characteristics whilst providing results of the subjects' true value.

Territory Analysis

Koropanovski and Jovanovic (2007) implies, tactical behaviour of the athlete influences the type of attack executed. Also clarifying, the competition area is not strictly segmented. The 4x4 centre area can be associated to “the central zone”, any other space can be referred to as a corner peripheral zone. Figures 1, 2, 3 show various mat territories.

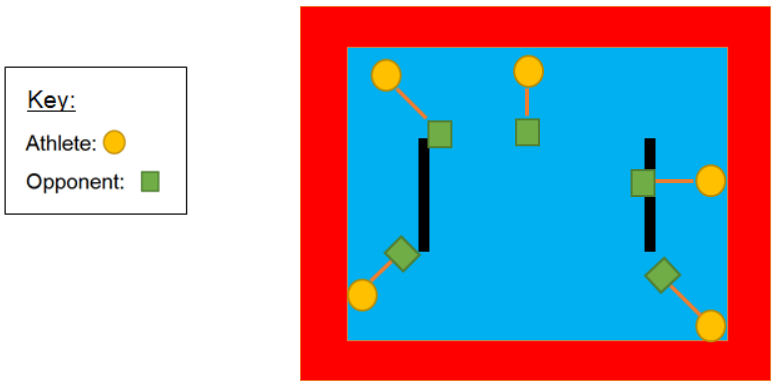

Figure 1: Defensive Territory

Defensive Territory can be referred to as the athlete being cornered by the opponent.

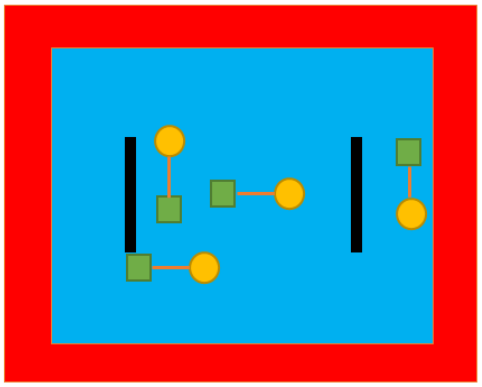

Figure 2: Neutral Territory

Neutral Territory can be referred to as the athlete and opponent having equal territory, where territory is not pressuring either opponent.

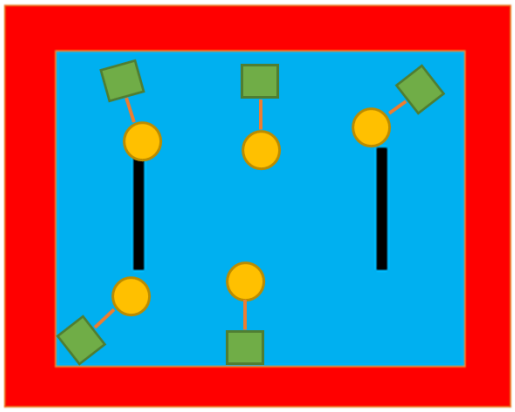

Figure 3: Dominant Territory

Dominant Territory can be referred to as the opponent being within a cornered position.

A competitor within all mat territories can attack with both offensive and defensive techniques. Offensive and Defensive sub-categories were structured to notate each technique under the type of execution pressure (offensive or defensive, whilst being specific to mat position.

Notational colour representations:

Successful- **S**

Unsuccessful- **U**

Last 30 seconds- **S** or **U** (Underline).

Offensive Left		Defensive Left		Mat Territory	Techniques		Offensive Right		Defensive Right	
Head	Body	Head	Body				Head	Body	Head	Body
				Cornered Territory	Kicks	Mai Geri				
						Yoku Geri				
						Mwashi Geri				
						Ushiro Geri				
						Ushiro Mwashi				
						Ura Mwashi				
						Sweep				
					Punches	Gyaku Tsuki				
						Oi Tsuki				
						Uraken				
				Neutral Territory	Kicks	Mai Geri				
						Yoku Geri				
						Mwashi Geri				
						Ushiro Geri				
						Ushiro Mwashi				
						Ura Mwashi				
						Sweep				
					Punches	Gyaku Tsuki				
						Oi Tsuki				
						Uraken				
				Dominant Territory	Kicks	Mai Geri				
						Yoku Geri				
						Mwashi Geri				
						Ushiro Geri				
						Ushiro Mwashi				
						Ura Mwashi				
						Sweep				
					Punches	Gyaku Tsuki				
						Oi Tsuki				
						Uraken				

Figure 4: Data Collection

Operational Definitions

Techniques were assigned with operational definitions to gain a greater understanding of performance indicators; whilst improving reliability.

- Table 1 shows operational definitions for punching techniques; also the scoring tariff for each technique.
- Table 2 shows operational definitions for kicking techniques; also the scoring tariff for each technique.

Scoring tariff was an important element within the data analysis, investigating whether the athlete scored frequently with lower tariffs, or less frequently with higher tariff techniques.

Table 1. Punching techniques and scoring tariff with assigned notation symbols.

Hand Techniques				
Symbol	Technique	Definition	Body Part	Scoring Tariff
Gyk	Gyaku Tsuki	Back hand punch	Trunk	1
			Front of Head	1
			Back of Head	2
Oi	Oi Tsuki	Straight punch	Front of Head	1
			Back of Head	2
Urk	Uraken	Back Fist	Front of Head	2

Punching techniques are only rewarded by the referee when the knuckles of the hand makes contact with the opponent's trunk or head. Scores are only rewarded if applied with force, ensuring that control and accuracy is demonstrated. Athletes must ensure that all punches are executed through a straight linear movement, whilst using a 'pull-back' to prevent a 'follow-through'.

Table 2. Kicking techniques and scoring tariff with assigned notation symbols.

Foot Techniques				
Symbol	Technique	Definition	Body Part	Scoring Tariff
Mwa	Mwashi Geri	Roundhouse Kick	Trunk	1
			Front of Head	3
Yg	Yoku Geri	Side Thrust Kick	Trunk	1
MaG	Mai Geri	Front Kick	Trunk	1
Swp	Ashi-barai	Sweep	Below the Knee	3
UraM	Ushiro Mwashi-Geri	Half Roundhouse	Front of Head	3
UshG	Ushiro Geri	Spinning Back Kick	Trunk	1
Ura	Ura Mwashi Geri	Reverse Roundhouse	Front of Head	3

Description of operational definitions

Descriptions of technical execution were aided by Nakayama (1978); Best Karate Series, Fundamental Guide. These series are used as the technical execution guidance for World/European Championships. Each technique executed is instructed from front stance (Zenkutsu -dachi).

Zenkutsu-dachi (Front Stance).

Nakayama (1978) states, it's fundamental for the acquisition of a correct and balanced stance for techniques to be fast and accurate. Whist reporting an effective Zenkutzu –dachi provides a strong base for technique execution. To adopt this stance, feet must be approximately two shoulders long and one shoulder wide. Placing the back foot pointing forward at a 45 degree angle, whilst the front foot points straight forward. The weight transition; should be 60% weight on front foot, 40% on back foot (Dudley Associates, 1998). This weight transition is what is used for transitioning of weight forwards when executing attacks. The back leg must be locked at the knee, whilst front knee bent in line with toes. The back leg being bent allows a 'push off' for technique execution, whilst the back leg lock enables stability of techniques. All the following techniques are applied using Zenkutzu –dachi:

Gyaku Tsuki-Hand technique

The punching hand will be the back hand. If the right leg is forwards, the punch would be executed with the left fist. This punch is delivered using a straight linear path forwards to the opponents' head/body (Dudley Associates, 1998).

Oi Tsuki- Hand technique

Placing the left leg forward, the hand executing the technique will be the left fist. Similar to a 'Jab' punch, the front hand will be executed within a straight linear path towards the opponents' head.

Uraken- Hand technique

This technique is literally a strike with the back of the fist. Placing the left leg forwards, the hand strike is undertaken with the left. To begin, preparation of fist execution begins with preparing the fist against own chest. The forearm must face parallel to the floor, whilst pointing the elbow forwards toward opponent (Dudley

Associates, 1998). Pointing the elbow forwards to the opponent allows the athlete to position the aim and establish path of travel. When releasing the fist from the chest, the fist should follow along an arcing path, travelling with the back of the hand facing upwards toward opponent until the fist makes contact to the head.

Mwashi Geri- Foot technique

Can be referred to the term ‘roundhouse kick’; can be executed using the front or back foot. Front foot Mwashi Geri is executed at a much faster rate, compared to the back foot; due to back foot requiring a longer path of travel. Mitchell (2002) claims, Mwashi Geri is the most popular Kumite technique. Mwashi Geri for back/front execution follows a horizontal arc towards the targets head/body. The foot position at point of contact is the instep of the foot (Mitchell, 2002).

Mai Geri- Foot technique

Mai Geri can be executed with front or back foot. The leg position at point of contact must be in front of the body at a 90 degree angle. The knee must be positioned in front of own body, with high knee elevation High knee elevation allows the kick to be pushed out towards opponents’ trunk (Mitchell, 2002). The kick must make contact with ball of the foot, whilst maintaining body posture and the hips squared forward. The kick must use a ‘snapping’ at the knee action when delivering. A stable Zenkutzu –dachi must be adopted in order for this technique to become more effective, maintaining a 60% weight transitioning on the front foot will allow weight transitioning to be used as forward momentum. When making contact, maintaining a bend on the front knee provides balance and stability throughout technique execution.

Yoku Geri- Foot Technique

Yoku Geri can be referred to as a ‘side thrust kick’, making contact with side ‘knife edge’ of the foot (Mitchell, 2002). This technique must be executed using the back leg. Preparation of weight transitioning, and stance stability is similar to the execution of ‘Mai Geri’. The back leg must be elevated with the knee placed in front of the body at a 90 degree angle. Whilst bending the knee, hips must be maintain square forward. The knee must be elevated to a 90 degree angle, allowing a straight linear path towards the body. Once the leg has almost fully extended outwards towards the

target, the hips will rotate to enable the kick to push further and provide more power. The hip twist during the third part of the movement will position the foot to be executed with the side ‘knife edge’. This kick must only be executed towards the body.

Ura Mwashi-Geri- Foot Technique

The back/front leg must be lifted similar to the preparation of Yoku Geri, positioning the knee in front of the body at a 90 degree angle. When extending the kick, and hips should rotate to the side similar to Yoku Geri. The foot should not be positioned in-line with the body; but slightly in front. This allows after the kick to be thrusted, snapping the lower part of the leg in a reverse motion towards the target; making contact with the inside of the foot. The kick must be delivered with a knee ‘snapping’ action, allowing the knee to be pulled-back to the chest before returning the foot to the floor.

Ushiro Mwashi-Geri- Foot Technique

Ushiro Mwashi –Geri can be referred to as ‘half round house’, only executed with the back leg. The most complex technique to execute within Kumite, due to many technical aspects. Preparation requires a 60% weight being placed on the back foot, having a stable Zenkutsu- dachi for balance throughout the spin. Ushiro Mwashi-Geri begins with turning the head to look over the shoulder. Standing with the left leg forward, the head must turn over the right shoulder, whilst beginning to pivot on the left leg and twisting the front foot and body. Whilst turning the body the right kicking leg must start to lift, the supporting leg must be bent throughout to maintain balance. The kicking leg must be placed at a 90 degree angle in front of the body (similar to Mai Geri whilst spinning). Once the target is visible and the body have rotated enough for the kick to be extended, the kick must make contact to head with inside of foot. All weight must be transferred to the front foot. The weight transitioning must be placed heavily forwards to send momentum towards the target, the kick now follows the same guidelines as Ura Mwashi -Geri. Due to Ushiro Mwashi- Geri and Ura Mwashi –Geri being the same kick; except for Ushiro Mwashi –Geri acquiring a spin for more speed, power and momentum, due to body rotation.

Ushiro Geri- Foot Technique

Ushiro Geri can be referred to as ‘spinning back kick’. Whilst standing in Zenkutzu-dachi, this technique must be executed using the back foot. Preparation requires the head to look over the right shoulder (standing with left foot forward). Position the right foot, kicking knee at a 90 degree angle whilst rotating the supporting foot. When target is visible, the right leg must thrust towards the target in a straight linear motion, with toes pointing down towards floor (Mitchell, 2002). The point of contact is the opponents’ body, whilst making contact with the heel of the foot.

Ashi-Barai- Sweep technique

Ashi-Barai can be referred to as a sweep technique, can be used within a number of situations to trip an opponent off balance. This technique can be used to intercept an attack from the opponent; for example, using the sweep to attack the opponents’ supporting leg when executing a kicking technique. Ashi- Barai must be executed within a front stance positioning, with weight transitioning being placed mainly on back leg for executing with the front foot, or placing weight on the front foot for back leg execution. Ashi –Barai is primarily using the foot to attack below the knee. If executing this technique from a ‘clinch’ position, the use of arms can be implemented to execute a throw/takedown. Whilst undertaking Ashi-barai, the leg must travel low to the floor. Before making contact, the leg must be lifted from the ground in order to disrupt the opponents balance.

RESULTS

A total of 266 techniques were executed by the athlete within a series of 20 fights, total scores awarded were 58, calculating to be an 18% success rate. Analysis revealed the most predominant scoring technique was Gyaku Tsuki, accounting for 54% of all scores. Table 3 shows descriptive statistics for total techniques executed by the athlete, in comparison to the opponents'.

Table 3: Total amount of techniques executed by the athlete and opponents'.

	Technique Frequency	Total Techniques Awarded	Success Rate
Athlete	266	58	18%
Opponent	321	5	2%

The first samples undertaken were related samples. Comparisons were made between two sets of data, referred to as non-parametric data. The data was undertaken using the Wilcoxon test. In order to identify the Z-Score, whilst most importantly establishing the P Value.

Table 4: Statistical values for all (two set related) bout variables.

	Right - Left	Kick – Punch	Body - Head	Offensive – Defensive	First30 - Last30
Z	-1.693[b]	-1.434[b]	-3.828[b]	-2.281[c]	-3.706[c]
Asymp. Sig. (2-tailed)	.090	.152	.000	.023	.000

Due to the means of Table 4, a descriptive test was run for all bouts. There was a significant difference between body parts contacted. The athletes mean value for techniques to area of contact; 10 techniques to the Head and 3 techniques to the body. Table 5 shows descriptive statistics for the opponents' place of contact.

Table 5: Descriptive Statistics for opponents place of contact.

	Minimum	Maximum	Mean	Std. Deviation
Head	4	25	14	5.4
Body	0	11	2	2.5

Figure 5 shows mean values for place of contact for the complete series of bouts, for the athlete and opponents'. Table 4 showed these visual differences were also statistically different ($p<0.05$); the most predominant place of contact for both participants was the head. Percentage of techniques executed to the head was 76%, to the body 24%.

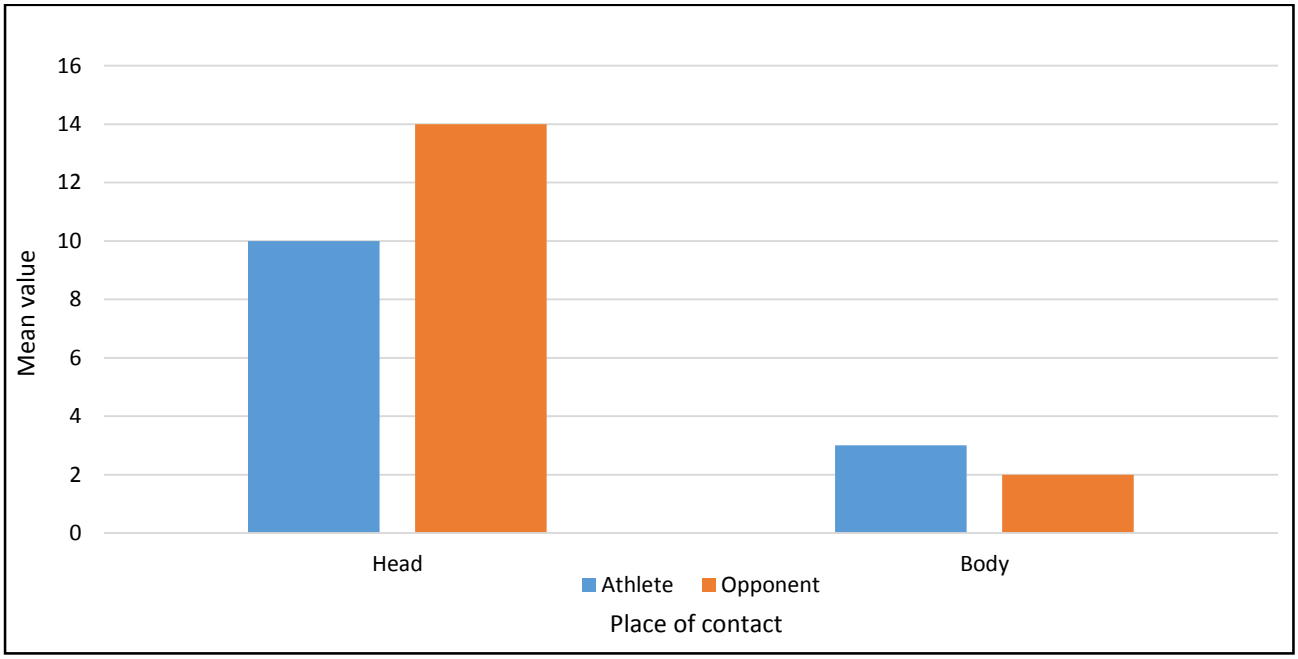

Figure 5: Comparisons of mean values for head/body.

Table 6 shows descriptive statistics for all the athletes' bout variables; Table 7 shows all bout variables for the opponents.

Table 6: Descriptive Statistics for all bout variables (Athlete).

	Minimum	Maximum	Mean	Std. Deviation
Left	2	12	7.6	3.2
Right	0	11	5.6	3.1
Punch	1	12	7.5	3.6
Kick	1	10	5.7	2.7
Head	5	17	10.1	3.9
Body	0	7	3.1	1.8
Cornered	0	4	1	1.3
Neutral	0	14	6.9	3.6
Dominant	1	18	5.4	4.4
Defensive	0	12	4.8	3.1
Offensive	1	18	8.4	4.2
Last30	0	5	2.4	1.3
First30	2	26	11.2	5.6

Table 7: Descriptive Statistics for all bout variables (Opponents').

	Minimum	Maximum	Mean	Std. Deviation
Left	0	19	4.3	4.2
Right	2	24	12.2	5.9
Punch	2	21	11.1	4.8
Kick	1	14	5.3	3.2
Head	4	25	14.2	5.4
Body	0	11	2.4	2.5
Cornered	1	10	5	2.8
Neutral	0	22	8.4	5.5
Dominant	0	11	3.2	3
Defensive	1	12	5.2	2.6
Offensive	2	26	11.5	5.1
Last30	0	6	2.4	1.9
First30	3	26	14.6	5.1

Table 8 shows statistics calculated from all the opponents' offensive/defensive techniques, executed within all 20 bouts.

Table 8: Descriptive Statistics for opponents' offensive/defensive executions.

	Minimum	Maximum	Mean	Std. Deviation
Defensive	1	12	5.2	2.6
Offensive	2	26	11.5	5.1

Figure 6 shows the athlete and opponents' mean values for offensive/defensive techniques; visually comparing the tactical intention. Data reveals that there is a distinct difference between the frequencies for offensive and defensive execution, whilst both predominantly executing offensive techniques. Figure 6 visually shows that the athlete and opponents' tactical intention for defensive execution are closely similar for defensive execution. Examining results for mat territory provided indication for why the athlete and opponents' frequency for defensive execution was similar. Total techniques expressed as a percentage executed offensively was 64%, defensively 36%.

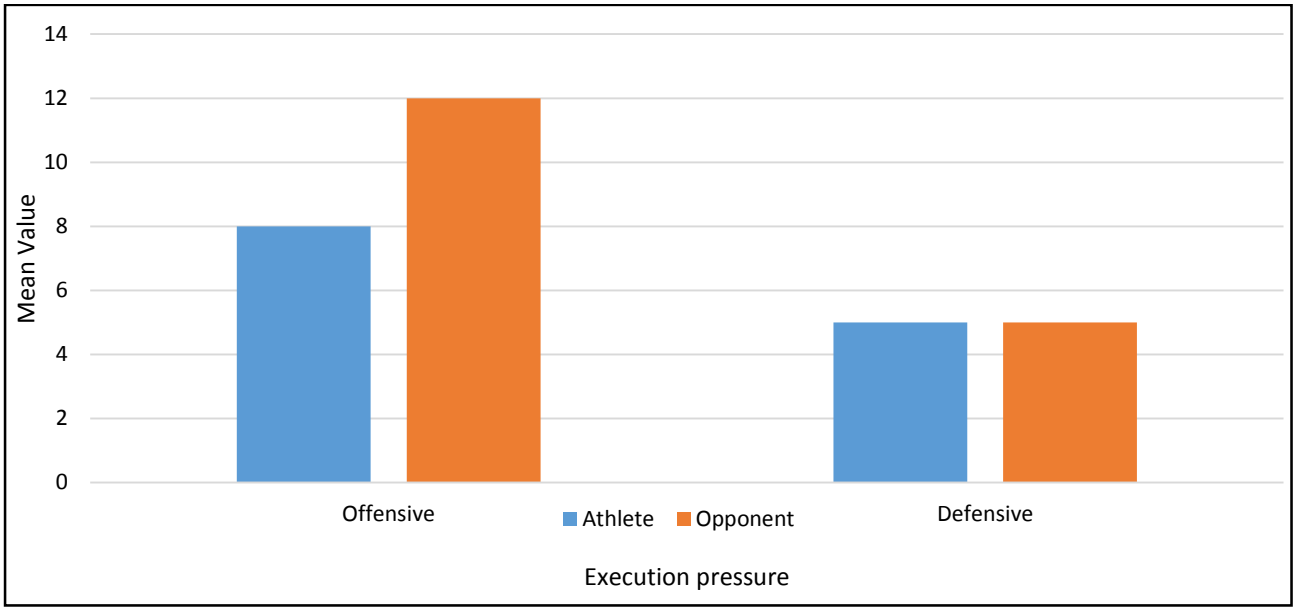

Figure 6: Mean values for Offensive/Defensive executions

Figure 7 shows visually shows mean value for left/right technique execution for the athlete and opponents'. The athlete's choice of execution was predominantly left, obtaining 39 scores awarded; left execution had a success rate of 25%. Percentage of total techniques executed left was 58%, right calculated as 42%.

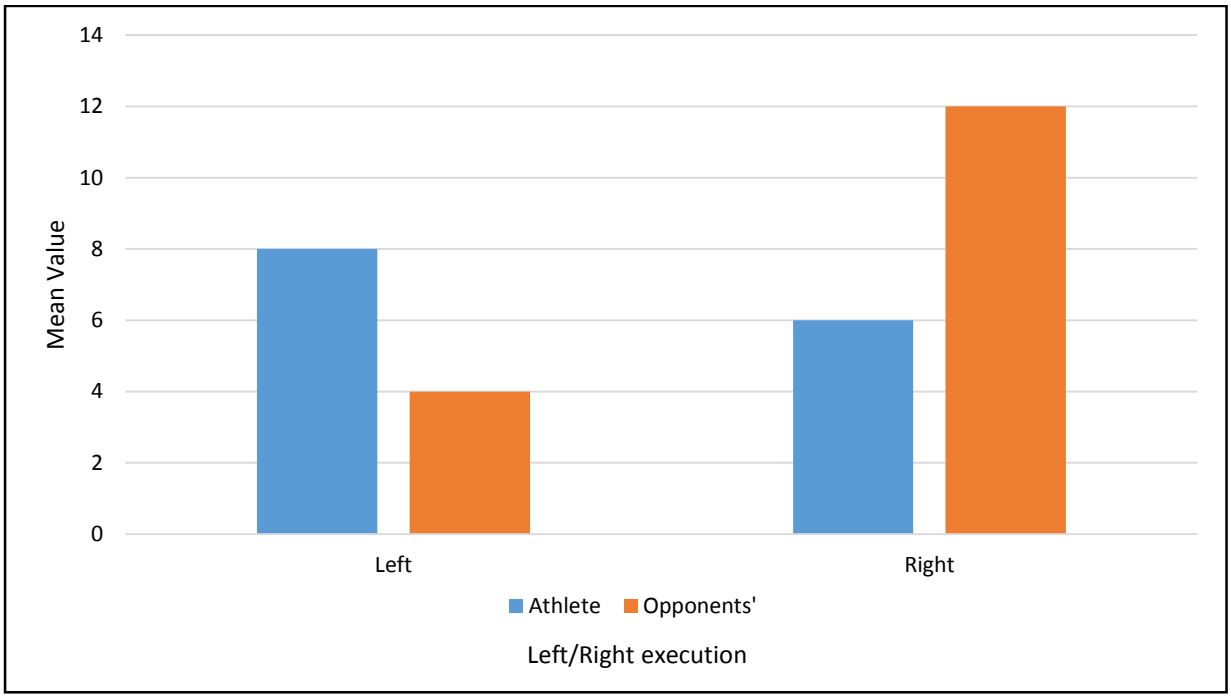

Figure 7: Athlete and Opponents' mean values for left/right execution.

Table 9 shows there is a significant difference, although visually and statistically results show more balance with the athlete. Opponents' show less variation, and dominance on left side.

Table 9: Left/Right execution statistics (Athlete).

	Right - Left
Z	-1.693[b]
Asymp. Sig. (2-tailed)	.090

Even though p is not <0.05 there may still be practical significance.

Figure 8 shows comparison of mean values for punch/kick techniques, executed by the athlete and opponents. Visual statistics for the athlete are more balanced than the opponents', enabling the athlete to have a wider armoury of attacking skills. Percentage of total punch techniques was 57%, total kicking techniques 43%.

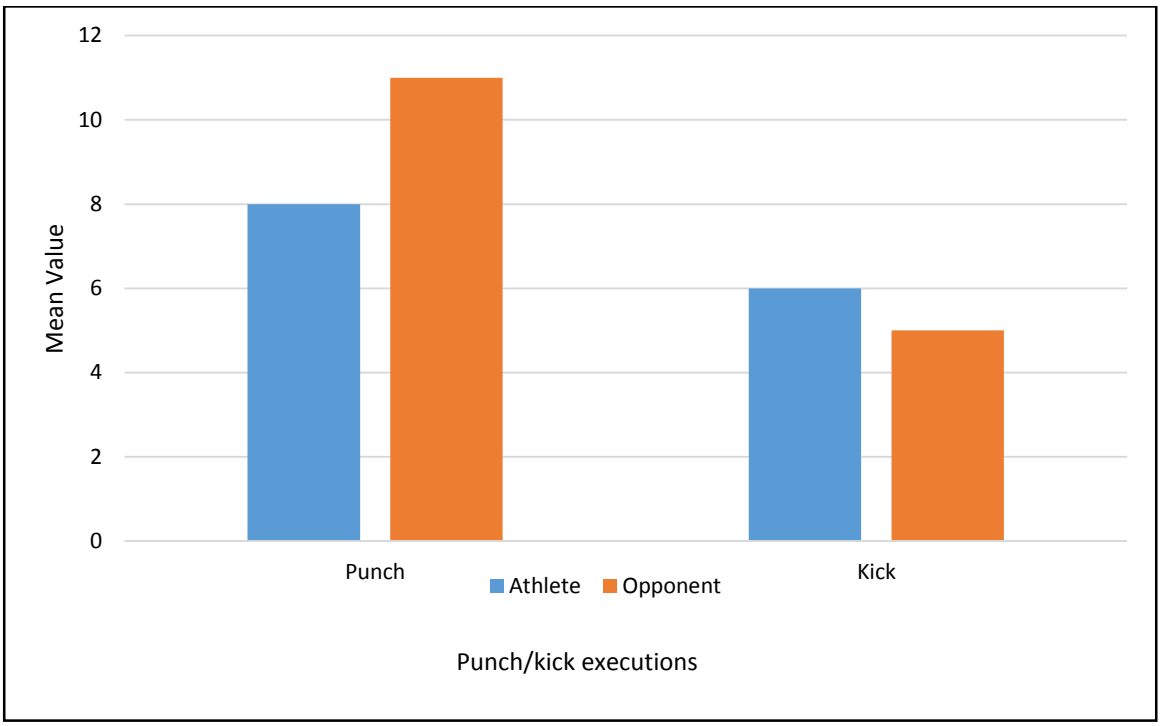

Figure 8: Mean values for punch/kick executions by the athlete and opponents'.

There was a significant difference between the total amount of techniques executed within the first 2.30 minutes and the last 30 seconds by the athlete. Table 10 shows statistical values for the frequency of all techniques executed within the bout duration.

Table 10: Statistical values for the Athletes frequency of techniques executed within first 2.30 minutes, and last 30 seconds.

	Minimum	Maximum	Mean	Std. Deviation
Last30	0	5	2.4	1.3
First30	2	26	11.2	5.6

Figure 9 shows a graphical representation for mean values of bout durations.

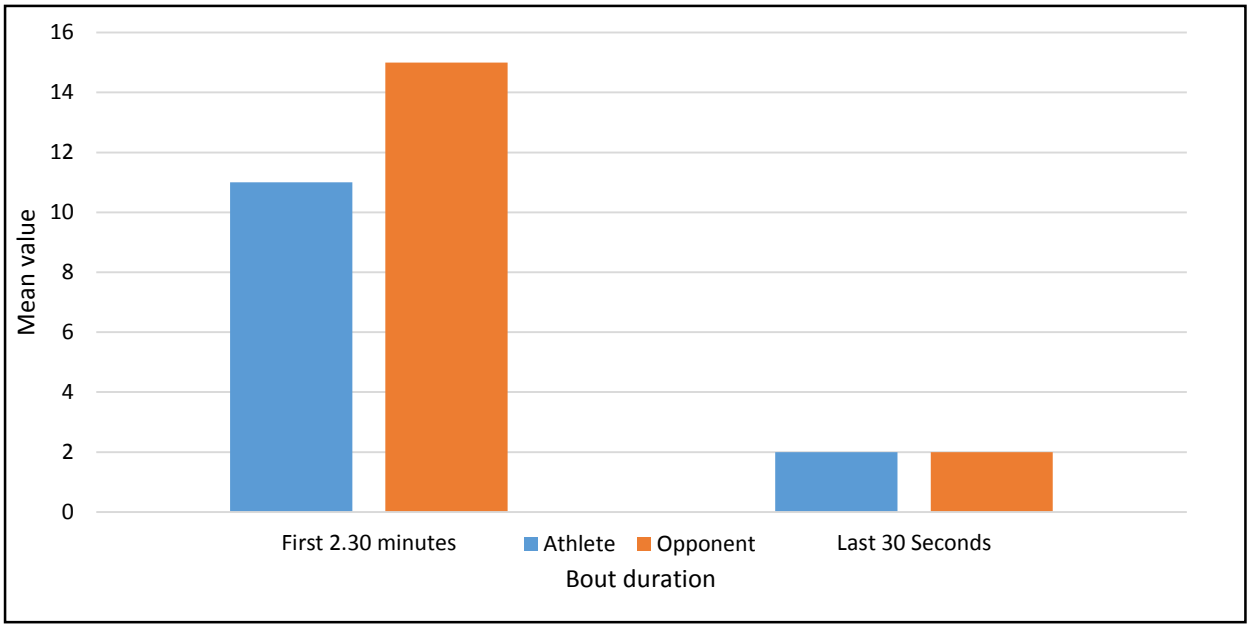

Figure 9: Mean values of technique execution within first 2.30 minutes, and last 30 seconds.

From the means of table 10, the data was further examined to calculate the rate of technique execution per minute during the two time durations, to indicate technique execution rate.

Table 11: Technique execution per minute.

	Minimum	Maximum	Mean	Std. Deviation
Last30 p/min	0	10	4.8	2.7
First2.30 p/min	8	10	4.4	2.2

Calculations show that the athlete within the last 30 seconds increased technique execution rate. Statistical values show the athlete was executing 4.4 techniques p/min within the first 2.30 minutes, and a rate of 4.8 techniques p/min within the last 30 seconds.

Figure 10 visually shows technique execution rate by the athlete per minute. Showing comparison of techniques executed within the first 2.30 minutes and last 30 seconds; Figure 11 shows the same representation of the opponents'.

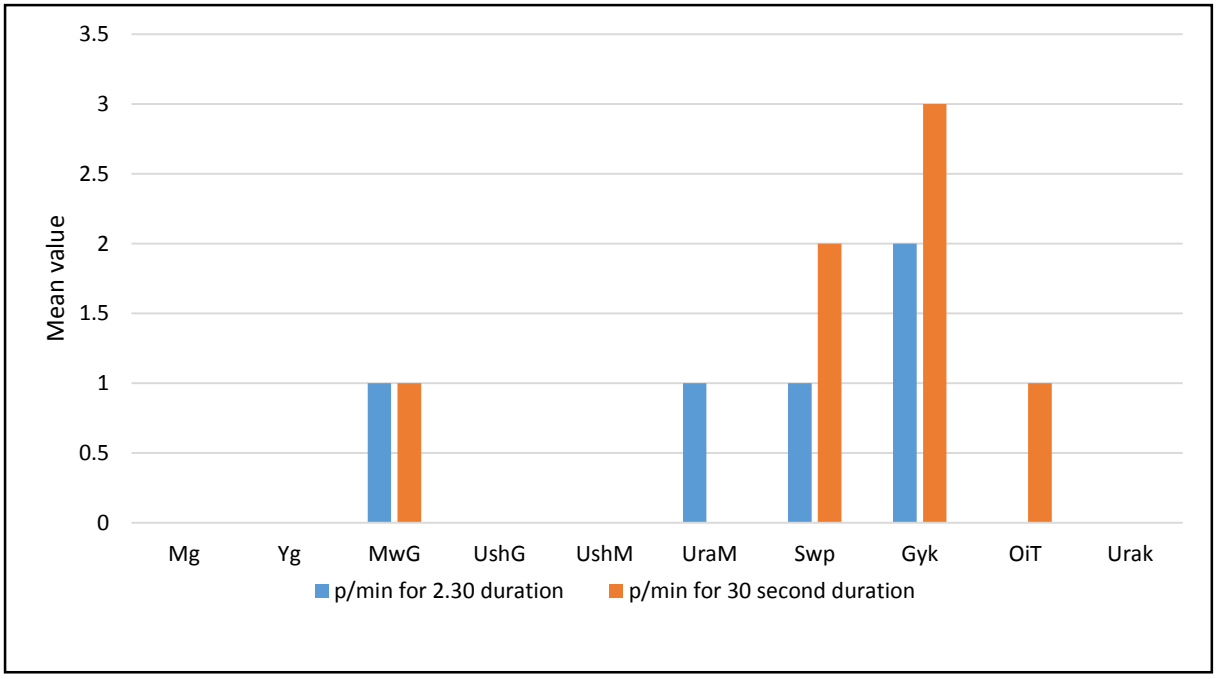

Figure 10: Comparison of the athlete's technique execution rate; within first 2.30 minutes and last 30 seconds.

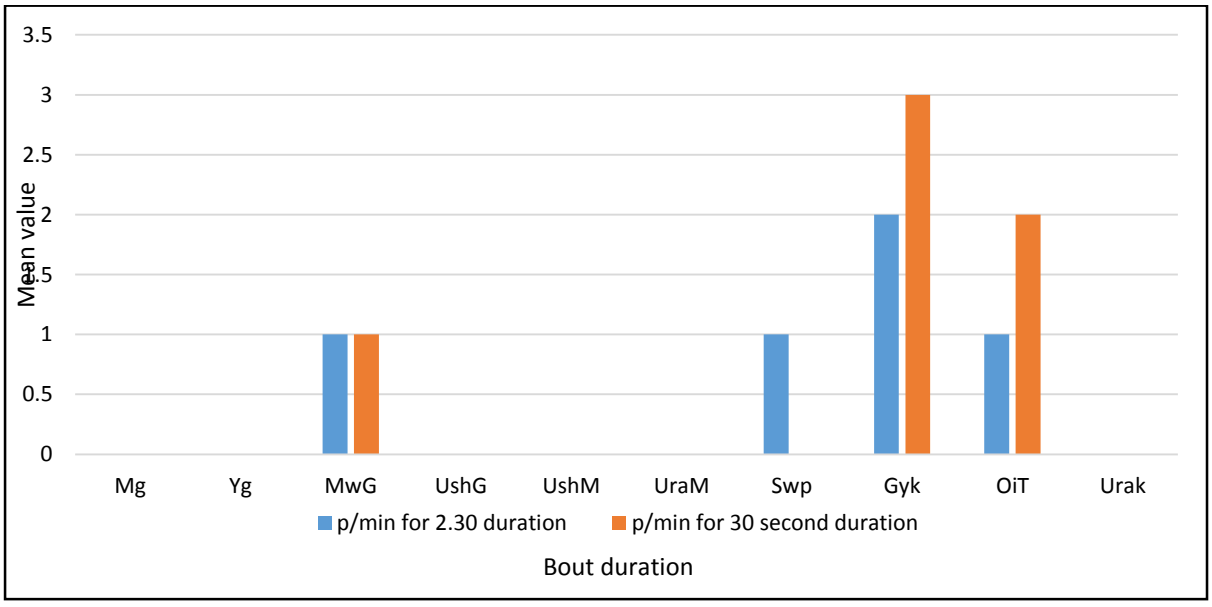

Figure 11: Comparison of the opponents' technique execution rate; within first 2.30 minutes and last 30 seconds.

The Friedman test was used to test 3 variables. Table 12 shows a significant difference between dominant, neutral and cornered territory. Due to these results, a series of tests were undertaken to compare against one another, p-value showed <0.05 (Table 13).

Table 12: Data statistics showing a significant difference between territories.

N	20
Chi-Square	25.923
df	2
Asymp. Sig.	.000

There's a significant difference between comparisons of territories, although dominant/neutral are statistically close (Table 13).

Table 13: Statistical comparisons of mat territories.

	Dominant - Neutral	Dominant - Cornered	Neutral – Cornered
Z	-1.665[b]	-3.427[c]	-3.839[c]
Asymp. Sig. (2-tailed)	.096	.001	.000

Table 14 statistically shows mean value, and standard deviation for all techniques executed within specific mat territory positions. Figure 12 visually shows the comparison of mean values for the athlete and opponents. Table 14 shows the frequency of techniques were significantly executed within the dominant and neutral positions. Percentage of total techniques executed within a cornered position was 8%, neutral 51%, dominant 41%.

Table 14: Statistics of mean values for mat territory positions.

	Minimum	Maximum	Mean	Std. Deviation
Cornered	0	4	1	1.3
Neutral	0	14	6.9	3.6
Dominant	1	18	5.4	4.4

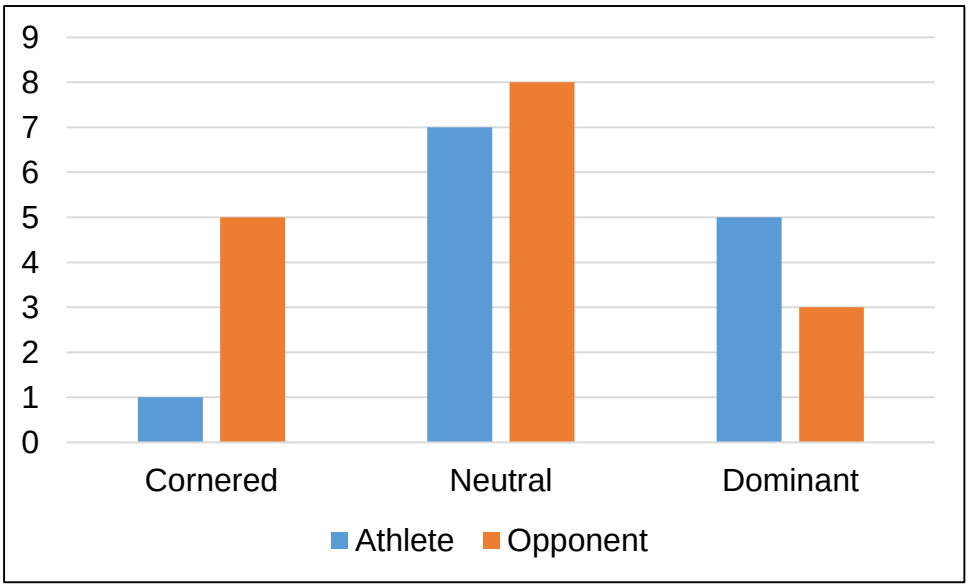

Figure 12: Mean values of technique execution in relation to mat territory positions.

DISCUSSION

There were a total of 266 techniques executed by the athlete within 20 bouts analysed. Table 4 showed total scores awarded were 58, to be an 18% success rate. A low success rate was due to the athlete executing a high rate of techniques with the intention of pushing the opponent into a defensive (cornered) position. Nelson (2004) states, the use of executing a technique as a feint improves offensive pressure. Gyaku Tsuki was the most predominant scoring technique executed by the athlete, accounting for 54% of all scores. This result is in agreement with previous research undertaken. Findings of Koropanovski and Jovanovic (2007) also found that Gyaku Tsuki was the most predominant scoring technique executed within 110 fights analysed; achieving 35% of all scores. Table 3 showed the opponents' executed more techniques; 321, only being rewarded 5 scores. This calculated a low success rate of 2%. The opponents' most predominant executed technique was also Gyaku Tsuki.

The overall execution rate for the opponent is much higher in comparison to the athlete, also gaining a low success rate of 2%. This was due to the opponents' excessively executing techniques without an intention of gaining a score. The opponents' were excessively executing techniques to make the athlete 'back off'. Techniques were executed by the opponents' with a close range of kick/punches. Punches were predominantly being used to counteract the athlete, and kicks being used to make the athlete 'back off'. When pushing the athlete, the predominant place of contact was the head; using Mwashi Geri (head), and Gyaku Tsuki (Body) being used to counteract the athlete. As indicated by Nishimura and Sakamoto (2003), kicking techniques have a much slower execution rate, contributing to being more vulnerable for an opponent to block and counteract. This was observed frequently by the athlete, when the opponents' were offensively attacking with Mwashi Geri (to the head). The athlete would counteract with either Gyaku Tsuki (to the body), or when losing he would intercept the opponents' supporting leg with a sweep in order to gain a high scoring tariff. Findings show that Gyaku Tsuki was likely to be the most predominant techniques, due to the technique being the shortest execution time. Furthermore, implementing this technique allows a competitor to remain protected, due to the other hand being used to provide a protective block.

(Marine Corps, 2014) The sweep technique can be used as a defence, the athlete frequently applied this during the opponents' execution to attack the supporting leg. The sweep was predominantly used by the athlete whilst within a cornered position, however a block was the most frequent counteract technique within a neutral and dominant territory for quick reaction.

In comparison to the athlete, Gyaku Tsuki was being used equally within many situations, being adaptive between the variables made it more difficult for the opponents' to counteract/intercept an incoming technique. Due to the athlete being more adaptable between variables, this suggests why results were more closely balanced in comparison to the opponents'. In this study, Mae Geri, Yoku Geri and Ushiro Geri were not executed by both the athlete and opponents'. In agreement, Koropanovski and Jovanovic's (2007) states, Ushiro Geri, Mae Geri and Yoku Geri were not executed within 110 bouts. Due to these techniques not being executed, this could possibly be due to the high technical difficulty for execution. Difficulty of execution can be related to the speed of the technique, or an individual's biomechanical limitations (e.g. kicking to the head). However, Uraken was executed one by the athlete throughout all bouts; Koropanovski and Jovanovic's (2007) claims, Uraken was not executed within their study. The athlete and opponents' both used a small range of techniques, if more techniques were adopted, this would make the athlete and the opponents' more effective; enabling a wider range of techniques to select from. Furthermore, contacting with complex techniques will reward a higher scoring tariff. The athlete and the opponents' used a small range of techniques, although what made the athlete gain scores was the adaptability of variables. The adaptive variables made it more difficult for the opponents' to 'read' the incoming technique.

Left/right execution

All techniques can be executed using left and right. Results have established a closely matched left/right execution by the athlete, a mean value of 8 executed left and 6 executed right. Although the athlete predominantly executes left techniques, both sides being closely matched enabled the athlete to be more adaptable. In comparison to the opponents left/right side execution, results show the opponents' execution for both sides were unbalanced. The opponents' mean values are

calculated as 4 (left), 12 (right). The athlete's punching and kicking techniques were balanced. Although, the opponents' predominantly executed Gyaku Tsuki with the right side. The left side was predominantly used for Mwashi Geri (left side). As previously stated, the athlete would counteract this kicking technique with Gyaku Tsuki (body), or intercept with a sweep.

Punch/Kick

The athletes mean value for punch/kick executions are closely matched, although punching techniques were the most predominant execution; Gyaku Tsuki being the most predominant scoring technique. Again, it's essential for these two related characteristics being closely balanced. Having the ability to be adaptive depending on the fighting situation. Further analysis established what types of techniques were used, depending on the bout duration. This was important to investigate, as depending on the bout duration depended on the technique variations. Punching techniques were predominantly executed throughout duration of bout, used within offensive/defensive pressure. Punching techniques were used to push opponents' into a defensive mat territory, also used as a defensive technique for counteracting.

Bout Duration

Undoubtedly, there was significant difference between total amount of techniques executed within first 2.30 minutes and last 30 seconds by the athlete. However, table 11 showed the athlete increased execution rate within the last 30 seconds. Increased execution rate can be due to two circumstances; either the athlete losing on points, executing more frequently to gain points, or defensively blocking/counteracting the opponents' techniques. Figures 10 and 11, established specific techniques as a mean value in relation to bout duration per minute.

Results showed the execution rate p/min for first 2.30 minutes (mean value= 4.4); last 30 seconds showed there was an increase in execution rate (mean value= 4.8). Due to results of many variables being balanced (For example; dominant mat territory, offensive executions, 58 techniques awarded, total techniques executed being much lower than the opponents), this showed the opponent was behind on points; chasing the athlete, causing the athlete to increase execution rate to defend.

An increase in sweep execution by the athlete rate within the last 30 seconds suggests a defensive strategy was taken place. Marine Corps (2014) states, a leg sweep is commonly used to takedown an opponent when being pushed backwards. Also indicating that a sweep is commonly used as a defensive technique to put an opponent off balance. When the athlete executed a sweep within this position, a higher scoring tariff was gained (3 points). The athlete also increased execution rate, using Gyaku Tsuki and Oi Tsuki (punching techniques), this also suggests the athlete was executing more defensive executions within the last 30 seconds, Research indication that these techniques are predominantly used with defensively counteracting all techniques (Nakayama ,1978).

Place of contact.

Table 4 showed there was a significant difference between places of contact. The athlete's mean value for techniques place of contact was 10 to the head, 3 to the body. The opponents' mean values calculated as, 14 to the head, 2 to the body. As previously stated, requiring a wider range of fighting characteristics will make an athlete more effective. Both competitors have not used a wide range of techniques, although what allowed the athlete to make contact to the opponent more frequently was attaining more balanced characteristics. The athlete has a more balanced left/right side execution, also balancing punching/kicking techniques. The opponents' were executing head techniques whilst repetitively using right side executions, and predominantly punching. Continuously attacking an elite athlete to the same body part, repetitively using the same characteristics would undoubtedly have a lower success rate. It's essential to have a wider variety of characteristics in order to adapt to for specific situations. The athlete was predominantly contacting the opponents head throughout both bout durations.

There was a similarity between the place of contact for the athlete and the opponents'. The place of contact statistics were not balanced, techniques to the head were the most predominant place of contact. The athlete was able to achieve more scores than the opponent, due to techniques being executed with adaptable variables. Contact to places of contact were similar between the athlete and the opponents'. Competitors predominantly contacted the head more frequently throughout bouts when under an offensive pressure. The body was predominantly

used when counteracting an opponents' technique. When the opponents' executed a technique under a defensive pressure, the most predominant method used was Gyaku Tsuki (body); commonly used for counteracting technique's. Kicking techniques were predominantly executed to the head. As stated, WKF (2013) suggests competitors execute more head kicks rather than to the body, due to the higher scoring tariff given when targeting this place of contact.

Offensive/defensive technique in relation to mat positioning.

Techniques can be executed offensively and defensively within all mat positions. Depending on the mat territory the athlete was being placed within and the oppositions' tactical intentions. This influenced whether an offensive or defensive technique was executed. Figure 6 visually shows it's important for a competitor to have adaptable techniques and a wide range of characteristics. Throughout the complete series of fights, the athlete was under the three following situations, in relation to the mat positioning.

- Athlete- Dominant position

The athlete throughout the series of fights, aimed to place the opponents' into the corner and himself into a dominant position to score an offensive technique. The opponents' frequently waited for the athlete to attack in order to counteract with a defensive technique. The predominant technique used by the athlete within this position was Gyaku Tsuki (Head); offensive pressure, balance of left/right.

- Athlete- Cornered position

The athlete was rarely placed into a cornered position. When in this position, the athlete would tactically place himself into the corner; influencing the opponents' to execute an offensive technique. The athlete was placed within the cornered position, whilst predominantly being in control. The tactical intention was to make the opponents' think they were in control, whilst waiting for the opponents' to execute an offensive attack, to counteract with an offensive execution. The athlete predominantly executed the opponent's incoming attack with a sweep, using the technique as a block, to invade the incoming attack. Nelson (2004) implies, an

opponent with less experience can be provoked into executing a counter that the athlete wants them to do, in order to tactically set up a strategy.

- Athlete- Neutral Position

As stated, the opponents' total execution was 321. The opponents' were frequently executing more techniques within a bout than the athlete, frequently executing most techniques within the neutral position. Techniques within a neutral position was often used to back the athlete within the corner. When both competitors were within a neutral territory, the athlete balanced between offensive techniques. Offensive techniques were used to push the opponent into the corner; defensive techniques were used to counteract incoming attacks whilst in neutral position. The most predominant techniques used within the neutral position was a defensive Gyaku Tsuki; to counteract. An offensive Gyaku Tsuki and Mwashi Geri was used to pressure the opponent into the corner.

CONCLUSION

The study developed a notational system to examine the predominant scoring technique for the WKF World Senior Karate Champion, Rafael Aghayev of Azerbaijan. A number of conclusions have been established to identify the predominant tactical intentions which the athlete applied through 20 series of Kumite bouts. It can be concluded that the athlete's most predominant scoring technique was Gyaku Tsuki; accounting for 54% of all scores. Due to the execution rate of Gyaku Tsuki, this influenced the dominance of punching techniques awarded. Overall, the punch/kick results were closely matched but were numerically significantly different.

In order to establish the athlete's most predominant side of execution, left and right side was examined. Results were closely matched which made the athlete more effective, the athlete was adaptable at executing techniques either side. Although, there was significant difference; mean value for left was 8 (58% of executions), right side mean value was 6 (42% of executions). Due to the left/right side and punch/kick variables being balanced, this made the athlete more effective due to the ability of characteristics.

The predominant place of contact was the head. The athlete was still able to effectively score due to techniques being executed with balanced and adaptable variables. Undoubtedly, there was significant difference between the total amount of techniques executed within the first 2.30 minutes and the last 30 seconds. However, results showed there was an increased execution rate within the last 30 seconds. Due to specific techniques such as Ashi- Barai, Gyaku Tsuki and Oi Tsuki increasing, this suggests the athlete was executing defensively; the opponents' were increasing execution rate to chase scores. Literature by Nakayama (1978) and Marine Corps (2014) provided knowledge of these results, indicating that these specific techniques are predominantly used for counteracting within a defensive position. Total number of techniques executed within mat positions expressed as a percentage; Cornered 8%, Neutral 51%, Dominant 41%. Results showed, the athlete was predominantly executing techniques within the neutral and dominant position. Percentage for total number of offensive executions was 64% (mean value of 8), defensive execution 36% (mean value of 5).

REFERENCES

Books

Dudley Associates (1998). *Play the Game*. London: Sterling Publishing Company. Pg 49 & 62.

Hughes, M & Franks, I. (2004) .Notational Analysis of Sport: systems for better coaching and performance in sport. (2nd Edition). Routledge. London.

Marine Corps (2014). *Fundamentals of Marine Corps Martial Arts*. United States Marine Corps: U.S Marine Corps. Pg32-33.

Mitchell, D. (2002). Know the Game: Karate (2nd Edition). London. A & C Black. Pg.27-32.

Nakayama, M (1997). *Best Karate Comprehensive*. Okinawa: Kodansha. pg.20-30

Nelson, D. (2004). *Focusing Martial Arts Power: A Guide for Beginners and Advanced Students*. London: Lulu Press. Pg18-25.

Journals

Chaabène, H; Franchini, E; Miarka, B; Selmi, M; Mkaouer, B; & Chamari, K. (2014). Time-motion analysis, physiological and rate of perceived exertion responses to karate official combats: Is there a difference between winners and defeated karatekas?. *International Journal of Sports Physiology and Performance*. 9 (2), 669-675.

Critchley, G. R; Mannion, S & Meredith, C. (1999). Injury rates in Shotokan Karate. *British Journal of Sports Medicine.* 33, (1)., pg174

Imamura, H., Yoshimura, Y., Nishimura, S., Nishimura, C., Sakamoto, K. (2003). Oxygen uptake, heart rate, and blood lactate responses during 1,000 punches and 1,000 kicks in female collegiate karate practitioners. Journal of Physiological Anthropology and Applied Human Science, 22(2), 111–114.

Koropanovski, A & Jovanovic, S. (2007). Model Characteristics of Combat at Elite Male Karate. *Serbian Journal of Sports Sciences*. 1 (3), 97-115.

Macan, J., Vrbanac, D. B. And Romic, G. (2006) ‘Effects of the new karate rules on the incidence and distribution of injuries’, *British Journal of Sports Medicine,* 40:326-330.

McLeod, K & Laird, P. (2009). Notational analysis of scoring techniques in compeitive men's karate. *International Journal of Performance Analysis of Sport*. 9 (2), pg171-187.

Tabben, M., Coquart., J. Chaabene., H. Franchini., E. Ghoul., N. Tourny, C. (2014). Time-motion, tactical and technical analysis in top-level karatekas according to gender, match outcome and weight categories. *Journal of Sports Sciences*. 33 (8), 841-849.

Tsolakis, C., and Bogdanis, G. C. (2012). Acute effects of two different warm-up protocols on flexibility and lower limb explosive performance in male and female high level athletes. *Journal of Sports Science and Medicine*, 11(4), 669–675

Zetaruk, M. N; Violan, M. A; Zurakowski, D & Michelo, L.J. (2005). Injuries in martial arts: a comparison of five styles. *British Journal of Sports Medicine.* 39 , 29-33.

Web Addresses

World Karate Federation. (2013). *Kata and Kumite Competition Rules.* Available: http://www.wkf.net/pdf/wkf-kataandkumite-competition-rules.pdf. Last accessed 20/03/2015.