DOES PARTICIPATION IN ORGANIZED ATHLETICS INCREASE A CHILD'S SCORING ABILITY ON THE WAYNE SACCADIC FIXATOR?

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ABSTRACT

This investigation was undertaken to determine if children who participate in organized athletics score better on the preprogrammed activity #3 on the Wayne Saccadic Fixator than children who have not participated in athletics. The results indicated that children who have been active in athletics and athletic training programs do perform better on this particular Wayne Saccadic Fixator task than those children without athletic experience.

KEY WORDS

athletic activity, eye-hand coordination, saccadic eye movements, Wayne Saccadic Fixator

The Wayne Saccadic Fixator[a] (WSF) consists of a 29-inch square panel containing 33 red light switches (see Figure 1).

The instrument is controlled by a computer chip that generates a variety of patterns of lights to which the subject responds by pushing the lighted switch to extinguish the light. Numerous combinations of display patterns, speed, and response situations can be programmed to challenge the skills of the subject in a variety of ways. In fact, the WSF is supplied with over 50 preprogrammed procedures to both train and evaluate patient performance. By measuring and observing the individual's performance, inferences can be made about the child's eye-hand coordination, visual reaction times, peripheral awareness, and eye movement skills.[1]

Figure 1.

To date there have been a limited number of articles published on the WSF. In 1983 Sherman[1] used an earlier model of the WSF and published data on the visual pre-action and reaction scores based on a study using 371 amateur and professional athletes. He theorized that subjects participating in sports that required fast visual reactions to a moving target such as in baseball, basketball, and tennis, would score higher on the WSF than players in such sports as archery, golf and bowling. Sherman concluded that the WSF could provide a method for comparing the visual performance skills of athletes. In 1984, Appler and Quimby[2] tested 1,251 children to establish performance standards on the WSF for students in grades one through five. Their study found a direct relationship between scoring ability on the WSF and the child's age. They also found an inverse relationship between scoring ability and ambient illumination on the WSF during testing. No distinction was made in their study, however, between those children who were active athletically and those who were not. They also suggested that other factors such as competitiveness, maturity levels, and cultural differences may affect scoring ability on the WSF. Christenson and

Winkelstein,[3] sought to develop a sports vision testing battery. They compared the visual skills of college football and softball players with a group of non-athletic college students. Several parameters were evaluated, including scoring ability on the WSF. They concluded that there was a significant difference in scoring ability when comparing the athletic and non-athletic groups. Their study suggests that athletes have better visual abilities than non-athletes and that better athletes have better visual skills than poorer athletes. In 1990, Kirscher[4,5] published scoring norms using data from two studies of women tennis players. This study, however, did not compare WSF scoring ability of the athlete vs. the non-athlete. More recently, Mitchell, Nicholson and Maples[6] published data establishing performance norms for 6- to 13-year-old children for visual pre- action times, visual reaction times, and the near-far-near accommodative procedure on the current 33-light model of the WSF. Their data indicated a direct relationship between age and performance scores similar to that found by Appler and Quimbly's study.[2] Mitchell et al. suggest that there may be a correlation between motivation and academic achievement and WSF scoring ability. In our previous study,[7] we also reported a similar correlation between both visual reaction times and performance scores on the WSF and age. Both of these skills proved to be strongly age dependent when evaluated on the WSF.

It is commonly assumed that children who participate in sports will have better overall motor development, eye-hand coordination skills, concentration, and quicker reactions than those children who do not. This study was undertaken to investigate if children who participate in organized sports do score better on the WSF than those children who do not.

METHODS

The subjects chosen for this study included 91 children (51 males, 40 females) between the ages of 8 and 13 (see Table 1).

The subjects were evaluated on the WSF following a comprehensive optometric examination which included tests for ocular health, refractive status, binocular vision skills, color vision, stereopsis, and eye tracking skills. Only those individuals with normal saccadic and pursuit eye movement skills were chosen for this study. Saccadic and pursuit skills were evaluated by using the King Devick Test[b] and by observational scores based on criteria developed by Maples[8] on the NSUCO's Oculomotor Test. An observational score of 4 or 5 on the NSUCO Test or a score within one standard deviation of the age mean on the King Devick Test was considered acceptable for this study. As reported by their parents, none of the children were attending special education classes. None of the subjects had any complaints of asthenopia following near work. If eyeglasses were normally worn, the child was tested while wearing his/her habitual correction. All subjects had less than 5 prism diopters of esophoria or exophoria at 40 cm. None of the subjects had a tropia. The sample group was multiracial.

Age	Males	Females	Total
8	12	10	22
9	6	7	13
10	10	3	13
11	9	7	16
12	8	7	15
13	6	6	12
Totals	51	40	91

Table 1. Age (in years) distribution for the subjects in the WSF study.

Each child (or his/her parent) was asked the following questions to determine whether the child could be placed in the "athletic" or "non-athletic" group:

1. Are you now or have you ever participated in any organized team sport such as soccer, volleyball, baseball, football, etc.? This could include any sport, either private or school, that required regular practice sessions and refereed games.
2. Have you taken more than a year of instructional classes in gymnastics, judo, karate, swimming, dance, ballet, pom-poms, etc. or attended a sports training camp?

To be included in the "athletic" group the child had to meet one of the following three criteria:

1. The child must have participated in at least two organized sports for at least one year. For example, a child who played on a baseball team in the summer and on the school basketball team in the fall would be placed in the "athletic" group.
2. The child must have played the same sport for two years or more.
3. The child must have participated in one organized sport and taken one instructional class for at least a year. A child who played organized soccer and had taken a year of gymnastic lessons would meet this criterion.

Children who had never participated in an organized sport or had not taken any type of instructional athletic classes were included in the "non-athletic" group. Several of the "non-athletic" students reported that they did play "sand lot" baseball or football regularly. Several reported that they "swam a lot" or that they "liked to play tennis." However, none had ever played on an organized team or had taken formal instructions in a sport.

Fifty-one children met the athletic criteria for this study and 40 children met the non-athletic criteria. Of the 51 athletic students, 20 were females and 31 were males. Of the non-athletic children, 20 were females and 20 were males.

Activity #3, a preprogrammed, self-paced technique on the WSF was utilized for this study. During this procedure, one of the 33 red lights is randomly illuminated on the board. It remains lit until the child depresses the light with his/her finger tips. Immediately following, a new light randomly appears. This continues for a 30-second testing period. The total number of lights depressed during the testing period are recorded by the instrument.

The following instructions were given to each subject: "When you see a light appear, I want you to depress the light with your finger tips as quickly as possible. Try to get as many lights in the 30 seconds as you can. Your score will depend on how many lights you get and how fast you get the lights."

For the purpose of this study, hand dominancy was determined by asking each child about five tasks. "Which hand do you use to write or color, to throw a ball, to eat, to brush your teeth, and to drink from a glass?" If the same hand was used for at least four of the five tasks, that hand was assumed to be the child's dominant hand. If these criteria were not met, the child's data were not included in this study. Eighty-five of the 91 children in this study met five out of five of the hand-dominancy criteria. The remaining

six children met four of the five criteria. According to these criteria, 86 children were classified as right hand dominant and 5 children were classified as left hand dominant.

The procedure was first demonstrated to the child by the examiner. The subject was then allowed a 30-second practice trial before the testing began. Four separate scores were recorded for each child. On the first 30-second trial, the child scored as many lights as possible using only his/her dominant hand. On the second 30-second trial, the child used only his/her non-dominant hand. The third trial repeated the use of the dominant hand only. The fourth trial repeated the use of the non-dominant hand. The two scores for the dominant hand were then averaged to obtain a mean dominant hand score for each child. Similarly, the two scores for the non-dominant hand were averaged. A fifth and final 30-second score was then obtained. The child was asked to extinguish the lights on the right side of the WSF board with his/her left hand and on the left side of the WSF with his/her right hand (referred to as the Right X Left Procedure). This activity required the child to cross his/her midline to score a light. If the light appeared on the middle, vertical row of WSF lights,, the child could extinguish it with either hand. Only one score was recorded for this activity. In addition, the number of errors made during the Right X Left Procedure was also scored. In many cases the child reached for a light with the wrong hand but caught his/her error before depressing the light. An error was scored only when the child actually depressed the light with the wrong hand.

The following instructions were given to each child for the Right X Left Procedure: "If the light comes on this side of the board, use this hand. If the light comes on the other side, use this hand. If the light appears on the middle (vertical) row, you can use either hand that you want." The "right" and "left" labels were not used when presenting these instructions to the children. Rather, we pointed to the hand and the side of the WSF that we wanted the child to use. The center light of the WSF was placed at the subject's eye level and the child stood at arm's length from the WSF for all measurements.

Appler and Quimbly's[2] study on the WSF indicated an inverse relationship between the ambient room illumination and the scores obtained on the WSF. Their study suggested that higher scores were obtained when room illumination was lower and, therefore, contrast between the target light and background was higher. All testing for this study was done under overhead fluorescent lighting. The level of illumination on the WSF as measured by a Cambron Spot Meter was 15 foot-candles.

	Mean Score and Standard Deviation When Using the Right Hand Only	Mean Score and Standard Deviation When Using the Left Hand Only	Mean Score and Standard Deviation On the Right X Left Procedure
Children with an athletic background N = 51	27.3 4.5	27.2 5.0	21.3 4.3
Children with a non-athletic background N = 40	22.7 4.9	22.4 5.3	16.8 4.1
t value p value	4.25 <0.0001	4.09 <0.0001	4.51 <0.0001

Table 2. Comparison of scoring ability on the WSF for the children with an athletic background vs. those children with limited or no athletic experience.

RESULTS

The mean scores obtained on this procedure for both the athletic and non-athletic students are displayed in Table 2. A visual inspection of this data indicates that there was no significant difference in the mean scores obtained for right hand vs. left hand performance. Since 86 of the 91 children were classified as right hand dominant, there was no apparent difference in mean scores obtained for the dominant vs. non-dominant hands. Consequently, the dominant and non-dominant data was grouped and presented as the mean scoring ability for the right hand vs. the left hand rather than the dominant vs. the non-dominant hand.

When using their right hand only, the athletic group had a mean score of 27.3 lights while the non-athletic group averaged 22.7 lights. The t test indicated that these mean scores were significantly different at the 0.0001 level (t = 4.25). When using their left hand only, the athletic group attained a mean score of 27.3 lights and the non-athletic group scored 22.4 lights (t = 4.09, p = 0.0001). And, finally, on the more difficult Right X Left Procedure, the athletic group obtained a mean score of 21.3 lights compared to 16.8 lights for the non- athletic group (t = 4.51, p = 0.0001). The data also indicates that there was no significant difference in the scoring ability for either group between right and left hand performance.

DISCUSSION

The results of this study support the conclusion that children who have participated in organized athletic programs or in motor training programs (such as ballet, gymnastics, judo, karate, etc.) tend to score better on the WSF than children with a limited athletic background. Scoring ability on the WSF encompasses a number of visual skills including quick visual reaction times, peripheral visual awareness of targets, eye-hand coordination, and accurate eye movements. Depending upon the specific WSF task being evaluated, the subject's motivation, mental alertness, enthusiasm, level of concentration, understanding of the procedure, and age can all influence his/her scoring ability. If the WSF provides a measure of these combined skills, it can be concluded that children with a strong athletic background tend to have better visual skills (as measured on

the WSF) than children with a limited athletic history.

The subjective observations of a child's (or adult's) performance on the WSF can be as valuable as the objective measurements. For example, how does the child prepare for the task? Does he/she assume a readied stance with hands in a scoring position? Or, does the child just stand and wait until the lights begin to appear, perhaps even missing the first light or two? How does the child recover from mistakes? If a light is reached for and missed, does the child become frustrated and confused or does he/she recover and proceed with the task? Does the child stand with his/her midline coincident with that of the WSF or is the child's stance off center? How much upper body movement, head movement, and lower body movement does the child make? It was observed, for example, that most children who scored high on this task tended to stand at a readied position with their body centered over the midline of the WSF. A few children who initially stood off center quickly adjusted to the midline position when they realized it would be a more effective position. High scorers tended to develop a rhythmic, fluid motion of their arms and hands as they responded to the lights. Some children made excessive head and body movements attempting to scan the board for target lights. These children typically scored lower than those who made minimal head and body movements. Performance scores on this task were dependent on the child's ability to learn the best strategy in new visual motor tasks. Children with an athletic background and presumably stronger motor skills tended to do better on this task than children with limited athletic experience.

Richman,[9] in his review of the 1990 optometry literature, suggested that the research published to date on the WSF provides valuable information for using this instrument as a diagnostic screening tool to identify high risk children in a visual fixation/saccadic reaction test. As clinical studies continue to be published, the WSF appears to have clinical validity as an instrument for evaluating not only the visual skills of athletes but non-athletic adults and children as well. However, as the literature review in this article indicated, there are both visual and non-visual factors than can affect scoring performance on the WSF. For this instrument to gain even greater clinical validity, future studies should isolate and measure each of these other variables.

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