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THE INFLUENCE OF COMPETITIVE CO-ACTION ON KATA PERFORMANCE THOMAS, LUGO, CHANNON & SPENCE

DOI

10.18573/mas.49

KEYWORDS

Karate, kata, social facilitation, performance, individual differences.

CITATION

Thomas, S., Lugo, R.G., Channon, A. and Spence, A. 'The Influence of Competitive Co-action on Kata Performance', *Martial Arts Studies* 5, 52-60.

ABSTRACT

Social facilitation is a phenomenon that can help explain performance outcomes in competitive sports. Previous research has shown that performing in the presence of others may increase physiological arousal and that performance can be either facilitated or inhibited depending on the skill level of the performers and the complexity of the skill performed. Although extensive research on this phenomenon has been reported in the sport psychology and related literature, previous findings have not focused on individual differences in terms of how social facilitation influences performance, and very little research has focused on martial arts. To bridge these gaps in knowledge, we investigated how a co-action situation would affect performance among 17 participants performing karate kata routines at a regional competition in SE England, comparing outcomes across age and sex variables. Expert judges awarded scores to each participant in both solo and co-action settings. Results showed higher performance scores in the co-action setting across the entire sample, with female karateka and older performers appearing to benefit the most. We argue that more research is required to explain this phenomenon, specifically with respect to understanding the apparent effects of age and sex on social facilitation.

Despite issues surrounding the contextual model developed by Zajonc [1965], purporting that individual performance significantly improves on simple, well-learned tasks when in the presence of others (audience and/or co-actors or competitors), authors still retain a research interest in the phenomenon often labelled social facilitation (SF) [Rhea et al. 2003; Grindrod et al. 2006; Corbett et al. 2012]. This interest dates back to the late nineteenth century; seminal research by Triplett [1898] investigated the effects of the presence of other bicyclists on performance times, concluding that faster times were achieved as a result of the presence of co-actors making individual cyclists more competitive [Strauss 2002].

These results were repeated with young children winding in fishing reels, and this effect initially became known as ‘dynamogeny’ [Triplett 1898, cited in Strauss 2002]. Of particular note is a more recent and fascinating publication entitled ‘The Truth About Triplett, But Nobody Seems to Care’ by Stroebe [2014], where the description of Triplett’s experimental task (in this case, with fishing reels), the findings of the social psychology experiment, and the historical status of Triplett’s work are seriously questioned. Stroebe [2014: 54] argues that ‘the experimental task was described wrongly and the evidence for social facilitation overstated’. However, despite this alluring read into such misrepresentation, as well as further misgivings associated with Zajonc’s theoretical explanations of SF, Stroebe [2014: 56] still acknowledges that Zajonc’s ‘empirical generalisation is generally accepted’.

Zajonc’s [1965] research has identified task difficulty as an important factor for SF. The presence of others, Zajonc reasoned, was either facilitative or debilitating depending on task difficulty. Simple, well-rehearsed tasks, when performed in the presence of others, were performed better, while complex tasks performed in the presence of others showed declines in performance. Alport [1924] was the first to label this social psychological research area as social facilitation, and throughout most of the last century it became a major research area [Henchy and Glass 1968; Chapman 1973, cited in Strauss 2002].

A good example of this interest manifests itself in the study of above-average and below-average pool players conducted by Michaels, Blommel, Bracato, Linkous and Rowe in 1982 [cited in Strauss 2002]. Skilled players were classified as those who made at least two-thirds of their attempts at potting the ball (66%) and unskilled players were those that missed at least two-thirds (66%) of their shots. The presence of others (in this case, the audience), upon moving closer to the pool tables to continue watching, noticed a performance increase for the skilled players (14%) and a performance decrease of over 30% for the unskilled performers.

These findings have been corroborated by research incorporating psychophysiological measurements. Blascovich and colleagues [1999]

showed that differences in cardiovascular responses while performing in front of others could be predicted by task difficulty [Blascovich et al. 1999]. They deemed the interpretation of tasks as either challenging (well-rehearsed task) or threatening (unrehearsed task), where challenging tasks would show an increase in heart-rate arousal with a decreased vascular resistance, while threatening tasks would show an equal heart-rate arousal but with an increased vascular resistance. Results confirmed their hypothesis and strengthened SF findings by applying this biopsychosocial model.

Recent findings, however, show that SF can be explained by different factors than Zajonc’s [1965] theoretical explanation. Researchers [e.g., Uziel 2007; Stein 2009] have identified individual differences that have higher moderation effects on performance when performing in the presence of others. These factors include extraversion, neuroticism, and self-esteem. More specifically, Huguet and colleagues posit a ‘cue utilization hypothesis’ to explain SF results [1999: 1020]. Cue utilization can be defined as how one interprets being observed by a potentially evaluating audience [Bruning et al. 1968 in Huguet et al. 1999] and can provide an alternative explanation to SF research. Results show that cue utilization can explain both social facilitation and inhibition [see Huguet et al. 1999 for discussion]. Cue utilization theory can explain results in single, competitive and co-action situations.

Developmental and individual differences, as well as social demographic variables such as age and sex, must be also taken into consideration when discussing SF, as these may help explain how individuals engage in cue utilization. For instance, Albion, Fernie & Burton [2005] have shown that age positively moderated effects on proactive behaviours that include positive attitudes and coping styles. Factors indicating participants’ experience (i.e., age and belt rank in a martial art) could therefore have an effect on SF. Specifically, older/more experienced participants may perceive social cues in such ways that could lead to increased performance, either through facilitation as described by SF, or through increased arousal caused by the presence of others.

With respect to sex, Gneezy, Niederle and Rusticini [2003] showed that females were on average less competitive than males when completing a range of tasks, displaying lower levels of performance in mixed competitions, but displaying higher performance under same sex conditions – this may be due to perceiving males as dominant and more competitive, and therefore not performing to their best ability in mixed settings. Van Vugt and colleagues [2007] support these results through what they term the ‘Male-Warrior Hypothesis’. These authors suggest that males are more likely to perceive intergroup/interpersonal competition (with other males) as a form of confrontation – a response less likely among females when in competitive situations with others of the same sex.

However, sex differences are not always evidenced in other studies. Rhea and colleagues [2003] examined the effects of a presence of an audience on thirty-two recreationally trained weight lifters. All lifters performed a one-repetition maximum (1RM) bench press under three different conditions (co-action, competitive co-action, audience effect) and results demonstrated significant differences in performance for both men and women ($p < 0.05$) under all three conditions, enabling Rhea and colleagues [2003] to conclude that performance of a 1RM significantly increases when an audience is present and when a competitive situation exists. Grindrod and colleagues [2006] investigated whether total distance covered by males and females in a six-minute walk test significantly changed between two specific conditions, either walking alone or walking in a group of four on two separate occasions seven days apart. They concluded that distance covered increased significantly for both the male group ($p < 0.05$) and the female group ($p < 0.01$) under the co-action condition and that 'psychological factors have an effect on the (performance execution) of the test' [2006: 877].

While the phenomenon of SF has been a topic of much research in the sport psychology literature, there has been relatively little work done applying the concepts outlined above to martial arts. This present study seeks to bridge this gap by exploring how performances in a specific martial art activity – competitive kata performance in karate – can be affected by the presence of co-acting others. Before outlining our study, we offer a short, contextualising explanation of what kata performance involves.

COMPETITIVE KATA PERFORMANCE

The globally popular martial art of karate, as practiced in Western societies such as the United Kingdom today, is generally imagined to have roots in the traditional martial arts practiced on the Southeast Asian island of Okinawa. However, it is difficult to confidently speak of karate's origins in any concrete terms, given that Chinese, Japanese and, in more recent years, Western cultural influences have all shaped the practice of the art in significant ways, both within and beyond its Okinawan 'home' [Krug 2001; Tan 2004; Mottern 2010a].

As karate began to develop in its modern form throughout the late nineteenth and early twentieth centuries, schisms within its leadership and the impact of external political forces resulted, in part, in the proliferation of various different styles of the art. The global spread of karate in the latter part of the 20th century drove further diversification and change [Tan 2004; Wedlake 2010]. Among many important outcomes of this process, and similar to other Asian fighting arts,

karate's globalization has seen the incorporation of competition formats derived from Western models of sport within its various different schools/styles [Hamaguchi 2006; Mottern 2010b].

As with many Asian martial arts disciplines, the practice of kata (or 'patterns' or 'forms' in some arts' vernaculars) is a routine element of training, being one manner in which 'traditional' techniques of the art can be passed across generations. However, kata performances also feature as an aspect of karate competition today, organized and evaluated by judges, in a similar manner to aesthetic sports such as gymnastics and figure skating. Here, choreographed sequences of movements are employed in order to demonstrate a karateka's mastery of the art. As Tan writes:

In essence, kata practice is a pedagogical exercise that encompasses the honing of physical skills and a state of mind in which one is supposed to perform an idealized combative encounter ... One is then expected to mentally project the application of these techniques as if they were being executed against a real attacker.

[Tan 2004: 171]

The notion of performing kata 'as if' one was actually fighting marks competitive kata out from the free sparring (kumite) competitions in which karateka might otherwise engage. Here, rather than overcoming a resisting opponent through the efficacious use of techniques, karateka must produce communicative performances to demonstrate that they are both able to perform specific techniques and also *understand how* to perform them in ways which illustrate a specific conception of martial competence. Thus, kata performances must be effectively 'sold' to judges in line with specific sets of grading criteria.

In this sense, the social context, along with the physical and mental skills required to succeed in kata competitions, are different to those found within kumite. Here, practitioners are essentially performing for, rather than against, a specified other – in this case, a judge/judges instead of an opponent, whom they must *persuade* instead of *defeat*. As such, an audience is always a presupposed element of competitive kata practice, underscoring its very purpose. Exploring how certain types of audience presence influences kata performances thereby becomes an interesting avenue for unpicking how the modern transformation of martial arts (i.e., the 'sportization' of kata practice) impacts upon the ways in which they are performed by their practitioners and helps form the contextual backdrop for the present study.

In previous research on psychological factors impacting karate performance, Bell and Yee [1989] undertook an investigation into the skill level (skilled: 12 male, 4 female; unskilled: 13 male, 4 female)

and audience effect on performance of a karate drill. The participants (age range 13-38, mean age 23.85) were asked to perform a 'multiple standing roundhouse kick' [1989: 195] at a specified target as many times as possible in four 15-second trials. The kicks were completed both with and without the presence of an audience of karate experts. Results suggested no statistical significance on accurate kicks or mistakes for the skilled group under the audience condition; however, a statistically significant reduction in frequency of kick accuracy was noted for the unskilled group when the audience were present.

In a similar approach to our present study, Layton and Moran [1999] investigated the effect of what they classified as 'group spell' upon Shotokan black belt performance of the *Heian* kata. Eleven male karate black belts (average age of 15.8 years) were required to perform the kata's series of set moves as a group. Layton and Moran [1999: 494] concluded that the timing of certain movements increased in consistency when movements were performed in a group setting.

Based on the findings of this previous research, as well as a lack of attention paid within it to individual differences, we decided to investigate the effects of social facilitation by taking into account both sex and age of practitioners in competitive kata performance. We predicted that a co-action situation would lead to better performances across a sample of intermediate and advanced karate practitioners (H1), performing a task with which they were reasonably familiar (i.e., one they had practiced ahead of attending a competition), as in previous research noted above. Additionally, we anticipated that female karateka (H2) and older performers (H3) may benefit more from a co-action situation than male karateka and younger performers respectively.

METHODS

Data were collected at competitive events held within the Southeast of England during 2015. Participants in the study consisted of club-level karate practitioners (i.e., not elite performers) who train at local clubs in the Southeast of England. According to information provided by participants, these clubs included members of various ages, experience levels and ability, and all included both male and female karateka.

Originally, the participants in this study consisted of 15 male and 10 female karateka. Four of these held at least a first-degree black belt, with the remainder holding lower belt grades. Because belt grading in karate is considered to be a marker of ability level, this provided a means of differentiating among participants on this basis, considered crucial for investigating the effects of social facilitation [see Bell and Yee 1989]. Eight participants were excluded from this study due to lower ability

(belt degree under orange) or young age (under 14). This gave a final cohort of 17 participants (males = 9, females = 8; under 16yrs = 6, 16yrs and above = 11).

To test the effects of social facilitation on kata performance, each participant performed a pre-rehearsed kata under two conditions. Firstly, in the 'alone' condition, the participant performed the kata with one judge watching. The name of the kata was announced and then performed with no other communication being made. Secondly, under the 'co-action' condition, the participants performed the same kata again, although this time alongside at least one other competitor, of the same sex, performing the same kata at the same time, and in the presence of a small audience as well as the same judge as before.

In each case, the kata performances were judged by two experienced competition referees in accordance with the World Union of Karate-do Federation rules [WUKF 2014]. These rules are widely used for judging kata competitions, and while they cannot eliminate individual judges' subjective biases entirely, they do provide a standardized framework around which judgements can be made. Because the principal purpose of the study was to investigate the effects of co-action and audience presence on performance, judges did not vary for any participants between the two conditions outlined above.

Following these rules, each performance was examined on the basis of two major sets of criteria – basic performance and advanced performance.¹ While points were awarded for correct/effective demonstrations, points were subtracted for corresponding errors/omissions. Furthermore, disqualifications were considered in accordance with WUKF rules. A written evaluation of each kata was also produced by the competition referee(s) with respect to the consistency of performances across the 'alone' and 'co-action' conditions, to supplement the scoring produced under the WUKF rules. The results of either evaluation were not provided to the participants until after the completion of the second performance.

Lastly, statistical analysis was done with SPSS v.22. All variables were centred and standardized for analysis. Action and co-action scores were entered as dependent variables, while age and gender were used as predictor variables. Alpha (α) levels for hypothesis testing was set at the .05 level (two-tailed).

¹ 'Basic performance' includes judgements on the following points: Correct kata sequence; control of power; control of tension and contraction; control of speed and rhythm; direction of movements; understanding kata technique; showing proper understanding of the kata bunkai (how the kata strikes and blocks would be used to put down an opponent); co-ordination; stability and balance; pauses; kiai (attack cry); breathing; concentration; and spirit. Meanwhile, 'advanced performance' is evaluated on the basis of mastery; degree of difficulty; and demonstration of the budō attitude.

RESULTS

All variables showed accepted variance and parametric tests were used to test all hypotheses (see table 1 and 2).

H1 Results

To test the first hypothesis, a paired sample t-test was performed and supported the hypothesis. The group (N=17) had an increase in judged performance in the co-action situation ($t(16)=4.123, p=.001; CI L: -.30 U: -.10$), as the co-action situation scored higher ($M=7.43; SD=.74$) than in the alone condition ($M=7.23; SD=.73$). The effect size was small according to Cohen's descriptions (Cohen's $d=.27$).

H2 Results

To test the second hypothesis on sex differences, two analyses were done. To test sex differences, an independent sample t-test was performed followed by a paired sample t-test for within sex comparisons. Scores between sexes did not significantly differ in both conditions (see table 3). To test for sex differences, a paired sample t-test was performed. Both sexes did have a significant effect from the co-action condition (Males $Mdiff = -.20, SD=.26; CI L: -.40 U: -.00$; Females $Mdiff = -.20, SD=.12; CI L: -.30 U: -.10$), but females had a greater effect size whilst performing with others (Cohen's $d_{males} = .22$; Cohen's $d_{females} = .50$), suggesting at least some difference in social facilitation according to sex, partially supporting the hypothesis.

H3 Results

To test for differences in age, a 2-way ANOVA was performed with the alone and co-action condition scores entered as dependent variables and age as the predictor variable. Age did have an interaction with strong effect sizes in both conditions ($F_{Alone} = 9.443, p=.008, \eta^2=.386$; $F_{Co-action} = 6.602, p=.021, \eta^2=.306$), supporting the hypothesis. We further investigated the influence of age on performance by dividing the participants' ages into younger (under 16, $n=6$) and older (16 and older; $n=11$) in accordance with the AACAP definition of adolescent groups [Spano 2004].

An independent sample t-test was then executed and effect sizes were calculated. The older participants showed significant differences in both conditions compared to the younger participants (Alone $Mdiff = -.97, t(15)=-3.39, p=.004$; Co-action $Mdiff = -.88, t(15) = -.28, p=.014$). Older participants had better effects in both the alone and co-action conditions (Cohen's $d_{alone} = 1.64$; Cohen's $d_{co-action} = 1.33$). We further tested to see how the two conditions would influence the different age groups on how they differ in their benefits from performance between the conditions. The younger group had no significant effect of co-action ($Mdiff = -.28 (.36) t(4)=1.723, p=.160, CI LL: -.73 UL: .17$) but the older group had significant effects of performing with others ($Mdiff = -.17 (.08) t(11)=7.42, p<.001, CI LL: -.22 UL: -.12, Cohen's d=1.64$).

Table 1: Descriptive Statistics (N=17; $n_{female} = 8; n_{male} = 9$)

	Age	Alone*	Co-action*
Mean	15.82	7.2	7.43
Std. Deviation	1.380	0.73	0.74
Minimum	14.00	6.0	6.00
Maximum	18.00	8.80	9.00

* kata scores in the range of 1-10

Table 2: Pearson's Correlations (N=17)

	1	2	3
1. Age	—	0.622**	0.553*
2. Alone		—	0.963**
3. Co-action			—
Maximum			—

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

	n	M (SD)	SD	T	df	p	CI LL	CI UL
Alone				.347	15	.733	-.65	.90
Males	9	7.23	.89					
Females	8	7.16	.55					
Co-action				.343	15	.736	-.66	.91
Males	9	7.49	.92					
Females	8	7.36	.52					

Table 3: Comparison of Means between gender

DISCUSSION

The results showed a high degree of correlation (Table 2) between the alone and co-action scores, but the changes can be attributed to performing in the presence of others and thus confirm our first hypothesis. As in previous research on social facilitation [Corbett et al 2012; Grindrod et al. 2006], we found that co-action performance in kata significantly improved scores from experts. In line with the classical research from Zajonc [1965], kata performers showed significant improvements in performance under the co-action condition versus the individual condition, but this was mitigated by age. Younger participants did not show any significant benefit. Even though the findings were significant for older, more experienced practitioners, effect sizes were small ($d=.27$).

While males and females both performed better under co-action situations (hypothesis 2), females demonstrated somewhat greater effects ($d=.50$) than males. Our findings of medium effect sizes ($d=.50$) are similar to those in the study conducted by Gneezy and colleagues [2003] (converted r to d : .40) but higher than those of Rhea and colleagues [2003] ($d=.23-.29$). To be clear, while both males and females did improve during co-action situations, the females in this study experienced greater benefits.

While our data do not allow us to confidently ascertain why this is, one possible explanation could be via the notion of cue utilisation differing between groups. It is possible that the women in our sample interpreted the presence of others as a form of social support as found by Gneezy and colleagues [2003], whilst the men may have experienced some inhibition due to a perception of confrontation, in line with the 'Male-Warrior Hypothesis' as outlined by Van Vugt and colleagues [2007]. That is, women may use different psychological strategies for managing arousal in co-action scenarios that do not rely on viewing others as

threatening competition, which may benefit their performance more [Blanchard-Fields et al. 2004].

Either owing to different modes of socialisation into sport, socially-learned gender scripts, innate psychological factors, or perhaps a combination of all, women may be more adept at using emotional-situational factors that focus on social support – particularly when co-acting with other women – to help performance. This may stand in opposition to men who, for the same reasons, may be more likely to interpret and experience same-sex competitive co-action in a more confrontational manner, which may be a less beneficial approach when it comes to managing arousal and achieving peak performance. Such a hypothesis cannot be confirmed by our data though, meaning more research is needed to both extend the size (and thus generalisability) of our sample as well as add qualitative dimensions to the data in order to flesh out possible explanations for the small but notable difference observed.

Older participants (both male and female) also benefitted more from co-action situations than their younger counterparts. Effect sizes were large in this instance (Cohen's $d_{alone}= 1.64$; Cohen's $d_{co-action}= 1.33$). This may be due to participants' skill levels in karate. Although all participants included in the study were judged by the authors to be at either an intermediate or advanced skill level, skill differences within the sample were nevertheless associated with age, as participants in the 16 and above category held higher belt grades than the younger competitors.

The older age group could also be considered more experienced not only through skill level, but also through cognitive development [Spear 2000], making up for the significant differences in terms of karate-specific as well as more general psychological skills. However, as with

the noted differences by sex, our data do not provide conclusive answers as to why differences by age exist in the effects of social facilitation, inviting further research on the interaction of these factors.

These findings show that social facilitation is a complex phenomenon. Experience through interaction with one's environment may lead to using others to help facilitate performance. Experience is a necessary factor for expertise development [Ericsson 2006], and this entails understanding how the presence of others may help or hinder performance. With respect to demographic variables, our findings repeat those of some previous research [e.g. Gneezy et al. 2003] by showing that females received greater benefits of facilitation from competitive co-action compared to males. This might be explained by different ways of interpreting co-active conditions, principally as either supportive or confrontational. These cognitive interpretations might explain the small differences observed between the sexes, but require more research to substantiate.

Our study does have certain limitations. The age of the participants is young (all under 20), meaning other developmental aspects may also be used to explain some of the differences observed here, while the assumptions made about the impact of age on experience may not be true for all in the sample. For instance, some of the younger participants in the sample may have spent longer training at the kata being performed in this study than the older participants, even if those older participants may be more experienced overall. Likewise, the fact that participants were not all performing the same kata may have influenced the results, even if it is a safe assumption that each participant was familiar with the kata they performed, having elected to perform it at a competitive event.

Furthermore, it should also be noted that, while belt degree rankings give some indication of skill level, this is not a perfectly accurate measurement of actual skill in karate, since different schools award them in different ways; therefore, our use of this variable to define a threshold skill level for the inclusion of participants does not guarantee that our sample were all as skilled as we have assumed. Additionally, our study also has a very limited sample size, although the effect sizes and confidence intervals show that type I errors are limited. And last of all, we only investigated kata in this study, while other forms of karate performance (such as kumite) might show other results.

Despite these limitations, though, the study has some key strengths. Performance was rated by experts within the field. Directed hypotheses were used with conservative alpha levels (two-tailed) and results were both significant and in the predicted direction. Furthermore, the study's results have raised interesting questions for further research into the impact of competitive co-action on martial arts performance.

CONCLUSION

This research has shown how individual differences, in the form of experience and gender, are necessary to include in future social facilitation research on martial arts as well as other sports. Previous research has tended to omit these factors. Future studies within this field will also need to account for psychosocial measurements of individual differences (i.e., personality, self-efficacy) to investigate whether individual factors may mitigate or aggravate the effects this phenomenon. These findings suggest that social facilitation is not just a matter of producing a dominant response in the presence of others, but a complex cognitive evaluation of the situation and understanding of how one can use the presence of others to facilitate one's own performance. This involves a meta-cognitive understanding of situational factors not yet investigated in this field.

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Cardiff University Press
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cardiffuniversitypress.org

Journal DOI
10.18573/ISSN.2057-5696

Issue DOI
10.18573/mas.i5

Accepted for publication 24 January 2018

Martial Arts Studies
Journal design by Hugh Griffiths

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