Experimental Study on Color Recognition Using a Hand-Eye-Coordination Board

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Introduction:

The interaction of visual and motoric component is known as hand-eye or hand-foot coordination and demands a lot of the perception system.[1] [2] This ability can be practiced with a novel coordination board (*twall® Premium 64, IMM Holding GmbH*) by deactivating flashing fields by hand, foot or even sports equipment (Fig. 1). In addition to the coordination, endurance and reaction time can be trained. This board is currently used as a fitness device for athletes, for rehabilitation of patients with restricted mobility or just to motivate people for movement and activity.

Fig. 1: Sixty-four flashing fields of the hand-eye-coordination board

Purpose:

For an increasing usage of the *twall®* in sports vision trainings, more knowledge about device-specific characteristics and visual parameters with reference to optometry are required. The aim of this study was to determine one preference color out of the seven emitted light colors (red, green, yellow, blue, turquoise, rose and pink) using a combination of hand-eye coordination in a visual selective perception test.

Methods:

Fig. 2: Participant doing the experiment

Data of 44 healthy participants (25.0 ± 1.9 years; 64% female, 36% male) were included in this prospective study. They had to focus their attention on selecting a target color from six distractor colors in a visual selective task. One search field consisted of 13 flashing positions (one target color field and two fields of each distractor color, Fig. 2). There were seven rounds, one for each color, in which the target appeared in randomized order and position and had to be deactivated ten times by hand. After each round the new target color was presented. If mistakes were made, the participant was allowed to search again until the right target was deactivated (Fig. 3).

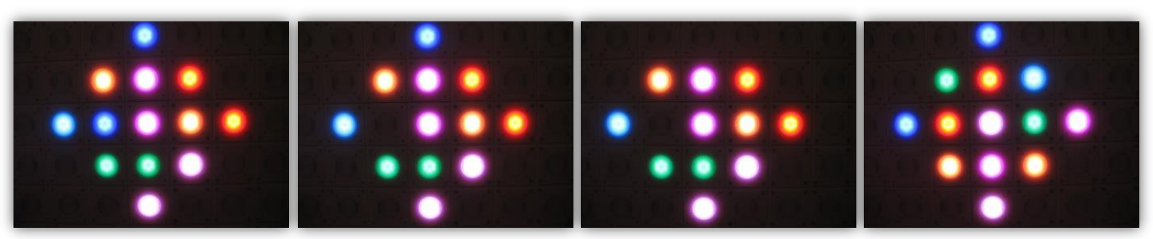

Fig. 3: Example of two mistakes (blue instead of target color turquoise was deactivated)

Results:

The average reaction times of each color as well as the number of mistakes were recorded.

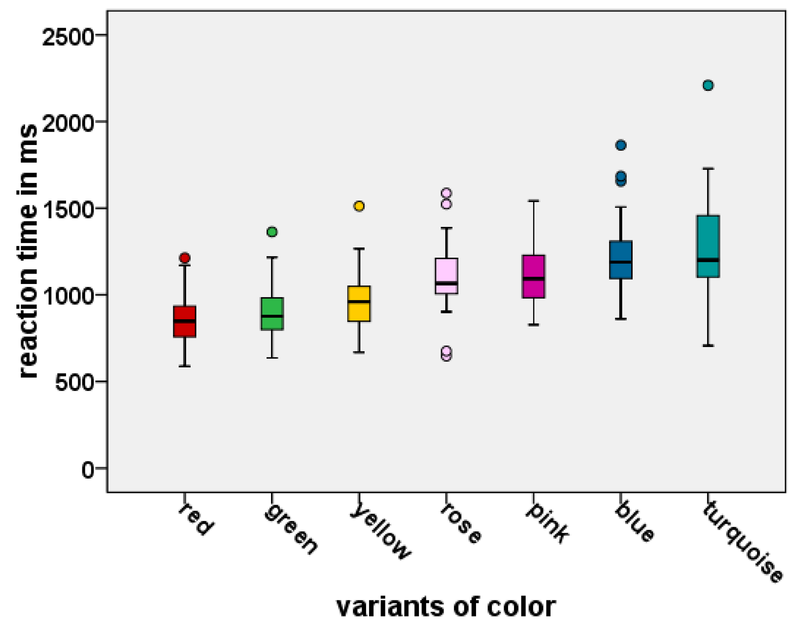

Fig. 4: Overview of the average reaction times of all seven colors

The visuomotor reaction time includes the duration of stimulus detection, the sensory, cortical and neuromuscular processing up to the point of motoric reaction.[2] Fig. 4 shows that red had the shortest average reaction time and turquoise was deactivated more slowly.

Differences between these non-normally distributed reaction times for each color have been statistically tested with *Friedman* and indicate a grouping of significant different reaction times for red, green and yellow, as well as for rose, pink, blue and turquoise (Fig. 5). This means that the target colors red (851 ± 147ms), green (904 ± 152ms) and yellow (960 ± 164ms) have been deactivated significantly faster ($p < 0.05$) in the selective task than rose (1103 ± 184ms), pink (1119 ± 167ms), blue (1225 ± 204ms) and turquoise (1281 ± 274ms).

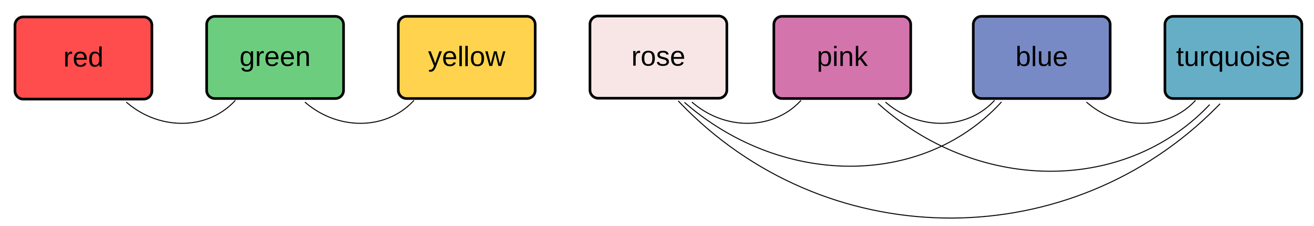

Fig. 5: Graphical marking (arches) of the colorspecific average reaction times, which are non-significantly different ($p > 0.05$)

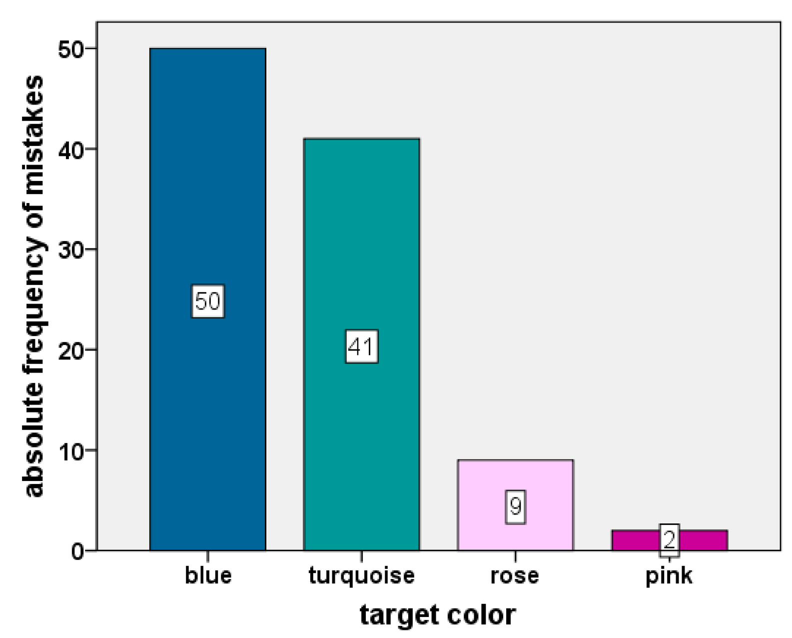

Fig. 6: Absolute frequency of incorrect deactivated target colors

Mistakes were gathered quantitatively. They occurred only at the target colors blue, turquoise, rose and pink. Fig. 6 shows that most of these mistakes were made at blue color fields (50 times, equates to 49.0% of all mistakes). Turquoise was hit incorrectly 41 times (40.2%), rose nine times (8.8%) and pink two times (2.0%).

Discussion:

The results show a significantly faster and more accurate color recognition for red, yellow and green targets in a selective task. One reason for this is, that in a feature search these color shades can best be differentiated out of all distractor colors. Therefore they are selected more quickly in a parallel perception process.[3]

The high rate of mistakes as well as the longer reaction times of the target colors rose, pink, blue and turquoise are explainable with the context effect.[4] Blue/turquoise and rose/pink are very similiar in color shade. If one of them is the target and the other one the distractor color (Fig. 7), the object-feature color shade is interferenced, as a result.

Fig. 7: Typical colors which can be mixed up (rose/pink and blue/turquoise)

It is important to note that the results of this study were established by using combinations of all seven emitted light colors.

Conclusion:

A clear recognition of the flashing colors is a basic requirement for the use of the hand-eye-coordination board *twall®* to valuate visuomotor skills. Otherwise the performance decreases dramatically. For this reason, a color optimization is necessary. With new, optometrically-oriented programs, the utilization of the hand-eye-coordination board could be broadened for visuomotor trainings of professional and recreational athletes. It would be possible to train the visual perception while being in motion. For example, a sports vision training of the peripheral color recognition or selective attention by a color stimulus could be created.

References:

[1] Wilson, T. A. & Falkel, J. (2004). SportsVision. Training for better performance. Champaign, IL: Human Kinetics.
[2] Erickson, G. (2007). SportsVision - Vision Care for the Enhancement of Sports Performance. St. Louis: Butterworth-Heinemann.
[3] Hagendorf, H. et al. (2011). Wahrnehmung und Aufmerksamkeit. Berlin, Heidelberg: Springer-Verlag.
[4] Neisser, U. (1963). Decision-time without reaction-time: experiments in visual scanning. The American Journal of Psychology, Vol. 76 (3), p. 376-385.

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