A Trip To The Toy Store

Stephanie McLin, BS
Shannon Brown, BS
Marc B. Taub, OD, MS
Memphis, Tennessee

Abstract

Background: *Most vision therapy is performed on children. Because children have short attention spans, it is imperative for vision therapists to have various techniques to assist with the development of each intended skill. In addition, many of the children in vision therapy have school-related problems that cause them to form negative associations with school or its associated homework. Many vision therapy techniques involve pencil and paper tasks; therefore, home therapy becomes a continuation of school work in the mind of the patient. Fortunately, many games found at toy stores can be used to target these techniques while keeping patients motivated and challenged.*

Methods: *Investigators analyzed Phase 10, Blokus, Flippin' Frogs, and I Spy-Mysterious Objects and assessed what area(s) of vision therapy are addressed by each one. In addition, the investigators looked for various ways to simplify the games and make the games more difficult as the patient's skill level improves.*

Discussion/Conclusion: *Vision therapy activities are designed to address desired skill areas but often fail to capture the patient's attention and interest. Using a variety of modern games could enhance vision therapy programs and possibly increase compliance; however, it is imperative to evaluate activities to identify clearly the area of skill targeted by each task.*

Key Words

visual analysis, visual information processing, visual integration, visual perception, visual-spatial, vision therapy

Optometric vision therapy (OVT) requires the practitioner and/or therapist to use a variety of techniques. Traditional OVT involves pencils, paper, and characters on a page. Children might associate this negatively with school; therefore, home therapy can be seen by the patient as a continuation of school work. An excellent way to improve visual information processing (VIP) skills while keeping the patient's morale high is to use games that are currently found in any toy store.

VIP, or visual perception, is defined as "the active process of locating and extracting information from the environment."[1] VIP can be divided into three areas, visual-spatial (VS), visual analysis (VA), and visual integration (VI).[1,2] A summary of these visual perceptual skills can be found in Table 1.

VS skills consist of the ability to perceive the position of objects in space and include such skills as bilateral integration and laterality/directionality.[1] These components can be seen as a hierarchy. Bilateral integration is the earliest step in understanding the position of objects and involves the patient understanding that his body has two sides (right and left) that can be controlled in a separate and simultaneous manner.[1] Understanding that the body has a midline that divides into two equal halves, and that each half has an arm, hand, leg, foot, etc., leads to the establishment of internal coordinates based on the relationship of these body parts to each other, or a sense of laterality.[1] Once the understanding of self is established, the patient can project his understanding onto another person.[1] The projection of these internal coordinates into space onto another person, object, or letter/word is termed directionality.[1] The projected coordinates involved in directionality are important to learning the difference between letters, such as b, d, p, and q.[1,2] This also helps to avoid confusion of words like on and no. VS skills have been shown to have a positive correlation to both reading and written arithmetical calculations.[3]

VA contributes to the ability to evaluate visually presented information by using skills such as visual discrimination, visual form constancy, visual closure, visual figure-ground, visual memory, visualization, and visual thinking.[1,2] Visual discrimination is the ability to find differences between forms and objects, while visual form constancy is the ability to find similarity between various forms.[1] Both of these skills are used to identify the correct word when similar words are presented, such as esotropia and exotropia. For example, visual form constancy allows an optometry student to find the similarity between these conditions ("tropia"–one eye turns away from the target), but visual discrimination allows the optometry student to find the difference between them ("eso"–turns in; "exo"–turns out). Visual closure refers to the ability to recognize a complete feature from fragmented stimuli.[1] An example of this would be the skipping of small or short words such as "the," "an," etc. when reading a sentence but still understanding the meaning of the sentence. Visual figure-ground skills help us distinguish an object from irrelevant background stimuli, such as when finding a car in a parking lot full of cars.[1] Visual memory is the ability to recall a dominant feature of a stimulus or the ability to re-

Table 1: A summary of the definitions used to assess the games in this article

Visual-Spatial: the ability to perceive the position of objects in space

- **Bilateral integration**: the understanding that the body has two sides, which can be controlled separately and simultaneously
- **Laterality/Directionality**: the establishment of internal coordinates, which are then projected onto others or inanimate objects in space

Visual Analysis: the discrimination of visually presented information

- **Visual Discrimination**: the ability to find differences among objects
- **Form Constancy**: the ability to find similarities among objects regardless of size, orientation, etc.
- **Visual Closure**: the ability to complete a picture/object from several incomplete parts of the picture/object
- **Figure-ground**: the ability to ignore background, irrelevent data
- **Visual Memory**: the ability to remember visually presented data
- **Visualization**: the ability to recall and manipulate pieces of visually presented data
- **Visual Thinking**: the manipulation of visually presented data to solve problems

Visual Integration: the ability of the visual system to support and/or direct other senses

- **Visual-Motor Integration**: the ability of the hand and/or body to move in the way directed by the visual system
- **Visual-Auditory Integration**: the ability to equate an auditory stimulus to a visual stimulus

call the sequence of visually presented stimuli.[1] This is used in school when children copy words from the board to their papers. A student who can remember eight to 10 words will copy more efficiently than a student who can only remember one or two words at a time. Visual memory is used to recall letters, phonemes, and irregular words, as well as to recall math tables, such as multiplication tables, and improve the efficiency of solving simple, straightforward, and complex mathematics problems.[4] Visualization is the ability to recall visually presented materials and to manipulate these images mentally.[1] Visual thinking is the manipulation of information to solve problems.[1] VA skills are used in differentiating would and wood or here and hear when reading.[2,5] Patients also use VA skills in the field of mathematics to differentiate between numbers and arithmetic signs, to break down problems into manageable components, and to organize calculations spatially.[4,5]

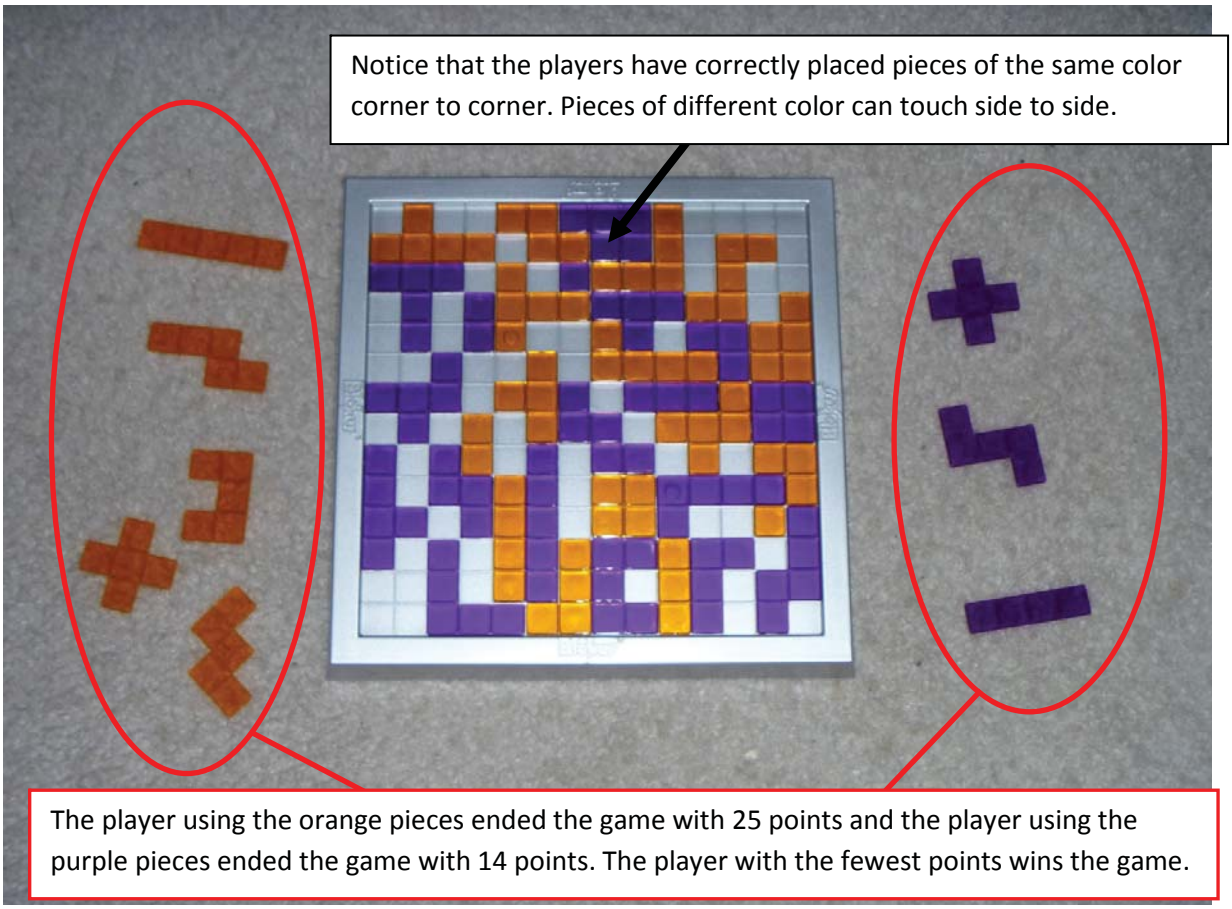
VI refers to the ability of the visual system to support and/or direct other senses and has two main aspects.[1] The first, visual-motor integration, is the ability to integrate vision with body movements.[1,2] This is used extensively to establish legible handwriting as a patient must be able to duplicate a letter with his own hand as viewed by the visual system.[1,2] The second, visual-auditory integration, is the ability to match serially presented visual stimuli with auditory counterparts.[1] This is used when a patient follows along in a book being read to him or her.

It is important to understand that visual perception defects are not the only causal factor of reading and learning difficulties.[3] Accepted theories emphasize that visual perception ability is simply one component that affects learning and reading. Many previously published studies by various authors support correlations among visual perceptual skills and classroom scores as well as standardized tests.[2-8] Kulp used the Beery Developmental Test of Visual Motor Integration-3rd Revision (Beery VMI), a test administered by many optometrists that assesses visual discrimination, VS, visual fine motor, and VMI skills, to support this correlation.[5] This investigation found that the Beery VMI score could be related to reading, math, and writing achievements in seven year olds; reading, math, writing, and spelling achievements in eight year olds; and math, writing, and spelling achievements in nine year olds. It was also found that the Beery VMI score was correlated with performance on the Stanford Diagnostic Reading test and the Otis-Lennon School Ability test (Otis-Lennon).[5] In addition, Kulp et al found a correlation between the Test of Visual Perceptual Skills-Visual Memory subtest scores, the Stanford Achievement Test Series, and the Otis-Lennon in second through fourth graders.[4] Maples supported this finding when he showed scores on the Beery VMI and Wold Sentence Copy to be very good predictive factors of academic success on the Iowa Test of Basic Skills, another standardized test administered to elementary school students.[6] Furthermore, data supports that advancements in visual perceptual skills can result in improved performance in the classroom and in circumstances throughout life where these skills are utilized.[3,5,7] For an optometrist to provide inclusive therapy for patients with learning and/or reading difficulties, it is important to be able to treat patients with visual perceptual difficulties effectively.[3]

Blokus

In the game of Blokus, the players try to arrange pieces of various shapes and sizes on the game board so that their pieces are connected to each other corner to corner. The side of one piece cannot be touching the side of another piece of the same color, but each piece placed on the board must be connected to another piece of the same color corner to corner.

Figure 1: A photographic explanation of the basic rules of the game of Blokus.



The players also attempt to block their opponent and prevent them from placing additional pieces on the game board. The game ends when no additional pieces can be placed on the board without two pieces of the same color touching side to side. The pieces are an arrangement of squares, and the goal is to have the fewest number of squares not on the board at the end of the game. Figure 1 provides a guide to these rules.

When playing the game as directed in the instructions, Blokus addresses VI, VS, and VA skills. The easiest skill to appreciate in Blokus is the skill of visual-motor integration. Players utilize vision to correctly use their hands and fingers to pick up, manipulate, and place the pieces on the board.

One VS skill that Blokus addresses is laterality/directionality. As the players handle the game pieces and appreciate the differences with each turn or flip, they are using the fundamental skills to help understand "right vs. left" on themselves and others. This eventually leads to the understanding of what differentiates b, d, p, and q.

The VA skills addressed by Blokus include visual discrimination, visual form constancy, visual figure-ground, visualization, and visual thinking. Visual discrimination and visual form constancy skills are needed to recognize the piece required for a certain position on the board regardless of the piece's orientation off the board. Similar skills are used when finding the necessary piece in an assortment of pieces that are not yet placed on the board. Visual figure-ground skills are also used when trying to find areas on the board where each player can place his/her piece(s). Visualization and visual thinking must be used to strategize ways to block an opponent. These skills allow the players to place the maximum number of squares on the board.

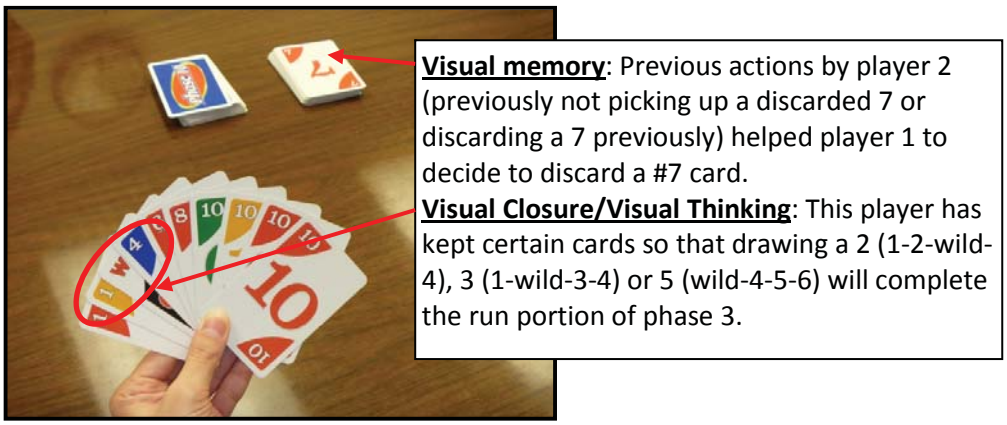
Some additional requirements of the players can help to further develop skills already being used by Blokus. One can require players to move a game piece to the board in one smooth, planned motion and not allow them to try out pieces (placing them on the game board and then removing them) This will help to increase the demand of visualization and visual thinking skills. This will help the players to learn to plan the movement of pieces. Eventually the players will progress to the ability to formulate plans in their minds regarding strategy.

Playing within a team will allow the training of auditory-visual integration and further train an understanding of laterality/directionality. In a team atmosphere, the players will be forced to use their own speech and language ability to describe the proposed piece placement to their teammate(s) as well as interpret a proposal described by a teammate. This will also likely demand an understanding of laterality/directionality and allow this aspect of visual perception to be trained further. This is especially true if the players are not allowed to touch the piece prior to the movement of that piece to the board.

Phase 10

Phase 10 is a game that requires players to collect certain cards to complete a specified combination of sets (cards of the same number), runs (cards in sequential number order), and/or cards of the same colors. These combinations are called

Figure 2: Visual perceptual skills for Phase 10



phases; there are ten phases that each player must complete in sequential order.

Each player is dealt ten cards. The remaining cards comprise the draw pile and are placed in the center in a face-down pile. The top card is flipped and placed beside the draw pile to make the discard pile. Each player can only complete one phase per round of play. The players try to complete each phase by drawing and discarding cards. Each player draws a new card from the top of the draw pile or takes the top card off the discard pile. Upon doing so the player now has 11 cards in his/her hand and the player must place one of these cards face up onto the discard pile. The players take turns until one player collects the cards for the specified phase. Before discarding a card for that turn, this player should lay out his/her completed phase. Play continues with the players taking turns.

As players complete their phases for the round, they lay the phase in front of them. Players that have already completed their phases try to get rid of the remainder of their cards by adding to the sets, runs, or color series presented in front of other players or themselves. (Examples: adding an additional 4 to an established set of 4s, adding a 7 to a run of 2-3-4-5-6, adding a yellow card to a set of yellow cards). The round continues until one player runs out of cards.

The players that have completed their assigned phase for that round may advance in the game by trying to complete the next specified phase during the following round. However, those players that do not complete their assigned phase must try to complete the same phase again during the following round. In addition, each card left in any player's hand, regardless of whether they completed their assigned phase, gives the player points. The rounds continue until a player completes the final phase. The first player to do so is the winner. If two or more players complete the final phase during the same round, then the player with the fewest number of points is the winner.

The VA skill of visual discrimination and the VS skill of laterality/directionality are used when reading the numbers on the cards. These skills can be further employed by instructing the players that a run must be shown in increasing order from left to right or right to left. Also, if a run and a set are in the same phase, the players can be told to place the set on his/her left and the run on the right or vice versa. The players can also be instructed to place the set on a certain opponent's right/left and the run on the other side of the opponent.

The VA skills of form constancy and visual closure are used when the players try to complete a phase. Visual form constancy is used to ignore the colors of numbers when finding the numbers that could complete a set or run. An inability to do so could cause the loss of a set or run. Also, the player must ignore the numbers when finding the color series. They must use visual closure to assess the missing numbers in a run. For example, the player may have the numbers 2-4-5-6-8-9. Visual closure is used to assess that a 3 and 7 are needed to complete the run.

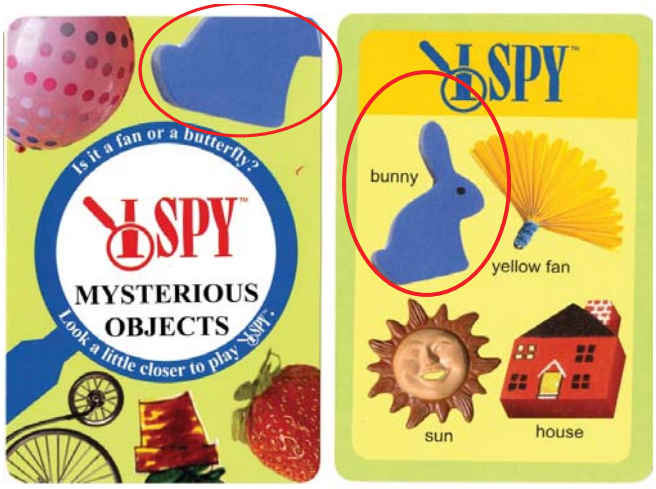
Even visual memory, another VA skill, is used in Phase 10. In order to prevent an opponent from running out of cards or completing a phase, a player must decide what card to discard during each turn based on an opponent's previous pick ups and discards. Visual memory demands can be increased if the players are told that they can only see the phase's requirements one time at the beginning of the round. Each time a player has to look at the requirements, another point can be added to his point total.

The VI skill of visual thinking is also used when players decide what cards are best to discard. For example, if a player has two 7s and two 11s, they may wish to discard a 9 instead of a 7 or an 11 in order to have two options to complete a set of three. They may also choose to discard higher numbered cards instead of lower numbered cards because higher numbered cards give more points if they remain in the player's hand at the end of the round. These thoughts involve advanced planning and visual thinking. Some visual perceptual skills for Phase 10 can be found in Figure 2.

I Spy-Mysterious Objects

The kids' card game I Spy-Mysterious Objects is a picture matching game. In this game, players try to match objects from their cards to the same object partially shown on the game cards. Each player has 10 players' cards with four labeled objects on each. The game cards have multiple partially shown objects on them. Upon their turn, players match one of the objects from one of their players' cards to a hidden object on the game card. For example, a player may have a cat on one of his players' cards. The game card may have a bicycle tire, a sail boat, a teapot spout, a doll's head, and a cat's tail. The player must match the cat on his/her players' card to the partially shown cat (its tail) on the game card, and explain why it's a match. Once a match is made, both cards are discarded. If a match cannot be made, the next player gets a turn.

Figure 3: The card on the left shows a game card, which shows parts of five objects, and the card on the right shows a players' card, which shows four objects in their entirety and are labeled. An example of a match, which is indicated by the red circles, would be the bunny pictured on the players' card to the bottom half of the bunny shown on the game card. The player would describe why it is a match, including color, shape, and other unique characteristics.



The player who runs out of cards first is the winner. Two cards are shown in Figure 3.

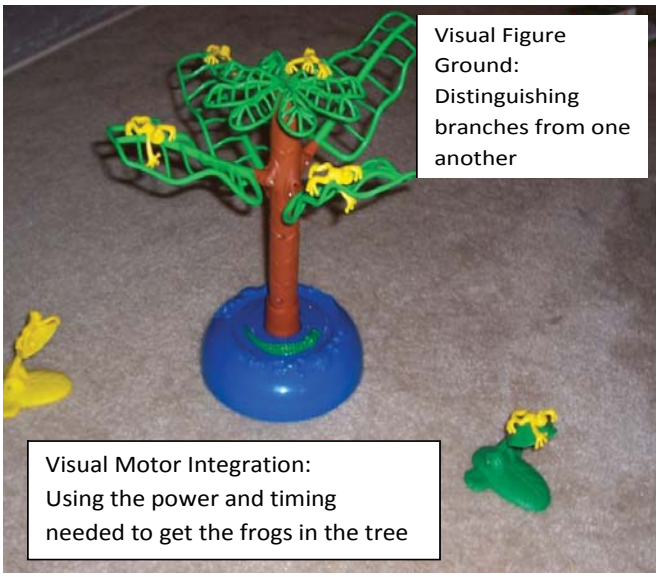
Playing I Spy uses VA skills including visual discrimination, visual form constancy, visual closure, visual figure-ground, and visual memory. A player must use visual discrimination to notice the object features on the game and the players' cards. Visual form constancy is used to notice the similarities in the objects on the two cards even though the object is turned and flipped in a different way on the game card when compared to the players' card. Visual closure is needed to see the similarity between objects, although the full object is not seen on the game card. Visual figure-ground is trained when the player must pick out certain characteristics even though there are background changes between cards and multiple hidden objects on the game card that distract from the object being matched. Visual memory is used briefly when the players search for objects on the game card while remembering what objects are on their players' card. Auditory-visual integration is addressed when the players describe why the match is valid.

Some alterations to the game can help to focus on other areas of visual perception. Laterality/directionality can be addressed by having the players identify the position of the objects being matched on the game card and the players' card as top left, top right, bottom left, or bottom right.

Flippin' Frogs

Flippin' Frogs is an upbeat, fast-moving game. Each player is given a lily pad launcher and multiple frogs, with each player getting a certain color of frog. The object of the game is to flip (using lily pad launchers) as many frogs as possible onto a spinning tree with branches during an allotted time frame. Just before time runs out, a warning bell sounds indicating there are only a few seconds left before the tree stops spinning and time is up. At the end of a round, the person with the most frogs in the tree wins, and the first player to win three rounds wins the game. The set up for the game is shown in Figure 4.

Figure 4: Above is the setup for Flippin' Frogs. When the game is started, the tree spins around as the players launch as many frogs as they can into the tree branches.



The main skills used to play this game are visual-motor integration, visual figure-ground, and visual thinking. Visual-motor integration is used as the players watch the tree spin around and launch frogs into the tree at exactly the right time with accuracy and the proper amount of power. Visual thinking and visual-motor integration are used when the players change their aim or power based on the frog's path from previous attempts. Visual figure-ground skills are used to help differentiate the branches from each other, which is necessary for the players to have accurate aim.

Bilateral integration is helped by mandating the players to alternate the hand used with each turn or flip of the lily pad launcher. This will foster the crossing of midline and encourage the use of both sides of the body. Visual-motor integration is trained because the player must be able to manipulate the game pieces or cards effectively. Simply reading the instructions can help the player's visual perceptual skills. If auditory-visual integration and visualization need to be improved, the directions can be read to the players; however, if reading comprehension needs to be improved, the players can read the directions themselves. A summary of the areas each of these games addresses can be found in Table 2.

Discussion

Often, OVT centers on activities that successfully target the problem but fail to capture the child's attention and interest. The use of varied, modern games could enhance any vision therapy program and improve compliance. Traditional techniques should in no way be abandoned, especially for in-office therapy. These games could easily be used to supplement home-based support, or as a reward for hard work. Home-based therapy often depends on proper communication of the technique to the parent, the ability of that parent to understand the home therapy, the ability of the parent to communicate with the patient, and lastly, the ability of the parent to identify and correct any issues experienced while performing home therapy. These concerns are minimized when commercially available games are used as home-based therapy as each game comes with its own understandable and accessible directions.

Table 2: The areas of visual processing that are addressed in each game if played as initially instructed

		Blokus		Phase 10		ISpy		Flippin' Frogs	
		Initial Presentation	With modifications	Initial Presentation	With modifications	Initial Presentation	With modifications	Initial Presentation	With modifications
Visual-spatial skills	Bilateral Integration		X		X		X		X
	Laterality/Directionality	X	X	X	X		X		
Visual analysis skills	Visual discrimination	X		X		X			
	Form constancy	X		X		X			
	Visual closure			X		X			
	Visual figure ground	X				X		X	
	Visual memory			X	X	X			
	Visualization	X	X		X		X		X
	Visual thinking	X	X	X				X	
Visual integration	Visual-motor integration	X		X		X		X	
	Auditory-visual integration		X		X		X		X

There are general age recommendations instituted by the manufacturers, so be certain the patient understands and can perform the tasks needed to play each game. Also, the patient must be ready for the skill level of the game in that stage of their therapy. A successful therapy activity is one wherein the patient does not always succeed or fail. The level of the activity must be placed at about the 70% rate of success so that the patient is left with a feeling of doing well but leaving room for improvement.

Conclusion

This paper highlights that the use of commercially available games in an OVT program can be helpful, but that proper implementation by the therapist and/or doctor is necessary in order to use their full potential. Games provide variety and fun to the therapy program and can address several visual perceptual areas. While only four different games are covered in this paper, simply take a stroll down the toy aisle and the possibilities of games to choose and the variations that can be implemented are limited only by the imagination.

References

1. Mitchell S, Rouse MW. Optometric Management of Learning-Related Vision Problems. St. Louis, MO: Mosby, 2006.
2. Borsting E, Rouse MW. Detecting learning-related visual problems in the primary care setting. J Am Optm Assoc 1994;65:642-50.
3. Sloan HA, Ciner EB. Visual perception and learning: issues and answers. J Am Optom Assoc 1989;60:457-60.
4. Kulp MT. Relationship between visual motor integration skill and academic performance in kindergarten through third grade. J Optom Vis Sci 1999;76:159-63.
5. Kulp MT, Edwards KE, Mitchell GL. Is visual memory predictive of below-average academic achievement in second through fourth graders? J Optom Vis Sci 2002;79:431-34.
6. Maples WC. Visual factors that significantly impact academic performance. Optometry 2003;74:35-49.
7. Christenson GN, Griffin JR, Wesson MD. Optometry's role in reading disabilities: Resolving the controversy. J Am Optom Assoc 1990;61:363-72.
8. Rainey BB, Lowther A. The visual information processing multidisciplinary superhighway. Pract Optom 1998;9:52-56.

Corresponding author:
Marc B. Taub, OD, MS
1245 Madison Avenue
Memphis, TN 38104
mtaub@sco.edu

Date submitted for publication: 28 January 2011
Date accepted for publication: 22 June 2011