

Viewpoint ▶ Tunneling—A Pervasive Vision Disorder

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ABSTRACT

Tunneling, a form of exclusive concentration, is a common spatial adaptation. The patient seems to be solely aware of that on which they are centering and block or ignore all other sensory input. It is both a sensory and motor phenomenon that is pervasive in our culture and presents concurrently with all refractive, binocular, and monocular conditions. Tunneling is a common symptom of visual perceiving, processing, and performance issues. Tunneling affects all sensory systems and is caused by physical, physiological, or intellectual/psychological stress. The symptoms affect how we think, speak, listen, and move. If tunneling is not addressed, it can effect an individual's ability to see the bigger picture quickly and easily.

Keywords: attention, exclusive concentration, spatial projection, tunneling

Introduction

Tunneling is defined as a form of exclusive concentration.¹ We are centering on a target and restricting or ignoring awareness of all other sensory input. Tunneling reduces peripheral awareness, and to the extreme, reduces focal awareness. Essentially, in moderate to high degrees of tunneling, people lock into the task, visually paying attention to the central visual field or a portion of the central field, and ignore all other sensory information.² Whether they are diving and locked in on the wonders of the undersea world or are only attentive to the computer screen, there is a reduced spatial volume. It is pervasive in our culture and a common symptom of visual perceiving, processing, and performance issues.

In my over 40 years of optometric practice, I have become more cognizant of the high number of patients who tunnel. The following characteristics of tunneling stand out:

1. Tunneling is a subconscious spatial adaptation to reduce the information the individual handles. The individual is either overwhelmed with information or has trouble sorting out the significant area for attention.
2. It is a sensory and motor phenomenon impacting perception, processing, and performance.³ It is a sensory phenomenon in that we ignore or block out information. It is a processing phenomenon as we subconsciously preclude our attention, and it is a motor phenomenon in that it can affect us posturally. For example, when we reduce our peripheral awareness we tend to lean forward as we walk (toe walker) or we can be unstable.
3. It is pervasive in all refractive, binocular, or monocular conditions.
4. It causes a wide range of symptoms affecting how we think, speak, listen, and move.⁴

The signs and symptoms of tunneling will be discussed later; the following discussion demonstrates how tunneling permeates life. A current patient of mine, a 38-year-old high school science teacher, was referred by an optometrist because

of nearpoint stress. During the evaluation it became evident that the patient was tunneling. As I explained my observations, the patient realized the true extent of her vision problem and how it permeated much of her life experience. She related the following very frightening incident that had occurred while scuba diving:

It is difficult and even dangerous to dive if you have a tendency to tunnel and are not aware that it occurs. I started diving a few years ago. It is recommended that one always dive with a buddy. This is a good thing because it has helped keep me alive. I remember once being so excited after I had spotted a turtle at the surface that I tried to get to it quickly. I began ascending too fast which is not good because of dissolved nitrogen. Both my dive computer and my dive watch sounded the alarm, yet I never heard either of them. My buddy could hear them going off from a few feet away but I never did. I was concentrating too much on the turtle. Finally, I realized my dive computer's reading, and it was the reading that saved me as I saw the words "slow down, slow down ..."

It is natural to center on a target so that the rest of the field becomes the background. However, if we have sustained moderate to exclusive concentration or attention, it leads to maladaptations. For orientation, or being able to locate objects in space, we have to appreciate things in relationship to the environment in which they reside. When we cannot do that appropriately, we have difficulty staying in our lane when driving or staying on the line when writing, we miss the ball when we swing, and we lose our place when reading, for example. Table 1 shows the signs and symptoms of tunneling.

A tunneling adaptation occurs because of physical, physiological, or intellectual/psychological stress.⁵ The adaptation is mediated through the visual process. An example of physical stress is when a student is placed at a desk that is too big and his head is too close to the desk top, leading to a shortened reading and writing distance. When that student is required to read for extended periods of time and does not

Table 1: Signs and Symptoms of Tunneling

We call someone several times to get their attention when they are reading, working on a computer, or watching TV.
We lock in on the road in front of us and miss our exit sign.
We go off on tangents in conversations, failing to keep in mind the bigger picture.
We answer a question, but we are not responding to the question being asked. That is, we have locked into part of the information in the question and are ignoring all the other content.
There is difficulty making transitions, e.g. the child or the adult who blocks out everything else while engaged in an activity and doesn't like to be interrupted until it is completed despite time constraints or scheduling issues. It is as if time and space do not exist outside the activity for the person who tunnels.
There is reduced or lack of body awareness, e.g. unaware of shoulder, neck, or back tension from reading, writing, or computer activities until it becomes intense.
There is difficulty following multiple directions—this is the struggling of a very bright child or adult who locks into part of the information and ignores the rest and is misdiagnosed with central auditory processing problems.
The head moves up and down while speaking.

follow visual hygiene guidelines, physiological stress occurs. Intellectual stress is found in a pre-schooler who is cognitively ready to read but who does not have the physiological visual skills to support comfortable and efficient reading without making maladaptations. An example of psychological stress is the high school student who becomes anxious prior to or during timed tests (standardized achievement tests) or lengthy reading assignments because they know they are slow readers or need to re-read for comprehension. The anxiety makes him unaware of what is going on around him and aggravates preexisting problems. A tunneling pattern is likely to develop regardless of whether the stress is chronic or acute.²

Once the tunneling adaptation is made in a particular situation it tends to become a generalized response to being in the world. Studies have demonstrated that stress reduces the amount of information we perceive through our vision or auditory processes.² Hence, a universal reaction to stress is to reduce or limit input so we can cope with the world. Hans Selye, an endocrinologist, wrote about how we respond to a stressor; we can fight (engage the task) or flee, and the sympathetic branch of the autonomic nervous system becomes aroused. The parasympathetic branch of the autonomic nervous system then allows us to return to rest. A sympathetic or parasympathetic response produces a cascade of neurological and physiological responses under control of the autonomic nervous system from changes in pupillary dilation to breathing. It is a non-specific or generalized response to the perceived stressor. This can be perceived as fun or positive (a puzzle or thought-provoking book) or negative (a lengthy reading assignment for the person suffering with a binocular dysfunction or a receded nearpoint of convergence). Tunneling is a “fight” response and is driven by sympathetic

arousal. Acute or chronic stress leads to the organism making an adaptation and being locked into that pattern as a generalized response to being in the world.³

Below I have detailed how cognition, speech-auditory, and body awareness are affected by tunneling. One symptom of tunneling, moving the head up and down while speaking, is something you can demonstrate on yourself. While visualizing a person 10-15 feet away, count out loud backwards from 100 to 80 so they can hear you. As you count, move your head up and down. Then, repeat counting from 80 to 60, this time with your head being still. Typically when the head is moving up and down, speech becomes softer, monotone-like, fragmented, or with pauses because of the effort to ignore the constantly changing peripheral input. This input can be disorienting, so we start to ignore the periphery. With the head still, the constant peripheral input is a stabilizing factor, and our speech becomes more fluent and often louder because of more accurate spatial projection, i.e. knowing where things are in space allows us to project our voice accurately.⁶ Competent spatial projection is derived from being able to center on an area of space and simultaneously sustain peripheral awareness.⁷

In behavioral optometric terms, we are evaluating the organism's competency at central-peripheral or figure-ground relationships and how it will impact cognition, as well as posture, balance, movement, speech-auditory, and emotions and feelings. If the dynamic balance, or synchrony, in the central-peripheral relationship is not present, the central-peripheral relationship becomes compromised. Tunneling impacts thinking because we can become too central (focal vision) and focused on the details and then struggle to see things in perspective; or we can become too peripheral (ambient vision) and have difficulty perceiving the intra-relationships.³

As previously stated, tunneling is a phenomenon regulated by the visual process, and it affects all sensory systems. We become so intent on that on which we are centering that our awareness of all other sensory input is diminished. This has massive implications due to the way we organize space; our vision serves as the foundation for how we think (abstract and conceptual learning), speak, listen, and move. Vision sets the stage for allowing an individual to select an area for attention and simultaneously see the space and objects around it. This allows humans to see the big picture. Thus, a competent visual system allows us to stay on the subject matter without going off on tangents. A visual system that has not developed properly with regard to being able to maintain figure-ground relationships will not be able to support abstract or conceptual thinking. As a result, many of the patients that I see will go off on tangents or begin obsessing about things because they lose sight of the bigger picture. In addition, when given multiple directions, we can lock in on part of the information presented and ignore the rest. In my experience, I have seen it misdiagnosed as a central auditory processing problem. Also, we can trip, stumble, and bump or walk into

someone or something because we have been inattentive to our surroundings. This tunneling behavior can be exhibited in thinking, speaking, listening, and moving through space.

Let's relate tunneling to sports. In soccer, if the players are visually competent, they are able to center on the ball, see teammates and opponents, and predict where the ball is going simultaneously. When the player begins to tunnel, and thus compromises the central-peripheral relationship, they begin to see things in a fragmented or piecemeal manner and may eventually only lock onto a part of what is happening in the field of play. Consequently, the player is a step behind the action, or is out of position, and at worst becomes disoriented or overwhelmed.

As stated earlier, tunneling is present in all refractive states and binocular conditions. In my experience, with myopia² and esophoria the field of view becomes constricted in all dimensions; the ground is reduced and details become squeezed together. I often observe myopic or esophoric individuals who see a world full of details and feel overwhelmed with all the information. Missing is the ability to see the details in perspective so they can be managed. To do this we need to be able to see the ground or the bigger picture. Myopia is a more natural form of tunneling, making it easier to reduce the information needing to be processed. In comparison, with hyperopia and exophoria, we see an expanded space world, but the world is flattened so the details or intra-relationships are difficult to select because they do not stand out. The hyperopic or exophoric individual will then tend to jump from one detail to another because of difficulty centering and seeing things in perspective.⁴ In either example, the organism is making an adaptation as a response to stress. This adaptation results in the patient living in a reduced-space world.

Operating in a reduced-space world will produce various motor and postural changes. For example, one might walk with smaller steps, round their shoulders, lock their knees when standing, and develop upper back, shoulder, or neck tension.² Harmon's work dealt with the postural changes evident with myopic and hyperopic refractive states. Harmon observed that a myopic adaptation would result in a forward shift of the pelvis, creating a backward tilt of the head, resulting in a chin up appearance and a feeling like the eyes are turned in.⁸

The hyperopic and exophoric adaptations tend to be more challenging to individuals. In my experience, patients with hyperopic and exophoric adaptations have a higher link to learning, reading, coordination, and organizational issues. Cognitively speaking, for these individuals to succeed, they subconsciously fragment space or tunnel, i.e. reduce the amount of information processed in order not to be overwhelmed in dealing with abstract or conceptual activities. In the physiological aspect, the complications of this adaptation for the hyperopic patient include moving the pelvis backward and the forehead forward, and the eyes feel like they are turned out.⁸ The exophoric patient adapts with

the feet being turned outward, creating tension in the upper and lower back.

What is meaningful can be limited to what is directly in front of our faces; we ignore our surroundings. It is as if we are seeing the world through a telescope and do not see things in plain sight. For example, we cannot find our keys on the table amongst other objects or cannot find the ketchup bottle in the refrigerator if it is not directly in line with where we are looking. Another characteristic of those that suffer from tunneling is that they can be unaware of their bodies. They are unaware of visual adaptations made by the body unless pointed out to them, or their symptoms and/or resulting body or facial tension and adaptations have increased dramatically.

Body and facial tension is produced by concomitant body adaptations to the refractive state and binocular conditions.² Anytime the head is moved from its neutral position for sustained periods, tension is produced. In addition, the change in the pelvic position creates tension in the back and legs. When we tunnel we typically do not feel the tension until it increases to a high amount or it is pointed out to us. For example, we have all seen patients who are sitting and turn their feet inward. As an experiment, sit with your feet turned maximally inward and then point your feet outward and feel where the tension is produced in your body. When we turn our feet inward there is tension from our feet all the way up our legs and through our thighs. When we turn our feet outward tension increases, but not to the level of turning our feet inward. Tension in the body is produced anytime we move away from the ideal dynamic or static posture. Myopia, hyperopia, exophoria, and esophoria are adaptations occurring for the most part due to a generalized response of being in the world affecting the operation of the mind-body.

Measurement and Treatment of Tunneling

Tunneling is measured in several ways. The easiest way to chart tunneling is through a syntonics field assessment or kinetic field testing. Another way is the confrontation test with Wolff wands. The patient and doctor are sitting 30" across from each other with their head at the same level. The patient has one eye covered. The wand with the gold ball is held at the doctor's nose. The patient is instructed that the silver Wolff wand is going to be brought in slowly from the periphery while the patient centers on the gold wand at the doctor's nose. The patient is asked to say 'now' when they can clearly identify the silver wand and not just when they are merely aware of it. The silver wand is brought in slowly from the periphery in all the cardinal positions and halfway between the patient and the doctor, towards the patient's midline position, so it would end up at halfway between the patient and doctor and in front of the patient's nose if the silver wand came in all the way. Typically, if all the points where the patient can identify the silver wand are connected, a circle is formed. The size of that circle is then estimated, e.g. beach ball, basketball, volleyball, softball, baseball, or ping

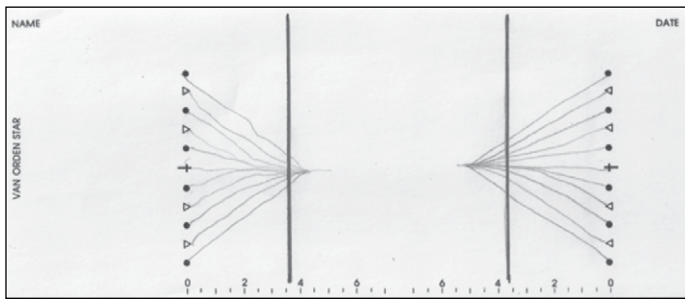


Figure 1: An example of a VO Star for a patient who is tunneling.

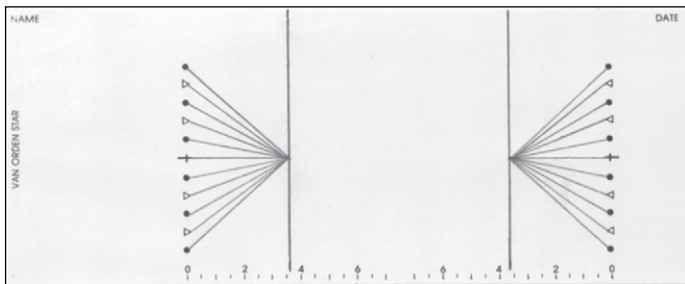


Figure 2: An example of a VO Star for a normal patient.

pong ball size. The diameter of the circular field can also just be estimated. The expected response is basketball to beach ball size. A smaller response zone indicates tunneling. The testing is then repeated with the other eye. Often one eye will have a smaller field than the other eye.

Using the same guidelines for doctor and patient positioning, with both eyes open for children under age 10, the child is instructed to look at the doctor's eyes. The doctor brings in his or her index fingers slowly from the periphery and the patient is to say 'now' when he can see the fingers of each hand at the same time. Preschoolers typically don't make a verbal response, but look off to one side when they see both the doctor's fingers.

Another way of measuring tunneling is through the use of the Van Orden (VO) Star. Figure 1 is an example of a VO Star in a patient who is tunneling. The two vertical lines, which indicate the ortho position, are drawn in after the patient has completed the VO Star. The apices are connecting within the ortho position with an asymmetric pattern and greater tunneling on the right side. A patient who was unlikely to tunnel would have the apices meeting at the ortho position (Figure 2).

Consequently in optometric vision therapy or training (VT), it is important to emphasize appropriate posture beginning with foot positioning. The feet are the foundation and support the legs. The legs support the torso and the torso holds up the head. The head is the center for the visual system.

If the feet are not in the appropriate position, adequate posture becomes difficult to uphold, and body tension is created. Tension or tightening in general creates additional stress, resulting in more tunneling or lack of awareness. A detailed discussion of VT for tunneling warrants another article unto itself; consequently, the topic will not be addressed at this time, but in a future article.

Conclusion

In summary, tunneling is a widespread visual adaptation present in all refractive states and perceiving, processing, and performance issues. Tunneling affects how we think, speak, listen, move, speech-auditory, and emotions and feelings. If tunneling is not addressed in VT, we have patients who are more comfortable and efficient visually but who lack the wherewithal to see a bigger picture quickly and easily.

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