Visual-Vestibular Integration, Motor Planning and Visualization "The Slotnick Scramble" A Vision Therapy Activity

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Abstract

This article describes a dynamic vision therapy activity that can be up-loaded or down-loaded to maintain the engagement of the patient for optimal learning. It is a multisensory integration activity engaging visual, vestibular and auditory senses. It requires: gross motor planning, laterality, directionality, visual information processing skills including visualization, visual planning, visual memory, and central-peripheral organization in both a spatial and temporal context. The activity is performed with a rebounder (trampoline) and two letter/number charts in landscape orientation. It is appropriate for a wide range of ages from about age 5 upward.

Key Words

auditory, central-peripheral organization, rhythm, temporal processing, vestibular, vision therapy, visual information processing skills, VIPS

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INTRODUCTION

In order to provide opportunities for growth and learning, vision therapy (VT) activities are designed to engage the patient and to motivate interest. Educational resources refer to an "optimal challenge level" for self-motivation, driving curiosity while maintaining a modest stress level. Learning takes place as patients strive to reach an attainable goal.[1,2] I generally try to arrange for patients to experience an 80-85% success rate during VT. When working with individuals who are more emotionally fragile, I modify the activity so that the success rate is closer to 90-95%. Progress may be slower in these cases, but interest and the perception of success can be maintained.

This article describes a powerful, dynamic VT activity that can be up- or down-loaded to maintain engagement and optimal learning. It is appropriate for a wide range of ages from about age 5 upward. It is a multisensory integration activity, engaging visual, vestibular and auditory senses. It engages: gross motor planning, laterality/directionality, visual information processing skills including visualization, visual planning, visual memory, and central-peripheral organization in both a spatial and temporal context. The activity is performed with a rebounder (trampoline) and two letter/number charts, generally in landscape orientation.

"The Slotnick Scramble," A Vision Therapy Activity

Format

Two identical letter charts (numbers/ letters/ arrows/ mixed) are placed on opposite walls of the VT room. The charts are arranged five characters/line, four lines per page. This may be more or less complex as the therapist sees fit.

A rebounder is placed on the floor, half way between the two charts.

Basic Instructions

"Bounce on the rebounder, reading one letter every other bounce."

Once a rhythm is established, instruct the patient to "make a half-turn (180°) and read letters on the opposite chart, without losing your place or adding/omitting a beat."

The patient continues to make half-turn rotations at regular intervals, as outlined below.

Uploading/downloading Options

1) Rotation frequency

Vary the number of letters read before the 180º turn. The more letters that are read before turning, the easier the task.

Beginner: Have the patient rotate once at the end of each line (five letters).

Intermediate: Have the patient rotate every four letters. If they master this, try rotating every three letters.

Goal: Have the patient read two letters facing one chart, then two letters facing the opposite chart. If the patient is initially capable of this performance, the activity should begin at this level.

2) Direction of turn

Vary the direction of rotation, turning to the right or the left.

Beginner: Do not instruct the patient as to the direction to rotate on the first attempt. Let her turn either right or left."

Intermediate: Once the patient has developed good timing for the rotations, add a level of gross motor planning:

a) Only turn to the Right (clockwise).

b) Only turn to the Left (counterclockwise).
c) If there are asymmetries in performance between (a) and (b), continue to warm up with the easier direction and work to improve the activity in the direction that is more demanding.

Challenge level

d) Turn 360º by executing two consecutive half-turns in the same direction, then reverse directions for the next 360º (two consecutive half-turns).

An example would be:

Read two letters / Rotate Right / read two / Rotate Right / read two / Rotate Left/ read two / Rotate Left again / read two / Rotate Right, etc.

3) Cognitive Loading

If the patient handles the rotational challenge level, add the cognitive demands of reading the chart as suggested below:

a) Clap your hands on the vowels but do not say the vowel.
b) Clap on even numbers.
c) Introduce arrows into the letter/number chart and call out the direction the arrow is pointing.
d) Add one to each number when it occurs.
e) Subtract one from each number
f) Call out the opposite direction of the arrows.
g) Say the next letter of the alphabet for each letter
(i.e., if the line reads, 'D N E Q A', they would read it as, 'E O F R B').
h) Combine different cognitive tasks on a chart mixing letters, numbers and arrows.

DISCUSSION

This activity provides many opportunities for learning and development. It engages gross motor planning, laterality and directionality, and visual information processing skills (VIPS), visualization, visual planning, visual memory, and central-peripheral organization in both a spatial and temporal context.

Auditory/Temporal Processes

The rebounder is a useful tool for helping the individual to understand timing, particularly when auditory processing is deficient. A person's pace is based on the tension of the springs, the person's weight, and the force of the person bouncing. If one simply lets his body bounce after the initial jump, she should maintain a regular rhythm.

Any rebounder activity performed in tandem with visual attention should provide timing support. Auditory processing often interferes with one's ability to hear and speak in unison, or to hear and touch in unison. The patient's timing awareness can be facilitated by reading the letters in rhythm to the bounce of the body. Reading the letter chart aloud provides auditory input while rebounding stimulates the proprioceptive and vestibular input. The synchronized inputs from the visual, auditory, proprioceptive and vestibular systems are all processed simultaneously, reinforcing rhythm and timing.[3] Temporal planning is reinforced as the patient learns to say each letter at the exact same moment of each bounce, preferably at the bottom of the bounce.

Vestibular and Proprioceptive Senses

Rebounding stimulates the gravity-sensitive components of the vestibular system, primarily engaging the utricle with movement in a vertical direction. When rebounding, at the bottom of each bounce, the patient receives a strong proprioceptive signal from the muscle spindles about the feet and ankles. This occurs precisely at the moment of direction reversal, between the deceleration downward and the acceleration upward. This three-part cue is experienced at a specific moment in time (the bottom of the bounce) at regular, repeating intervals.

The rhythm and timing of successive eye movements are important for efficient reading.[4,5] This sense of rhythm can be effectively developed with the use of a rebounder, and with practice the sense is often transferred to metronome work.

Adding the body rotation (180°) component to this activity provides an additional vestibular stimulation to the horizontal semi-circular canal. The patient's jump to rotate 180° in a single motion must be made rapidly. This generates a vestibulo-ocular reflex (VOR) eye movement in the opposite direction of the rotation. When the patient breaks fixation from one chart and turns to re-fixate the chart on the facing wall, she must exert an elevated level of oculomotor control to re-stabilize fixation. This elevated level of attention and neuro-muscular control is required to control optokinetic nystagmus (OKN). The patient must override the OKN, dampening it sufficiently to allow re-fixation following the VOR[6] so she can gather the next chunk of visual information. Thus, the rotational aspect of the activity provides the patient with a novel opportunity to gain oculo-motor control.

When higher levels of cognitive work are required, it behooves the patient to steady the eyes and leave time for planning other actions such as clapping, mathematical operations or letter substitutions. Thus, the cognitive loading process helps the patient learn to further automate the underlying gross motor and oculo-motor processes.

Visual Skills and Visual Information Processing

Ocular Motility and Fixation

When rebounding and rotating, the patient is provided with opportunities to exert oculomotor control. Fixating after a body rotation requires them to over-ride the OKN, and rebounding requires vertical gaze stabilization. This activity actively engages saccadic eye movements as the chart is read from left to right and top to bottom. The rotations create interruptions in fixation which require the patient to regain his or her place on the chart much like a near-far or even a near-near copying task.

Visual Planning and Visual Memory

The body rotation every two or three letters, requires an exercise in visual memory to maintain his place on the chart without losing the beat. Whether he finds his place by remembering what he has read, or whether he begins to plan ahead and visually recall the upcoming letters is a matter of his own development and comfort with the activity. It is common for patients at the four- or five-letter level to lose a beat after each rotation, needing additional time to find their place. It is not considered cheating to look ahead. It is necessary to look ahead when reading to prepare for the next portion of text. When the patient has accomplished this level, it is an indication that he is capable of additional cognitive loading. Learning to read ahead is yet another positive, intended effect of this activity.

Motor Planning, Laterality and Directionality

Visual planning occurs in concert with motor planning with these procedures. Body movement planning and speech planning are evident. Motor planning demands are very high for gross motor and spatial organization skills.

Gross motor planning is required as the patient controls body rotation to the right

or to the left, reinforcing laterality. A greater level of right/left awareness is incorporated when using left or right arrows in the letter chart as the patient calls out the direction of the arrow.

Directionality requirements are introduced at the challenge level (2d). The patient makes two consecutive half turns before reversing direction. This means that at any given point in time, the patient's next turn may be left or right. The patient may keep track of this sequentially, counting the number of times they turn each way. She may learn to recognize that she needs only to keep track of her orientation with respect to the room and this provides a cue for direction reversal.

Central-Peripheral Organization

Central-peripherial organization is the ability to maintain perspective on the big picture (or scenario) while simultaneously directing attention towards a specific aspect or component of that picture. It encompasses the ability to maintain focus without losing context, to recognize the forest while attending to a specific tree.

When working at the challenge level (2d) there are multiple opportunities for the patient to develop central-peripheral organization skills.

Before the patient becomes proficient at a given activity level, she may be able to identify her own specific mistakes. This indicates (1) that she understands what she is trying to accomplish, and (2) that she has expanded her level of self-awareness, remaining involved during the activity and conscious of her errors. This skill requires central-peripheral integration, over time (reviewing her work) and over space (acknowledging the location where errors occurred).

If she is attending to the number of times she has rotated each way, she must remain oriented to the passage of time in order to know when to rotate. The next move may be either a bounce or a bounce and a rotation. The next rotation may either be to the right or to the left, repeating or reversing in direction. This requires sustained awareness of the activity. Thus, it requires central-peripheral organization in time.

Visualization

Visualization is the ability to create and manipulate pictures in one's mind. It can be a powerful tool for practicing an activity via mental rehearsal without actually executing the activity. The skill is commonly used by athletes to prepare for various competitive situations. Visualization of this complex series of actions on the rebounder provides another opportunity for self-projection in time and space. Visualizing the activity has been the key to enabling some patients to conquer this activity. Visualization allows patients time to correct errors before they have been executed. It awakens the patient to a number of components they must consider and coordinate.

This procedure can be introduced to older patients as a visualization exercise. Challenge them to understand the activity at any appropriate level and execute it in their minds, make mistakes and correct these mistakes in their mind before actually performing the task. Further, challenge them to perform the activity with accuracy on the first attempt by working out the "kinks" in their mind's eye first.

SUMMARY

The Slotnick Scramble is a dynamic, engaging VT activity. It can be up- or down-loaded to provide a variety of opportunities for learning and development. This activity helps the patient to integrate awareness across multiple senses: visual, vestibular, auditory, temporal and proprioceptive. The Slotnick Scramble engages a variety of VIPS, supporting gross motor planning, laterality/directionality, visual planning, visual memory, visualization, and central-peripheral organization in both a spatial and temporal context.

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