TACTICAL OPTIONS AND EFFORT DISTRIBUTION OF 200M EVENT IN VARIOUS SWIMMING STYLES AMONG ELITE SWIMMERS

By

LOW KHENG AIK

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Abstract

The aim of this study was to investigate the tactical options (also known as pacing strategy of the swimmers in 200m event. A total of 16 male swimmers were selected from the finals' result sheets in the 14th FINA World Championship, 2011 and Incheon Asian Games, 2014.

The tactical options were investigated through analysing the timing of the races with each 50m split and according to the individual's total time of the race. Only the time factor and efforts distribution were considered in this study.

Comparisons were made within the winners and losers of their 50m split timings as well between those. Comparisons were also made using 50m split timings between the winners and losers. For all the 50m split comparisons, there was a statistically significant difference between each of the 50m split timings. As of within winners and losers comparisons, all events showed no statistical significance while between winners and losers, only 200m Backstroke event has shown statistically significant difference.

In conclusion, there were differences in the tactical options used by the medallists and non-medallists for all four swimming styles in 200m swimming event.

Abstrak

Tujuan kajian ini dijalankan adalah untuk mengkaji pilihan taktikal atau strategi jarak dalam kalangan perenang dalam acara 200m. Sebanyak 16 perenang dipilih daripada pusingan akhir Kejohana Dunia FINA ke-14, 2011 dan Sukan Asia Incheon, 2014.

Kajian berkitan pilihan taktikal dibuat melalui analisis masa perlumbaan untuk setiap pecahan 50m dan juga jumlah keseluruhan perlumbaan individu. Hanya faktor masa dan taburan usaha yang diambil kira dalam kajian ini.

Perbandingan dibuat antara pemenang dan yang kalah dalam pecahan masa 50m. Selain itu, perbandingan juga dibuat melalui pecahan masa 50m untuk pemenang dan yang kalah. Perbandingan untuk pecahan masa 50m antara pemenang dan yang kalah, terdapat perbezaan untuk setiap pecahan masa setiap 50m. Manakala untuk perbezaan antara pemenang dan yang kalah, hanya acara kuak lentang 200m menunjukkan perbezaan.

Sebagai kesimpulannya, terdapat perbezaan dalam pilihan taktikal yang digunakan oleh pemenang dengan yang kalah dalam keempat-empat acara renang 200m.

CHAPTER I - INTRODUCTION

1.1 Background of the Study

In the current era, sports have advanced and evolved tremendously if compared to even a few decades ago. Currently, the rise in demand for excellence in high level performance is commonly seen in every type of sports. Swimming is a sport where it had increased its popularity over the years. Not to mention the technique and skills about swimming had both evolved drastically over the years.

According to the Economic and Social Research Institute (ESRI) survey in Ireland, swimming is a most common sport and physical activity among young adults. Approximately 7% of adults aged 16 and over do swimming in a week, piling the number up to approximately 230,000 regular swimmers (Kelly & Lunn, 2013).

On the other hand, swimming is one of the most competitive sports and the performances are improving as time passed. Nowadays, there are many ways on analysing the swimming performance. According to the World Swimming News, swimming is a competition where one competes against time. Time does not lie or favour any swimmer. It is one of the most accurate measurements of success. The time is the sum of splits where splits are the result of strokes and kicks. Speed, velocity, anthropometrical measurements also play a role in affecting the final time. Therefore, statistical analysis can be used to analyse and enhance the swimming performance. As for the gender concerns, elite male swimmers typically swim average 10% faster than their female counterparts.

Swimming competitions include the variety of events, the shortest being 50m and the longest – 1500m, exposing the competitors to the variety of physiological mechanisms right from anaerobic a-lactic up to aerobic in nature. This fact basically

divides swimming events into sprint (50-100m), which does not involve much of a tactics or strategy; middle distance (200-400m) swimming which opens a lot of options of efforts distribution; and long distance swimming (800-1500m) which typically is about economisation of performance.

According to the USA swimming organization, Russell Mark (Mark, 2013) from the national team sports performance consultant stated that a 200m event requires both distance per cycle and speed. The time for each 50m splits is different and the tempo increases from 2nd 50m to the 4th 50m. By analysing the 50m splits in a 200m event, we can analyse or evaluate the race execution. The 1st 50m will always be faster than the 50m because of the starting dive. When fatigue increases, the split for each 50m also increases progressively. On the other hand, the last 50m will be slightly faster than the 3rd 50m due the transition turn and the finishing touch difference. On the other hand, no studies were so far attempted to compare the efforts distribution in various swimming styles, although they all differ in the skill requirements and skills stability throughout the 200m race.

The Australian Institute of Sport had conducted a preliminary analysis in Olympic swimming events and managed to identify two main trends. Firstly is that in sprint events such as 50m and 100m the races were decided in the last 25m and last 50m respectively. Secondly, middle-distance such as 200m and 400m events were set up with second lap speed.

Apparently, 200m event becomes a combination of skills, tactics and effective utilisation of physiologic mechanisms, which all together make this event very attractive from the scientific and practical point of view. This opens up a wide variety of

performance structure possibly applied during the competitions. The same has not been seriously researched so far.

1.2 Problem Statement & Limitations

Considering the absence of the research studies comparing four swimming styles in respect to the tactical options of competing in 200m race, we expect getting some new knowledge on the problem. It seems very prospective to analyse the influence of mounting through the race fatigue on more complex skills' styles of swimming (back stroke and butterfly) in comparison to the less complex styles, like breast stroke and free style.

In this study, we will only use the middle distance event which is the 200m event in all four strokes, which are Freestyle (Front Crawl), Backstroke, Breaststroke and Butterfly. A 200m event is more appropriate to investigate the tactical options of the individual. Tactical options in the current context are equal to the effort distribution, for example how the swimmer varies his/her speed/time to win the race. Instead of analysing stroke, kicks or turns for each 50m in a 200m event, this study aims analysing the split timings for each 50m to investigate the different tactical options or pace distribution used by swimmers. Comparison among swimmers will be done also in relation to the mean race timing while dividing the research subjects into the winners and 'losers' (rather non-winners) groups as per their finishing timing and placing. This may allow to figure out what is the winning efforts distribution to follow.

The limitation to this study is that there is no control group to evidently determine the best tactical option for a 200m event. The comparison in this research will be done only among the data collected from 13th FINA World Championship 2013 and Asian

Games 2014. There are not many studies about tactical approach in swimming due to the nature of this sport which is dealing with time factor as an opponent. Therefore, results of this study may help contributing and enhancing the validity and reliability of other similar attempted research.

1.3 Significance of the Study

This study will help providing better tactical options and strategy planning for swimmers in middle distance events. This will also ease coaches by statistically analysing the swimming performance using the time factor which is for each of the 50m splits. The findings of this study can be significant for practical application in both training and competitions, thus will be also useful when coaches are teaching the swimmers to include tactics and strategy in their swimming performance.

Results of the study might be useful for the coaches in the sub-elite division in their quest to improve performance of their trainees up-to the top international level.

1.4 Research Objectives

General Objective

- To determine the available tactical options based on split timings among male swimmers in 200m event in various strokes.

Race dynamics do not develop spontaneously, but rather reflect the strategy on situation. Hence, specific objectives are as follow:

Specific Objectives

- To determine the available tactical options based on split timings swam by the medallists and non-medallists in 200m Freestyle event.
- To determine the available tactical options based on split timings swam by the medallists and non-medallists in 200m Breaststroke event.
- To determine the available tactical options based on split timings swam by the medallists and non-medallists in 200m Backstroke event.
- To determine available tactical options based on split timings swam by the medallists and non-medallists in 200m Butterfly event.

1.5 Research Hypothesis

(H_0): There would be no difference in tactical options based on split timings among male swimmers in the 200m event of the four strokes.

(H_A): There would be a difference in tactical options based on split timings among male swimmers in the 200m event of the four strokes.

CHAPTER II – LITERATURE REVIEW

2.1 Swimming Performance

Swimming performance has improved so far due to advanced training procedures, sophisticated selection methods and superior stroke mechanism (Arellano, Brown, Cappaert, & Nelson, 1994). Arellano, Brown, Cappaert and Nelson proposed that there is variability in the velocity components due to stroke rate (SR) and stroke length (SL). Swimming velocity also includes the parameters of body physiology and its anthropometrical features but it is suggested that these components contribute little to the swimming velocity. Elite male swimmers are faster than female swimmers averagely by 10%. In the study of Arellano, Brown, Cappaert, & Nelson (1994), it is said that previously reported investigations concerning various aspects of swimming performance often been somewhat narrow in scope. It is either the study consists of small sample size or lack the presence of elite swimmers. Conducting the research under training or experiment conditions could also lead to narrow scope of study. Arellano conclude that as the race distance increases from 50m to 200m, stroke length and the time to complete each phrase, while stroke rate and age of the swimmers decrease (Arellano, Brown, Cappaert, & Nelson, 1994).

2.2 Swimming Styles' Variations

The fastest stroke is Freestyle, followed by Butterfly, Backstroke and Breaststroke. A high-level Freestyle swimmer presents higher and more stable data throughout the race in regards to spatial-temporal parameters in 100m and 200m distances (Tiago, Barbosa, Reis, & Marinho, 2010). In this research, Barbosa (2010) stated that all stroke parameters had the tendency to decrease in longer events. Chollet, et. al. (1996) proved that in high-level swimmers, stroke frequency decreased from 100m to 200m but the

stroke length had no changes between the event Backstroke and Freestyle. In Butterfly, stroke length decreased from 100m to 200m, Breaststroke on the other hand increased during this instance (Chollet, Pelayo, & Tourney, 1996). In Barbosa's (2010) study of intra-cyclic variation of the horizontal velocity of the centre of mass between the four strokes, Butterfly and Breaststroke present a higher variation than Freestyle and Backstroke.

2.3 Swimming Distance and Course Tactics Dependence

Sundstrom et al (2014) had confirmed the findings of Morton (2009) that an all-out effort is optimal for pacing strategy in courses without turns and bending. On the other hand, in curved courses, the power output pattern differs which is an all-out start to increase speed followed by a moderate decrease in power output to a steady state phase. Power output decreased to nearly zero before braking in some distance but this braking phase was characterized as in order to achieve the required speed for cornering, braking power is then quickly increase to the point of minimum course bend radius (Sundstrom, Carlsson, & Tinnsten, 2014). Sundstrom (2014) considered the pacing strategies adopted in the research study to be variable distribution of power output. The most substantial differences in the pacing strategy between the two curved courses were breaking energy and the maximal braking power. It is concluded in the study that pacing strategy may be greatly affect by the course bends and applying proper pacing strategy on races with sharp bends is crucial to performance (Sundstrom, Carlsson, & Tinnsten, 2014).

Vasile (2014) stated in specialty literature (Maglischo, 2003), swimming performance for 100m race can be improved by up to 0.5 seconds if the swimmers can

master a correct stroke strategy in temporally managing their arm movements through a sustained paced and adapted to the swum distance. Two elements: perception of temporality and perception of one's own movements are related to the ability to adopt a correct pacing strategy in swimming. Perception of temporality is achieved by the auditory analyser, visual and kinaesthetic ones (Epuranm, Holdevici, & Tonita, 2001) While perception of one's own movements is a psychic cognitive process differentiated from kinaesthetic motor sensations (Golu, 2005). Stroke strategy choice is one of the most important decisions to be made before approaching a race. A swimmer who changes stroke rate frequently or has movement schemes abruptly alternated, will exhaust earlier than desired (Craig, Skehan, & Boomer, 1985). Therefore, each athlete must have certain types of race plans (Vasile, 2014).

The 3 types of pacing mentioned were even, fast-slow, and slow-fast pacing. Even pacing seems to be mostly used in the 200m events whereby swimmer keeps the same pace through the entire race. Fast-slow pacing is used by the swimmer who felt the need to take race out ahead the competition. They usually swim faster in the early part of the race, keep the pace or slow it down and lastly sprinting the last part of the race. Slow-fast pace also known as negative splitting, are for those who desired to delay fatigue early in the race. This is mastered by advanced athletes (Vasile, 2014). Swimmers must analyse their pacing to control the effort distribution during the race.

Dr. G. John Mullen (2014) stated that pacing is a vital element for most swim races. Factors, such as avoiding the slowdown are potentially damaging in view of the homeostatic disturbance (Mullen, 2014). Skorski (2014) conducted a study in three trials, which are self-selected pace, fast pace during first 100m and slow pace during the first 100m. In general, some of the subjects recorded the fastest time in manipulated race pace but on average swimmers were 0.6% faster in the self-selected pacing strategy.

Skorksi (2014) concluded that self-selected pacing strategy fits best for most swimmers but on the other hand, a significant portion of swimmers did a better performance with either slow or fast pacing strategy (Skorski, et al., 2014).

Successful performance in competition relies on complex interaction with many factors. (Hopkins & Hewson, 2001). One of the main factors is the pacing strategy which is considered a key element in performance (Foster, et al., 1993). Self-selected pattern of pacing is important to be characterized to determine the most effective pacing for an event. Although simmers are routinely advised by the coaches to adopt a particular pacing plan for an event, limited quantitative data on how variations in lap times affect swimming performance in international performance are bound to occur (Robertson, Pyne, Hopkins, & Anson, 2009). Robertson's study stated that in international swimming competitions, semi-finalists and finalists showed similar pattern of lap times but winners had a faster final lap than other swimmers for the 100m freestyle. On the other hand, in 200m and 400m freestyle, winners generally maintained a lead through each of the intermediate laps.

2.4 Pacing Approach

There are many research articles devoted to swimming which mostly involve technique of movement such as the position of body parts, stroke length, rate, velocity, indices, technique of start and turn, improving of propulsion, diminishing of resistance forces, turn segments and the finish segments. According to the theory effort, lowest expenditure is obtained when the velocity movement tends to be steady (Lipinska, Kinematic tactics in the Women's 800m Freestyle Swimming Final at the Beijing 2008 Olympic Games, 2009). In the research of Lipinska (2009) in women's 800m freestyle

swimming final, it is stated that only the top 3 swimmers had an ascending line of velocity but the first swimmer that finish did not have the highest ascending line. It is also shown in the variation analysis that 2 swimmers swam the second half of the race faster than the first half which is also called the negative-split. Only the winners kept the similar velocity for all quarters in this research. The other swimmers had different swimming approach which their middle segments being slower while the first and the last segments were faster. Patrycja (2009) concluded in her research that the general trend is to swim a little faster within the second half of distance in comparison with the first quasi-half (Lipinska, Kinematic tactics in the Women's 800m Freestyle Swimming Final at the Beijing 2008 Olympic Games, 2009). In other research which is on men's 1500 freestyle swimming final, it is concluded that to approach sport performance with proper tactics, sportspersons need to be taught on how to achieve a good distribution of velocity of movement along the entire distance of swimming with the general tendency to swim faster within the second half of distance (Lipinska, Kinematics Tactics in Swimming Races on the Example of the Beijing 2008 Olympic Games and the Rome 2009 World Championship, 2011).

In the study of Vasilios et al, (2013), it is stated that technique and tactics are subordinate to just obtaining the shortest time of running a course in a competitive alpine skiing (Giovanis, Aschenbrenner, & Erdmann, 2013). Although it is a different sport, it has the same goal for both alpine skiing and swimming which is achieving the fastest time to complete the race. In this research, Vasilios (2013) stated that to obtain optimal distribution of effort during the entire race duration, appropriate tactics should be taken into consideration. Vasilios (2013) discussed that a before the start of the race, information on the situation at the race can influence the decision made according to their performance and strategy. This is based on the analysis of kinematics indices one

can see the influence of succession of start on the end results (Giovanis, Aschenbrenner, & Erdmann, 2013).

Although not many studies were done on tactical approach in swimming events, David et al. (2004) had conducted a study on progression and variability of competitive performance of Olympic swimmers. It is stated that one of the fundamental component to competitive swimming is the issue of progression of performance times within and between races (Pyne, Trewin, & Hopkins, 2004). Progression is generally required to ensure that a swimmer qualifies for the finals. This can be seen as a tactical approach within event progression. In this study, near linear improvement in performance between races within competition were observed. Beneficial effects of training such as improvements in fitness and conditioning, swimming skills and technique, tactics and pacing strategies, and psychological skills are the manipulating factor for the progression in performance times from competition to competition (Pyne, Trewin, & Hopkins, 2004). Pacing strategies could explain the faster times from heats to finals within a given competition.

Pacing strategy or tactics is largely related to the duration of a competitive event (Koning, et al., 2011). It is stated in de Koning's research that shorter events show much more 'all out' while 'faster-slower-faster' prevails as duration of the event increases. De Koning (2011) stated that runners accelerate quickly and then decelerate slowly over their race, speed skaters has high early velocity with a comparatively large slowdown while swimmers traditionally display very evenly paced races. There is evidence in swimming stating that velocity variations associated with the start and push-off on the turns VS free water swimming (Koning, et al., 2011)

De Koning (2011) also stated a few factors about the dictation of pacing pattern. First of is the difficulty of accelerating at the beginning of the race. Second is the loss of power output due to fatigue causing a slowdown. Third, the power losses to the environment and lastly the amount of essentially wasted kinetic energy at the end of the race. Jos's model shows that optimal solution for 200m swimming is that swimmers are almost evenly paced with a very close to average velocity and ideal 50m splits of 24.9%, 25.0%, 25.1% and 25.2% of total time (Koning, et al., 2011). It is also stated that the top three world best 200m swimmers have splits of 23.5%, 25.4%, 25.8% and 25.2% of total time.

2.5 Basics of Competitive Tactics in 200m Races

The literature dealing with competitive swimming distinguishes three basic tactical approaches which are Even Splitting, Negative Splitting and Positive Splitting (Rakowski et. al, 2008). In this study of Kucia-Czysczon, Dybinska, Bieniek, & Ambrozy (2014), Even Splitting enjoys the greatest popularity and is considered most effective as this aims to evenly distribute the energy expenditure throughout the race. Negative Splitting is where swimmer gradually increases speed thus having faster split in the 2nd half of the race. Positive Splitting is where swimmer gradually decreases in speed, having faster split in the first half of the race. Kucia-Czyszczon et al (2014) state in this study, that Negative Splitting is not as effective as tactical solution but recommended for low endurance swimmers who can accelerate at the final phase of the race. On the other hand, Positive Splitting could give an advantage mainly due to the psychological effect on opponents but only if the swimmer has optimal psychological preparation (Payton, Hay, & Mullineaux, The Effect of Body Roll on Hand Speed and

Hand Path in Front Crawl Swimming - a simulation study, 1997) & (Payton, Bartlett, Baltzopoulos, & Coombs, 1999).

Kucia-Czyszczon et al (2014) state that Michael Phelps shows the most significant difference in the 200m Freestyle event in the 2008 Beijing Olympic which respectively are 1.5s, 0.99s, 0.51 and 0.75s for each 50m comparing to the other 2 medallists. In this study authors suggest that individual tactics do play an important role in swimming. Every swimmer has his/her own preference of tactics for the competition which allows them to minimize fatigue effect and to mobilize the body (Kucia-Czysczon, Dybinska, Bieniek, & Ambrozy, 2014). This research also shows that the medallists share the same characteristics for the 100m Freestyle event which the first 50m is faster than the second 50m due to the start. Apparently, the key to swim 200m event effectively is to achieve and maintain the longest possible maximum swimming speed throughout the race. In the research of Kucia-Czyszczon et. al, it is stated that swimming as a sports discipline is not a typical tactical discipline. Athletes compete somewhat with time, and not directly with the opponents, therefore there is no major interaction during races. Besides that, the studies of Kucia-Czyszczon et. al. also state that a better tactical approach in swimming could increase the chance of qualifying or winning a medal.

Robertson (2009) discussed that mainly even pacing had been reported in 200m swimming with the most successful swimmers starting the race at the highest speed that can be maintained for four laps (Maglischo, 2003). It is reported in other middle distance events, predominantly even pacing is the most successful approach (de Koning, Bobbert, & Foster, 1999). A modelling approach combining between swimmers and within swimmer effects, shows that in the between-swimmer effect quantifies the magnitude of improvement required by an individual to improve the chances of a medal.

While on the other hand, the within-swimmer effect indicates the magnitude of improvement in final time an individual swimmer can anticipate (Robertson, Pyne, Hopkins, & Anson, 2009).

CHAPTER III – METHDOLOGY

3.1 Sample

The data of this study was obtained from the 13th FINA World Championship 2013 and the Asian Games 2014 result sheets. Only the finals result with the 50m split timings of the 200m event for male were analysed. This study focused on Freestyle (Front Crawl), Breaststroke, Backstroke and Butterfly. The data consists of both national and international swimmers.

Result sheets are presented in Annexure 1.

3.2 Procedure

Results are taken from the Finals of 14th FINA World Championship and Incheon Asian Games. Only the Finals were taken as the purpose of this study was to compare the tactical options of medallists and non-medallists. The split timings for each 50m was calculated and recorded in according to the total time for each individual. Comparisons were made together between the medallist and non-medallist of both tournaments.

3.3 Statistical Analysis

Statistical Package for the Social Sciences (SPSS) version 22.0 statistical program was used to analyse the data collected in this study. Results are exported into Microsoft Excel format for further analysis.

Means of total time are compared between winners and losers for all four 200m events. Bar charts were plotted to show the difference.

Descriptive Statistics were reported in mean and standard deviation for total time, each 50m split timings and swimmers (winners & losers). Comparison between the data was done by using Mixed ANOVA to compare the means of groups and standard deviation. There are 2 comparison done in this test, first - the within-subject analysis which is all four of the 50m split timings, second - each of the 50m split timing with winners and losers. The 50m split timings are in accordance to their respective total time for the 200m race. A level of significance of $p<0.05$ is used for all of the statistical analysis.

The relationship between each 50m split can be observed through the Pairwise Comparison of the Mixed ANOVA test for all events. Besides that, difference between winners and losers can also be observed in Pairwise Comparison.

For all four events of Freestyle, Breaststroke, Backstroke and Butterfly, the Mixed ANOVA was used in order to establish if any significant differences were observed between the split timings in all four styles independently. This study consists both within and between subject factors for all the events researched as shown in Table 3.1 and Table 3.2.

Table 3.1: Within-Subject Factors

Splits	Dependent Variable
1	P_Time
2	Q_Time
3	R_Time
4	S_Time

Table 3.2: Between-Subject Factors

Group Of Swimmers	Value Label	N
1	Winner	6
2	Loser	10

CHAPTER IV – RESULTS

Results of the study in relation to the swimming style and winner/loser total timing as well as split timings of the 200m distance are presented down below.

4.1 Tactical Options Used by the Medallists and Non-Medallists in 200m Freestyle Event

The mean timings for both the winners and losers swimmers in 200m freestyle event are presented in Figure 3.1. Winners in the 200m event have the mean timing of 105.8±0.488sec, while the losers have clocked 108.13±2.233sec. Therefore, it is obvious that the winners' group had a 2.33 sec faster mean timing as compared to losers' group which is shown in the bar chart.

Figure 4.1: 200m Freestyle total swimming timing comparison

Mentioned mean timing difference is significant, based on Table 4.1 which shows the independent sample test analysis. Reading from the equal variances assumed is taken because the *p* significant value is less than 0.05. As the t-test equality of means state that p=0.006 (t=3.25), which means that there is statistically significant difference between winners and losers mean timings (p<0.05).

Table 4.1: Independent T test for 200m Freestyle

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total Time	Equal variances assumed	16.188	.001	-3.252	14	.006	-3.04667	.93688	-5.05606	-1.03727
	Equal variances not assumed			-4.152	10.369	.002	-3.04667	.73378	-4.67378	-1.41956

Further analysis of the 50 m split timings is presented in table 3.2 and Figure 3.2

Table 4.2: Mean Time for Each 50m Split in 200m Freestyle

Group of Swimmers	Splits	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Winners	1	24.645	.191	24.235	25.055
	2	26.720	.180	26.333	27.107
	3	26.965	.256	26.416	27.514
	4	26.748	.307	26.091	27.406
Losers	1	25.283	.148	24.966	25.600
	2	27.343	.140	27.043	27.643
	3	27.788	.198	27.363	28.213
	4	27.711	.237	27.202	28.220

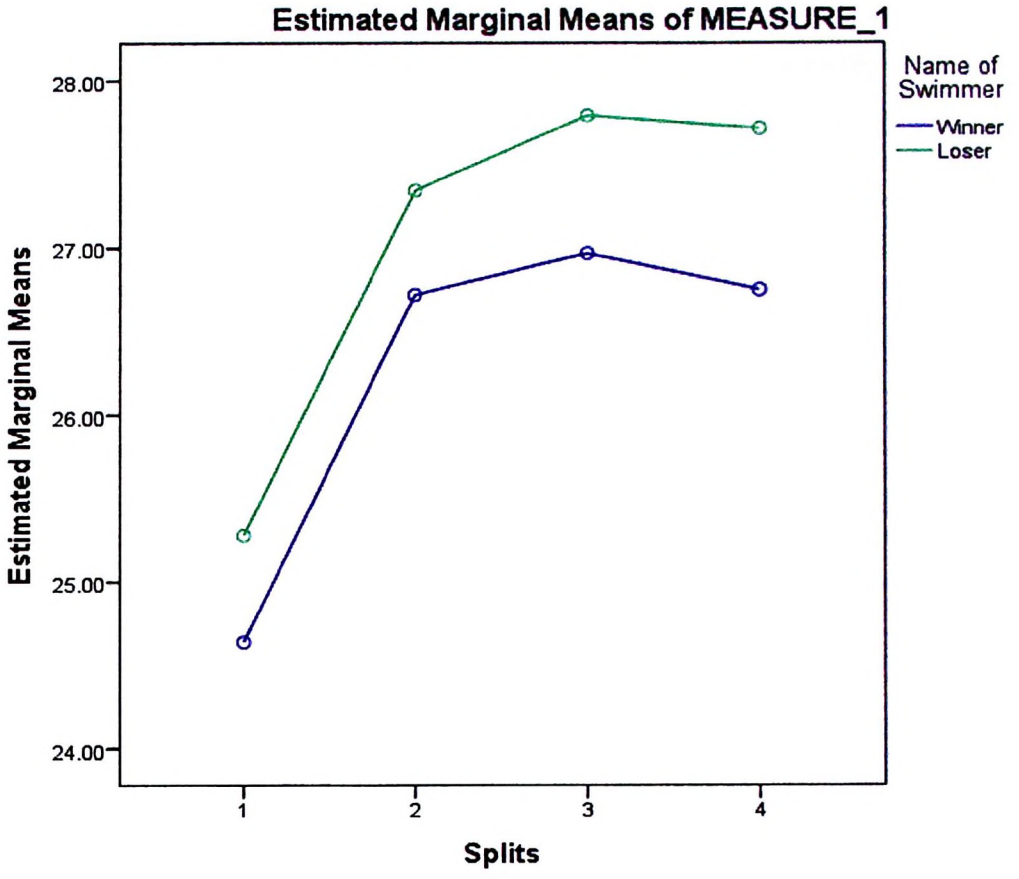

Figure 4.2: Line Graph of Means for 200m Freestyle

Table 4.2 shows the mean timings of each 50m splits in 200m Freestyle event. Figure 4.2 shows the plotted means for each 50m split timing between winners and losers based on the table 4.2. It is clearly shown that the trend to differentiate the winners' from losers' timings starts from the 2nd to the 4th 50m fragment, where winners had a higher decrease in time value as compared to the losers. In the 1st 50m split, winners had the mean of 24.64 sec, while losers had the mean of 25.28 sec. At the 2nd 50m split, winners had 26.72 while losers had 27.34. Winners had a mean of 26.96 sec and 26.75 sec in the 3rd and 4th 50m split respectively while losers had a mean of 27.79 and 27.71 in the 3rd and 4th 50m split respectively.

As it is seen from the Table 4.3 on the sphericity test using the Mauchly's test for 200m Freestyle, it is seen that significance value p=0.011, therefore the sphericity of this test is violated. If sphericity is violated, we would be looking at the Greenhouse-Geisser result because sphericity is not assumed and the p value of Greenhouse-Geisser is 0.618 which is less than 0.75.

Table 4.3: Mauchly's Test of Sphericity for 200m Freestyle

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Splits	.310	14.900	5	.011	.618	.759	.333

Table 4.4 shows the test of within-subject factors effects of 200m Freestyle. It is computed by setting value alpha to 0.05 which means the confidence interval is at 95%. Results are taken from the Greenhouse-Geisser test. In the Splits segment, the p value is 0.000. Since p<0.05, there is statistically significant difference between each of the 50m of 200m Freestyle. However, in the Splits*Swimmer segment, the p value is 0.577. Since p>0.05, there is statistically no significant difference within winner's 50m split timing and loser's 50m split timing.

Table 4.4: Test of Within-Subjects Effects for 200m Freestyle

Source	Type III Sum of Square	Df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Splits	57.779	1.855	31.156	105.429	0.000	0.883	195.518	1.000
Splits*Swimmer	0.295	1.855	0.159	0.538	0.577	0.037	0.998	0.127
Error(Splits)	7.673	28.963	0.296					

Table 4.5 shows the test of between-subject effects which is the 50m split timings between the winners and losers. It is seen that the significance value is 0.006, with a confidence interval of 95% ranging 2.59 to 1.264 (from loser to winner). Since p value is less than 0.05, there is statistically significant difference between winners and losers in 200m Freestyle event.

Table 4.5: Test of Between-Subjects Effects for 200m Freestyle

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	42614.683	1	42614.683	51787.403	.000	1.000	51787.403	1.000
Swimmer	8.702	1	8.702	10.575	.006	.430	10.575	.856
Error	11.520	14	.823					

Finally, Table 4.6 shows the pairwise comparisons for splits of 200m Freestyle. Bonferroni correction is used in this comparison. It is seen that the 1st 50m split has a statistically significant difference with the rest of the 50m splits in 200m ($p <$ is 0.001) with a 95% confidence interval ranging -2.309 to -1.826, -2.855 to -1.970 and -2.911 to -1.621 respectively for the 2nd to 4th 50m split. The 2nd 50m & 3rd 50m have a p value of 0.071 with 95% confidence interval of range -0.711 to 0.021; hence there is no significant difference between 2nd & 3rd 50m split. Besides that, the 2nd 50m & 4th 50m and 3rd & 4th 50m have the same p value of 1.000 with 95% confidence interval of ranging -0.757 to 0.361 and -0.363 to 0.656 respectively. Since p>0.05, there are no significant differences for both groups of 50m split timing.

Table 4.6: Pairwise Comparisons of Splits for 200m Freestyle

(I) Splits	(J) Splits	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-2.067*	.079	.000	-2.309	-1.826
	3	-2.413*	.144	.000	-2.855	-1.970
	4	-2.266*	.210	.000	-2.911	-1.621
2	1	2.067*	.079	.000	1.826	2.309
	3	-.345	.119	.071	-.711	.021
	4	-.198	.182	1.000	-.757	.361
3	1	2.413*	.144	.000	1.970	2.855
	2	.345	.119	.071	-.021	.711
	4	.147	.166	1.000	-.363	.656
4	1	2.266*	.210	.000	1.621	2.911
	2	.198	.182	1.000	-.361	.757
	3	-.147	.166	1.000	-.656	.363

Overall, only the 1st 50m split with the rest of the 50m split have significant, therefore resulting in insufficient proof to provide a statistically significant difference for the Mixed ANOVA for 200m Freestyle.