VISUAL PERCEPTION TRAINING FOR YOUTH DIVERS WITH A "SOMERSAULT SIMULATOR"

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In diving a vertical entry into the water is very important. Divers control their orientation in space by integrating sensory information from the visual, vestibular, and somatosensory system. Scientists and coaches have discussed two important types of control in diving: visual control and time control (inner clock model). Visual control is based on visual perception. The aim of the present study was to analyse effects of visual perception training. Divers should use visual perception for the control of the movement from tucked to straight position of the body for the entry into the water. A measuring unit with a "Somersault Simulator" was used for practicing visual perception. Ten divers took part in the study and demonstrated the capacity of visual perception. The results of visual performance development were not conclusive and depend on the task.

KEY WORDS: vision, visual perception, springboard diving, platform diving.

INTRODUCTION: The visual system plays a crucial role in guiding the athlete's search for essential information underlying skilful behaviour. Lately, there has been an increased interest in visual search behaviour and visual perception of athletes in different kinds of sport (Williams, 2002). Scientists and coaches agreed, visual control is also one important part of orientation during somersaults in platform and springboard diving. The control of the movement is a requirement for a good and successful performance. Several studies have presented results of the question on what athletes recognize during the performance in sports such as gymnastics, trampolining and diving. Another type of studies investigated the visual search behaviour, typically examined using an eye movement registration system. Gundlach, Dahl & Krüger (1984) reported on the influence of vestibular nystagmus to visual perception during longitudinal rotations. It was concluded that the nystagmus decreased the optic perception, but not substantially. In addition, divers had better visual performance than untrained subjects. Hondzinski & Darling (2001) investigated the somersault performance including head position (back double somersaults on trampoline) under three visual conditions (normal, reduced, and no vision). The performance scores and landing scores showed differences between vision and no vision conditions but no differences between normal and reduced vision (subjects wore special contacts with the central 8 mm opaque to reduce optical input). Regarding the head motion, it was found that angular head velocity was slowed to a greater extent just before landing in normal and reduced conditions when compared to the no vision condition. Diving coaches report also this head movement and the importance of "spotting technique" (de Mers, 1983). A similar study was presented by Davlin, Sands & Shultz (2001). Ten gymnasts performed standing back somersaults from a stiff foam block onto a safety mat. Four visual conditions were used (normal vision, no vision, vision only in the first part of the skill, vision only in the second part of the skill). Landing balance was less stable when no vision condition existed. Measured kinematics of the performed somersaults were similar among the vision conditions. These studies had elite athletes. There is no similar data on youths and unskilled subjects and on divers. Divers use the "spotting technique" to look to points like springboards, pool and the surface of the water. Young divers should practice the visual orientation during their basic diving tasks. This is an important prerequisite for difficult dives. Learning new skills without using spotting techniques could cause disorientation when visual cuing is attempted later on with the same skill

Figure 1. subject in the somersault simulator.

(Gabriel & George, 1990). Coaches and scientists developed an apparatus called "Somersault Simulator" (figure 1) for training different tasks (Knoll, 1999). Some of the advantages of this apparatus are the possibility to use it for unskilled athletes and the possibility to perform the correct handstand position after the somersaults to simulate the entry into the water. The "Somersault Simulator" was lised to study the vestibular adaptation (Naundorf & Krug, 2000). In this study, the same apparatus was utilized to investigate the visual perception during the somersault of young divers. There were two main questions:

1) Can divers identify visual information during the somersault?
2) Will practice improve the visual performance?

Thanks to the three belts on legs and trunk athletes feel save and without anxiety in the "Somersault Simulator". When athletes are anxious, their focus narrows to the point where some task-relevant stimuli may be ignored and their performance may suffer. Moran, Byrne & McGlade (2002) showed, in a study with gymnasts, that anxiety was associated to an increase in the number of fixations to peripheral areas. That's why we assume the "Somersault Simulator" is a good apparatus for practicing visual performance.

METHODS: Ten divers (5 male and 5 female) took part in this investigation. The performed skill in the "Somersault Simulator" was the two and a half somersault backward tucked body position (diving terminology: 205c). The athletes (age: M 14.4 SD 1.71) started in an upstanding position, arms straight above the head (see figure 1), simulated the take-off from the springboard, turned backwards and got into the tucked position. At the end of the skill, the athletes left the tucked position into the straight position and simulated the entry into the water. A measuring unit with the "Somersault Simulator" (figure 2) was configured. Using the speedometer and the signal receiver the position and the angular velocity of the athletes could be calculated. The data of angular velocity and angular position were recorded by the computer. On an individual position, similar to the individual orientation point in the diving hall, the diode lamp was added. The diode lamp was used with a randomized order if the athlete reached a defined position during the somersault. In both somersaults of the skill the lamp could light up for 0.20 seconds. After every performed skill athletes were asked whether the lamp was switched on separately for first and second somersault. The divers repeated the task 8 times per training unit, 6 sessions were realized, the first and the last session were test sessions without feedback. There was a second demand for the divers. Using the video camera, video computer and the feedback monitor athletes were informed about their performance (static images of dynamic motion with reference images, criterion-actual value discrepancies). They should improve leaving the tucked into the straight position for a correct entry and were instructed to change their technique for the preparation of the entry. Verbal feedback was also given for correction like "open the body position earlier" or "open the body position later". This is not focused in this paper, but these demands influenced the visual perception especially in the second somersault. the software package SPSS 9.0 was used. For statistical analysis the binominal test (Bortz, Lienert & Boehnke, 2000) was used for proving statistical hypothesis.

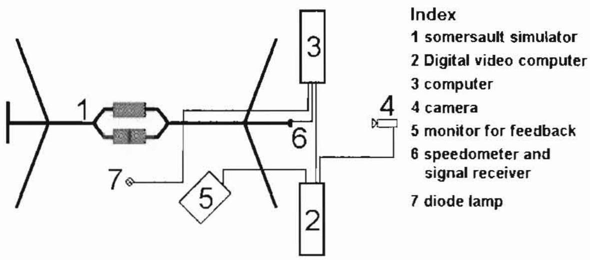

Figure 2. Measuring unit for the investigation.

RESULTS AND DISCUSSION: The angular velocity of the two and a half somersault backward tucked in the "Simulator" was maximal 727 deg/s (M 639 deg/s, SD 38.7 deg/s).

The visual performance of the first session (80 percent correct identification) and all other sessions was always higher than the probability to advice fortuitously (50 percent). More detailed results are showed in table 1 and figure 3. There were no significant differences between session 1 and 6 for both somersaults (p=.08) and for the second somersault (p=.40). If you have a look at the first somersault, there was a significant increase from session 1 to 6 (p=.01). Because of visual perception in the second somersault is important for a successful entry into the water, we compared the results between the first and the second somersault. There were no significant statistical differences (for all sessions: p=.26; for first session: p=.13; for last session: p=.94).

Finally, we will have a look at the second somersault. Because of the verbal and imagery feedback in sessions 2, 3, 4 and 5 athletes wanted to correct their performance. This task influenced the visual perception. The visual performance on session 1 and 6 (test session without feedback) is significantly (p=.02) better than in the other sessions (with feedback).

The movement from tucked to straight position was realized on all sessions and athletes were able to do both tasks (visual perception and changing body position). But with the aim of correcting the movements, the visual performance was decreased. We assume that the correction of the movement needs more attention and there is not enough attention for the visual task.

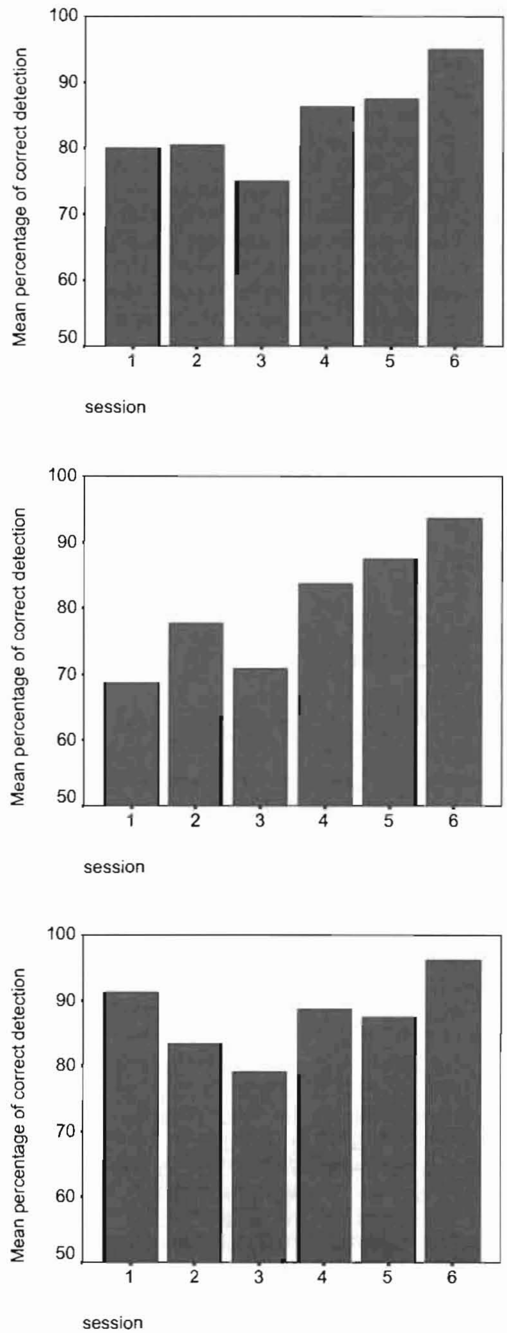

Figure 3. Mean percentage of correct identification per session (top: both somersaults, middle: first somersaults, bottom: second somersaults).

Table 1. Mean percentage of correct identification.

Number of the Session	Both somersaults	1st somersault	2nd somersault
1	80,00	68,75	91,25
2	80,56	77,78	83,33
3	75,00	70,83	79,17
4	86,25	83,75	88,75
5	87,50	87,50	87,50
6	95,00	93,75	96,25

CONCLUSION: The decreasing performance of the dual-task is not characteristic for an automatic skill. Both tasks need attentional control. The importance of visual perception for the control of the movement from tucked to straight position was not showed. One conclusion could be the practice of visual perception should be realized with easier skills or without a second task. If a good visual performance can be realized, the visual information can be used for other tasks. Furthermore, we assume that the athletes do not use the visual information for movement control. After further analysis of the movement performance we can inform about the relationship between correct identification of the diode lamp and the quality of the movement performance. The next task for the future should be the comparison between visual performance in the "Somersault Simulator" and in the diving hall (in training and competition context). In order to reduce the probability to advice fortuitously if the lamp was switched on, in the future we will use three different lamps.

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