# PREPARATION WITH A "SOMERSAULT SIMULATOR" FOR LEARNING A NEW TASK WITH YOUNG DIVERS

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In diving it is important to learn different difficult kinds of somersaults. Before young divers perform a new task for the first time they prepare with various exercises and the help of different apparatus. By using a "somersault simulator" five young divers were prepared for a new task in six training sessions. After the special training three divers did the task under real conditions. Their performance was compared with other divers, which did not train with the "somersault simulator". Altogether we can report, that there was no significant effect of the special "simulator" training on preparation for the water entry or actual diving performance. One explanation was the amount of practice with the "simulator" (four times training and two times (pre and post) test) was not enough for positive effects on diving performance.

**KEY WORDS:** springboard diving, somersault simulator, transfer, motor learning.

**INTRODUCTION:** Modern springboard and platform diving is well known for many difficult tasks with various somersault rotations sometimes combined with longitudinal rotations. To learn these difficult kinds of somersaults a lot of training is necessary. Before young divers perform a new task for the first time they prepare with various exercises and the help of different training apparatus. Coaches design and teach task progressions to minimize the possibility of injury and to maximize positive transfer between tasks and component parts. They use different apparatuses (uniaxial and biaxial spotting belts, trampolines, dry boards) and manual spotting for securing the young divers.
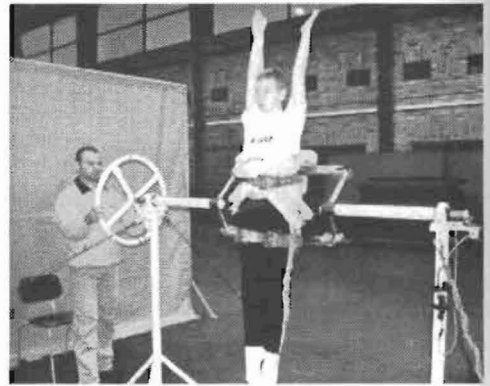


Figure 1: Subject in the somersault simulator.

Coaches and scientists developed another apparatus called "Somersault Simulator" (see Figure 1) for training different tasks (Knoll, 1999). Advantages of this apparatus are the possibilities to use it for unskilled athletes and also to perform the correct handstand position after the somersaults to simulate the entry into the water. The "Somersault Simulator" was utilized to study the vestibular adaptation (Naundorf & Krug, 2000) and visual perception during the rotations (Naundorf, Krug & Lattke, 2002). In the present study, the same apparatus was utilized to prepare young divers for a new task (two and a half somersault backward; diving terminology: 205 C). The divers should improve leaving from the tucked into the straight position for a correct water entry. There were two main questions:

1) Can divers improve their technique of preparation for the water entry with the "somersault simulator"?
2) Can divers, who use the "somersault simulator" perform better than divers who did not use the simulator?

**METHODS:** Five divers (3 male and 2 female; age M: 13,2 SD 0,75) took part in this investigation. The divers should learn the task two and a half somersault backward tucked body position with the "somersault simulator". Athletes had no experience with this task, but they were able to do easier tasks like one and a half somersault tucked (203 C) and the double backward (204 C). In the "somersault simulator" athletes started in an upstanding position,

arms straight above the head (see Figure 1), simulated the takeoff from the springboard, turned backwards and got into the tucked position. At the end of the task, the divers left the tucked position into the straight position and simulated the entry into the water.

A measuring unit with the "somersault simulator" (see Figure 2) was configured. Using the speedometer and
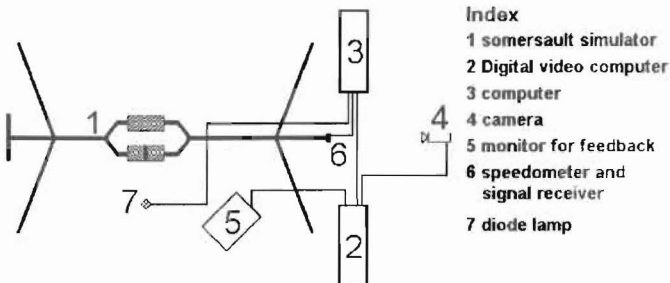
Index
1 somersault simulator
2 Digital video computer
3 computer
4 camera
5 monitor for feedback
6 speedometer and signal receiver
7 diode lamp

Figure 2: Measuring unit for the investigation.

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. Using the video camera, video computer and the feedback monitor athletes were informed about their performance. After every second trial the athletes could see static images of dynamic motion with reference images (see Figure 5). With this image (see Figure 3) criterion-actual value discrepancies were shown. Athletes were able to identify if their own position was too late, correct or too early. Verbal feedback was also given for correction like "open the body position earlier" or "open the body position later". For three special positions (start of the entry preparation; stretched legs; water entry position) feedback images were shown. The reference image (model image) was individual for every diver. They were generated by their individual performance of the one
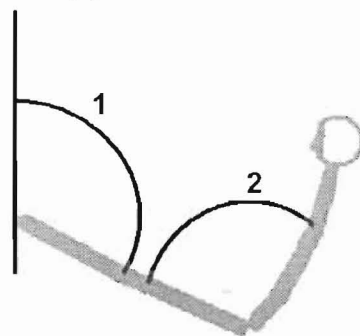
Figure 3: Sample image for one position of the feedback procedure.

and a half somersault tucked (203 C) and the double backward tucked (204 C), which was analyzed with special diving software. The divers repeated the task eight times per training unit with the "somersault simulator", six sessions were realized, first and last session were test sessions without feedback. The frequency of late, correct or early performance for the three positions was registered. After the training session a special analysis of position 2 (stretched legs) was realized. We measured two angles (see Figure 4): hip angle (2) and leg-space angle (1). The absolute error (AE) was calculated (see Formula 1 and 2).

$$AE_{(hip\ angle)} = |RP_{(hip\ angle)} - AP_{(hip\ angle)}| \qquad (1)$$
$$AE_{(leg\text{-}space\ angle)} = |RP_{(leg\text{-}space\ angle)} - AP_{(leg\text{-}space\ angle)}| \qquad (2)$$

were:
RP      reference performance
AP      actual performance

Figure 4: Angles for position 2.

Three of the five divers did the two and a half somersault backward tucked from three meter springboard into the water after the special "simulator" training. The dives taken from one of their first six trainings sessions in the diving hall were recorded by a video camera (DV Camcorder Panasonic NV-DX 100, 50 Hz) and analyzed with special diving software. For comparing these dives a control group of three divers (Age M 13,05; SD 0,58) was arranged. These divers did not take part in the "simulator" training, but their dives (also taken from one of their first six trainings sessions)

were also recorded by the video camera and analyzed. Divers of both groups did also "normal" training with their coaches. During this training they also went through special preparation for the new task (special tasks on trampoline, dry board training).

For nonparametric statistical analysis the software package SPSS 11.0 was used. To compare data of two sessions the Wilcoxon Sign-Rank Test (for measured angles), the Bowker-Test (for frequencies) (see Bowker, 1948) and to compare two groups the Mann-Whitney U Test was utilized for proving statistical hypothesis.

**RESULTS AND DISCUSSION:** Results of the training sessions with the "somersault simulator" are presented first. For the three positions the frequency of "late", "correct" and "early" performance in session one and six is shown in Table 1.

**Table 1 Frequencies of "late", "correct" and "early" performance for the test sessions.**

|  | Session 1 | | | Session 6 | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | early | correct | Late | early | correct | late |
| Position 1 (start of the entry preparation) | 12 | 27 | - | 30 | 10 | - |
| Position 2 (stretched legs) | 10 | 12 | 17 | 28 | 6 | 6 |
| Position 3 (water entry position) | - | 1 | 38 | - | 12 | 28 |



Figure 5: Reference images for Position 1 (left), 2 (middle) and 3 (right).

If we compare the frequencies of the three performance categories of session one with session six, there are statistical differences (Position 1: $Chi^2=10,703$, $p<0.05$; Position 2: $Chi^2=16,133$, $p<0.05$; Position 3: $Chi^2=9,308$, $p<0.05$;). But the significant changes of the frequencies are only for the Position 3 in the expected direction. As shown in Figure 5, Position 3 was die water entry position and divers could direct attention to this position more than to the other positions. Because water entry is most important for a successful dive.

We also focused our analysis on Position 2. The difference (absolute error) between the angles of the diver and the model was calculated for hip angle and the leg-space angle (see Figure 4). Results are reported in Table 2.

**Table 2 Median of the absolute error for the angles in the test sessions (N=5).**

| Angle | Median AE Session 1 | Median AE Session 6 |
| --- | --- | --- |
| Hip angle | 31,0 ° | 19,5 ° |
| Leg-space angle | 27,0 ° | 46,0 ° |

Using the Wilcoxon Sign-Rank Test there is no statistical difference between the two test sessions (Hip angle: $Z=-0,944$; $p=0.173$; leg-space angle: $Z=-0,674$; $p=0.250$).

Comparing the performance in the diving hall of the experimental group (training with the "somersault simulator") with the control group (no "simulator training") there was also not a statistical difference ($Z$(two-sided)$=-1,550$; $p=0.121$). The optimal entry angle into the water for the two and a half somersault backward was 880°. The Median of the AE of the entry angle for the experimental group was 22° and for the control group 13°.

**CONCLUSION:** There was only a minor effect of training with the "somersault simulator" (only for Position 3). But if we compare this to divers without the "somersault simulator" there was no motor transfer (zero transfer) from the "simulator" to the dive in the diving hall (in training and competition context). There was no effect on preparation for the water entry or actual diving performance.

There could be different reasons for these results. The amount of special "simulator" training (four training sessions with eight trials plus two test sessions with eight trials) was not enough to get a measurable effect. The proportion of the special training on the whole training of the divers was undersized. That is why we will start a new experiment with younger divers. The task is to prepare the divers for the one and a half somersault backward (203 C). The measuring unit including the "somersault simulator" with the feedback system will be used in 25 sessions (including five test sessions). With this amount of "simulator" training we expect decreasing performance in the "somersault simulator" and positive transfer to the dive in training and competition context.

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