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Editorial

Regarding Noise and Visual Confusion

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One of the highlights but little known of the binocular function, is the elimination of visual noise.

Although the elimination of visual noise is a process of usual subtraction, it often passes unnoticed.

Even in the presence of a correct alignment, we usually see double if you become aware of what is happening outside the Panum's area. Indeed, asymptomatic persons may experience diplopia, for example, and be conscious of the limits of Panum's areas by just putting the tip of a pen as a stimulus between the patient and the doctor.

If the patient directs his gaze toward the pen, he'll see double the doctor, but on the contrary, if he focuses on the doctor, he'll perceive double the tip of the pen. Seeing double outside the Panum´s area is already known, we do at every moment without being aware of it. The brain eliminates the visual noise in a consistent and efficient way.

However, when there is a binocular competition between eyes, either by a different input between one and the other eye, or by substantial differences of ametropia, opacity, or distortion of vision in one eye, or the simple misalignment of the visual axis, the different image, can generate noise and visual confusion if not eliminated.

Being the human binocular visual system a cybernetic model that seeks to maintain a steady state of negative feedback, it is understandable that the positive feedback trigger different types of visual noise which are a challenge for the brain to save energy in order to maintain a stable state, however, the mechanisms through which they seek to maintain a stable state are not always effective nor known.

What is known is that the binocular visual system seeks to eliminate the visual noise and that both the oscillation and amplification that this noise induces, usually is modulated by cortico-cortical regulator circuits, which unfortunately, is not always possible.

To maintain a stable state, both the thalamus and the cerebral cortex participate by prioritizing the relevant information, the thalamus by representing a gate which prevents the passage of irrelevant information, while the associated cortex makes it by secreting visual information.

The noise is not priority information, so that it can be filtered and dimmed constantly in an environmental context and binocular competition, depending on the brain plasticity.

Children tend to eliminate the noise quite effectively, unlike adults, for whom the visual noise usually stays for life.

Indeed, it is not always possible to eliminate the noise, both, by the countless environmental visual stimulus that exceed us, and because there are conditions where already prevails a binocular competition well established on the basis of a great input difference between one eye and another. This binocular rivalry not only prevents the correct elimination of visual noise, but rather encourages it.

The maximum disruption of human binocular visual system, is an inborn error in the visual, special and time calculation which is able to induce a sensory and motor dissymmetry, that cannot be corrected by the cortical integrator and can motivate the ocular deviation known as congenital strabismus, which, as a biological model has allowed a better understanding of the two effective mechanisms for the elimination of the visual noise in children.

One of these mechanisms occurs due to hypofunction of the ipsilateral striate cortex to the deviated eye. Through this mechanism, which is known as "amblyopia," the false image is dimmed if not rejected; in order to avoid visual confusion, while the director eye offers a better resolution, provides greater details, promoting this way attention, which inhibits the noise induced by the contralateral eye.

This strategy of the cerebral cortex is a passive process, but indirectly helps to eliminate the visual noise produced by the constant different input between eyes which takes place in early stages of visual integration.

Amblyopia is the decrease of visual acuity not attributed to an organic damage of the eye but to a functional imbalance between the Parvo and Magnocellular visual pathways, where it can be found a hypoactive striated cortex as a result of the asymmetric binocular competition.

But there is a more sophisticated resource than the previous one carried out in the associated cortex and not in the striated one. This resource consumes energy and consists in inhibiting the image already formed.

This mechanism happens possibly through two channels that are directed toward the working memory, Occipito-Temporal and Occipito-Parietal pathways. Therefore, suppression is not a phenomenon achieved by striate cortex which focuses on accommodating and classifying the information according to the spatial and temporal frequencies or inhibiting some irrelevant aspects of the act of seeing, but definitely it is not her role disappearing visual noise.

During pediatric age, in rehabilitated strabismic patients, visual noise can arise as a problem of interaction between contours called crowding. Finally, in some of these patients even if they are children can occur a phenomenon called horror fusionis, impossible to eliminate.

In the same way, if the ocular deviation occurs in adulthood or young people with slower brain plasticity, as a result of oculomotor paresis, for example, visual confusion will derive from the double image.

Not only the excess of environmental visual stimulation produces visual noise but entropy phenomena such as scotomas, floaters or phosphenes, are a source of visual noise too.

This type of noise coming from the inner environment is difficult not to be perceived. It corresponds to the associated cortex and not to the thalamus. Deleting this information of inner origin, through a process that requires a lot of energy is a phenomenon known as active cortical suppression.

But what can we do with a patient who experiences visual confusion?

The first step is identifying where the visual noise is coming from. It may be something as simple as a non-corrected ametropia, or perhaps a recent eye surgery, or an incipient cataract, but it can also be something as disconcerting as an alteration of the visual field, oculomotor paresis, thyroid disease, myasthenia, history of palpebral cosmetic surgery, brain tumor, intracranial hypertension, dehydration, among many others.

While looking for the real cause of visual noise, there is something simple that can be done. Just occlude one of the eyes if the confusion is binocular, and if it is monocular, for example in case of floaters, we need to reassure and encourage the patient to divert its attention, trying to focus on what is really relevant to the environment.

In the presence of a recent onset of visual noise, the neurologic study should include the visual acuity test, eye fundus exam, pupillary function, campimetry test by confrontation, study of the function of the III, IV, VI cranial nerves and in its case, consult the Neuro-Ophthalmology department, ask for Neuroimaging and Laboratory studies.

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