The effect of cognitive intervention on stroke distance in age-group swimmers

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Advanced age-group swimmers and their coaches try to optimize their individual swimming technique. Therefore the stroke distance is often mentioned as a criteria. If swimmers cover more distance stroke by stroke, their movements under water are more efficient. The base of a successful motion sequence is a well-structured mental representation. Mental representation can be visualized by using special software. Based on these results, special workouts have been designed. During a six-week training period the participating group worked precisely according the advised concept. As pre-and post-tests the swimmers worked on the computer and performed 25 meters freestyle starting in the water, as fast as they could. On the date of the post-test the swimmers had a mental representation that was more organized and made improvements in their swimming performance. The distance was covered at nearly same speed, but with a lesser stroke rate; the stroke distance therefore increased.

Key words: *front crawl, cognitive intervention, mental representation, stroke parameters*

INTRODUCTION

Highly skilled swimmers cover as much distance per stroke as possible in an aquatic space. Therefore the stroke distance is often mentioned as a criteria for a good swimming technique (Dekerle et al. 2005, Sanders 1999, Arellano et al. 1994, Reischle 1988). An improved technical swimming performance results, among other things, in a longer stroke distance. The athlete is able to swim the same race-distance with the same or even a lesser stroke rate and probably in less time. In case of less time and increased stroke distance the so-called stroke-index (speed squared and multiplied by stroke distance) will increase as well. RUDOLPH (2001) showed elite swimmers like Popov or de Bruijn, to reach their fastest swimming times by longer stroke distance and less stroke rates, with a higher stroke-index throughout.

Tab.1: Comparison of the performance of 50 meters freestyle of Alexander Popov (Olympic Games 1996 and 2000) (RUDOLPH 2001)

	Time 50m [s]	**Speed [m/s]**	**Stroke rate [1/min]**	**Stroke distance [m]**	**Stroke-Index [m³/s²]**
Olympics 96	22.13	2.13	52.4	2.44	11.07
Olympics 00	22.24	2,13	58.2	2.19	9.94

To gain more effective underwater-movement, swimmers could improve their power (without technical training this might be limited) and / or try to optimize their motion sequence in and with water. In contrast to most other sports, swimmers do not have a fixed base to push off. Instead, they produce propulsion due to an interaction of the body and the water-mass. Therefore it is very important to teach swimmers how to work with water properly while executing regular strokes. To achieve this, emphasis should be put on how stroking is mentally represented in swimmers, even age-group swimmers. Coaches always look for possibilities on how to improve the action associated with thrust production of each swimmer. In this context a cognitive intervention which is based on the structural dimensional analysismotoric (SDA-M)[1] according to SCHACK (2003) can be used. This method describes mental representation structures and enables statements about the cognitive architecture of complex movements in the long-term memory. So the main reason for problems of (stroking) actions can be localized in a way, which fits the demand of effective communication between coach and athlete.
The purpose of this paper is the report about the effect of mental-representation-research based intervention on the stroking ability of age-group swimmers.

METHOD

22 age-group swimmers preparing for their first participation in national championships took part in the intervention. On the appointed days they performed two X 25m crawl at full speed with water start. In doing so the data of the two trials were averaged. During these sprints a) the time over 10m distance – from 10 to 20 m – and b) the stroke rate

[1] Ungerechts/Schack (2006) did a first research about the representation of butterfly-swimmers using SDA-M. They also described the used method.

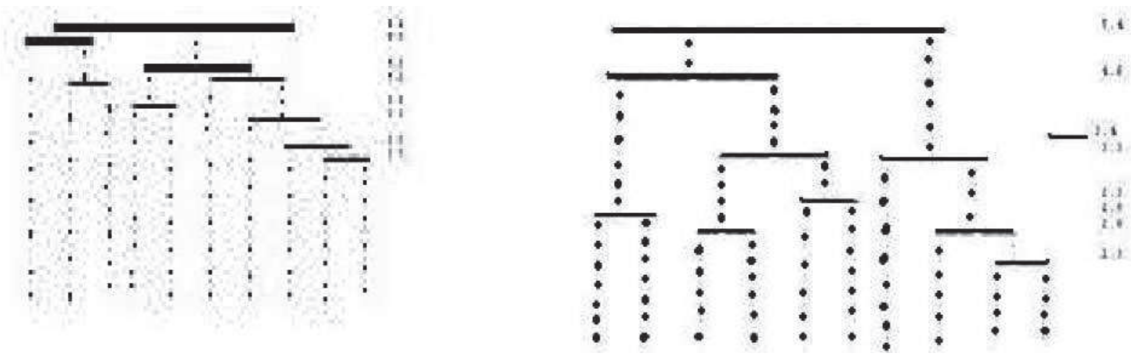
were measured. Finally the stroke distance and the stroke index were calculated.

Fig. 1 Surface of the Split-Program (ENGEL/SCHACK 2001)

The intervention consisted of using the following -a) appropriate software “Split” (SCHACK et al. 2000) used to sort out “basic action concepts”, called nodes, representing arm/hand actions during crawl stroke and b) individualized stroking instructions over a six week period. The nodes were established by the coach based on his usual stroking instructions, but in a more structured manner.

After sorting out all nodes according to the criteria, whether they belong to the anchor node or not, one gets an impression of the mental representation, which the swimmer has of his motion sequence (in this example of the crawl arm stroke). Using this so-called split-technique, “Split” calculates distances between the nodes, which is the basis for further data analysis. As a result of factor analysis one obtains a factor matrix, classified by clusters. These results can be demonstrated by a so-called dendrogram (Schack et al. 2006, Schack/Lander 1988). By analyzing the dendrograms and the clusters and after communicating with the coach special training-programs (theoretical and practical ones) had been worked out, to be done or to be followed for the six week training period. So the individual stroking instructions were inferred from the results of the SDA-M tests.

The two dendrograms below show the results of an age-group swimmer belonging to the intervention group. The first one points out the result of Split at the pre-test, the second one the result of the test after the six week training period. There are changes in the mental representation. Initially, the swimmer does not have a structured representation or a good idea of the crawl arm stroke and its nodes. But after the training period he shows a well-organized structure of the motion sequence. There are three clusters with the main phases of the movement: the part above the waterline with breathing and forward hand movement, the first phase of the underwater movement (entry to the end of forward-downward phase) and the main impulse phase (pronation to slicing of the hand).



1 2 4 5 8 6 9 10 7 3 9 10 1 2 3 4 5 6 7 8

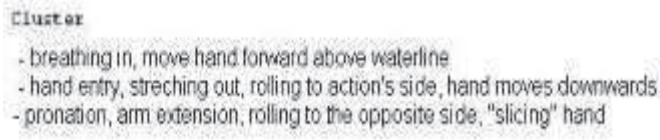


Fig. 2 The dendrogram on the left visualise the mental representation of the swimmer (without any cluster and without a real regularity). On the right is the dendrogram of the same swimmer after the six week training period – with cluster and regularity of nodes

RESULTS

The improvement of the mental representation shown in the example above also led to improvements in the swimming parameters. As a criteria for technical progress, which is a more efficient motion sequence, the stroke distance in first and the stroke index in second place has been chosen, because this combines stroke distance and swimming speed[2].

The following schedule show the corresponding data of Test I and Test II for the whole group. Apart from stroke rate and stroke index, speed and stroke rate are also shown as important parameters for the performance of the swimmer (and dependent parameters).

[2] Stroke distance and stroke rate are not independent of each other (cf. Sanders 1999). For an improvement of stroke distance the stroke rate must not decline too much, because then the speed will also decline also and the swimming performance in competition will be worse than before.

Tab. 1 Statistical data for group

Parameter	Test 1 (mean, std)	Test 2 (mean, std)
Speed m/s	1,52 ± 0.09	1,51 ± 0.11
Stroke rate 1 /min	49,64 ± 4,4	47,88 ± 3,43
Stroke distance m	1,85 ± 0,16	1,90 ± 0,19
Stroke index	4,33 ± 0,70	4,39 ± 1,01

Comparing the results of stroke distance, there is an increase of approximately 0.05 meters. So if a swimmer for instance does 60 strokes, in Test II he would advance 3 meters more than in Test I. The speed stays nearly at the same level. It slowed down only 0.01 meters per second. The stroke rate decreases by nearly 2 strokes per minute. Due to the stroke distance the stroke index increases by 0.06.

The following diagram shows the changes from Test 1 to Test 2, as an effect of the special intervention during the six week training period. The stroke distance of Test 1 and Test 2 are copied, including the shortest and the longest shown distance. Furthermore 25%, 50% (median) and 75% per cent are described as well as the mean of all the stroke distances. On the left the results of the pre-test are shown, on the right there are the results of the post-test.

The mean variation is bigger for the Test 2, the longest distance increased and the shortest distance declined, although the mean and the median increased. In Test 1 the mean and median were nearly at the same level, while in the Test 2 the median increases considerably. The mean increases as shown in the tables above. There is a 75 per cent increase, and a 25 per cent decline, so there is an overall improvement after the six week training period, although it is not statistically significant. Analogue to the stroke distance are the changes in stroke index, because of the nearly same speed: The mean variation is bigger for the Test 2I, the highest stroke index increased and the lowest declined, although the mean and the median increased.

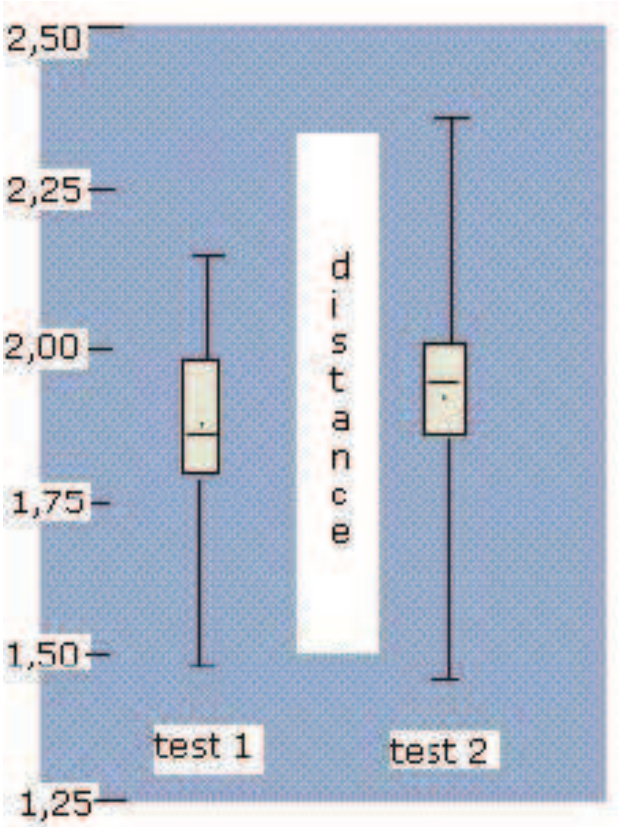


Fig 3 Stroke distance of Test 1 (left) and Test 2 (right)

DISCUSSION and CONCLUSION

Comparing the results of pre-and post-test it is obvious that the stroke distance increased at a similar speed. This can be also seen in the development of the stroke index, which comprises both speed and the stroke distance.

After six weeks training, including a SDA-M based intervention nearly the same average speed was reached by using less stroke cycles. The specific work on the identified stroking problems triggered most of the swimmers to modify their motion sequences. Longer stroke distance indicates an increased effect of the stroking action. In combination with a lower stroke rate a total increase of efficiency is obvious. Even though the change was not statistically significant the intervention made an impact: The participating swimmers increased their cognitive ability and thus enhanced their own power to improve their aquatic space activities.

Furthermore, many swimmers could not stabilize their motion sequence because of the relatively short time of practise after intervention. Even if the SDA-M based stroking instructions caused large-scale changes, the tested swimmers were not able to stabilize the new motion sequence in less than six weeks. Trying to swim at maximum speed, either they failed to produce an optimized constant motion sequence or they did not reach maximum speed because the test was done some days after main competition. This special group of swimmers would need more time to stabilize and automate their motion sequence at a slow speed (cf. Sweetenham/Atkinson 2003, Maglischo 2003).

The selected method stands the test, but in future it will be important to study this type of training in the domain of motion control and motion learning, for example with a longer time for practise after intervention. Using an individual SDA-M based instruction improves the teaching of swimming movements, not only because of the better structured communication. In conclusion, an effect of mental-representation-research based intervention on the stroking ability of age-group swimmers is possible and likely.

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