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Effects of Visual Control Training on the Shooting Performance of Elite Female Basketball Players

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ABSTRACT

In the current study, a method was tested to train visual control in basketball shooting. Using a sender/receiver system, Plato liquid-crystal goggles were wirelessly and manually controlled by the experimenter to manipulate vision of players while they were shooting. During the training the goggles were only open during the final instances of each shot forcing players to use optimal information. In three months, six elite female basketball players, selected on the basis of their shooting style and performance, received 9-15 shot sessions, each consisting of 50 three-point shots with the goggles. Pretest-posttest comparisons revealed that the players who had received the goggle training improved their shooting percentages significantly while two control groups did not. Gradual increases of shooting percentages over training sessions inspired additional confidence in the conclusion that pre-posttest improvements were related to the visual control training. The Plato-goggle system provides a promising tool to be used in sports practice to improve performance.

Key words: Basketball Shooting, Expertise, Perceptual Training, Visual Control

INTRODUCTION

Basketball jump shooting is an important skill in basketball, as it provides one of the ways to score. However, in contrast to dunks and layups for which the final shooting distance is quite small (i.e., very close to the basket) the jump shot is often taken from further away. In the Women's National Basketball Association (WNBA), over 60% of the field goals are jump shots from more than 2 m from the basket (wnba.com). The jump shot is a difficult skill that is hard to master and even top shooters' shooting percentages remain well below 100%. For three-point shots (from further than 6.25, 6.75, or 7.24 m depending on the competition) the

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best shooters shoot around 50% both in the NBA and the WNBA (nba.com; wnba.com), while the last in the top-50 of three-point shooters (the 50th best shooters in the NBA and WNBA), shoot between 30% and 40%. This implies that even for elite players there is room for improvement, making it worthwhile to find ways to do so. Apart from *rote learning* to optimize and automatize shooting technique (involving many repetitions on a daily basis) ([1-3], see also [4]), specifically improving visual control seems to hold promise in that regard.

Previous research into visual control of basketball jump shooting has shown when and for how long shooters should look at the rim during their shot to obtain good performance [5-7]. Approximately 350-400 milliseconds (ms) of seeing the rim appears to be necessary and sufficient for expert basketball players to detect relevant optical information from the rim to control the shooting action and achieve optimal shooting percentages, provided that these 350-400 ms occur as late as possible, that is, as late as the shooting style of the basketball players allows [5-7]. Note that this late information provides the most up-to-date information about the player's position relative to the rim which will continuously change up until the moment of ball release. As such, the late information provides the most up-to-date information about the distance that the ball needs to travel to reach the rim, hereby providing the best information to be used for the control of the final shooting movement [5-8].

Visually, roughly two shooting styles can be distinguished, a high and a low style (see [7-8]). Players with a high style lift the ball above their head during the shooting movement, after which optical information from the rim is detected by looking underneath the ball. Optimally this should be done during the final 400 ms before ball release, that is, before the ball leaves the hands. In contrast, players with a low shooting style do not lift the ball above their line of sight. They block their line of sight during the final part of the shot movement, implying that optical information from the rim has to be picked up by looking over the ball (for about 400 ms) before the line of sight is blocked. For a more detailed explanation on shooting styles, see Oudejans et al. [7].

It can be argued that suboptimal shooting performance even of expert basketball players may be the result of looking at the rim either at the wrong moment (not as late as possible) or simply for too brief a period (or both). Under that assumption, two earlier studies investigated whether specifically designed visual control training can improve shooting performance of highly talented junior male basketball players [8] and elite wheelchair basketball players [9]. In both studies, the visual training intervention involved a large screen that was used to initially block vision of the basket for the shooters. In the study of Oudejans et al. [8] players took jump shots from behind the screen in such a way that they could only see the rim while they were airborne during their jump shot and therefore able to look over the screen to see the rim. As such the screen only allowed vision of the rim at the final instances prior to ball release to force players to learn to use the late information that was shown in earlier studies to lead to optimal performance [5-8]. Similarly, in the study of Oudejans et al. [9] during the training intervention elite wheelchair basketball players took shots after driving underneath a large screen that initially blocked their view on the rim. Once they cleared the screen they could see the rim and shoot immediately, again forcing them to use relatively late and hence most up-to-date information about their position relative to the rim. In both cases, several weeks of shot training with the screen led to significant and meaningful improvements in shooting percentages of at least 10%.

Both studies reveal the potential value that specifically designed visual control training can have on the shooting performance of (even) elite basketball players. Moreover, in both cases the screen training can be easily implemented in practice by coaches and players

themselves, however, with one major disadvantage: the screen as used by Oudejans et al. [8] is only suited for able-bodied high style shooters, and the screen as used by Oudejans et al. [9] only for wheelchair basketball players. In the current study, I took a first step in developing a form of visual control training that can be easily implemented in basketball practice and adapted to any shooting style, whether it is a high or low style executed by an able-bodied or wheelchair basketball player. Plato liquid crystal (LC) goggles (Translucent Technologies, Canada) that can be opened and closed within milliseconds provided the basis for the training intervention. The control of the goggles was made wireless in such a way that it can also easily be used by coaches and players in basketball practice to force players to learn to use that information that is optimal for their style.

In short, the aim of the current study was to examine whether visual control training with Plato LC goggles leads to comparable improvements in shooting performance to the screen training used previously by Oudejans et al. [8, 9]. Shooting performance was assessed using a pretest-posttest design with a three-point shooting test consisting of three-point shots from five different positions while running from position to position. It was expected that the visual training intervention would lead to significant improvements in shooting performance from pre- to posttest.

METHOD

PARTICIPANTS

In two seasons, a total of twenty one elite female basketball players with a mean age of 18.3 years ($SD = 1.3$) participated in the study. On average, they had 9.8 years ($SD = 2.7$) of competition basketball experience. All were members of the National talent program in which players train for 20 hours a week under the leadership of several certified coaches. All participants played in the highest league for women's basketball in The Netherlands and, as a requirement, all players were also in the National selection of their age group (U16, U18, U20, Seniors).

In the first season, six players were assigned to the experimental group to receive the visual control training ($M_{age} = 17.7$, $SD = 1.63$). Eight players were assigned to one control group (Control 1) that did not receive the visual control training but performed other shooting drills instead ($M_{age} = 19.3$, $SD = 0.89$). Players of these two groups were not randomly assigned to the groups. Together with the coach, several players were selected for the visual control training based on shooting styles that were visually not optimal (some players seemed to block their own vision with ball and hands at the moment that seeing the rim would be optimal; as determined from video-analyses), in combination with shooting percentages during the pretest. As this violates pure scientific procedures, in the season following the experiment proper, data from an additional control group (Control 2) were obtained. Seven players new to the program in that season were assigned to Control 2 ($M_{age} = 17.7$, $SD = 0.95$).

Permission to execute this study was granted by the institutional ethics committee and each participant provided informed consent before participating in the experiment. Parental consent was provided for players younger than 18 years.

DESIGN AND PROCEDURE

All participants first performed a pretest followed by a posttest 10-12 weeks later. Both tests consisted of a shooting drill—the star-drill—specifically developed by the coach to provide an ecologically valid three-point shooting test (see Figure 1). In basketball, shots from behind the three-point line yield three instead of just two points. At the time of the

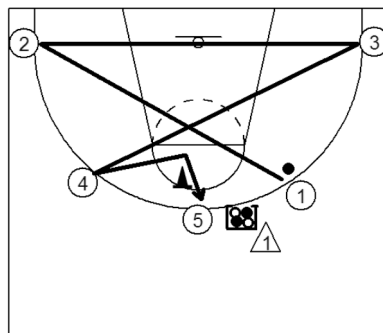


Figure 1. Star Drill: Shot Positions 1-5 and Running Lines from One Position to the Other. After the first shot from Position 1, the shooter runs to Position 2, etc. Shots from Positions 2-5 are taken after a pass from passer (remaining on the same position all the time). All shots are 3-point shots.

experiment, the three-point line was 6.25 m from the rim (the three-point line in European leagues has more recently changed to 6.75 m from the rim). In the star-drill, players take three-point shots from five key positions around the three-point line (see Figure 1). Players shoot and run to the next position where they receive the ball from a pass before they take the next shot and run to the next position.

During the tests participants repeated the star-drill (one shot from each of the five positions) five times yielding 25 shots in a row. After several minutes of rest, each player performed this test of 25 shots one more time yielding a pretest (and posttest) of 50 shots. Players took turns in performing the two subtests of 25 shots, that is, one player took 25 shots while others rebounded and passed the ball. After a player finished 25 shots, the next player took 25 shots and so on. Shooting percentages and execution times were registered. Execution time was the sum of the times a player needed to shoot the first 25 shots (from the first shot leaving the hand to the last shot leaving the hand) and the second 25 shots, thus net time needed to shoot 50 shots in total. Regarding the tests, there was one difference between Control 2 and the other two groups. In the new season, together with the coach it was decided to make each test 30 shots (twice 15 with a brief break in between) which was considered more than sufficient to obtain a reliable measure of shooting performance. As a result, only shooting percentages could be compared for all three groups, because the execution times of Control 2 were not comparable to those of the other two groups.

Between the pre- and posttest, the groups followed their normal program (i.e., training twice a day totaling about 20 hours per week as well as playing one or two games per week). Players of the experimental group received the special visual control training once or twice a week during regular training sessions depending on training attendance. On average, players received 12.8 training sessions (ranging from 9 to 15). The visual control training consisted of 50 three-point shots, 10 shots in a row from each of the five shooting positions in the star-drill. Players trained in pairs with one player taking the 50 shots and the other rebounding and returning the ball. After 50 shots, roles were switched. A training session lasted about 15-20 minutes for a pair of players. Shooting percentages were registered.

During the training sessions the shooting player was equipped with Plato liquid crystal

(LC) goggles that could be shut and opened within 3-5 milliseconds. To obtain a training tool that can be implemented by coaches in individual shot training, the control of the goggles was modified using a sender and receiver (XBee Pro, Digi International Inc., Minnetonka, USA) to allow for wireless control (see Figure 2). The hard- and software of the sender and receiver were such that in most cases goggles opened within 5-10 ms. Occasionally, when communication between sender and receiver was not optimal, the delay was visibly longer. In those cases the goggles clearly opened much too late (or not at all). Whenever this occurred, the trial in question was repeated. As mentioned, long delays were the exception rather than the rule. Normally goggles opened within 10 ms.

Each time the shooting player had received the ball prior to taking a shot, the experimenter manually shut the goggles using a hand-held switch controlling the sender. Then the player took a dribble and step to the shooting position and took a shot. During the shot, the experimenter released the switch thereby opening the goggles again and allowing the player to see the rim for the final instances during the shot (between about 500 and 800 ms before ball release). Thus, the goggles were always closed while taking the dribble and step towards the shooting position. It was somewhere during the last phase, around the start of going up for the jump shot until ball release that the goggles opened up, providing vision of the rim during the final instances before ball release. As this was done manually and on the practice court, there is no formal record of how long this period lasted. A video frame count (frame rate 30 Hz) of 10 shots of one player yielded an average of 700 ms ($SD = 94$). Note that the absence of a fixed and non-variable period that the goggles were open is not a problem as in all cases, whether it was 500 ms on one shot and 800 ms on another, players were forced to use information about the position of the rim as late as possible, which was the aim of the intervention and which was shown to be necessary and sufficient for expert shooting in earlier studies [5-7]. As such, the manipulation educated the attention of the player to use relevant information at the relevant time with the aim of improving shooting performance.



Figure 2. Plato® LC Goggles That Can Be Shut and Opened Within Milliseconds (See Left); Right: Goggles With Wireless Control

EXPERIMENTAL SETUP

Tests and training sessions took place in the regular training facilities of the National talent program using official FIBA regulation baskets (rim height 3.05 meter) and women basketballs (size 6).

STATISTICAL ANALYSIS

Shooting percentages for the star-drill three-point shots were analyzed using mixed design ANOVAs with the factors Group (Experimental, Control 1, Control 2) and Test (Pretest, Posttest) with repeated measures on Test. In addition, regression analyses of shooting percentages of the experimental group during the training sessions were performed. Execution times for the star-drill three-point shots were analyzed using mixed design ANOVAs with the factors Group (Experimental, Control 1) and Test (Pretest, Posttest) with repeated measures on Test.

RESULTS

Table 1 presents the individual and average shooting percentages of all the participants in the three groups. As can be seen, in the experimental group five of the six participants showed increases in shooting percentages from pretest to posttest, varying from 6% to 18% improvement. One player's performance dropped 4% (from 38% to 34%). In the control groups, there were only one of eight and two of seven participants, respectively, who showed increases in shooting percentages.

Table 1. Individual and Mean Shooting Percentages of the Three Groups on Pretest and Posttest

Group	Participant	Pretest	Posttest
Experimental	1	46	52
	2	34	46
	3	20	28
	4	28	46
	5	38	34
	6	20	28
	Mean (SD)	31 (10.3)	39 (10.3)
Control 1	1	40	26
	2	46	42
	3	40	32
	4	56	50
	5	32	48
	6	60	50
	7	52	42
	8	34	28
	Mean (SD)	45 (10.3)	40 (9.8)
Control 2	1	33	33
	2	30	27
	3	23	23
	4	37	27
	5	37	43
	6	53	60
	7	47	33
	Mean (SD)	37 (10.1)	35 (12.7)

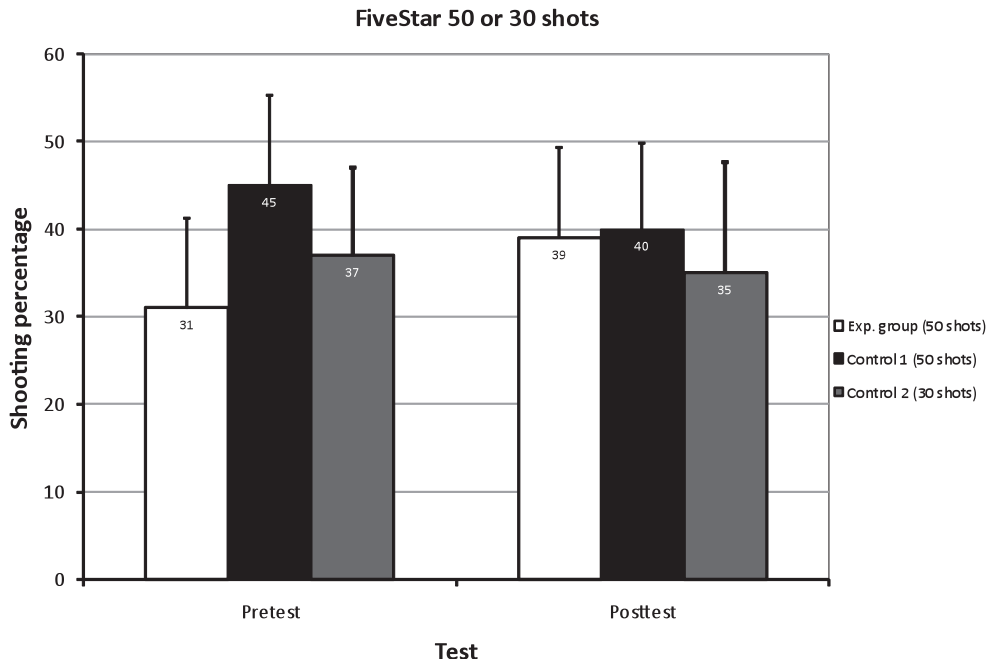


Figure 3. Average Shooting Percentages (and *SDs*) on the Pretest and Posttest for Those Who Received the LC-Goggle Training (Exp. group) and the Two Control Groups That Did Not (Control 1 and Control 2)

The ANOVA on shooting percentages confirmed the pattern that can be observed in the individual percentages (see also Figure 3). It only yielded a significant interaction between group and test, $F_{2,18} = 4.7$, $p = .023$, $\eta_p^2 = .34$; other F s < 1.2 , $ps > .32$. Pairwise post-hoc comparisons revealed that shooting percentages of the experimental group showed a significant increase from pre- to posttest, $p = .028$, 95% CI [1.0, 15.0], while such an increase was absent for Control 1, $p = .09$, 95% CI [-11.3, 0.8], and Control 2, $p = .53$, 95% CI [-8.5, 4.5] (see Figure 3). In line with the original group selection procedure, it seemed that on average shooting percentages of Control 1 were higher than those of the experimental group on the pretest, $p = .063$, 95% CI [-0.6, 28.6], a difference that had disappeared on the posttest, $p = .99$, 95% CI [-14.9, 16.4]. None of the other group comparisons on the pre- and posttest yielded a significant result, $ps > .45$.

That the increase in shooting percentages for the experimental group was related to the visual control training is also indirectly supported by their percentages during the training sessions with the LC goggles (see Figure 4). Linear regression analysis showed that on average shooting percentages increased over training sessions by 0.8% per session, $p = .023$, $R^2 = .45$.¹ The best curve fit was obtained using a cubic function, $p = .007$, $R^2 = .81$, indicating

¹One participant was excluded from this regression analysis as halfway into the training period her shooting technique was adjusted and the distance during the training session was shortened, leading to high shooting percentages on her final training sessions. Including her in this analysis would lead to an even more positive, yet unfair, description of the training session percentages. There was no need to exclude her from the ANOVAs on the tests as the tests were the same for everyone (50 shots from three-point range), including for her.

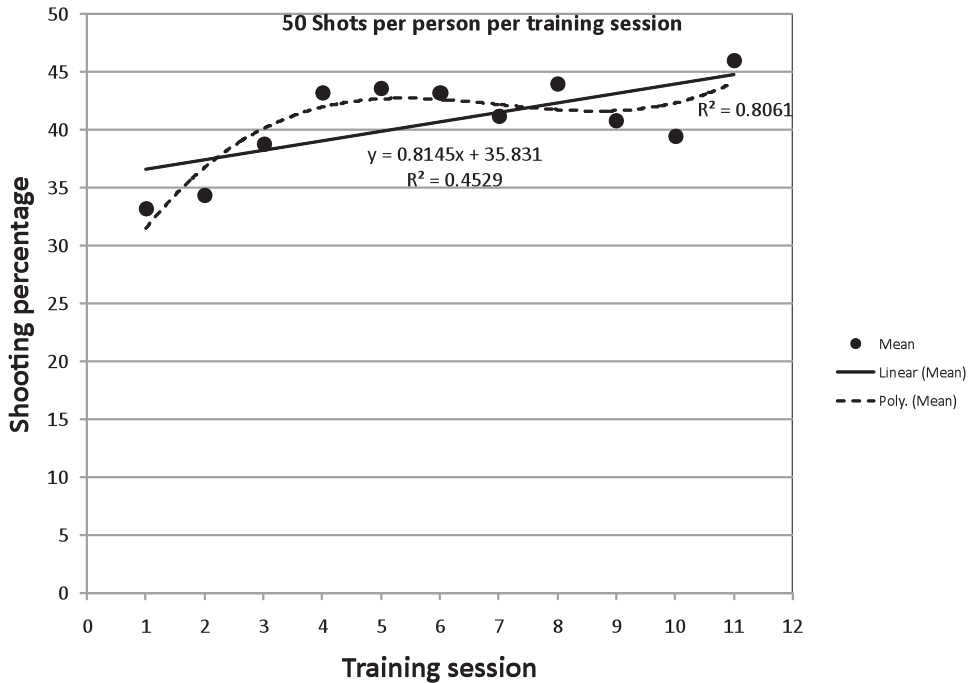


Figure 4. Average Shooting Percentages During the Training Sessions with the LC-Goggles (Averages for Training Sessions 1-9 are Based on Five of the Six Participants [See Footnote 1], Those for Sessions 10 and 11, on Four of the Six Participants)

that the steepest increase occurred over the first four training sessions (see Figure 4).

Finally, the ANOVA on the execution times of the star-drill during the pretest and posttest (a comparison that only included the experimental group and Control 1) revealed that on average participants from both the experimental group and Control 1 executed the 50 shots significantly faster on the posttest ($M = 3:53$ min, $SD = 0:11$) than the pretest ($M = 4:05$ min, $SD = 0:14$), $F_{1,12} = 23.0$, $p < .001$, $\eta_p^2 = .66$, 95% CI [-0:17, -0:06] (see Figure 5). The main effect of group nor the interaction were significant, $F_s < 1$, $p_s > .40$.

DISCUSSION

The aim of the present study was to investigate the effectiveness of visual control training using Plato LC goggles in improving the shooting percentage of elite (female) basketball players. Using a sender and receiver, the control of the LC goggles was made wireless and thereby suitable for on-field training purposes. Over a period of three months, six elite players trained their three-point shooting with the goggles for one or two times per week. Pretest and posttest shooting percentages showed that after training with the goggles shooting percentages had significantly increased by 8%, on average. A similar increase was absent in both control groups taken from the same talent program. Shooting percentages during the training sessions with the goggles support the notion that the improved shooting percentages of the experimental group were related to the visual control training with the goggles. For the participants from the experimental group and Control 1, it was found that the 50 shots on the posttest were executed significantly faster than on the pretest. Provided

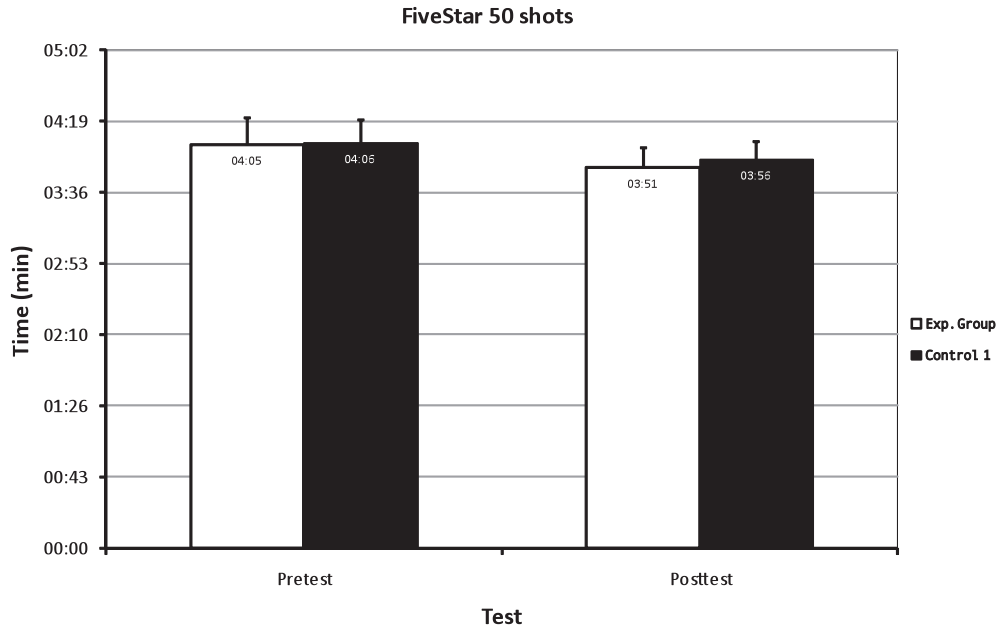


Figure 5. Average Execution Times (and *SDs*) on the Pretest and Posttest for Those who Received the LC-Goggle Training (Exp. Group) and Control 1

that neither group showed a significant performance decrease, faster shooting may also be considered a performance improvement, one that is most likely related to the intensive training program of the National talent program.

Note that it is unlikely that the improved shooting performance of the experimental group was the result of an increase in practicing three-point shots. The control groups also did additional shooting drills (including three-pointers) comparable to that of the experimental group. Furthermore, an average of 12.8 training sessions over a period of three months is not a large training increase for players who practice their shooting five days a week (including three-pointers). As for the selection of players in the experimental group, five of the six players were shooting forwards or guards, while one was a power forward/center that also regularly shoots three-pointers in games. All of these players, as well as the players from the control groups, were used to practicing three-pointers.

Next, it is also unlikely that the increase in shooting percentages during the training sessions was due to familiarization with shooting with the goggles. This would have been an option if shooting with the goggles would initially have led to a performance decrease with subsequent recovery of performance over time as players got used to shooting with the goggles. However, average shooting percentages on the first training sessions were close to and somewhat above the average pretest percentage indicating that, on average, shooting percentages were not harmed by wearing the goggles. It is unclear why accommodation to the goggles would lead to increases in shooting percentage above and beyond full-vision shooting percentages. In the study by Oudejans [7] (see also [10]) it was shown that there could be adaptations to the goggles, but that these were instantaneous (within several shots). Getting used to the goggles and accompanying occlusion period is not something that seems to take place gradually over a period of several weeks.

In short, it seems that the visual control training helped in improving the shooting percentages of the experimental group. As discussed in the introduction, the mechanism by which the visual control training is assumed to work, is that players are forced to learn to use the information available during the short time that the goggles are open during their shot. As such, they learn to rely on the most up-to-date and relevant information about their own position relative to the rim, and thus, about the distance that the ball needs to travel to reach the rim [8]. The same mechanism was proposed to explain the positive effects of training with the screen in the studies of Oudejans et al. [8-9]. An alternative or additional explanation for the positive influence of training with the goggles may be that concentration during shooting is improved. As the goggles are closed during the approach to the shooting position, players cannot be (visually) distracted by other stimuli in the environment, such as teammates, opponents and the crowd. As a result, they may learn to better focus on their shooting without being distracted. Future studies are needed to investigate these speculations.

Similar to the studies of Oudejans et al. [8-9], one major strength of the current study is that the coupling between perception and the shooting action was preserved in the training intervention. In part, this was possible because the control of the LC goggles was made wireless allowing vision to be constrained on the field during actual shooting. Earlier attempts to enhance perceptual skill in sports situations using specific training interventions often involved the presentation of video clips of sport situations (e.g. [11-14]). As indicated by Van Lier et al. [15], despite improvements in perception for the experimental task in those studies, transfer to the actual action often remains unclear. Furthermore, the information available in the display is impoverished (e.g. [16-17]) and perception is trained in isolation of the actual sports action one wishes to improve [15, 18]. In the current study, perception (vision) was constrained on the field with the specific intention to improve the visual control of the actual shooting action.

It is clear that there were also several limitations to the current study. First, as gaze behavior was not directly assessed, we should be careful in drawing definite conclusions concerning changes in visual control of the basketball shot. Future studies are needed to investigate changes in gaze behavior following visual control training with LC goggles. In addition, timing of the opening of the goggles was now done manually, implying that the temporal control of opening the goggles was not perfect. A check on the basis of video-footage did indicate that between about 500-800 ms of viewing was allowed during the goggle training, a period prone to variation from shot to shot. As mentioned earlier, such variation does not undermine the effectiveness of the training as in all cases viewing was constrained in such a way that players were forced to learn to use information available during the final instances of the shot. Furthermore, the groups, especially the experimental group, were relatively small. It would be good to replicate the current findings with more players receiving the visual control training. Finally, future studies are needed to investigate retention and transfer effects, that is, whether effects are retained over a period of time after the visual control training has ended and to what degree the effects transfer to shooting in games. Such studies could also include the question of how many sessions are necessary to obtain positive effects. Looking at the shooting percentages during the training sessions (see Figure 4), the cubic fit seems to suggest that a large part of the positive effects was already obtained over the first four training sessions. Whether fifteen, twelve or only four training sessions are necessary for positive effects has practical implications for how and how easy visual control training with LC-goggles can be implemented in basketball training practice. Needless to say, given the limited number of participants in the experimental group, at this

stage we need to be careful with drawing too firm conclusions on the basis of the shape of the curve of the training percentages.

CONCLUSION

For now, on the basis of the current findings it can be concluded that special visual control training performed on the field with wirelessly controlled LC goggles seems to hold promise, both with regard to the applicability in the actual sports setting and with regard to the potential to improve performance.

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REFERENCES

1. Crossman, E.R.F.W., Theory of Acquisition of Speed-Skill, *Ergonomics*, 1959, 2, 153-166.
2. Ericsson, K.A. (1996). The Acquisition of Expert Performance: An Introduction to Some of the Issues, in: Ericsson K.A., ed., *The Road to Excellence: The Acquisition of Expert Performance in Arts and Sciences, Sports, and Games*, Lawrence Erlbaum Associates, Mahwah, NJ, 1996, 1-50.
3. Kottke, F.J., From Reflex to Skill: The Training of Coordination, *Archives of Physical Medicine and Rehabilitation*, 1980, 61, 551-561.
4. Bernstein N.A., On Dexterity and its Development, in: Latash, M.L. and Turvey M.T., eds., *Dexterity and its Development*, Lawrence Erlbaum Associates, Mahwah, NJ, 1996, 3-246.
5. De Oliveira, R.F., Oudejans, R.R.D. and Beek, P.J., Late Information Pick-up is Preferred in Basketball Jump Shooting, *Journal of Sports Sciences*, 2006, 24, 933-940.
6. De Oliveira, R.F., Oudejans, R.R.D. and Beek, P.J., Gaze Behavior in Basketball Shooting: Further Evidence for Online Visual Control, *Research Quarterly for Exercise and Sport*, 2008, 79, 399-404.
7. Oudejans, R.R.D., van de Langenberg, R.W., and Hutter, R.I., Aiming at a Far Target under Different Viewing Conditions: Visual Control in Basketball Jump Shooting, *Human Movement Science*, 2002, 21, 457-480.
8. Oudejans, R.R.D., Koedijker, J.M., Bleijendaal, I. and Bakker, F.C., The Education of Attention in Aiming at a Far Target: Training Visual Control in Basketball Jump Shooting, *International Journal of Sport and Exercise Psychology*, 2005, 3, 197-221.
9. Oudejans, R.R.D., Heubers, S., Ruitenbeek, J-R.J.A.C. and Janssen, T.W.J., Training Visual Control in Wheelchair Basketball Shooting, *Research Quarterly for Exercise and Sport*, 2012, 83(3).
10. Oudejans, R.R.D., and Coolen, H., Human Kinematics and Event Control: On-line Movement Registration as a Means for Experimental Manipulation, *Journal of Sports Sciences*, 2003, 21, 567-576.
11. Rowe, R.M., and McKenna, F.P., Skilled Anticipation in Realworld Tasks: Measurements of Attentional Demands in the Domain of Tennis, *Journal of Experimental Psychology: Applied*, 2001, 7, 60-67.
12. Savelsbergh, G.J.P., Van Gastel, P.J. and Van Kampen, P.M., Anticipation of Penalty Kicking Direction Can Be Improved by Directing Attention Through Perceptual Training, *International Journal of Sport Psychology*, 2010, 41, 24-41.
13. Smeeton, N.J., Williams, A.M., Hodges, N.J. and Ward, P., The Relative Effectiveness of Various Instructional Approaches in Developing Anticipation Skill, *Journal of Experimental Psychology: Applied*, 2005, 11, 98-110.
14. Williams, A.M., Ward, P. and Chapman, C., Training Perceptual Skill in Field Hockey: Is there Transfer from the Laboratory to the Field?, *Research Quarterly for Exercise and Sport*, 2003, 74, 98-103.

15. Van Lier, W., van der Kamp, J. and Savelsbergh, G.J.P., No Transfer of Calibration Between Action and Perception in Learning a Golf Putting Task, *Attention, Perception, & Psychophysics*, In Press.
16. Abernethy, B., Thomas, K.T. and Thomas, J.T., Strategies for Improving Understanding of Motor Expertise (or Mistakes We Have Made and Things We Have Learned!), in: Starks J. and Allard F., eds., *Cognitive Issues in Motor Expertise*, North-Holland, 1993, New York, 317-358.
17. Dicks, M., Davids, K. and Button, C., Representative Design for the Study of Perception and Action in Sport, *International Journal of Sport Psychology*, 2009, 40, 506-524.
18. Van der Kamp, J., Rivas, F., van Doorn, H. and Savelsbergh, G.J.P., Ventral and Dorsal System Contributions to Visual Anticipation in Fast Ball Sports, *International Journal of Sport Psychology*, 2008, 39, 100-130.