



Journal of Human Sport and Exercise

E-ISSN: 1988-5202

jhse@ua.es

Universidad de Alicante

España

Myers, Tony; Nevill, Alan; Al Nakeeb, Yahya
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competitors
Journal of Human Sport and Exercise, vol. 8, núm. 3, julio-septiembre, 2013, pp. 761-777
Universidad de Alicante
Alicante, España

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A comparison of the effect of two different judging systems on the technique selection of Muay Thai competitors

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ABSTRACT

Myers, T., Nevill, A. & Al-Nakeeb, Y. (2013). A comparison of the effect of two different judging systems on the technique selection of Muay Thai competitors. *J. Hum. Sport Exerc.*, 8(3), pp.761-777. Growing internationalisation of the sport of Muay Thai has prompted a debate on which judging system should be implemented internationally; a western system very similar to boxing (used pre-2005 in the UK) or the system used in Thailand, the country of origin. This paper examined the possible impact on athlete performance of these two different judging systems. Notational analysis was conducted on fights involving competitors who have been judged exclusively using the pre 2005 UK judging system (N=16), and on fighters exclusively judged using the Thai judging system (N=16), to determine if these judging systems produced quantifiably different performances. Statistically significant differences were found between the groups. A Friedman's ANOVA suggested that competitors judged using the Thai system were homogeneous in their technique selection using a similar pattern of techniques ($p=0.14589$), but that the competitors judged by the UK system were not ($p=0.00277$). Chi squared analysis suggested statistically differences across a range of variables including attacking techniques, defensive techniques, distancing, balance and effect. Fighters judged using the Thai system used more attacking and defensive techniques ($p<0.001$), had better distancing ($p<0.001$), balance ($p<0.001$), and a greater effect of their techniques ($p<0.001$). The study concluded that the judging system employed does have an impact on the performance given the differences found reflected different aspects of the judging criteria applied. In addition, the study found that the Thai judging system seemed to encourage competitors to use a greater number of more visually spectacular and effective techniques and as such may be more entertaining for spectators. Future research recommended included reanalysing fighters judged post 2005 in the UK where a system very similar to the Thai judging system has been implemented, along with the use of purposely-recorded footage. **Key words:** NOTATIONAL ANALYSIS, JUDGING, MUAY THAI, TECHNIQUE SELECTION.

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Submitted for publication August 2012

Accepted for publication August 2013

JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

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doi:10.4100/jhse.2013.83.01

INTRODUCTION

Modifications to rules in sport have been attributed to a number of reasons including player performances, technological advances and commercial pressures (Hammond et al., 1999). Safety considerations can be added to this list particular in contact sports in general and combat sports in particular. Nevertheless, in professional sports driven by profit and market pressures, rule changes commonly arise from the desire to increase spectator appeal and attract media sponsorships (Frey, & Eitzen, 1991).

Newly emerging professional combat sports have recently challenged the monopoly previously enjoyed by professional boxing as the primary televised combat sport. For example, Mixed Martial Arts (MMA) averages over 3 million viewers for pay-per-view fights and is growing in popularity (Brown, 2011). Muay Thai, the national sport of Thailand, is a major element of MMA (Bledsoe, 2009) and itself is growing in international popularity. With growing popularity and internationalisation in Muay Thai there have been debates over which interpretations of rules should be used. Some consider that the traditional Thai rules and scoring in the sport should be modified for an international audience; others feel that the rules and judging should be applied in the same way as they are applied in Thailand. While there has been some conjecture surrounding the impact of these different rule sets on competitors, no published studies have examined the differences different rule applications have on performance in the sport.

Until fairly recently the majority of Muay Thai competitions in the UK were judged in a similar way to international boxing, the concept being familiar to western judges. Conversely, in Thailand the sport is judged in a way unique to the sport with cultural nuances making it substantially different to the system traditionally applied in the UK (Myers et al., 2010). Understanding the differences in attacking and defensive skills encouraged by these different judging systems may assist rule makers in deciding which is more suitable. Moreover, such a comparison offers an opportunity to examine the impact of these rule and judging applications on performance. Evidence from other sports suggests the criteria used to judge sports can significantly influence the pattern of techniques used by competitors. For example, it was reported that some of the top elite gymnasts at the Beijing Olympics chose common yet difficult skills over unusual or unrated ones, as a result of changes in judgement criteria (Stickitmedia, 2008). Ice skating coaches reported that recent changes in criteria hindered skater development, particularly artistic aspects of performance (Laak, 2007). Hammond et al. (1999) found that even relatively minor changes to rules can have an effect on playing conditions.

Analysis of the effects of rule changes in sport has become reasonably commonplace (Hughes et al., 2007) and for a number of these studies notational analysis has been the tool of choice (e.g. Daggart et al., 1993; Giatis, 2003; Hughes, & Sykes, 1994). Notational analysis has been defined as "...the systematic gathering, analysis and communication of detailed information relating to competitive sport" (Liddle, & O'Donoghue, 1998) and represents "...an objective way of recording performance so that key elements of that performance can be quantified in a valid and consistent manner" (Nevil et al., 2008).

In practice, notational analysis is a generic term used to identify a number of different systems that use symbols to represent specific 'events' such as actions taken in competitive sport. For example, action that could be recorded in football may include the number of passes, shots and tackles occurring during a specified period in a particular game of football. The way in which these actions are recorded allows the information to be quantified and comparisons made. The systems used to record such actions can be manual or use computer software. Some manual systems use a series of symbols to record specific

actions; others use tally or frequency grids or charts. Computerised systems use an even wider variety of methods to represent important quantitative variables associated with the specific sport being analysed.

A number of combat sports have been the subject of study using notational analysis. For example, Hughes, & Franks (1997) provided an example of a notational analysis system for international boxing. The system recorded frequencies of punch delivery and contact made. A more comprehensive catalogue of technical information was gathered using a system developed by Gardiner described by Franks, & Goodman (1986). Gardiner examined amateur wrestling competitions. Using a laptop, Gardiner recorded the technique used, time of delivery and positioning. This system was used in compiling an extensive wrestling database using world championships and Olympic finals in every weight class. This information was used by coaches to inform training and strategy in future tournaments.

Given the success notational analysis has had in cataloguing technique application and delivery in other sports, it seems an appropriate tool with which to compare the techniques of competitors who have been judged exclusively by either a Thai judging system or the judging system traditionally applied in the UK pre 2005. Recent research has found the Thai judging system to be far more consistent than the system traditionally used in UK (Myers et al., 2010). If this consistency performance-based rather than due to social pressure, then competitors judged exclusively using that system should also be more consistent in their technique application reflecting the criteria used to judge them. Conversely, if there were no differences between the competitors judged by the Thai and UK system, this may suggest that any consistency is likely the result of conformity rather than performance effect. The aim of the present study is to identify if differences in criteria application result in quantifiable differences in technique selection and application between UK and Thai Muay Thai fighters judged by those country's respective judging systems. Giving an indication of which rule set might be beneficial for the future of the sport.

MATERIAL AND METHODS

Participants

Muay Thai technique selection and application of two groups of 16 professional Muay Thai fighters were assessed during competition in this study (N=32).

Group one – Thai fighters

The first group consisted of male Thai fighters (N=16) in weight classes' 50kg to 63.5kg (Mean=54.97 ± 4.60). All Thai fighters were Thai champions. The ages of the Thai group ranged from 17 to 24 years (Mean=20.75 ± 1.98). Throughout their careers these fighters have been judged exclusively using the Thai judging system.

Group two – UK fighters

The second group consisted of UK male Muay Thai fighters (N=16) competing in weight classes' 57kg to 71kg (Mean=63.38 ± 5.09). All UK fighters were UK champions. The age of the UK fighters ranged from 18 to 29 years (Mean=24.38 ± 3.67). All fights used in the analysis of UK fighters were videoed pre-2001 to ensure that at the time of recording, participants had been judged exclusively by UK judges using the traditional UK judging system throughout their careers.

Equipment

Computer hardware

A notebook computer was used to run the notational analysis software.

Video footage

All fights were presented in a digitally recorded format and included complete footage of each fight. The videos were not recorded specifically for the purpose of the study and as such included footage of more than one angle. All of the fights comprised of five rounds, each three minutes in duration. All fights analysed involved evenly matched competitors.

Analysis software

Notational analysis software was written in Visual Basic programming language. It was written specifically for the purpose of notational analysis of Muay Thai. The program was written to enable data to be entered via a mouse being “clicked” over appropriately labelled data “buttons” displayed on one of three interactive screens. The initial screen was designed as an interactive interface allowing the analyst to enter basic attack or defence technique details. The program allowed initial technique details to be entered and then automatically displayed a further screen allowing qualitative information on the attack or defence being analysed. For example, if the fighter being analysed had delivered a right round kick to the body the program allowed the operator to “click” the mouse button over the “right round kick to the body” button. The attack screen would then be automatically displayed allowing the operator to enter qualitative variables associated with that technique. They would be prompted to enter information on the distancing prior to delivery, if the technique was delivered on balance or not, the speed of technique, the result of the technique, its effect, if the fighter returned to a balanced stance, and if the technique was followed immediately by another technique. After this qualitative information was entered, the software automatically returned to the initial screen, ready for the operator to enter information on the next technique.

The program was written so that information entered via the interactive screens was automatically recorded chronologically in a Microsoft Excel worksheet. The program provided text details and number references for each technique recorded. The text details were intended to help “eyeballing” of data patterns, and the number references to help speed up data totalling.

Techniques analysed

A range of attacking (see figure 1) and defensive techniques (see figure 2) were analysed using the software, along with some associated quality indicators.

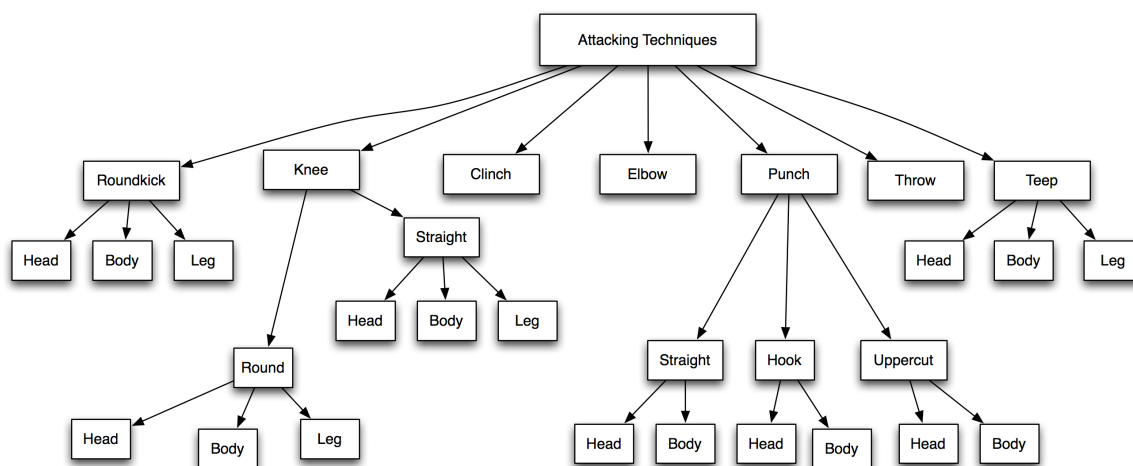


Figure 1. Hierarchy of attacking techniques

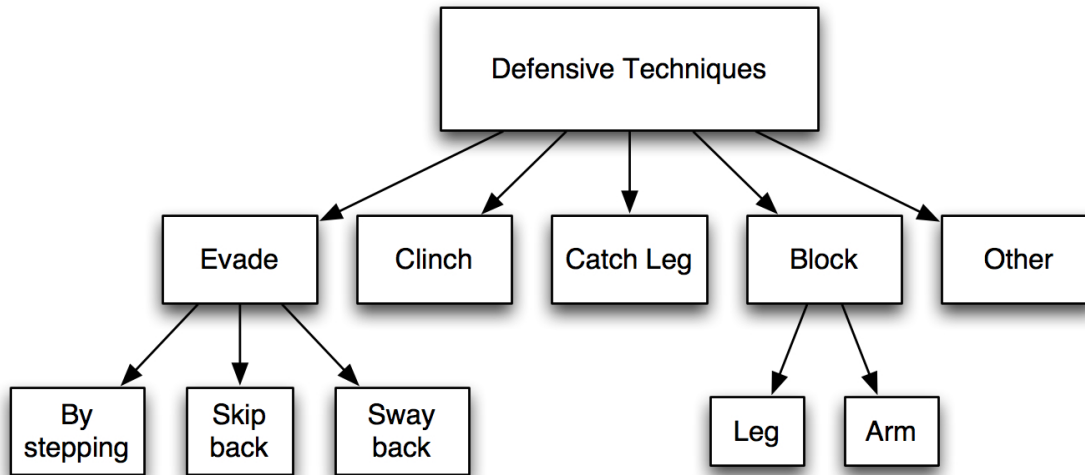


Figure 2. Hierarchy of defensive techniques

Reliability

Intra and inter-observer reliability testing was carried out on the computerised notational system. The same system was employed as used by Blomqvist et al. (1998) to calculate the reliability of data generated by a computerised notational analysis system used in badminton. An observer notated a single fight, then after a two-week period re-notated the same fight. A second observer also notated the same fight. Data was compared and percentages of agreement calculated for each variable (see results tables 1 and 2).

PROTOCOL

Performance aspects that were recorded related to the scoring criteria used by judges using the Thai system and judges using the UK system. These included: the frequency of attacking techniques, the type of technique used, the target of the technique, the effect of the technique, balance before and after delivery and distancing, and finally if the technique was part of a combination of techniques. The type and success of defensive techniques were also recorded. These included: the frequency of particular defensive techniques, the type of defensive techniques used, the effectiveness of the defence, balance after the defence and if it was followed immediately by a counter attack.

The following procedure was used in the notation of each of the fights. This included the data collection for intra-observer and inter-observer reliability testing. Each fight video was played initially at normal speed for the observer to get a subjective "feel" for the general speed and tempo of the fight. The video footage was then viewed in slow motion and paused when techniques were delivered, with the observer recording pertinent information as prompted by the software. Only the winning fighter's techniques were recorded. Each technique was viewed individually and then run twice at full speed. First the type technique used by the competitor was recorded. This included information on the technique used, whether delivered with the left or right limb or leg, and the intended target of the technique: head, neck, body, outside or inside the leg.

When an attacking technique was identified, the following additional information was recorded on the Excel spreadsheet: 1) balance before delivery, recorded as either "on balance" or "off balance". 2) the result of the technique, recorded as either "hit", "missed", "evaded", "blocked", "caught", "countered", "caught body", "caught neck", or "thrown". 3) the effect of the technique on the opponent, recorded as having "no effect",

“some effect”, or “highly effective”. 4) balance and physical composure after technique delivery, recorded as “returned to a balanced” stance or “didn’t return to a balanced stance”, and finally 5) an assessment was made of whether the technique formed part of a combination or not. This was recorded as either “followed immediately by another technique” or “not continued”.

When a defensive technique was identified, the following additional information was recorded on the Excel spreadsheet: 1) the technique used by the opponent in their attack. 2) balance on defence delivery, recorded as either “on balance” or “off balance”. 3) then result of the opponent’s technique recorded as either “hit”, “missed”, “evaded”, “blocked”, “caught”, “countered”, “caught body”, “caught neck”, or “thrown”. 4) the effect of the defence, recorded as having “no effect”, “some effect”, or as “highly effective”. 5) Balance and physical composure after defence delivery, recorded “as returned to a balanced stance” or “didn’t return to a balanced stance” and finally 6) If the defensive action was followed immediately by an attacking technique or not. This was recorded as either “continued” or “not continued”.

After each fight the information generated by the software from each round was summarised manually onto a fight summary spreadsheet. After the fights judged using the UK judging system had been notated, the summary data was transferred to another spreadsheet. This was repeated for data notated from the Thai competitors judged using the Thai judging system.

Data Analysis

Chi-square analysis was calculated using Minitab to compare the frequency distributions of techniques and selected qualitative variables to calculate any differences between groups (Thomas et al., 2011). A Friedman’s ANOVA was used to calculate any intra-group differences. In all statistical tests a probability level of $p < 0.01$ was deemed statistically significant.

RESULTS

Reliability of computer notational analysis software system

The fight notated for the reliability study included one hundred and fifty-four techniques the frequency of the different shots was as follows: the percentages of the intra- and inter-observer are shown in Tables 1 and 2. The highest intra-observer agreement was found in the following: “technique selection”, “balance on delivery”, “result”, “effect”, “balance after delivery” and “continued” (100%), the lowest were found in “speed of delivery” (98.35%). The highest inter-observer agreement was found in “technique selection”, “result” and “continued” (100%), the lowest in “speed of delivery” (97.7%).

Table 1. The percentages of intra-observer agreement levels the selected variables

Observer	Technique selection (%)	Balance on delivery (%)	Speed of delivery (%)	Result (%)	Effect (%)	Balance after delivery (%)	Continued (%)
1-2	100	100	98.35	100	100	100	100

Table 2. The percentages of inter-observer agreement levels the selected variables

Observer	Technique selection (%)	Balance On delivery (%)	Speed of delivery (%)	Result (%)	Effect (%)	Balance After delivery (%)	Continued (%)
1-3	100	99.35	97.7	100	99.35	99.35	100

These results indicated that the notational analysis system used in the study was reliable for evaluating the variables examined.

General differences between UK and Thai Muay Thai competitors

The most basic difference between the groups examined occurred in the overall number of techniques used. Thai fighters judged by the Thai judging system delivered more techniques ($n=2936$, $\text{Mean}=183.5 \pm 27.45$), than UK fighters judged by the UK judging system ($n = 1865$, $\text{Mean}=116.56 \pm 42.85$) representing a huge effect (Cohen's $d = 1.92$) which indicates very large differences between the groups of competitors suggesting practical differences between the number of techniques used by Thai and UK fighters. As Table 3 illustrates, differences were also found in the number of attacking techniques which represented a large effect (Cohen's $d = 0.87$), and the number of defensive techniques employed by each group, again these differences were of practical significance and represented a huge effect (Cohen's $d = 3.11$).

A chi-square analysis of the frequencies of particular attacking and defensive techniques used by the two groups of fighters also demonstrated a significant difference ($\chi^2 = 1048.182$, $p < 0.001$) between the groups. This suggests that each group of fighters have a distinctly different profile of attacking and defensive moves that they use.

Table 3. Descriptive statistics of attacking and defensive techniques used

Competitors	<i>n</i>	Mean	Std. Dev.
Attacks UK	1541	96.31	41.21
Attacks Thai	1985	124.06	22.056
Defences UK	324	20.25	8.88
Defences Thai	951	59.45	16.11

The results of the Friedman's ANOVA on the group of Thai fighters suggested that there was no significant difference ($\chi^2=20.72881$, $P= 0.14589$) in the pattern of techniques used by each fighter, pointing to the Thai participants forming a relatively homogeneous group in relation to techniques used in their fights. A Friedman's ANOVA performed on the UK group, however, suggested a statistically significant difference between contestants in their technique selection ($\chi^2 = 34.64320$, $P=0.00277$). This suggests that they were more heterogeneous, each using a different pattern of techniques.

Attacking techniques

Table 4. The frequency of attacking techniques delivered by competitors judged using the Thai system

Competitors Judged using the Thai judging system																	
Attacking Techniques	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Totals
Teep	32	17	23	22	25	27	18	25	17	27	16	38	16	26	26	23	378
Roundkick middle/ high	42	41	32	22	33	24	38	38	28	28	42	42	41	32	27	38	548
Roundkick leg	2	15	10	18	7	10	16	3	17	8	15	2	15	11	18	13	180
Clinching for attack	6	14	7	26	8	14	14	8	10	9	12	6	14	14	30	20	212
Knees	3	18	37	18	31	21	19	3	18	34	16	3	20	34	20	3	298
Punches	4	12	31	24	18	15	9	4	16	27	13	7	17	32	28	32	289
Elbows	0	3	7	5	12	4	5	0	3	6	3	0	3	4	5	0	60
Legal Throw	0	1	2	1	1	1	1	0	1	3	1	0	1	2	1	4	20

Table 5. The frequency of attacking techniques delivered by competitors judged using the UK system

Competitors Judged using the UK judging system																	
Attacking Techniques	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Totals
Teep	22	0	2	6	7	3	5	11	0	2	6	20	12	10	21	21	148
Roundkick middle/ high	21	9	12	9	25	13	25	17	7	9	9	33	38	24	12	38	301
Roundkick leg	10	3	1	8	19	18	29	20	4	1	8	10	20	0	19	18	188
Knees	1	24	7	31	8	21	1	2	20	14	44	24	16	14	48	18	293
Clinching for attack	1	6	5	8	14	12	0	1	6	5	8	20	6	5	8	31	136
Punches	23	13	18	13	39	44	60	21	15	17	12	25	30	16	36	49	431
Elbows	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Legal Throw	0	0	0	2	9	0	9	0	0	1	0	2	1	3	6	11	44

The frequency of attacking techniques differed between the groups (see tables 4 and 5).

Patterns of attacking techniques used by each group were examined for differences using Chi Square analysis. This analysis suggested a significant difference between groups ($\chi^2 = 291.789$, $p < 0.001$). Although the analysis suggested each group used a different pattern of attacking techniques, there were some similarities between groups. Kicking techniques were the favoured attack of both groups of fighters. The attack profile of the Thai group comprised of 55.72% ($n = 1106$, Mean = 69.13 ± 5.98) kicking techniques, compared with the UK group, where kicking formed 41.34% ($n = 637$, Mean = 39.81 ± 22.12) of attacks.

There were further similarities in the types of kicks used. The round kick was the most frequently used kick delivered by both groups. 65.8% ($n = 728$, Mean = 45.5 ± 7.22) of the kicks delivered by the Thai group consisted of round kicks. This compared to 76.77% ($n = 489$, Mean = 30.56 ± 16.73) delivered by the UK group. Teeps (front kicks) represented 34.18% ($n = 378$, Mean = 23.63 ± 6.08) of kicking attacks delivered by the Thai group and 23.23% ($n = 148$, Mean = 9.25 ± 7.85) by the UK.

Although there were similarities between groups in choice of attacking technique there were also some differences. An obvious difference was the frequency with which UK fighters used punching attacks, 27.97% ($n = 431$) of attacks delivered by the UK fighters involved punching, compared to 14.56% ($n = 289$) by the Thai group. Straight punches were the favoured punching technique of both groups. There was also some difference in the frequency with which particular targets were selected for attack with kicking and kneeing techniques, 84.33% ($n = 1184$) of kicks and knees delivered by the Thai group were used to attack the head and body. UK competitors delivered a higher proportion of their kicks and knees to their opponent's legs (28.98%, $n = 224$) when compared to the Thai group (15.67%, $n = 220$). Figure 3 shows the pattern of attacking techniques delivered by each group.

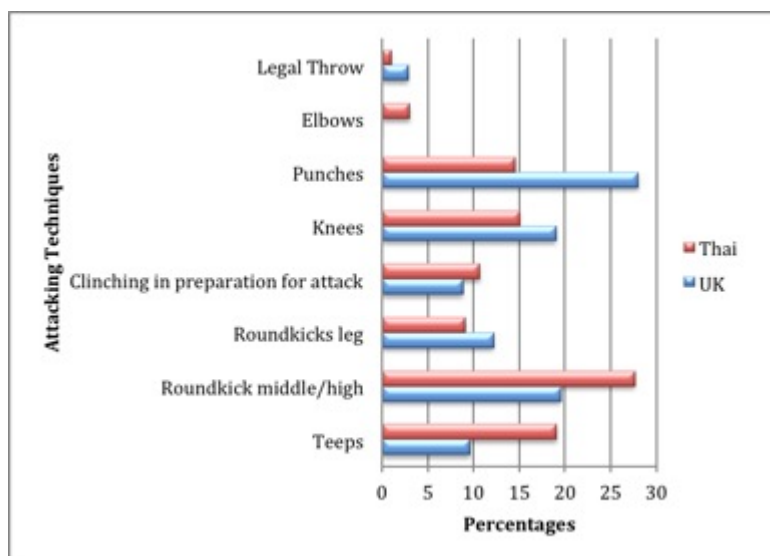


Figure 3. A comparison of the percentages of individual attacking techniques used by Thai and UK competitors.

Defensive techniques

The two groups of fighters employed quite different defensive strategies (see table 6 and figure 4. Blocking with the leg or raising the leg in a blocking position formed 48.37% of the defensive techniques used by the

Thai group. This was their most frequent employed defence (n=460, Mean=28.75, \pm 10.71). The same defence formed only 3.09% of the defensive strategy of the UK fighters, who used this form of defence much less frequently (n=10, Mean=0.63 \pm 0.89). Using a conventional international boxing cover position was the UK group most frequently used defence (n= 108, Mean=6.75 \pm 9.48). This formed 33.33% of their defence strategy. Although this defence is used, Thai fighters didn't use this defensive technique in the particular fights analysed. They chose to stop punches by blocking them on their arm (n=56, Mean=3.5 \pm 6.79). The only other defensive technique used exclusively by one group was jumping back away from a technique, 12.35% (n=40, Mean=2.5 \pm 2.22) of UK competitor's relied on this particular technique, but the Thai group did not. The only defensive technique with a similar proportion of use in each group was clinching an opponent to prevent an opponents' attack, 19.77% (n=188, Mean= 11.75 \pm 2.71) of the UK group used this technique compared with 25.31% (n=82, Mean= 5.13, \pm 3.01) of the Thai group. It was the second most frequently defensive technique used by both groups.

Table 6. The frequency of defensive techniques delivered by competitors judged using the Thai system.

Competitors Judged using the Thai judging system																	
Defence Techniques	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Totals
Evade by stepping	31	13	40	40	36	29	13	36	42	31	32	13	32	39	15	18	460
Leg Block raised	6	3	4	11	3	6	3	4	11	6	9	4	5	7	5	9	96
Blocked with arm	1	5	1	2	1	1	5	1	2	1	1	4	2	2	6	1	36
Skip/sway back	3	3	15	6	5	3	3	15	6	7	3	4	17	6	5	6	107
Defend with clinch	20	6	17	4	10	20	6	17	4	10	20	6	17	4	21	6	188
Catch leg	4	3	6	1	2	2	3	7	1	1	2	5	9	3	4	3	56
Other	0	0	0	2	0	0	0	0	2	0	0	0	0	2	0	2	8

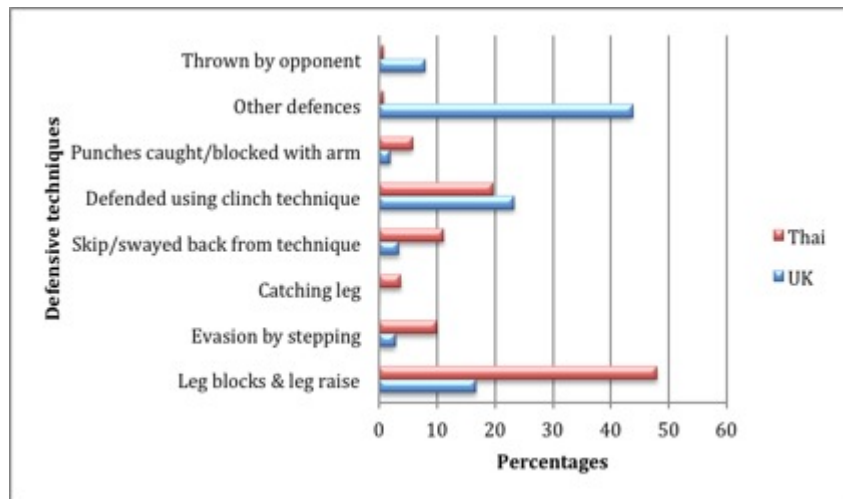


Figure 4. A comparison of the percentages of the types of defensive techniques used by Thai and UK competitors

Table 7. The frequency of defensive techniques delivered by competitors judged using the UK system.

Competitors Judged using the UK judging system																	
Defence Techniques	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Totals
Evade by stepping	0	0	5	11	4	4	4	0	0	0	11	0	0	5	11	4	59
Leg Block raised	0	0	1	2	0	0	0	0	0	2	2	0	0	1	2	0	10
Blocked with arm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Skip/sway back	0	0	1	1	3	0	0	0	0	1	1	0	0	1	1	3	12
Defend with clinch	10	3	8	2	5	3	5	1	7	8	2	10	3	8	2	5	82
Catch leg	0	0	0	3	0	0	0	0	0	0	1	0	0	0	3	0	7
Other	21	2	0	6	3	19	17	32	19	1	2	21	2	0	6	3	154

Qualitative aspects of technique delivery

Balance

A chi square analysis of techniques delivered from a balanced position suggested a significant difference between groups ($\chi^2 = 584.284, p < 0.001$). Figure 5 shows that although the majority of techniques used by both groups were delivered on balance there was a difference between groups. The UK group delivered

80.74% (n=1509, Mean=94.31 \pm 46.33) of their techniques on balance, compared to 99.80% (n=2938, Mean=183.63 \pm 27.53) of techniques delivered by the Thai competitors. There was an even greater difference between groups, when examining the frequency with which they returned to a balanced stance after technique delivery. The Thai group returned to a balanced stance after 94.7 % (n=2788, Mean=174.25 \pm 25.86) of the techniques they delivered. The UK group did so much less frequently, returning to a balanced stance after 61.96% (n=1158, Mean=72.38 \pm 44.25) of the techniques they delivered (see figure 6).

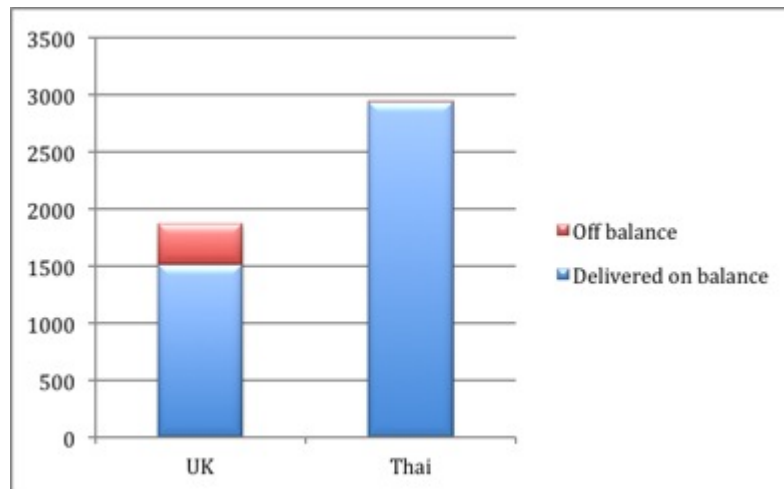


Figure 5. A comparison of techniques delivered on balance by UK and Thai Muay Thai fighters

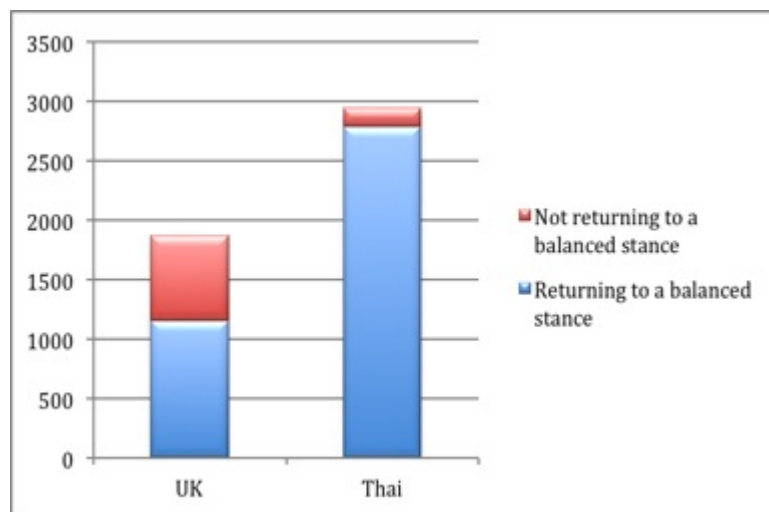


Figure 6. A comparison of techniques delivered by UK and Thai Muay Thai fighters where the fighter returned immediately to a balanced stance.

Technique effect

A technique was deemed effective if it caused an opponent to lose their position due to the force of a technique, because they were off balance or if the competitor showed obvious pain. A Chi square analysis of the effect of techniques delivered by the Thai group and the UK group, suggested a significant difference

between groups ($\chi^2 = 492.715$, $p < 0.001$). Figure 7 illustrates the difference between the three levels of effectiveness of techniques delivered by the two groups. There was substantial difference between groups in both the frequency and proportion of highly effective techniques delivered, 33.56% ($n=988$, $\text{Mean}=61.75 \pm 15.57$) of the Thai group's techniques were highly effective (resulted in a loss of balance or caused an opponent to show pain), compared to 16.75% ($n=313$, $\text{Mean}=19.56 \pm 19.71$) of techniques delivered by the UK group.

Another important difference was in the number of techniques delivered that had no effect on their opponent. The majority of techniques (59.6%, $n=1114$, $\text{Mean}=69.63 \pm 27.64$) delivered by the UK group were not effective. This compared with 27.58% ($n=812$, $\text{Mean}=50.75 \pm 27.58$) of the Thai group's techniques (see figure 7).

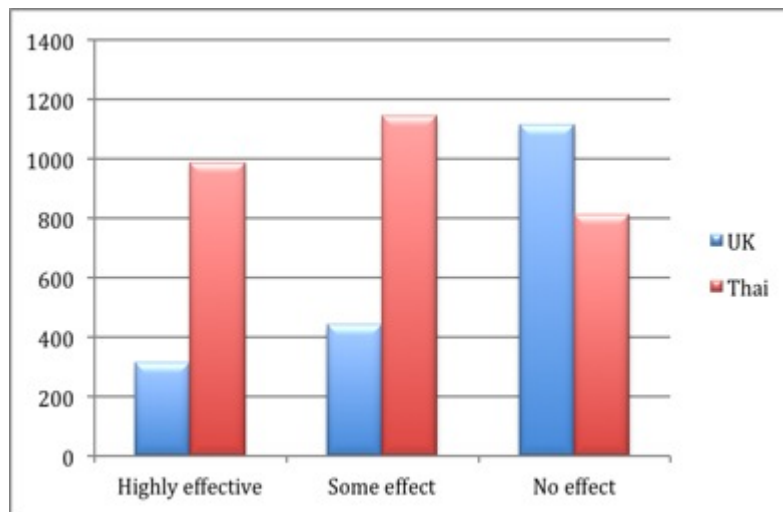


Figure 7. A comparison of the effectiveness of techniques delivered by UK and Thai fighters.

DISCUSSION

The results of the analysis highlighted a number of differences between the offensive and defensive techniques used by the two groups. Statistical analysis suggests the competitors judged under the Thai system are a more homogeneous group in terms of their technique selection and application. In contrast, the competitors judged by the UK system appear far more heterogeneous suggesting a more eclectic style. The reason for differences in homogeneity between groups may, at least in part, be accounted for by the fact that the Thai system uses very specific, easily visually determined judgement criteria that has been shown to have a high level of inter-judge consistency (Myers et al., 2010). This system is likely to have encouraged the use of specific techniques over time given judges using this system tend to be consistent in deeming these important. In contrast, the UK system has been found to have less inter-judge consistency than its Thai counterpart and seems to have provided a less consistent message to competitors in terms of strategy and technique preference.

Muay Thai has evolved over hundreds of years of actual combat and more recently has been shaped by the experience gained from Thai boxers participating in tens of thousands of fights judged by specific consistently applied scoring criteria (Myers et al., 2000). The results of the present study suggest the possibility that a relatively precise method of applying attacking and defensive techniques has evolved in

Thailand that capitalises on the way fights are scored. There were a number of significant differences between the groups of fighters that could be attributed to the judging criteria applied. These include the frequency of particular techniques employed, and qualitative aspects of techniques such as balance.

The findings appear to support the possibility that the inter-judge consistency of Thai judges identified by Myers and colleagues (2010) is performance rather than conformity based. The results strongly suggested that Thai fighters used a similar style of fighting, supporting the views of a number of experienced coaches (De Cesaris, 1999). Some authors (Harinck, 1988; Myers, 2000) have referred to a "European Muay Thai style", but the results did not demonstrate any evidence of this and this may be reflected in the lack of consistency in the application of judgement criteria by UK judges judging the fights used in the analysis. It could be argued that had there been a more consistent application of judgment criteria in the UK, this would have resulted in UK boxers having similarities in technique selection that reflect those criteria.

While the Thai fighters delivered a greater number of techniques overall compared to the UK fighters, the interesting differences in terms of judging criteria were the actual relative frequency of techniques selected by the different groups of fighters. Given that the effect of strong round kicks can be easily seen by judges and that effect is considered important in judging Muay Thai in both systems (De Cesaris, 1999; Myers, 2000) it was not surprising that both groups employed this technique. However, the Thai group favoured the round kick to the body as their primary attacking technique and delivered almost twice as many round kicks to the body than their UK counterparts. This more frequent use of this technique by the Thai fighters may be explained by the Thai judges generally considering body kicks to be intrinsically more effective techniques than either punches or round kicks to the legs, given similar levels of physical effect.

Kneeing techniques are considered important by a number of authors (Ruangsa, 1972; Saengsawang, 1979; Myers, 2002). Given that strong kneeing techniques have the potential to show a considerable effect on an opponent the prevalence in both groups was expected. However, although there was a similarity in the frequency of kneeing techniques there were some differences in the frequency with which fighters attacked the legs and body with knees. The Thai fighters delivered far fewer kneeing techniques to the legs compared to the UK group. This again appears to reflect the reported importance Thai judges place on knee strikes delivered to the body.

There were also differences in the profile of other attacking techniques used by each group. The UK judged competitors used punching attacks more frequently (27.97%) than the Thai group (14.56%). This may reflect the UK fighters more frequent exposure to international boxing when compared to Muay Thai. However, Thai fighters judged using the Thai system, are also very familiar with international boxing techniques, with part of their fight preparation often including international boxing sparring (Thienvibul, 1977; De Cesaris, 1995). Given this, the differences may again reflect Thai judges' perception that punches have a lower potential for scoring when compared to kicks or knees. For punches to score well in Thailand they have to show real physical effect rather than just land on target (Myers et al., 2009). Given this, it is possible that Thai fighters reduced punching volume, focusing on punching effect instead. Thai trained judges using the Thai judging system consider kicks and knee strikes to the body more important than punches, whereas UK trained judges using the traditional UK judging system considered punches, kicks and knees to be of equal value. Given differences in the relative difficulty of delivering punches on the one hand and kicks and knee strikes above the waist on the other, the latter being more difficult, it would seem sensible competitors would choose the more easily delivered techniques more frequently if each score equally well. This appears to be reflected in the types of attacks used by the respective groups.

There were also a number of significant differences in the qualitative variables examined. The Thai fighters returned to balanced stance after technique delivery more frequently than UK fighters. In arguably the most important variable, the effect of technique, there was also a statistically significant difference between Thai and UK fighters. The Thai's techniques had a greater effect on their opponent. Myers (2000) and De Cesaris (1995) highlighted the importance of balance in Muay Thai. They explained that balance in Muay Thai is an important factor in determining success. When judged using the Thai judging system, if a fighter loses balance after successfully striking an opponent that technique is unlikely to score as well as when they maintain balance (Myers, 2009). Myers (2002) suggests that to be successful in exploiting openings in an opponent's defences, a fighter needs to maintain close proximity to their opponent while maintaining a balanced stance and proposing that balance and appropriate distancing were essential prerequisites for taking advantage of any openings.

The question of which judging system might produce the most exciting fights for spectators is a moot point. The Thai judging system seemed to encourage the competitors to deliver more of the visually spectacular techniques such as high kicks and also tended to encourage the delivery of more effective techniques. However, the UK system seemed to result in a greater variety of fighting styles and this may be attractive to spectators. Nevertheless, the consistent approach used in Thai style judging seems to have helped consistency in competitors. As suggested by Myers (2010) this may be helpful to fighters and coaches in focusing on the particular strategies and technique delivery, so improving the overall quality of performance.

While the results seem to suggest differences between Thai and UK boxers are related to the differences in judgement criteria application, it is important to consider other reasons for differences between the groups other than being the results of the judgement criteria used. Another possible reason for technique diversity among UK fighters is the greater influence of other fighting arts on fighters and coaches. Many come to Muay Thai from other disciplines such as kickboxing, full-contact karate, knockdown karate, international boxing and Tae Kwon Do. In Thailand there are other fighting arts practiced, but these have little influence on the Muay Thai practiced there (Myers, 2000).

Limitations and future research

In addition to alternative explanations of results, a consideration of the study's limitations needs to be taken into account when considering the findings. It is possible that the differences found between the competitors was the result of the Thai competitors being superior athletes compared to their UK counterparts. This could be resolved by researching current UK fighters. Post 2005, more and more fights in the UK have been judged using a system that is very similar to that used in Thailand. As such, it would be interesting to re-examine UK fighters judged exclusively with the post 2005 system to determine whether this newly implemented system of judging produces similar results to those found in the present study.

A further limitation was that the present study used pre-recorded footage and would have benefitted from the accuracy of purposely-recorded footage, perhaps filmed from more than one angle. This would allow more control and the possibility of more detailed variables to be analysed. Using purposely-recorded footage would also have offered the possibility of using automatic analysis software that was incorporated with the actual recorded footage and may have resulted in the possibility of more detailed data collection and automatic statistical analysis and graphic output as part of an integral part of the software program, saving an enormous amount of analysis time. Reducing analysis time would allow a greater number of fights to be analysed, so improving the breadth of data collected.

CONCLUSION

In conclusion, the results of the study appear to suggest that the one plausible reason for the differences in homogeneity between groups may be the consistently applied judgement criteria used by Thai judges in Thailand. The differences in attack profile, frequency distribution over rounds and the balance appear to reflect differences in the applications of judgement criteria. The results highlight the possibility that technique use is strongly influenced by the judging system used and it needs to be considered in any debate on system should be applied internationally. The findings also point to the possibility that the Thai judging system offers the possibility of more exciting fights with higher numbers of attacking techniques delivered as well as a higher number of the more visually spectacular techniques.

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