

USE OF THE EYEPORT VISION TRAINING SYSTEM To Enhance the Visual Performance of Police Recruits A PILOT STUDY

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ABSTRACT

This study utilized a small sample of police recruits to determine whether use of the EYEPORT™ vision training system improves their visual performance during job training. Nine visually normal recruits underwent EYEPORT™ training for a three-week period during which they completed various eye exercises. Visual attention span for objects, speed and span of perception, and marksmanship were assessed before and after EYEPORT™ training. Significant improvement in visual attention for objects (mean number correct images recalled: before = 49.2, after = 57.4), speed and span of perception (mean number of correct digits perceived: before = 4.9, after = 5.4) and marksmanship (before mean = 51.1, after mean = 57.1) were demonstrated. The results of this study support the premise that the EYEPORT™ vision training system has the potential to improve specific aspects of visual performance in police recruits.

Key Words

EYEPORT™, visual attention, vision training, speed and span of perception, marksmanship

INTRODUCTION

We propose that effective and efficient vision is among the most important attributes for police officers because of its role in self protection, as well as protecting society at large. From visual acuity, visual reaction time, and visual memory, to depth perception, peripheral vision and speed and span of perception, good visual skills are essential for personal safety, accurate and timely decision making and high-level performance.

One area of police work where vision plays the lead role is in directing and monitoring virtually all of the skills involved in shooting. Initially vision provides a police officer all the crucial information about a target's location, identity, speed, direction of motion, and whether it poses a threat. Then, it should act to direct an accurate and timely response, and contribute to the decision of whether it is appropriate to fire, and if so, where and when.

The following visual skills must be functioning optimally to guarantee that a police officer's response is quick, accurate and appropriate, especially when it involves shooting.¹

Fixation ability for stable and accurate 'sight picture' awareness.

Ocular motility for maintaining accurate detail and awareness of any moving target.

Accommodative flexibility for automatic focal adjustments, as well as clarity of vision

Depth perception for accurate judgments of spatial relations

Dynamic visual acuity for discerning detail of both stationary and moving targets.

Peripheral/central integration for efficient figure/ground perception

Speed of recognition time for critical decision making

Visual memory for effective recall

Eye-mind-hand-body coordination for a quick, accurate and appropriate response to a given situation.

There is sufficient evidence that visual performance, comfort, and efficiency can be enhanced with vision training.²⁻⁹ However, the authors could not find published studies investigating the value of integrating vision training into the overall training program of new police recruits.

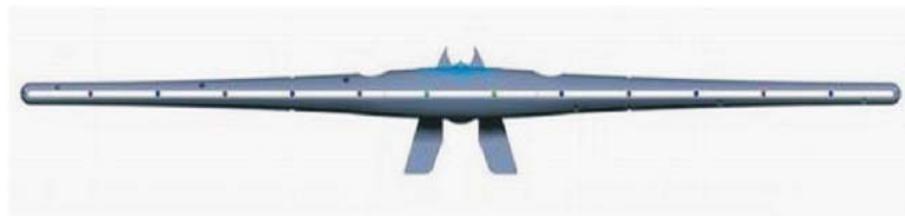


Figure 1. EYEPORT™ vision training system

Law enforcement is a highly stressful job where one continually faces the effects of murders, violent assaults, accidents and serious personal injury. Over 70,000 officers are assaulted each year on the job - more than 200 officers per day.¹⁰ In the year 2000, there were nearly 800,000 full-time law enforcement officers in the United States.¹¹ In 2003, 52 officers were feloniously killed, 80 were accidentally killed and 57,841 were assaulted in the line of duty.¹² This vast number of assaults clearly indicates the need for law enforcement officers to be able to respond to aggression rapidly and accurately with respect to reaction time and self-defense skills, especially in the use of firearms.

Many Olympic and professional athletes understand the importance of optimal vision and integrate vision training into their overall training regimen.^{13,14} Yet, police officers, whose safety often depends on their vision, generally do not experience the benefit of such training. Because high-level pressure is so prevalent in law enforcement, we propose that it is imperative that police officers have the highest level of visual functioning possible at all times.

We propose that a device and method called the EYEPORTM vision training system has the potential to improve the performance of individuals with unique visual demands. One study indicated that the performance of Little League Baseball players was enhanced¹⁵ and a further study has demonstrated the system's beneficial effect on the visual system.¹⁶

The purpose of this study was to evaluate the effectiveness of the EYEPORTM vision training system for improving aspects of visual performance of police recruits at the Maui, HI Police Department.

METHODS

Subjects

A sample of nine Maui, HI Police Department police recruits were enlisted for this study. They were all in good health and had normal vision corrected to at least 20/20, based on their initial intake examinations. There were seven men and two women, ages 24 to 34. The Chief of Police approved the study as part of the recruit-training program.

Material

The EYEPOR^{TMa} vision training system (Figure 1) consists of a patented, battery-powered, 36" folding rod, with an

array of 12 alternating, fully-programmable, red and blue light-emitting diodes (LED's). The unit can be oriented horizontally, vertically, diagonally, and from a further to a closer distance on the z-axis.

The unit is designed to improve overall visual performance by training the eyes to aim, track, focus and team faster, more accurately, more efficiently and with greater flexibility. It does this by using color to vary accommodative and convergence demands, while the eyes track a series of alternating red and blue illuminated targets in different meridians.

The use of red and blue LED's is a key feature of the EYEPORTM system. Due to chromatic aberration, red light focuses behind the retina and blue light focuses in front of the retina.¹⁷ Since the eye is an optical system with the retina as its point of optimal focus, each wavelength of light that does not focus directly on the retina requires a different accommodative response. Thus, red light simulates a concave lens, requiring a relatively greater accommodative response, and blue light simulates a convex lens, requiring a relatively lesser accommodative response.

Each unit comes with a pair of reversible glasses with one red and one blue filter. This allows for the training of each eye independently of the other. We propose that this fosters the non-dominant eye to become more efficient, resulting in greater visual balance. There are three factory-set programs. Program 1 is sequential fixations, Program 2 is sequential jump fixations and Program 3 is random jump fixations. There are 10 different speed settings (0-9), plus a changeable speed option. Zero (0) is the slowest speed (each LED stays on for 2.5 seconds), nine (9) the fastest (each LED stays on for .20 seconds) and (C) indicates changeable speed. There is also an auditory feedback option, which allows the user to hear a beep each time a light goes on.

Procedures

Pre-training testing:

All pre and post testings were done in the same location and under similar circumstances.

The following tests were administered to each subject in a designated Police Department recruit training room.

Visual attention span for objects

This area was evaluated using the Detroit Tests of Learning Aptitude (DTLA)

test # 9, Visual Attention Span for Objects.^{18,19} This test is made up of sets of pictures of common objects, increasing in number from two on a page to eight on a page. The examiner sits opposite the person being tested and says: "I'm going to show you some cards with pictures on them. After I take the card away, I want you to tell me each time exactly what pictures are on the card." The examiner exposes each card one second for the number of pictures on that card. After the card has been taken away, the number of correct answers is recorded. There are two scores, the raw (simple) and weighted scores. These are converted to equivalent mental ages, and then averaged to obtain the individual's mean mental age. Mental age norms are listed from age 3.0 to 18.9. We chose this test because we felt it probed two aspects that are of importance in police work; visual attention and short-term visual memory.

Speed and span of perception

Speed and span of perception were evaluated with the standard Rheem Califone Perceptomatic Tachistoscope^b set at a distance of 10 feet from the screen, a speed setting of 1/100 of a second and a target size of three inches. Participants were seated in a totally darkened room, seven feet from the screen and given two practice runs, followed by 10 measured trials. During each of the practice runs and the 10 trials, a target was presented to each recruit with six, 3" digits, flashed at a speed of 1/100 of a second. Target size (3") and number of digits (6) was used to simulate the size and number of figures on a state of Hawaii license plate. After each of the 10 measured presentations, recruits were given one point credit for each of the digits they correctly recalled in order from left to right.

Marksmanship

The Lead Firearms Instructor for the Maui Police Department administered all marksmanship tests at the Police Department shooting range, located in Maui, Hawaii. Precision shooting evaluations were undertaken in daylight, from 15 yards, using a Police B-27 Pro-G target (Figure 2).²⁰ The handguns used were Smith & Wesson M422 semi-automatic pistols, and Smith & Wesson M17 revolvers, both in .22 long rifle calibers. Recruits used the same weapon and firearm on the pre and post marksmanship testing, and fired in



Figure 2. B-27 Pro-G target

the same mode (either in single action, or in double action). Between the pre and post marksman testing all subjects took part in one practical shooting exercise. In this instance they used the Department issued Glock model 22, 40 caliber Smith and Wesson handgun.

Instructional and orientation session

A qualified individual demonstrated the operation of the EYEPORTM along with specific instructions for its use to the subjects in a group setting. Each participant was given an EYEPORTM unit, and specific instructions on its use. In addition, they received a three-week training protocol, comprised of progressively more challenging vision exercises (Appendix A). Subjects were instructed to date each session and follow the daily protocol outlined in Appendix A. Each session is clearly outlined, providing the appropriate program, speed and auditory setting, as well as the recommended orientation of the red/blue glasses for each of the first four exercises. Arrows were used to designate the orientation of the device (horizontal, vertical and diagonal) for the first four exercises. Red/blue glasses were not used during the fifth exercise

Training phase: One day after the initial pre-training the recruits were instructed to begin using their EYEPORTM vision training system at home, for six days a week, over a 3-week period. They were also required to fill in the date of each session on their weekly training schedule forms. During the first week, participants used Program 1, (sequential fixations), with the speed setting gradually increasing from 2 to 7, and auditory

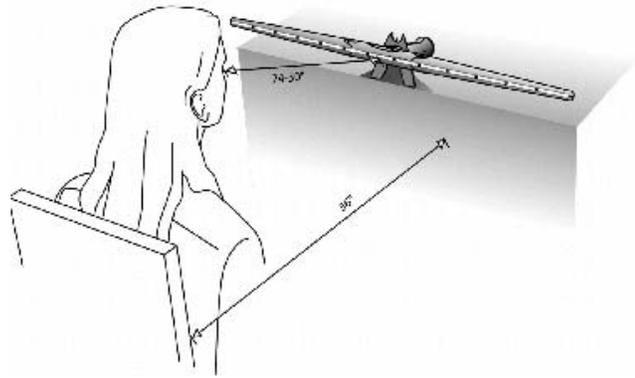


Figure 3. Appropriate study subject position for use of the EYEPORTM vision training system during the first (horizontal meridian) daily vision exercise.

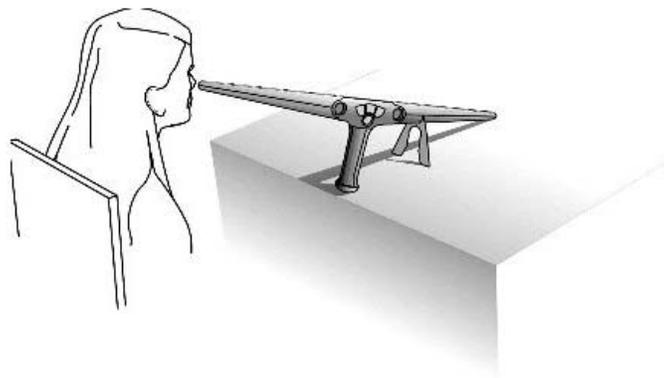


Figure 4. Test subject, using the EYEPORTM system, tracking LED's as they move closer and further away from their face during exercise #5.

feedback. During the second week, participants used Program 2 (sequential jump fixations), with the speed setting gradually increasing from 1 to 6 and auditory feedback. During the third week, participants used Program 3 (random jump fixations), with the speed setting gradually increasing 0 to 5 and no auditory feedback. During the entire three-week protocol, participants experienced a variety of speed settings ranging from 0, where each LED stays on for a 2.5 second duration, to 7, where each light stays on for a 0.5 second duration. When auditory feedback was used as reinforcement, the participants heard a beep each time one of the lights went on.

Each daily session consisted of a 10-minute vision-training program using the EYEPORTM system. The program consisted of five exercises, each 90 seconds in duration separated by a 30-second rest period. The first four exercises consist of visually tracking a series of alternating red and blue LED's in the horizontal, vertical and two diagonal meridians, with the

observer sitting at a distance of 1 yard from the unit (Figure 3).

During the first four exercises, the subject wore a pair of reversible red-blue glasses to alternately train each eye individually while both eyes are being used. When these red-blue glasses are used in combination with alternating red and blue LED's, a special cancellation effect occurs. The eye behind the red lens only sees the red LED, while the eye behind the blue lens only sees the blue LED. This allows the user to alternately train each eye to become the lead eye, at any given moment, while both eyes are open. The end result is that the eyes continuously exercise their individual ability to accurately and efficiently aim, focus and track a target, while simultaneously reinforcing their ability to work together as equal partners.

The fifth exercise, an electronic Brock string technique, consisted of tracking the same LED's, as they move closer and further away from the observers face, along the "Z" axis (Figure 4). The entire three-week exercise protocol is presented in Appendix A.

Post-training phase: All participants were re-tested, under identical conditions, to evaluate any changes in visual attention span for objects, and speed and span of perception, approximately three weeks later. The precision shooting follow-up evaluations took place two months after the training, due to the extensive recruit-training schedule, as well as the physical location of the shooting range.

RESULTS

The data analyzed here was collected from the nine subjects who completed this study. The raw scores (pre- and post-simple scores) from the visual attention span for objects test were analyzed using a two-tailed, paired sample t-test,²¹ as were the raw scores for the speed and span of perception test and for marksmanship scores. Each data set was analyzed independently. In each case, the null hypothesis was that there was no difference in the means of the paired scores for a given data set (e.g. attention span data, speed and span data, etc.) before and after the EYEPORTM training. The alternative hypothesis evaluated was that the mean difference in the scores before and after the EYEPORTM training was not equal to zero.

Table 1 reports the results of the DTLA vision attention span for objects test. Here, visual attention span was measured before and after EYEPORTM training. The final mental age of each subject is found by calculating the average of the mental age of both the simple score and the weighted score. Also reported are the participant's birth date and change in mental age following EYEPORTM training.

A two tailed t-test reveals that the mean difference between pre- and post-visual attention span test scores is highly significant ($t_{0.05,(2),8} = 4.347, p = 0.002$). The mean for the simple pre-score

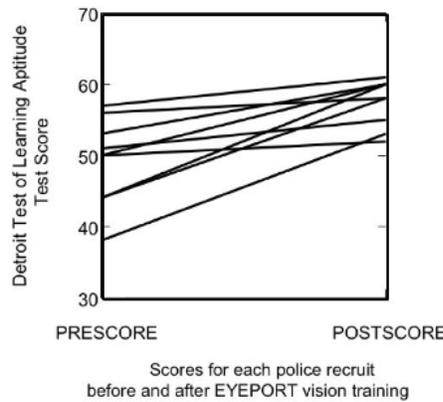
was 49.222 images recalled, and the mean for the simple post-score was 57.444. This indicates a statistically significant increase in the measurable visual attention span of these police recruits following EYEPORTM training (see final column of Table 1 And Graph 1). The mean increase in visual attention span was 43.2 months.

Table 2 reports the results of the speed and span of perception evaluation using

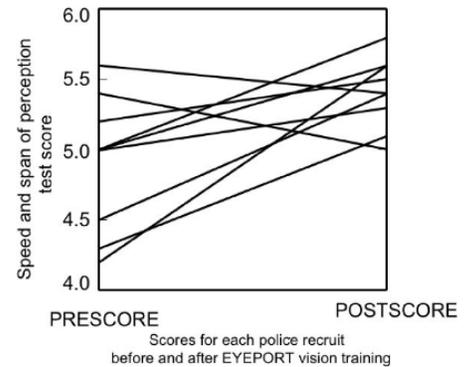
the Rheem Califone Perceptamatic Tachistoscope. Individual, as well as, mean scores are listed for both pre- and post-training test results.

The two tailed t-test for the speed and span of perception test also reveals that the mean difference between pre- and post-EYEPORTM training scores differ significantly ($t_{0.05,(2),8} = 2.666, p = 0.029$). The mean for the pre-training test scores was 4.91 ± 0.48 and the mean for the

Recruit	Birth date	Simple Score		Weighted Score		Mental Age (y=year m=month =increase)		
		Pre	Post	Pre	Post	Pre	Post	Change
1	7/24/71	50	52	266	282	12y/0m	13y/0m	12m↑
2	12/24/80	57	61	309	340	15y/0m	17y/2m	26m↑
3	9/21/70	51	55	279	302	12y/8m	14y/3m	19m↑
4	5/21/80	38	53	194	288	7y/9m	13y/3m	66m↑
5	6/19/79	50	60	263	335	11y/11m	16y/8m	57m↑
6	9/30/80	44	58	231	324	10y/0m	15y/9m	69m↑
7	3/21/81	56	58	311	317	14y/9m	15y/6m	21m↑
8	4/26/68	53	60	289	333	13y/5m	16y/8m	39m↑



Graph 1. DTLA score before and after EYEPOR vision training, for each police recruit (where each line on the graph connects the pre- and post-test scores for each individual tested).



Graph 2. Speed and span of perception data before and after EYEPORTM vision training, for every police recruit (where each line connects the pre and post-scores for each individuals tested).

Recruit	Birth date	Pre-Test Scores: 3/1/05										Mean	Post-Test Scores: 3/24/05										Mean
		5	5	4	5	4	6	5	6	5	5		5	5	5	5	6	5	5	6	5	6	
1	7/24/71	5	5	4	5	4	6	5	6	5	5	5.0	5	5	5	5	6	5	5	6	6	6	5.3
2	12/24/80	6	3	5	5	5	5	5	5	3	5	4.2	5	5	5	6	6	5	6	6	6	6	5.6
3	9/21/70	4	4	5	2	5	5	5	5	5	5	4.5	6	6	5	5	5	5	6	5	6	5	5.4
4	5/21/80	3	6	3	5	6	6	5	6	6	6	5.2	6	6	6	6	5	5	5	6	4	6	5.5
5	6/19/79	4	4	4	5	4	5	5	4	4	4	4.3	4	5	4	6	5	5	6	6	6	4	5.1
6	9/30/80	5	6	6	5	6	6	6	6	5	5	5.6	6	6	6	5	3	5	6	6	6	5	5.4
7	3/21/81	3	6	5	4	3	6	6	5	6	6	5.0	6	6	6	6	5	6	6	5	6	6	5.8
8	4/26/68	5	5	6	4	3	5	6	6	4	6	5.0	5	6	5	6	6	6	5	6	6	5	5.6

post-training test scores was 5.41 ± 0.25 . The resultant mean difference is 0.50, which indicates a statistically significant gain in speed and span of perception after EYEPORTM training (see Table 2 And Graph 2) for these nine recruits. The range for the pre-training test scores was 4.2 - 5.6, and for the post-test scores it was 5.0 - 5.8.

Table 3 reports the results of the marksmanship evaluation. Pre- and post-training test scores were collected on March 2, and May 9, 2005, respectively. Total points scored, as well as number of bull's eyes, are included.

A two-tailed t-test reveals that the mean difference between pre- and post-training marksmanship test scores is marginally significant ($t(0.05, (2), 8 = 2.263, p = 0.053$). A two-tailed t-test is the conservative test traditionally employed when the deviation from the pre-test mean can either increase or decrease in the post-test data. However, if there is reason to predict a one-directional change (e.g. preliminary data), a one-tailed test is a legitimate, more powerful statistic to employ. Based upon the fact that performance was known to improve in previous EYEPORTM studies,^{15,16} the one-tailed test was employed, and demonstrates significance ($t(0.05, (2), 8 = 2.263, p = 0.027$). The pre-training test mean is 51.111 and the post-test mean is 57.111 (see Table 3 and Graph 3).

Discussion

The results of this small study reveal statistical improvements in visual attention span for objects and the speed and span of perception of these nine police recruits after three weeks of using the EYEPORTM vision training system. A training regimen of 10 minutes per day, for a three-week period, resulted in enhancement of visual attention, speed and span of perception and marksmanship. Further, subjective performance assessments conducted by experienced police recruit trainers indicated improved speed of visual reaction time, accuracy of visual recognition, and speed, accuracy and appropriateness of physical response, when compared to prior groups of recruits. These training officers also observed that after the training program these recruits were noticeably better at acquiring and hitting moving targets with the training weapons; they attained qualifying scores

Table 3. Marksmanship evaluation. Pre and post-tests were done on March 2 and May 9, 2005, respectively. The first value in the pre and post score is the total points scored. The second value is the number of bull's eyes (x). Almost all recruits improved their scores.			
63 rd Recruit Class Maui Police Department			
Recruit	Birth date	Pre Score	Post Score
1	7/24/71	54/1X	57/2X
2	12/24/80	58/5X	54/1X
3	9/21/70	35/1X	55/1X
4	5/21/80	60/2X	60/3X
5	6/19/79	50/0X	58/1X
6	9/30/80	57/4X	57/3X
7	3/21/81	49/0X	58/3X
8	4/26/68	41/0X	57/2X
9	10/23/76	56/1X	58/2X

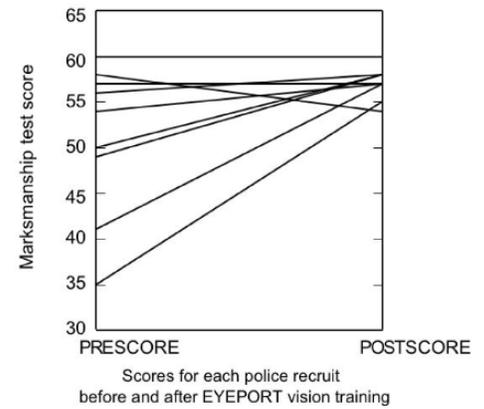
at least a day earlier than other recruit classes.

It would have been desirable to conduct the follow-up precision shooting evaluations immediately following the three-week period after use of the EYEPORTM system. Unfortunately, it was impossible to conduct the follow-up at that time due to the extensive recruit training scheduling, as well as logistic factors associated with the fact that the shooting range was not at the same location as the police training base. However, during the three-week period of our training regimen the strict scheduling of the police program did not allow any of the recruits to independently practice marksmanship. It is noteworthy that these scores improved markedly some seven weeks after our training period had ended.

This study is not without limitations. Since the study was comprised of a small, select group of individuals and was conducted without a control group, it is feasible that some of the enhancements were due to learning effects or motivational factors related to the training experience. In order to control for the possibility of the improvements seen during this work resulting from factors other than use of the EYEPORTM vision training system, future studies will incorporate both a control group and a larger sample size.

Conclusion

In summary, the EYEPOR Vision Training System demonstrates potential to facilitate police recruits improving visual attention, speed and span of perception and marksmanship. Additional



Graph 3. Marksmanship data before and after EYEPORTM vision training, for every police recruit (where each line connects the pre and post-scores for each individuals tested).

applications may include enhancement of performance of individuals with unique visual demands, including aviators, athletes, and those serving in the military. The results of this study, though limited in scope, have potential value to law enforcement personnel nationwide.

Acknowledgements

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Financial interest statement

Dr. L. Horth has no financial interest in the EYEPORTM vision training system. Dr. J. Liberman is inventor of the system and, as such, has a financial interest.

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Appendix A

Maui Police Department EYEPOR Pilot Study Weekly Training Schedule

Name _____ Date of birth ____/____/____

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Program 1: sequential pattern
 Program 2: sequential jump pattern
 Program 3: random jump pattern
 Speed 1: 2.0 sec. light duration
 Speed 7: 0.5 sec. Duration
 Auditory 1: feedback
 Auditory 0: no feedback
 R/R = red filter over right eye, blue over left
 R/L = red filter over left eye, blue over right
 NONE = no filter
 ⇔ = Horizontal ⇕ = Vertical ↗ ↘ = Diagonal
 Far-Near = Electronic Brock String

Week 1									
Day	Date	Program	Speed	Auditory	⇔	⇕	↗	↘	Far-Near
1	--/--	1	2	1	R/R	R/L	R/R	R/L	NONE
2	--/--	1	3	1	R/R	R/L	R/R	R/L	NONE
3	--/--	1	4	1	R/R	R/L	R/R	R/L	NONE
4	--/--	1	5	1	R/R	R/L	R/R	R/L	NONE
5	--/--	1	6	1	R/R	R/L	R/R	R/L	NONE
6	--/--	1	7	1	R/R	R/L	R/R	R/L	NONE

Week 2									
Day	Date	Program	Speed	Auditory	⇔	⇕	↗	↘	Far-Near
1	--/--	2	1	1	R/R	R/L	R/R	R/L	NONE
2	--/--	2	2	1	R/R	R/L	R/R	R/L	NONE
3	--/--	2	3	1	R/R	R/L	R/R	R/L	NONE
4	--/--	2	4	1	R/R	R/L	R/R	R/L	NONE
5	--/--	2	5	1	R/R	R/L	R/R	R/L	NONE
6	--/--	2	6	1	R/R	R/L	R/R	R/L	NONE

Week 3									
Day	Date	Program	Speed	Auditory	⇔	⇕	↗	↘	Far-Near
1	--/--	3	0	0	none	none	none	none	NONE
2	--/--	3	1	0	none	none	none	none	NONE
3	--/--	3	2	0	none	none	none	none	NONE
4	--/--	3	3	0	none	none	none	none	NONE
5	--/--	3	4	0	none	none	none	none	NONE
6	--/--	3	5	0	none	none	none	none	NONE

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