Define **Sherrington’s law**

- **Sherrington’s law**: Increased innervation to a muscle is accompanied by decreased innervation to its antagonist.

  - Violated in...Duane syndrome

- **Hering’s law**: Innervation to yoke muscles is equal.

  - Violated in...dissociated vertical deviation (DVD)

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Define Sherrington’s law

Sherrington’s law: **Increased** innervation to a muscle is accompanied by **decreased** innervation to its antagonist.

What is the full name of Sherrington’s law?
Sherrington’s law of... two words
Define Sherrington’s law

- **Sherrington’s law:** Increased innervation to a muscle is accompanied by decreased innervation to its antagonist

What is the full name of Sherrington’s law?
Sherrington’s law of…reciprocal innervation
Define Sherrington’s law and Hering’s law

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Define **Sherrington’s law** and **Hering’s law**

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Define **Sherrington’s law** and **Hering’s law**

- **Sherrington’s law**: Increased innervation to a muscle is accompanied by decreased innervation to its antagonist. Violated in Duane syndrome.

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*What is the full name of Hering’s law?*

Hering’s law of... [two words]
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Speaking of Hering’s law…What determines the total amount of innervational input?

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When the oculomotor control system is intact, it doesn’t. But when one eye has a muscle that is paretic, which eye is fixating has an enormous effect.
Define Sherrington's law and Hering's law, and for each state the classic example of a strabismus-type in which it is violated:

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Consider a pt with a paretic right lateral rectus (RLR). As expected, his muscle balance is ET. What happens if he looks at an object to his right? If he fixates with his intact left eye, a normal, moderate amount of innervation input to the left medial rectus (LMR) is all that is required to get this eye into right gaze. By Hering’s law, an equivalent moderate amount of innervation will be sent to the RLR. Given that it is paretic, the moderate innervational input it receives will not produce much abduction, and the measured ET will increase only modestly.

Next consider what happens if the pt fixates the same object of regard to his right, but this time with the paretic right eye. To get the paretic RLR to contract enough to abduct the eye, our pt must crank in a massive amount of innervational input. By Hering’s law, we know the same (massive) amount of innervation will be sent to the (intact) LMR, causing this eye to way over-adduct, thereby producing a large increase in the measured ET.

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The amount of strabismus present while the pt fixates with the nonparetic eye is called the primary deviation. Whereas the amount present while the pt fixates with the paretic eye is called the secondary deviation. Hering’s law is the reason these measurements are not identical, and why the secondary deviation is always larger.
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- **Hering’s law**: Innervation to yoke muscles is equal. Briefly, what is Duane syndrome?

*Duane syndrome* is a motility disorder with the following key findings:

- At least some limitation of horizontal movement
- Attempted adduction causes the globe to retract, and may cause it to up- or downshoot

What is the cause?

The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.
Define Sherrington's law and Hering's law, and for each state the classic example of a strabismus-type in which it is violated:

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**Duane syndrome**

Briefly, what is Duane syndrome? A motility disorder with the following key findings:

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*Q/A*

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How does this dysinnervation result in the key findings listed above?
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When someone with an intact oculomotor system adducts an eye, Sherrington’s law dictates that innervation is increased to the medial rectus and decreased to the lateral rectus.

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**How does this dysinnervation result in the key findings listed above?**
When someone with an intact oculomotor system adducts an eye, Sherrington’s law dictates that innervation is increased to the medial rectus and decreased to the lateral rectus. However, in a Duane’s pt CN3 innervates the LR, so when she attempts to adduct her eye, innervation is increased to both the medial rectus and the aberrantly-innervated lateral rectus, so the eye doesn’t adduct.

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Who is the typical DVD pt?

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What is the classic clinical finding?

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An eye will slowly elevate and extort, either spontaneously (manifest DVD) or when occluded (latent DVD). A crucial finding occurs when the drifting eye reorients downward, and it is this— the fellow eye does not move downward simultaneously (as would normally be the case).

How does Hering’s law relate to DVD?

As noted, in DVD the downward reorientation movement by the drifting eye is not accompanied by a downward movement of the fellow eye. As the muscles that depress the eyes are yoke muscles, this means that DVD represents a violation of Hering’s law.
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Who is the typical DVD pt?
A child with infantile/congenital ET or XT

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An eye will slowly elevate and extort, either spontaneously (manifest DVD) or when occluded (latent DVD). A crucial finding occurs when the drifting eye reorients downward, and it is this--the fellow eye does not move downward simultaneously (as would normally be the case).

**How does Hering’s law relate to DVD?**
As noted, in DVD the downward reorientation movement by the drifting eye is not accompanied by a downward movement of the fellow eye. As the muscles that depress the eyes are yoke muscles, this means that DVD represents a violation of Hering’s law.