DO SWIMMERS ALWAYS PERFORM BETTER USING THEIR PREFERRED TECHNIQUE?

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This study compared four underwater trajectories in order to determine if swimmers will always perform fastest using their preferred technique. Fourteen elite swimmers were asked to dive at three depths as well as their preferred dive. These conditions were labelled as Dive 1, Dive 2, Dive 3 and Preferred. The Wetplate Analysis System was used to collect all data before descriptive statistics were determined. Inter-trial variability on a group basis revealed little difference in variance between each dive type. Further individual analyses found that seven of the fourteen swimmers performed faster using a non-preferred technique. In contrast to other studies which have found that swimmers will favour their preferred start technique there is evidence in this study to suggest that elite swimmers are able to readily change their underwater trajectory.

KEYWORDS: dive, trajectory, swim start, elite

INTRODUCTION: In sport there have been multiple studies that have compared different techniques in order to determine if there is an “ideal movement pattern” which athletes must adopt in order to achieve superior performance. Specifically investigating the swimming start, there have also been a number of studies that have manipulated the swimmers’ technique with the aim of improving performance (Honda, Sinclair, Mason, & Pease, 2012; Kirner, Bock, & Welch, 1989; Slawson et al., 2011). Hay (1986) stated that most studies comparing different start techniques are flawed as swimmers will always perform better using their preferred start technique. Indeed, there are a number of studies that have shown swimmers will perform better with their preferred dive as this technique is more stable and reproducible (Hay, 1986; Jorgic et al., 2010; Vantorre, Seifert, Fernandes, Vilas-Boas, & Chollet, 2010).
There is also evidence in these studies that elite swimmers are able to readily change their technique, which suggests that these types of comparative studies are not flawed when using elite swimmers. Vantorre et al. (2010) compared elite swimmers preferential start technique with an un-preferential technique. They found that even through there were differences in kinematics prior to entry into the water, there were no differences in overall performance; stating that high-level swimmers are able to compensate lower block efficiency with effective underwater phases. Similarly, White et al. (2011) used experienced and less experienced swimmers to compare shallow and deep underwater trajectories and found that the more experienced swimmers were able to readily alter their technique.
The current study utilised a comparative design with elite swimmers only, aiming to determine if swimmers performed better using their preferred underwater trajectory. It was hypothesised that swimmers are likely to perform better using their preferred technique. Nevertheless, this study’s protocol will encourage swimmers to try a new technique, which may prove to be faster.

METHODS: Fourteen swimmers (11 male, 3 female, 19 ± 1 y) were recruited from the Australian Institute of Sport (AIS) Swimming Program and other state institute programs around Australia. All swimmers qualified for the National Championships in the 100 m freestyle (53.10 s for male, 59.00 s for female) and had at least 5 years of competitive swimming experience at the national level with an average FINA point score of 787 ± 19. Swimmers were asked to perform a series of dives at three depths. The depths were categorised as Dive 1, Dive 2, Dive 3 and the swimmers’ preferred dive. Dive 1 is

typically characterised by swimmers resurfacing as fast as possible with minimal underwater kick. This is the dive used mostly by swimmers who are weak at underwater kick as they spent the shortest amount of time underwater. During Dive 1 the swimmers were asked to resurface and commence free swimming almost immediately after entry. Dive 2 can be described as a gradual descent followed by a gradual ascent. For Dive 2 the swimmers were asked to dive deeper and aim to resurface around the 10 m mark. Finally, Dive 3 is most commonly used by swimmers who are highly proficient in underwater kick, as the swimmer stays underwater for the longest amount of time during this dive. In Dive 3 the swimmers were asked to dive down deep and resurface to commence free swimming at the 15 m mark.
To assist the participants in achieving the prescribed trajectories, brightly coloured markers were placed at 5 m, 7.5 m and 9 m on the bottom of the pool, to indicate the point at which the participants needed to begin rising to the surface in order to achieve the Dive 1, Dive 2 and Dive 3 conditions respectively. The distances that the markers were placed at was determined from a previous study by Tor et al. (2014) which stated that the mean horizontal distance of maximum depth for elite swimmers is 6.06 m with a standard deviation (SD) of 0.97 m. Therefore, the markers were placed at -1 SD (5 m), +1.5 SD (7.5 m) and +3 SD (9 m) according to the results of that previous study. The swimmers performed 16 dives at maximum effort to 15 m (4 dives at each set condition and 4 dives at their preferred depth) with two minutes rest in between each dive. The 16 dives were completed over two testing sessions (one day rest in between each session); eight dives per session. Each swimmer performed two of each dive type during the session in a randomized order. Testing was divided into two testing sessions to ensure that each trial was performed maximally by the swimmer. Each dive trial was tested using the Wetplate Analysis System. The Wetplate Analysis System is a propriety system developed by the AIS Aquatic Testing, Training and Research Unit (ATTRU) and consists of an instrumented starting block with the same dimensions as the Omega OSB11 starting block (that used at all major international competitions) and a series of high-speed cameras (Mason, Mackintosh, & Pease, 2012; Tor, Pease, & Ball, 2015). The Swimtrak time system was used simultaneously to measure split times.
Individual analysis was first conducted on the data using standard deviation as a measure of inter-trial variability. Each swimmer's fastest dive condition was identified and tabulated. Means and standard deviations were then calculated for each parameter using SPSS Statistical Package (version 19.0, SPSS, Chicago, IL).

RESULTS: Performance time (time to 15 m) and descriptive statistics of selected parameters for each dive condition are shown in Table 1. The mean and standard deviation of each dive type for performance time was Dive 1 (mean ± standard deviation, 6.62 ± 0.40 s), Dive 2 (6.54 ± 0.37 s), Dive 3 (6.56 ± 0.42s) and Preferred (6.48 ± 0.39s). Each swimmer's fastest dive condition was also identified on an individual basis. On seven occasions out of 14 the swimmer's preferred dive was not the fastest dive condition and on two occasions the fastest condition equalled the swimmer's preferred condition. Two swimmers each found that Dive 1 and Dive 3 were the fastest condition, while three swimmers found that Dive 2 was the fastest.

Table 1 Mean and standard deviation of selected parameters for each dive condition

Parameter	Preferred	Dive 1	Dive 2	Dive 3
Maximum Depth (m)	-0.98 ± 0.17	-0.74 ± 0.14	-0.92 ± 0.16	-1.03 ± 0.18
Distance at Max Depth (m)	5.86 ± 0.79	5.03 ± 0.58	5.75 ± 0.69	6.32 ± 1.21
Time at Max Depth (s)	1.78 ± 0.23	1.53 ± 0.18	1.75 ± 0.22	1.98 ± 0.46
Breakout Distance (m)	11.91 ± 1.52	8.11 ± 1.20	10.50 ± 1.41	12.43 ± 1.14
Breakout Time (s)	4.85 ± 0.69	2.94 ± 0.55	4.13 ± 0.68	5.22 ± 0.58
Depth of first kick (m)	-0.98 ± 0.20	-0.50 ± 0.24	-0.89 ± 0.18	-1.04 ± 0.17
Distance of first kick (m)	6.54 ± 0.68	6.16 ± 0.57	6.62 ± 0.68	6.65 ± 0.69
Time of First Kick (s)	2.04 ± 0.23	1.96 ± 0.19	2.08 ± 0.24	2.09 ± 0.24
Time to 15 m (s)	6.48 ± 0.39	6.62 ± 0.40	6.54 ± 0.37	6.56 ± 0.42

DISCUSSION: Most dive start studies have reported that swimmers' performed their best starts using a technique which they had the most practice with (Pearson, McElroy, Blitvich, Subic, & Blanksby, 1998). When examining different starting techniques, Hay (1986) stated that most studies are flawed because swimmers all have their own preferred start that is practiced almost exclusively. Therefore, studies which suggest one type of starting technique is superior to another may usually be associated with the swimmer's preference rather than real biomechanical advantages (Lyttle & Benjanuvatra, 2005). Further, an athlete's perception of their ability (sport confidence) and comfort in performing a skill (preference) may also affect their physical performance (Mills & Gehlsen, 1996). This study aimed to determine if swimmers always perform better with their preferred technique.

In this study, multiple individual analyses were used to determine if swimmers performed fastest using their preferred technique. Using standard deviation as a measure of inter-trial variability, there is very little difference in performance between each dive type and the swimmer's preferred condition. Even though previous research stated that the swimmers' preferred start technique is also the most stable and reproducible (Vantorre et al., 2010), there is evidence to suggest that this type of study is not flawed and that skilled swimmers are able to adjust from their preferred starting technique with similar amounts of inter-trial variability present for all dive conditions.

There is also evidence in this study that the swimmers' preferred technique is not the fastest. Each individuals fastest dive type was determined and showed that half of the participants performed faster using a non-preferred technique. Hence, even though the participants were considered highly competitive, a number of swimmers still had not optimised their performance and could further improve their start technique by altering their underwater trajectory. This was different to previous studies that have suggested swimmers will always perform better using their preferred or most practiced technique.

In addition, this study found that all swimmers were able to modify the maximum depth of their starts. White et al. (2011) tested 12 competitive and 13 less experienced swimmers at two different depths (preferred and shallow) and have shown swimmers with more competitive experience have been able to change the depth of their starts in comparison with less experiences swimmers. Conversely, in a study comparing two different start techniques Vantorre et al. (2010) found that there were no significant differences between the two techniques, stating that skilled swimmers were able to compensate lower block efficiency with effective underwater phases and there were no significant differences. Given that there was difference in maximum depth between each dive condition and some swimmers performed better using a non-preferred technique, the results from the present study and White et al. (2010) suggest that elite swimmers are able to adapt to a non-preferred technique with little training.

CONCLUSIONS: This study compared four underwater trajectories using an instrumented starting block and kick-start technique. Using this study design in the future coaches will be able to determine if their swimmers have optimised their underwater trajectory to improve start performance. Contrary to other studies this study found that elite swimmer's preferred movement pattern may not be their optimal technique. Elite swimmers, like the ones used in this study are able to change their technique with little training. Consequently, the findings of this study suggest that this type of design, when used with elite participants is not flawed and can be applied in the future.

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