A COMPARISON OF STROKE CHARACTERISTICS BETWEEN TEAM BOAT (K2) AND INDIVIDUAL (K1) SPRINT KAYAKING

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The purpose of this study was to compare the stroke characteristics of sprint kayakers in team boat (K2) versus individual (K1) 200-m racing. This case study centred on two male 200-m specialists from a national sprint kayak team. High-speed (120 Hz) videos were recorded from the sagittal view during an important selection time trial. Thereafter, video analysis was performed to identify stroke characteristics for each paddler in both K2 and K1, including stroke rate and a four-phase stroke breakdown of entry, pull, exit and aerial sub-phases. Results showed that the kayakers' stroke profile were more similar when comparing between K2 and K1 for the same person, rather than within both paddlers during the K2. It is likely that sprint kayakers have individually preferred stroke profiles but it is not clear how these profiles may be adapted for successful team boat performance.

KEY WORDS: stroke profile, performance, stroke synchronisation, technique.

INTRODUCTION: Kayak Sprint is a discipline of the Olympic sport of Canoe Sprint. Sprint kayakers compete in the individual kayak (K1), as well as the two-seater K2 and four-seater K4 team boats, over distances of 200-, 500-, and 1000-m. Team boat sprint kayaking may be classified as an interacting team sport where the crew must coordinate their efforts throughout the entire race for a collective outcome (Widmeyer & Williams, 1991). While some studies have identified the stroke characteristics of successful K1 performance (e.g. Michael, Smith & Rodney, 2009), the equivalent for team boat have not been documented.

Generally, it is accepted that successful team boat performance requires good stroke synchronisation (rhythm) within a crew (e.g. Wing & Woodburn, 1995; Fothergill, Harle & Holden, 2008). However, it is not known to what extent rhythm for individual kayakers are innate or may be adapted. Evidence from elite running found that 100-m sprinters with similar performance times differ on their step length-step frequency reliance; some sprinters prefer to take more, but shorter steps while others take lesser, but longer (Salo, Bezodis, Batterham & Kerwin, 2011). As step length and step frequency are akin to stroke length and stroke rate in sprint kayaking, it may be inferred that should such preference exist in sprint kayakers, then clearly there are implications for team boat sprint kayaking. For example, team boat performance may be aided by paddlers with the same stroke rhythm preference. The purpose of this study was to compare the stroke characteristics of sprint kayakers in team boat (K2) versus individual (K1) 200-m racing. Findings from the study would help increase the understanding of team boat sprint kayaking towards successful performance.

METHODS: A descriptive observational study was conducted on sprint kayakers of a national team during an important selection time trial. In this case study, two male paddlers who are 200-m specialists were chosen. Participant A was 23 years old (height 1.68 m, weight 77 kg) and had kayaked competitively for 10 years. Participant B was 22 years old (height 1.71 m, weight 76 kg) and had kayaked competitively for 9 years. In their K2 crew, participant A is the front paddler and participant B is the back paddler. Both participants have personal best timings for K1 200- below 38 s, and most recently at the 2014 Asian Games, they were ranked among the top 8 K2 200-m crew in Asia.

High-speed (120 Hz) videos were recorded from the sagittal view during each of the time trial events by a researcher on an accompanying speed boat. Thereafter, video analysis was performed to identify stroke characteristics for each paddler in both K2 and K1, including stroke rate and stroke phase durations (stroke profile). The stroke phase breakdown follows the model proposed by McDonnell, Hume and Nolte (2012) which contains four sub-phases (entry, pull, exit and aerial) separated by four phase-defining positions (catch, immersion, extraction and release). Figure 1 illustrates the four-phase stroke breakdown model.

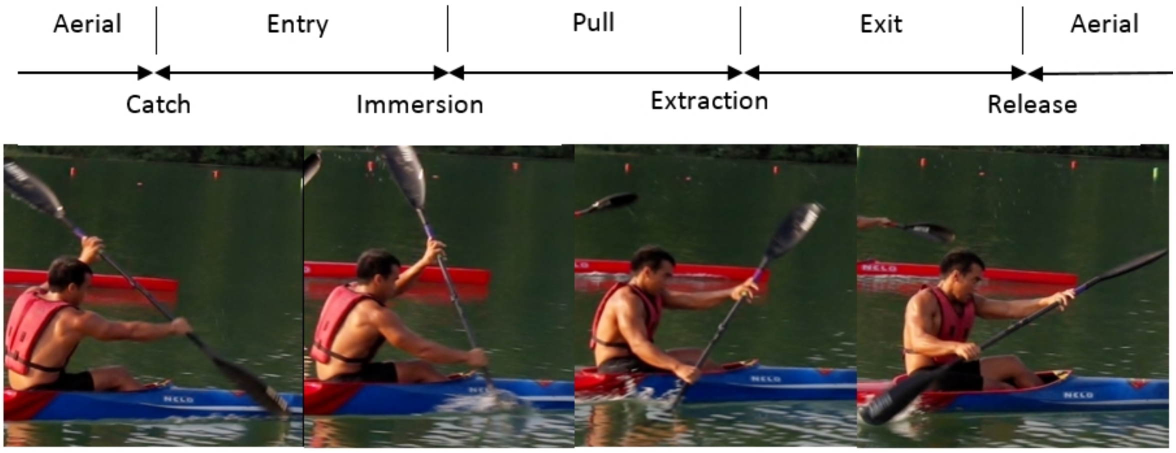

Figure 1: Kayak stroke phases (entry, pull, exit and aerial) and phase-defining positions (catch, immersion, extraction and release). The catch occurred at the first instance of contact between the paddle blade and the water, immersion occurred when the blade was maximally submerged, extraction was the last instance where the blade was maximally submerged, and the release was the last instance the blade contacted the water.

Stroke rate, measured in double strokes per minute (dspm), was calculated for each stroke based on stroke time, where Stroke Rate (dspm) = 60 s / Stroke Time (ms) × 1000. Average boat speed at 25-m intervals were determined by measuring the time taken for the tip of the kayak to cross the centres of consecutive lane buoys, where Speed (m/s) = 25 m / Time (s). Descriptive statistics were reported for two types of comparisons: 1) stroke characteristics between K2 and K1 for the same paddler, 2) stroke characteristics between the two paddlers (Participants A and B) in the K2.

RESULTS: The hand-timed results for the 200-m distance were 37.85 s (Participant A), 36.88 s (Participant B) and 33.77 s for the K2. Besides a faster speed, stroke rate was higher in K2 by ~6% (79 vs 74 and 75 dspm) compared to K1. Similar trends for stroke rate changes over time were observed for both K2 and K1 (Figure 2). Stroke rate rapidly increased in the first 25-m, and was mostly maintained until a gradual and slight decrease towards the end.

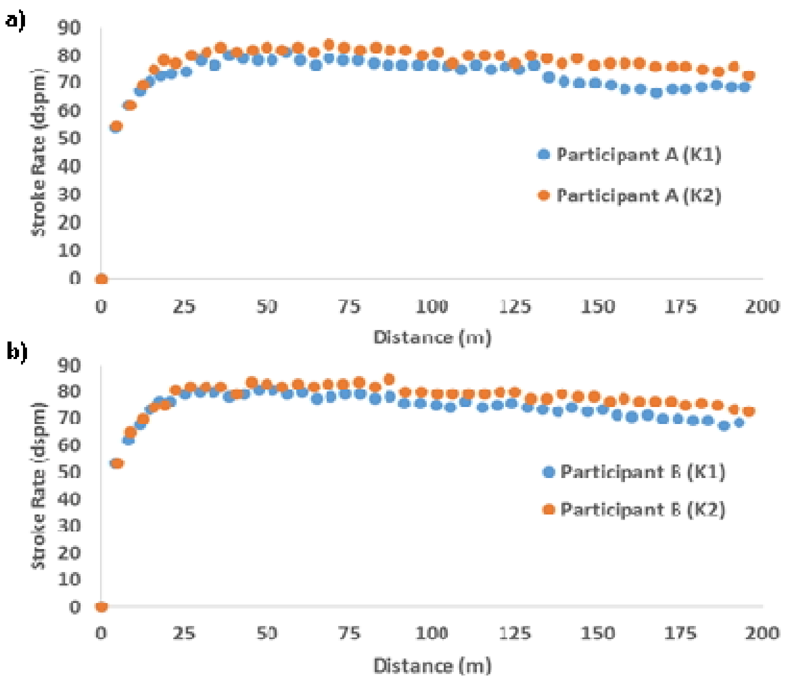

Figure 2 (a): Stroke rate-distance graph of K1 and K2 200-m for Participant A (b): Stroke rate-distance graph of K2 and K1 200-m for Participant B.

Figure 3 shows the stroke profile for each kayaker in K1 and K2. Individually, each kayaker performed similar stroke profiles between his own K1 and K2 races, e.g. Participant A (K1) versus Participant A (K2 Front). When comparing the two paddlers within the K2, however, there were noticeable dissimilarities. For example, Participant B (K2 Back) had a much longer pull sub-phase (147 ms versus 96 ms) than Participant A (K2 Front) despite paddling at the same stroke rate.

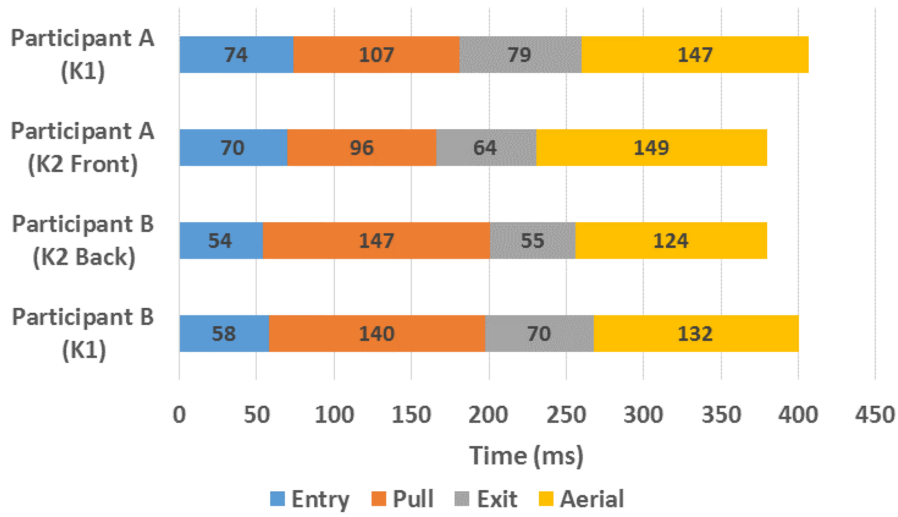

Figure 3: Absolute duration of the four-phase stroke breakdown (stroke profile) between K2 and K1 for each kayaker.

DISCUSSION: This study compared the stroke characteristics of national-level sprint kayakers in team boat (K2) versus individual (K1) 200-m racing. As evident from the faster boat speed and higher stroke rate, the demands of K2 team boat sprint kayaking are different from those of individual K1 paddling. The stroke characteristics comparisons revealed that a

kayaker's stroke profile tends to be more similar between himself during K2 and K1, as compared to with his team mate during K2 paddling. For example, Participant B has a longer pull sub-phase duration compared to Participant A in both K2 and K1 paddling – one would have expected the stroke profiles to be more similar within a K2 since crews are expected to paddle in rhythm. Thus, there is reason to believe that stroke profile in sprint kayaking has a strong element of individual preference.
The findings presented are a novel contribution to understanding sprint kayaking technique and performance in team boats since the literature has thus far focused on K1 (e.g. Michael, Smith & Rodney, 2009). Similar to the elite track sprinters in the study by Salo, Bezodis, Batterham, & Kerwin (2011), there is evidence to suggest that sprint kayakers also have individual preference for technique. At present, it is not clear how the differences in stroke profiles within a K2 crew affect team boat performance. Hence, future studies are needed to clarify whether kayakers should adapt their stroke profile to facilitate successful performance, or if such adaptations are even possible. Should it be confirmed that there are innate stroke profile preference within sprint kayakers (e.g. preference for a long pull phase), clearly this would affect crew selection. Crew selection is a complicated process where coaches and selectors typically have to identify the fastest crew from a pool of kayakers who are similar in K1 performance. On one hand, it could be that kayakers with similar stroke profiles perform better compared to crews with mismatched preferences. On the other, it may also be that mismatched preferences actually complement for successful performance. Exploring this spectrum of possibilities will enhance an understanding of team boat sprint kayaking.

CONCLUSION: This study compared the stroke characteristics of national-level sprint kayakers in team boat (K2) versus individual (K1) 200-m racing. The stroke profiles of kayakers tend to be more similar when comparing between K2 and K1 for the same paddler, rather than with a team mate in the same K2. As it remains unclear how stroke profiles may be adapted for successful team boat performance, future investigations are needed.

REFERENCES:

Fothergill, S., Harle, R. & Holden, S. (2008). Modeling the model athlete: Automatic coaching of rowing technique. In N. Vitoria Lobo, T. Kasparis, F. Roli, J. Kwok, M. Georgiopoulos, G. Anagnostopoulos & M. Loog (Eds.), *Structural, Syntactic, and Statistical Pattern Recognition* (Vol. 5342, pp 372-81). Berlin: Springer.

McDonnell, L.K., Hume, P.A. & Nolte, V. (2012). An observational model for biomechanical assessment of sprint kayaking technique. *Sports Biomechanics*, 11(4), 507-23.

Michael, J.S., Smith, R. & Rooney, K.B. (2009). Determinants of kayak paddling performance. *Sports Biomechanics*, 8(2), 167-179.

Salo, A.I.T., Bezodis, I.N., Batterham, A.M. & Kerwin, D.G. (2011). Elite sprinting: Are athletes individually step-frequency or step-length reliant*? Medicine and Science in Sports and Exercise*, 43(6), 1055-62.

Widmeyer, W.N, & Williams, J.M. (1991). Predicting cohesion in a coacting sport. *Small Group Research*, 22(4), 548-70.

Wing, A.M. & Woodburn, C. (1995). The coordination and consistency of rowers in a racing eight. *Journal of Sports Sciences*, 13(3), 187-97.

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