PERSPECTIVE

Multitasking a Perceptual Activity

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Performing vision therapy with a preschooler, especially one with developmental delays, can be very exhausting - especially in the current times of COVID quarantine. Turning therapy into a fun and interactive (yet therapeutic) game is how I have best found to perform therapy with my own such little patient. If done with some imagination, a simple game can be turned into a whole therapy session all on its own. The example I will go through below is done with a spelling puzzle and some foam letters but similar imaginative thinking can be applied to most games you find in a house with little kids.

My 4 year old, Gregory, chose to play with the spelling puzzles. My goal was to work on skills including oculomotor, visual spatial, visual analysis, visual-verbal, visual-motor, auditory-visual, as well as critical thinking and problem solving skills. I find it important to give him a choice between two or three games so that he feels empowered about making his own choice of activity. The game consists of 3, 4, and 5 letter words with pictures which are broken into puzzle pieces. The goal is to match the letters and complete the word/picture puzzles. The one I have at home is the Infantino Word Picture Puzzle but any such puzzle works great. All in all, it took us about 1 hour to do all of the below mentioned activities. It's important to mention that he rarely gives me an hour of attention so this may be broken down to 6 sessions of 10 minutes throughout the day.

I started specifically concentrating on and incorporating more directed perceptual activities with Gregory when he was about 3.5 years old because I noticed that he was having some delays in his perceptual development. For several years, he had been in speech and occupational therapy (since he was 1.5 years old) for global developmental delay with specific deficits in expressive speech. Even though he was only 3.5 years old, he exhibited poor number, letter, and short word identification with difficulty recognizing the constancy of a letter, number, or object in a different font, size, or color. He had difficulty transitioning between upper and lower case letters, with difficulty replicating information, and attending to visual tasks. He became overwhelmed by crowded visual information and had poor object location in a crowded background. He found it very hard to perform matching and sorting activities and had a very poor grasp on spatial concepts such as in, out, above, below, etc. There was a disinterest in playing activities such as coloring, painting, dot to dot, drawing, puzzles, Lego's, etc and his eye hand coordination as well as his pencil grip and graphomotor skills were very underdeveloped even for his age. While he had formal evaluations for speech and occupational therapy, I did not perform any formal testing for his visual perception, but instead relied on my observations and experience.

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Visual information processing is a non-motor visual analysis skill that allows us to locate, identify, and extract information from the environment by bringing together visual clues (integrated with other senses involved in higher cortical function) to give what we experience meaning and allow us to interact with our surroundings. The quality and efficiency of vision and visual processing have an overwhelming impact on how a person functions in his/her environment and can interfere with the ability to perform to one's full learning potential.[1-3]

The skills required for proficient visual information processing (VIP) include visual analysis, visual spatial skills, visual motor integration, visual verbal integration, and auditory visual integration.[1, 3-8]

- Visual cognition and analysis is the ability to recall, locate, select, extract, analyse, and manipulate relevant visual information. It is used in differentiating small differences in objects, sight word recognition, mathematics and spelling, idea expression, remembering visual sequences, and seeing the 'bigger picture' without losing sight of the details. Visual cognition consists of subsets including
  - Visual discrimination – are you able to recognise similarities and differences between images. It is an essential elementary reading skill for phonics and sight word processing.
  - Form perception – are you able to recognize the visual elements of an image or object.
  - Form constancy – are you able to recognize forms regardless of orientation.
  - Figure ground – are you able to locate and identify an item within a busy background without confusion.
  - Visual attention and visual attention span – are you able to select or attend to a subset of visual information for more in depth processing. This requires performing simultaneous processing of multielement displays and differentiating relevant vs. irrelevant information. Visual Span is the number of letters/visual information one can take in and accurately process in one look.
  - Visual memory and visualization – are you able to recognize or recall characteristics of previously seen images. Visualization is the ability to spontaneously envision an image in your mind and manipulate it. This is the most highly developed form of visual memory.
  - Visual closure – are you able to visualize and extract the whole image when only an incomplete part of the image is seen.
  - Visual sequencing and sequential memory – are you able to perceive and organize objects in a particular order and are you able to remember the specific order of the items.

- Visual spatial skills involve the ability to tell where you are in space, where objects are in space, and how you and different objects relate to one another. It deals with how your internal and external visual space is perceived and organized. Visual spatial skills are subdivided into three components:
  - Laterality – knowledge of your own right and left.
  - Directionality – knowledge of other object's right and left.
  - Bilateral integration – awareness of both sides of your body and the ability to use both sides separately and together, both unilaterally and bilaterally.

- Visual motor integration deals with the coordination of visual processing and motor skills, such as eye hand coordination, where visual information is integrated with fine motor skills. The eyes 'see' and then 'tell' the body what to do.
- Visual verbal integration deals with speed of rapid automatic naming (RAN) as well as expressive language (talking and reading). The eyes 'see' it and the mouth 'says' it. RAN involves the ability to accurately and efficiently call out a list of presented visual stimuli while reading involves the ability to recognize visual symbols as spoken word and quickly and accurately retrieve their label (meaning) and verbalize it.
- Auditory visual integration deals with the ability to identify an auditory stimulus as a visual representation and be able to write it down. The ears hear it and you have to match it to written symbols or write it down.

Figure 1: Turning all the pieces so that they pictures are right side up. Starting to pick out similar pieces to make his first completed puzzle.

Our first step was to dump all of the pieces out and turn them all around with the letters pointing up so we could see what we have. This required identifying which pieces were upside down and then physically turning them over (figure ground, visual attention, visual discrimination, and visual motor integration). This can be overwhelming for a child not experienced with the activity or in the initial steps of therapy so decreasing the amount of items may be best to start.

Next, I wanted to have him turn all of the pieces right side up so all of the images and letters were properly oriented toward him, but Gregory did not want to do that. He preferred leaving the items all scrambled, which actually makes the task of finding matches more difficult. As he started to find the matching pieces for each puzzle we were working on the following:

Visual Attention – is he able to attend to the visual information for in depth processing and analysis. This can be tricky and requires the child to be willing to perform the task. If they are not attending, all other factors will not be optimally performed. One way I have found to keep his attention is to constantly mix things up and create new games with the same pieces (which we will discuss later) and switch things around frequently to keep it entertaining and engaging. Intermixing physical activity and fun games in between more daunting tasks works very well.

Figure 2: No matter the activity, if the child is not attending, you're not going to get anywhere! I saw that he was losing attention at one point so we did some jumping jacks and sit ups and then got back on task.

Oculomotor – is he able to fixate and produce accurate and optimal searching saccades to locate the pieces? In the start of therapy, fewer targets that are further apart is preferable.

Figure 3: Cluttered visual stimuli requiring precise and efficient saccades.

Visual Discrimination, Form Perception, and Figure Ground – is he able to recognize similarities between the different images and find ones that go together? Can he pick out important characteristics about the pieces and recognize their visual elements? Can he locate and identify an item within a busy background? For example, one of the words is 'frog'. It is green in color and stands out from the other images. Can he pick out all of the similar colors and after that, can he separate which green colors belong to the 'frog' as opposed to something else that is green (there is a green hat with polka dots and a house with a green roof).

Figure 4: I told him that there is a zebra in the puzzle. We discussed the characteristics of a zebra and decided that it is similar in appearance to a horse (in terms of its general body characteristics like 4 legs and a tail) but is different from a horse because it has black and white stripes. After that, he was tasked with finding any pictures that included black and white stripes. If you notice, he picked out all the correct zebra pieces, but also added in a black and white piece from the 'panda' puzzle.

Form Constancy – is he able to recognize forms regardless of how they are oriented? This is compounded by the fact that he did not want to properly orient the pieces to be upright as well as by the fact that he kept moving around. If you want to load a task when performing a similar activity, having the patient constantly move from one side to another side or rotating the pieces so that they are observing the same piece from a different angle is a good loading procedure.

Figure 5: He starts putting the puzzle together. He chooses the zebra's face first because even though the picture was turned sideways, he realizes that that piece was the face portion of the zebra. He continues without realizing that he has an extra piece (the 'n' from 'panda'). My options here were to let him figure it out on his own or to ask him leading questions such as 'when you look at all the black and white stripes, do they all look the same way to you or is there one piece where the stripes are a lot bigger', 'when you look at the pieces, do all of them makes sense or is there one that looks a little different', 'let's try to think about what letters are in the word zebra, look at all of your pieces, is there a letter that does not fit into the word zebra', etc. For today I decided to allow him to keep going and see where it leads - self correction is one of the best ways for children to learn.

Visual Memory – depending on the day we will either collect all the needed pieces of a specific puzzle first and then start to build the puzzle or we will pick one piece try to figure out what it is and then try to find the other pieces to finish the puzzle one by one. If we are doing things one by one, once he starts building a puzzle, does he remember where he saw a piece that might match with

his unfinished puzzle? I will sometimes change things around and flip the pictures upside down to see if he can remember where things were to load the visual memory task further.

Figure 6: He realizes his mistake and we make jokes about it and try to imagine an animal that has a mix of a zebra and panda body. We discuss the similarities and differences and make more jokes. We make up new words by combining the words 'zebra' and panda' and create a new animal called a 'panbra'. Remember to always have fun and laugh!

Figure 7: He remembers seeing the small stars and tip of the moon somewhere in the middle of all the pieces so now he is trying to remember where he saw the final piece of the 'moon' puzzle.

Visual Closure and **Visual Sequencing** – if we are collecting all the needed pieces first, then once he identifies the pieces that he needs I have him try to guess what the final product will be, both by looking at the picture (visual closure) as well as looking at the letters (letter sequencing). We then put things in the correct sequence and connect them. If he is having difficulty, I'll have him place the first two pieces in order and look again to see if he can guess what it will be (picture closure) and what letters will come next (letter sequencing).

Figure 8: Later on that day we made brownies. We washed our hands really well and then tried to remember which words we saw in the puzzle from earlier in the day. We discussed how each word was spelled, what each letter looks like, and then Gregory used his finger to write out the word in the brownie mix. Here he is drawing out the word 'cat' in lower case and then upper case.

Figure 9: Here he has the 5 components of the word 'goose'. By looking at the pieces, he has identified the target image as a goose through visual closure and has started to place the first and second pieces to build that target image. He now has to choose the correct orientation (the letter 'e' is upside down) and the correct picture and letter sequence order to put the rest of the pieces to complete the puzzle.

Figure 10: He has correctly placed the first three pieces of the 'goose' puzzle. He correctly oriented the 'e' but incorrectly placed it as the 4th piece. He is now using his visual perception to analyze the fact that the 'e' does not belong as the next piece in the sequence and so something else needs to go in its place. He will sometimes get stuck and asking directional and leading questions like 'is there maybe another piece that you can try' helps guide him along.

Visual Motor Integration – can he pick up, turn, orient, and place the pieces properly (visually guided fine motor control). When placing the pieces together, I encourage him to think about how the pieces will go together and use his vision to guide the placement of the piece as opposed to a motor trial and error method where he jams the pieces together and hopes they fit. I will also have him imitate the object, so can he look at the picture of an animal for example and then orient his body to look like the picture and then move and make noises like that animal?

Visual Verbal Integration – can he call out the letters in the word (spell it out), say what sound each letter makes, and then read out the word after he has completed the puzzle.

Auditory Visual Integration – if he is having trouble (or as an alternate game) I will say something like "find the red picture with the letter 'c'" to get him started on the word 'coat'. I am looking to see if he is able to link the auditory stimulus he hears to its visual representation.

Figure 11: Here he is using his vision to orient, align, guide, and place the puzzle piece with his hand.

Figure 12: First he reads out the word zebra then he tells me a word that starts with each letter within the word zebra.

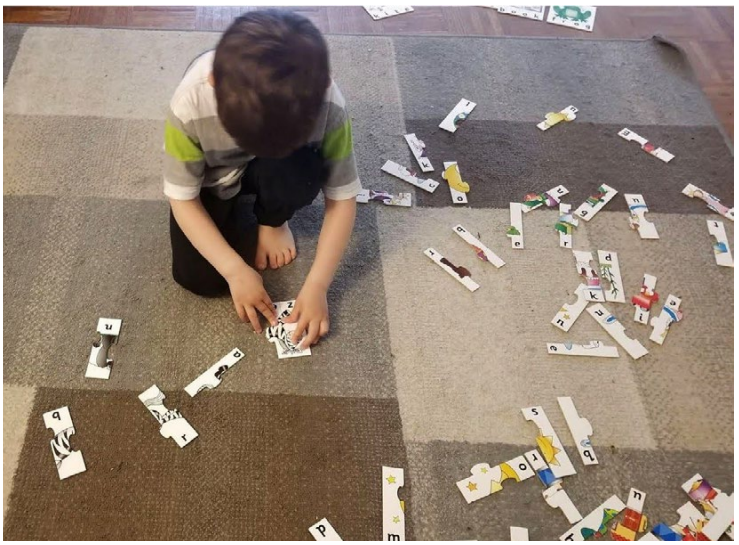

Figure 13: He needed a little help with the next piece so I asked him to look for the letter that makes the 'buh' sound.

Visual Spatial – can he tell where the pieces are in space and how they relate to one another and to him? I compound this by asking him questions and giving him directions like "do you need to put that to the right or the left?" "Does that look turned around to you?" "Can you put this finished puzzle above the first finished puzzle?"

Figure 14: Once finished, I asked him to place the finished 'book' puzzle in between the already finished 'frog' and 'star' puzzles.

Critical Thinking and **Problem Solving** – this whole entire procedure presents him with a problem that he needs to evaluate, think about, and solve to come up with a final, correctly completed product.

Figure 15: He is finishing up a puzzle and has paused to think about and review if he did everything correctly and what else, if anything, he needs to do to complete the task. It's almost like you can see him thinking.

We have also found new ways to play with this puzzle that are just as helpful. It's always fun to interchange the different games and tasks within the same activity to keep it from being boring. So we will do half of the puzzles as noted above and then we will start interchanging some of the other activities as listed below.

Figure 16: We pick out a word that we want to spell out, we review the sounds in the word, which letters make that sound, and the sequence needed to spell that word. He will then find the letters that are needed (this is very fun since there are several of the same letter with different pictures so he gets to pick out which letter/picture combination he wants to choose while improving on his reversal skills). There are two versions of this game. I can either have him do one letter at time (say a letter, have him find and place it, then say the next letter in the sequence) or I can add memory and sequencing into the activity by spelling a short word (for example Gregory chose the word 'help' here), review what the spelling of the word is and then have him recall, find, and sequence it all on his own. If a mistake is made, it's best to ask leading questions to have him find and fix his own mistake.

Figure 17: We also have fun and work on a lot of the above mentioned perceptual skills by trying to create rhyming words. Here he has created rhyming words 'moo' from moon and 'goo' from goose.

Figure 18: You can choose a characteristic and have him find all of the pieces with that characteristic. Here, for example, we found all of the pieces with the letter 'a' and then had a discussion about each one.

Figure 19: Align all the letters in alphabetical sequence. If needed, you can help with remembering the sequence either by saying it to them or providing a written representation of the alphabet. If they are able, it is best for them to try to do it from memory, as Gregory is doing here. Any letters that have already been placed go above the similar letter (as you see with the letter 'a' above). Here, Gregory has placed the letter 'h' after the 'f' instead of the 'g' and has just self realized his mistake. He is re-saying the alphabet to find where he went wrong and what he needs to do to fix his mistake. Once finished, we reviewed what sound each letter makes and called out a fun word or a word within a specific category that starts with each letter.

Figures 20-22: When he was completing the alphabet (we didn't have v, w, x, y in this puzzle so we used letters from elsewhere), I mentioned to him that the new puzzle pieces might not be properly placed (Figure 20). I did this after waiting to see if he would realize that he was placing them upside down. He had switched positions to the other side of the letters so he did not realize that while the letters v, w, x, and y were right side up for his new position, they did not correspond to the alignment of the rest of the letters. He was very confused and said 'no' (Figure 21). After gently asking him to look again and asking him to compare those letters to the rest of the letters, he realized his mistake and was able to orient them properly to match the rest of the set (Figure 22). I next told him that he might want to look at the sequence of his letters - he was not happy at all.

Figures 24-26: In the picture above, we chose a word he wanted to reproduce and he used foam letters to recreate the word. You can see that initially, he chose the wrong letter, 'd', but eventually self corrected his mistake and was able to reproduce the word correctly in both lower and upper case letters (Figure 24). When we initially started working on this activity, I would provide him with just the letters he needed to spell the word and would put them in the correct orientation as they were written on the picture. A harder version is providing him with all of the letters in the alphabet at once and having him pick out which ones he needs, as seen with the lower case letters (Figure 25). And finally, mixing letters up so that they are all mixed up in terms of orientation and organization where he needs to visually wade through the items and choose the appropriate ones (Figure 26). To take it one step further, I will put the foam letters he needs to spell a word in a bag, have him reach in, feel the letter and identify it, pick out the letter he is looking for, and then pull it out to see if he got the correct letter and place it on the ground. We do this until he spells the word out with the correct letter order.

Figure 23: Once he finishes putting the alphabet in order, I will remove one or more letters and try to have him identify which letter was removed. I will also have him try to recall what the picture was that went along with that letter and what the whole puzzle would look like. For example, the letter 'i' above is a piece from the 'king' puzzle. I also ask if there are any pieces we see that go together in the same word (e.g. the first 'a' and the 'l' both belong to the picture of a ball).

Figure 27: We add in graphomotor work into all of the perceptual work by having him copy over things like single letters, full words, or redraw pictures.

Figure 28: Finally, make sure all of the fun ends with cleanup. This is an important skill for the child to learn as well as allows them to work on their gross and fine motor skills. Sometimes Greogry will say 'I'm all done" when more than half of the pieces are still thrown all over the floor. This is a good opportunity to keep working on visual analysis and visual spatial skills by making a game such as 'I spy a puzzle piece under the couch' and so on.

In earlier forms of the above activity, I would isolate the 3 letter words to decrease the amount of targets as well as decrease the size of each whole completed puzzle so that things like searching saccades, figure ground, visual closure, form perception, and sequencing were easier to perform. In the very beginning, I would take a word like 'cat' and place those pieces about 2 inches apart in the correct order to see if he could simply identify that if he moved them closer together, he could form the picture of a cat. If that was too difficult, I would build the puzzle, take a picture of it, and show him a picture of the finished puzzle for him to try to reproduce. Later on, I would add in 2 or 3 puzzles oriented right side up and have corresponding pieces strategically close to one another so that they were bundled closer together and easier to identify. One of the first tricks I taught him is that with this puzzle, the letters are always on the bottom (pictures are on the top) and the very first puzzle piece will have a smooth wall on the left side. He is a lefty so we use his writing hand as a reminder of where left is. The key is to have a lot of discussion and to ask leading questions if he hits a wall. Sometimes he gets discouraged and I walk him through things step by step, have us take turns doing each step, or do the task for him as I talk through my thinking and why I'm doing what I'm doing and using a lot of descriptors.

In general, no matter the activity, I try to talk him through the steps of how to perform the analysis and give him strategies for success. I want to help him make sense of the activity and make a plan of how to attack the problem and solve it. We talk through what the goal is and what needs to take place for completion of the task. One of the biggest hurdles is identifying what the first step should be. Once he becomes proficient at a task, we start to work on automaticity by adding distractors, pacers, loading the task, increasing visual/cognitive/auditory stimulation, and working on multisensory integration.

Gregory has thrived with the incorporation of all his interdisciplinary therapies and if you met him today, you would not be able to tell the amount of struggle and work that went into making sure he had all of the developmental tools that he needs to thrive. The addition of occupational therapy, which introduced retained reflexes, balance, movement, and auditory integration into the mix was a key factor to making headway in his therapy on all fronts. He has graduated from formal speech and occupational therapy with flying colors and while before I would wish that he would be able to verbally communicate his thoughts, I now find myself sometimes wishing that he would stop talking so much. He can sit and read books for over an hour, enjoys painting, playing with blocks and legos, working with playdough and kinetic sand, and is learning how to spell out and write his name (which he is very proud of). He knows our address and my phone number by heart in case of emergencies and has a lot of pride and confidence when showing off a task he completed. While he is no longer in any formal therapies, I continue to work with him to make sure that all of the skills he has learned are retained and that his developmental and perceptual skills are honed. This will help ensure that he is able to extract information from the environment by bringing together visual clues and integrate them with his other senses involved in higher cortical function to give his experience meaning and allow him optimally interact with his environment and flourish.

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