How ADHD Develops, Sometimes gets Worse & Sometimes gets Better

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What is essential problem in ADHD?

- Old: behavior problems & not listening
- New: developmental impairment of the brain's management system: EF

- Aspects of brain's EF don't come online in usual time frame.
- And don't work consistently

TE Brown, Yale Medical School, 2013

Executive Functions

- Wide range of central control processes of the brain
- Connect, prioritize, and integrate cognitive functions–moment by moment
- Like conductor of a symphony orchestra

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"Will you do it and, if so, how and when?"
(Lezak, 2004)

Will you do it?	Motivation/Activation
How will you do it?	Planning/Organizing
When?	Timing/Remembering

Characteristics of ADHD Symptoms

- Dimensional, not "all-or-nothing"
  - Everyone sometimes has some impairments in these functions;
    in ADHD: chronic, severe impairment
- Situational variability: "If I'm interested"
  - Most persons with ADHD have a few activities where ADHD impairments
    are absent

ADHD looks like willpower problem, but it isn't!

T.Brown, Attention Deficit Disorder: The Unfocused Mind in Children & Adults (2005)

The Mystery of ADHD: Situational Variability of Symptoms

- Why focus for this, but not that?

"If it really interests me" (attraction)

- Why focus then, but not now?

"If I feel the gun to my head" (fear)

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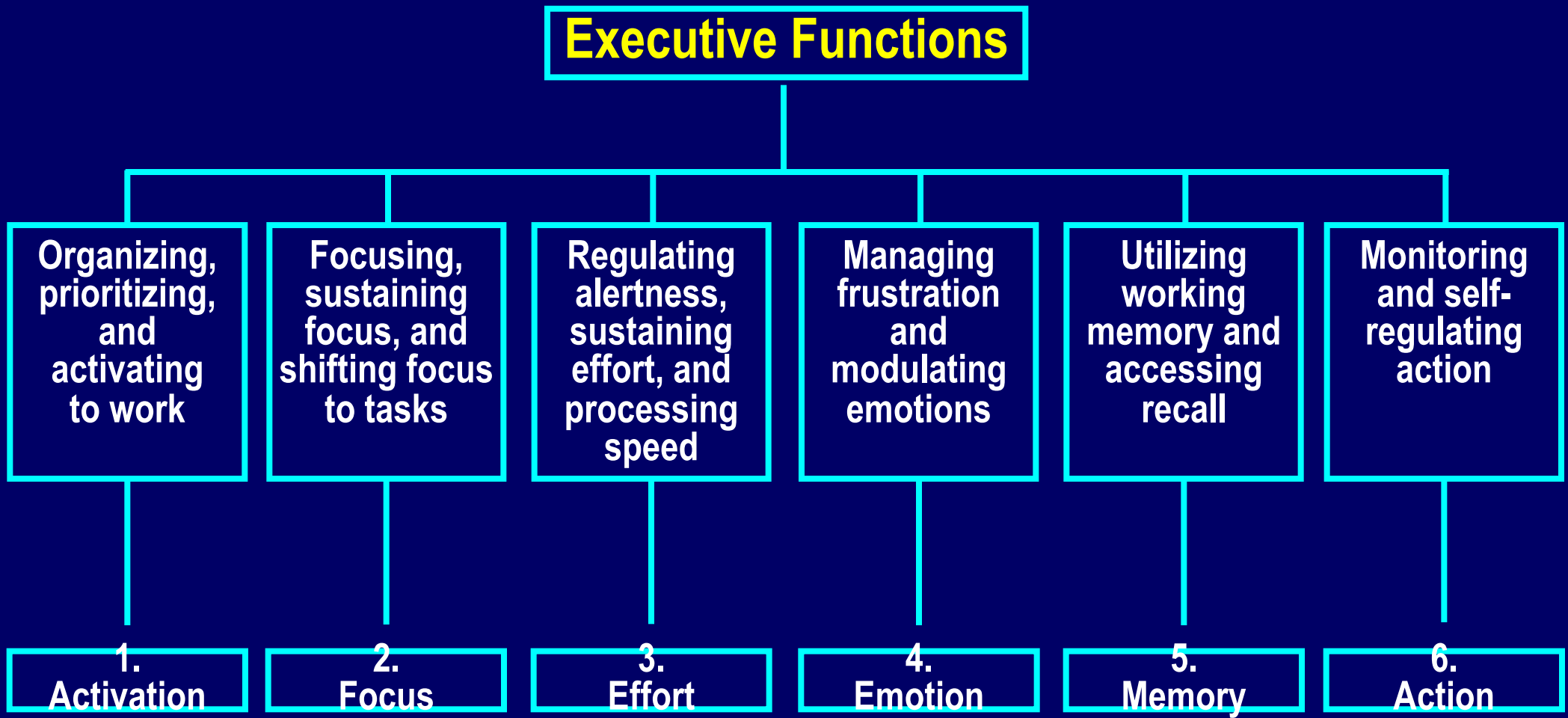
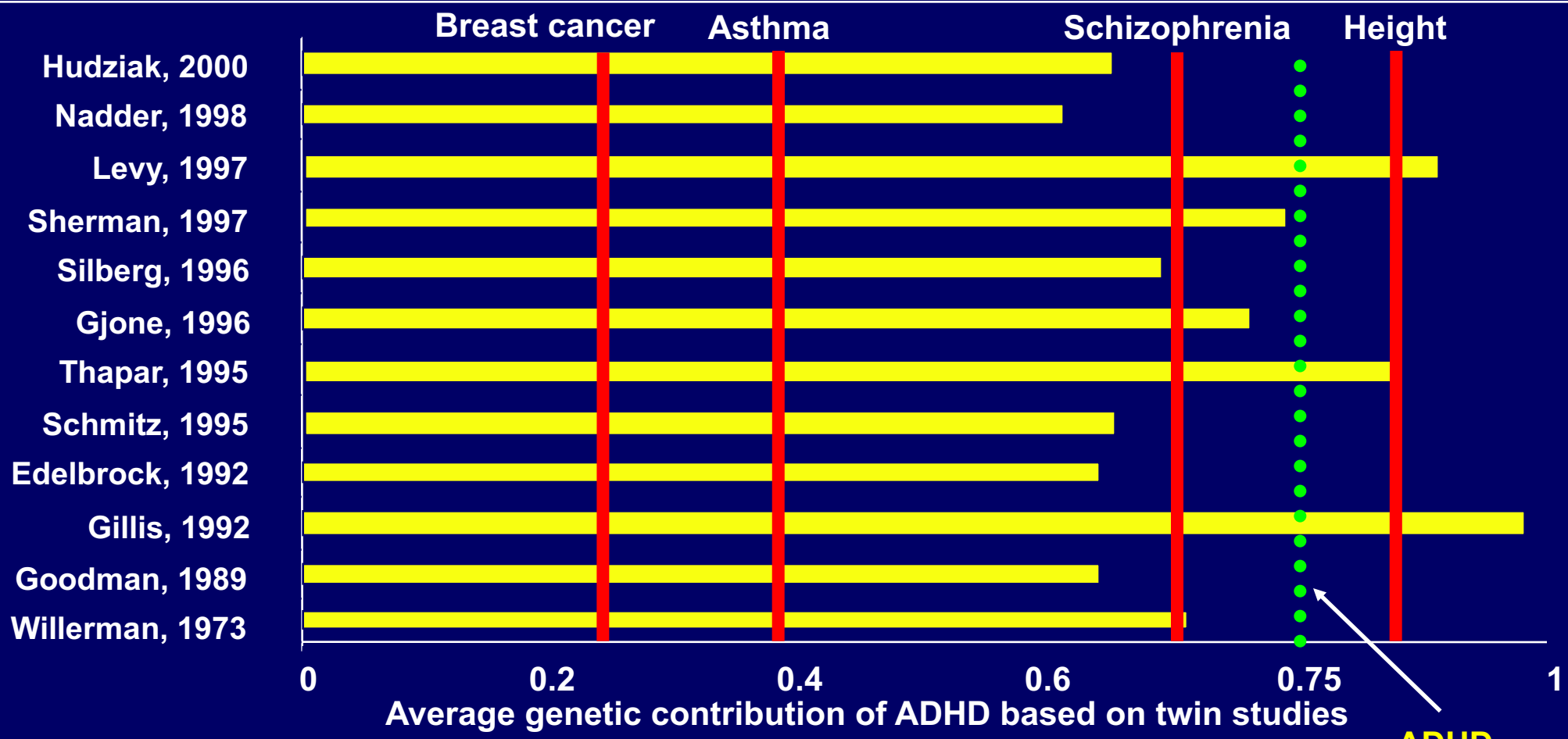
Brown's Model of Executive Functions Impaired in ADHD



Brown TE. *Manual for Attention Deficit Disorder Scales for Children and Adolescents;* 2001.

ADHD Genetics: Heritability Coefficient



Faraone. *J Am Acad Child Adolesc Psychiatry.* 2000;39:1455-1457.
Hemminki. *Mutat Res.* 2001;25:11-21.
Palmer. *Eur Resp J.* 2001;17:696-702.

Continuing Brain Development in Late Childhood and Adolescence

- Between 6-15 years, extreme growth (to 80%) occurs at the collosal isthmus that supports associative relay, while considerable synaptic pruning occurs
- Brain myelination increases 100% during the teenage years
- Dopamine (DA), norepinephrine (NE), and serotonin (5-HT) transmitter systems in the brain continue to develop into one's 20s

Thompson PM, et al. *Nature.* 2000;404(6774):190-193.
Benes FM, et al. *Arch Gen Psychiatry.* 1994;51(6):477-484.

Executive Functions: Development and Demands

- EF capacity develops through childhood, into adolescence, and beyond; it is not fully present in early childhood
- Environmental demands for EF increase with age, from preschool through adulthood
- EF impairments often are not noticeable by age 12 yrs!

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When Are ADHD Impairments Noticeable?

- Some are obvious very early and are noticeable in preschool years
- Some are not noticeable until middle elementary or junior high
- Some are not apparent until child leaves home to go to college or later

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Brain differences underlying ADHD
(temporary and/or longer term)

1. Delay in unfolding of brain development that supports executive functions
2. Impaired white matter connections between brain regions
3. Impaired control of oscillations that coordinate brain region communications
4. Inadequate release/reloading of transmitter chemicals at synapses

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Cortex Maturation in ADHD vs NC

- MRI studies of 40K cortex sites in 223 youths with ADHD vs matched controls
- Brain maturation was delayed ~3yrs in specific regions in ADHD youths vs NC
- Frontal areas of cortex slower in ADHD
- Medial PFC developed lagged 5 yrs

(Shaw, et al, PNAS, Nov, 2007)

Strutural Brain Differences in Persistent vs Remitted ADHD

MRI comparisons of persons with remitted vs persistent ADHD at 24 yrs indicated increased medial PFC cortical thinning in those with persistent ADHD while cortical thinning gradually began to thicken in those whose ADHD sx remitted, making their cortical thickness more similar to TDC. (Shaw, Malek, Watson, et al. 2013)

Is ADHD Brain Wired Differently?

- New model shifts focus from local brain abnormalities to dysfunction in broader distributed network organization.

  (Cortese, Kelly, Chabernaud,et al, 2012)

- DTI shows evidence for white matter ("subway") pathology & disrupted connectivity in ADHD

  (Konrad & Eichoff, Human Brain Mapping, 2010)

Gray & white matter Differences in Persistent vs Remitted ADHD

- fMRI comparison of adults w/persistent vs remitted ADHD showed clear differences in functional connectivity btwn the 2 grps (Mattfeld, Gabrieli, et al. 2014)
- DTI comparison of adults w/ADHD 33 yrs earlier vs controls showed persistent decrease in white matter connections for both current and remitted ADHD vs NC

(Cortese, Imperati, Zhou, et al. 2013)

Chemical Dynamics of Brain also contribute to impairments of ADHD

- Not due to overall "imbalance of chemicals" (not too much/too little salt in soup)
- But to inadequate release and/or reloading of transmitter chemicals in countless infinitesimal network junctions
- Except for "messages" re priority interests or fear of imminent unpleasantness

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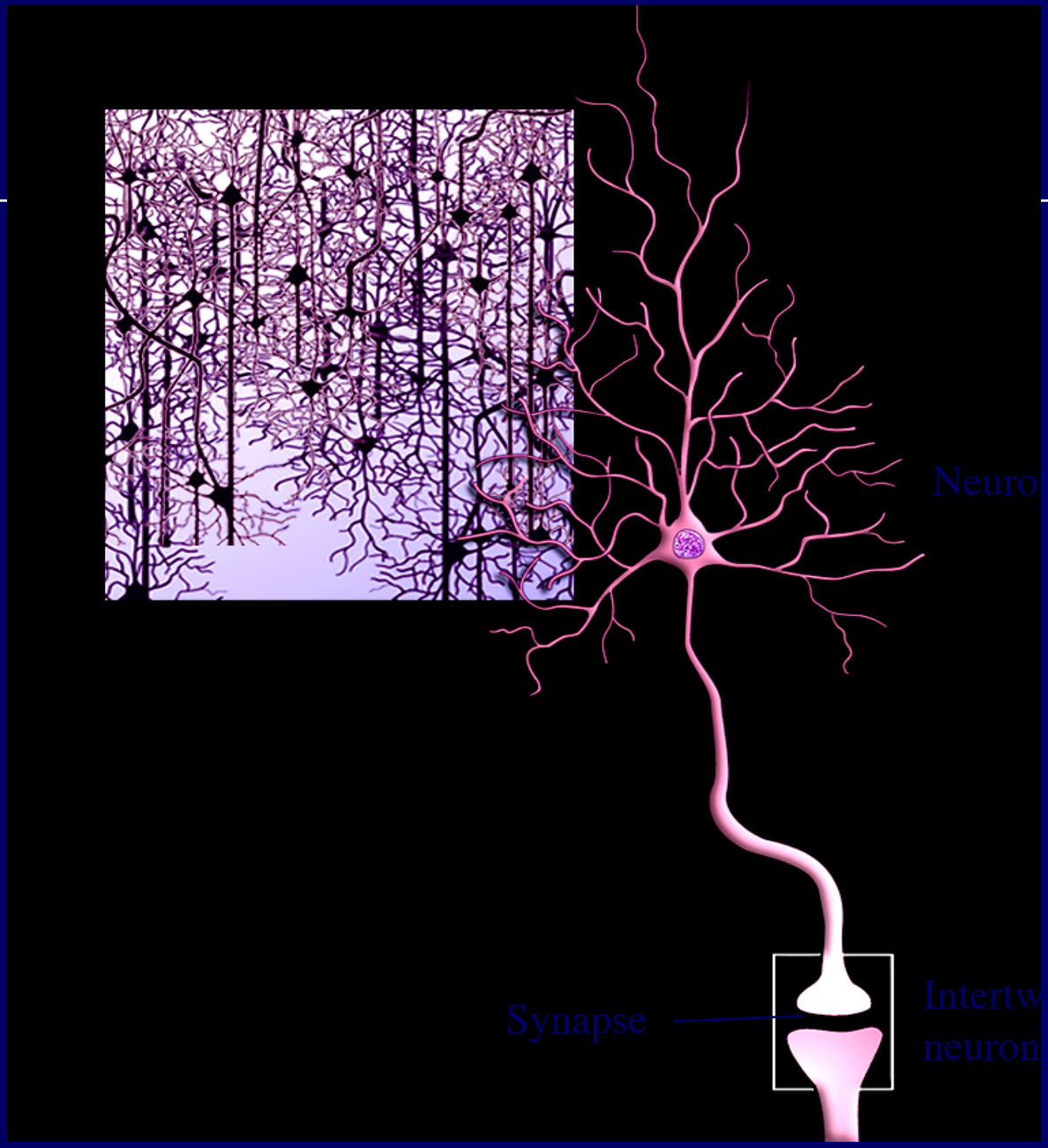
A Chemical Problem

- ADHD is fundamentally a chemical problem
- Most effective treatment is to change the chemistry with medication
- Unless the problematic chemistry is changed, other interventions are not likely to be very effective

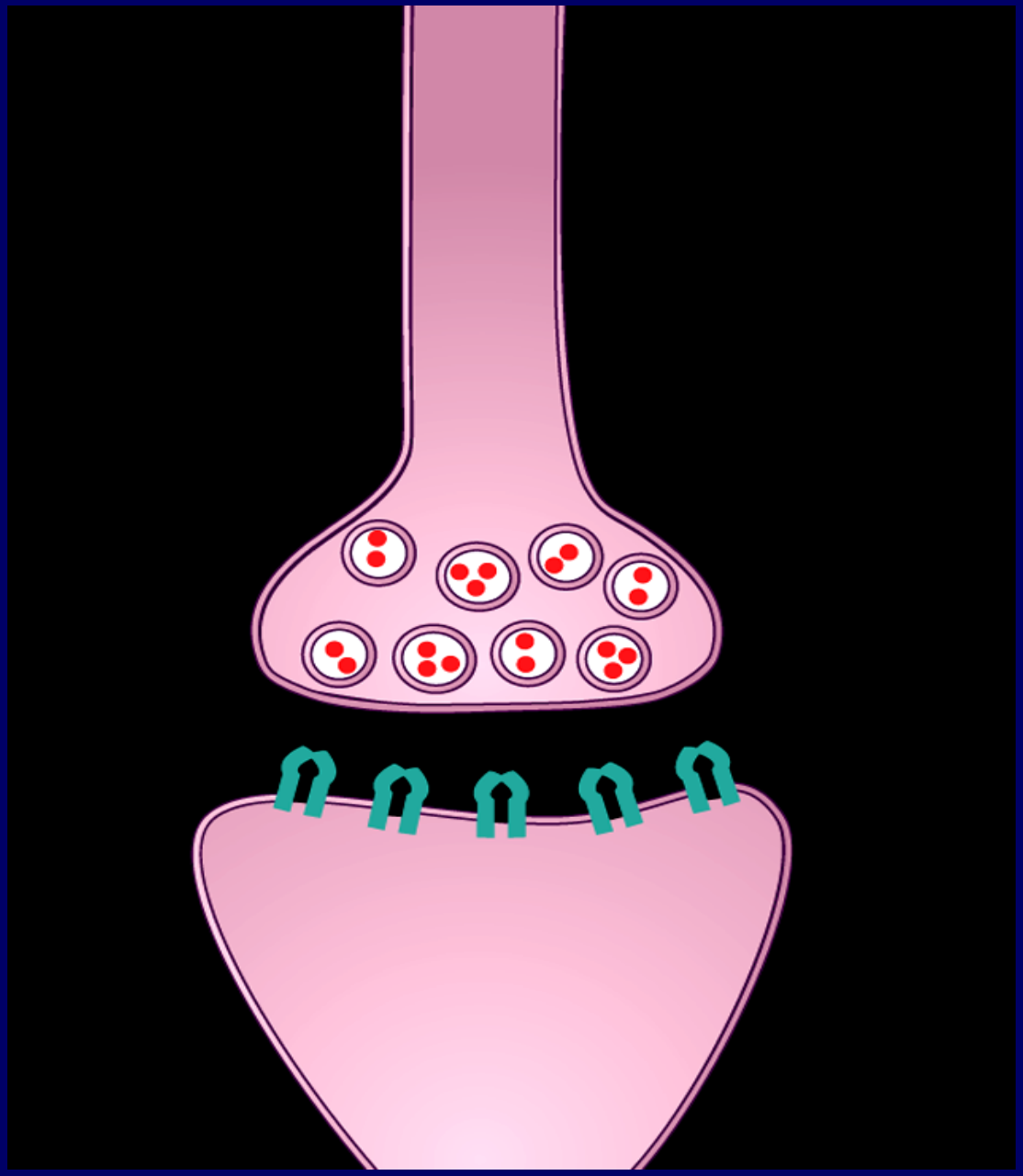
In the Human Brain

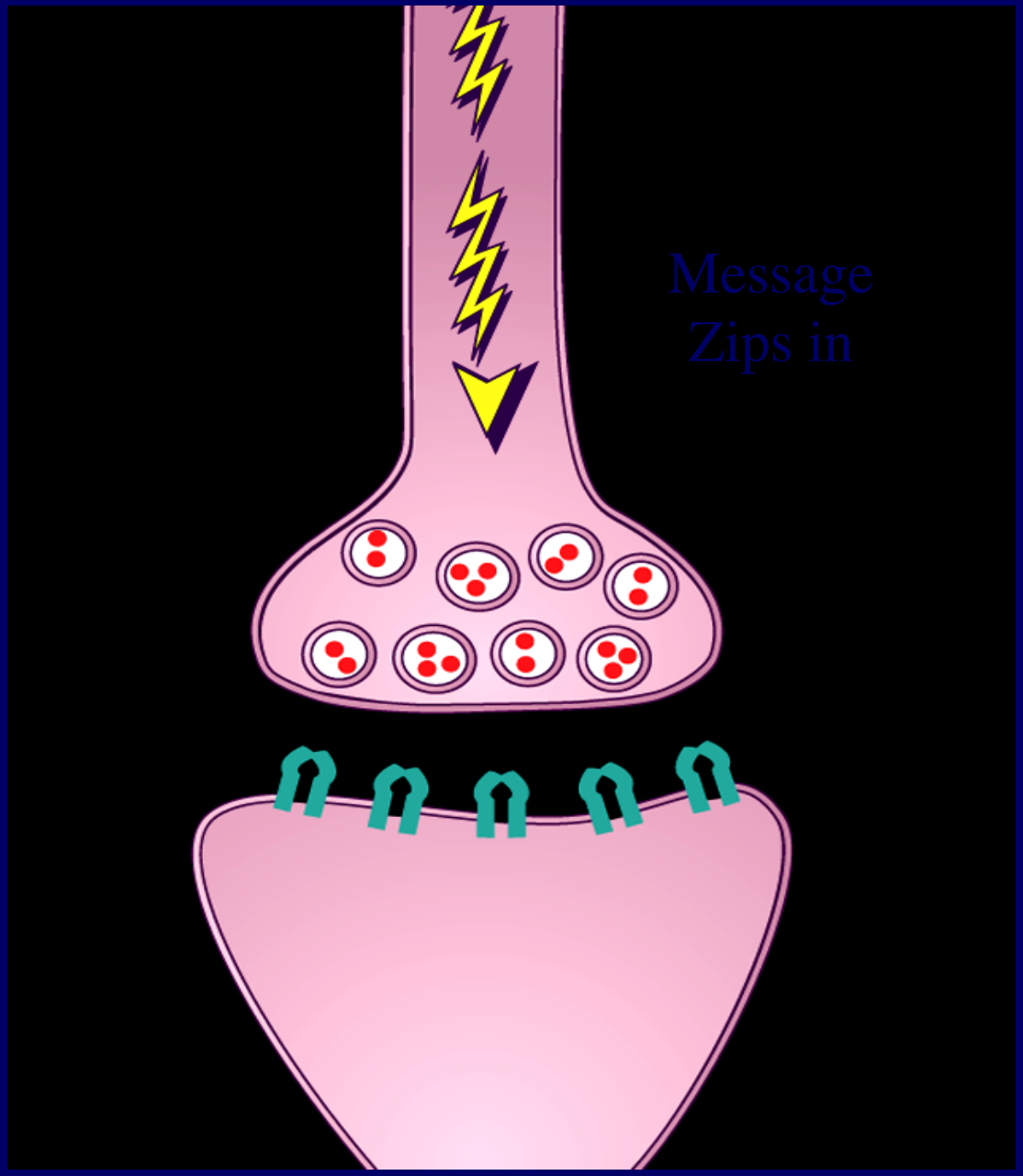
- 100 billion neurons
- each one linked to >1000 others
- in complex sub-systems
- that have to “talk to each other”
- using low voltage electrical impulses
- that have to jump across gaps
- so fast that 12 can cross in 1/1000 sec.


Neuro
Synapse
Intertw
neuron

Chemicals Jump the Gaps

- Inside brain >50 different chemicals are continuously made
- every neuron system uses 1 of them
- stored in little vesicles near tip of neuron
- when electrical impulse comes, mini-dots of that chemical are released,
- cross the gap, fire next neuron, then reload in fractions of a second

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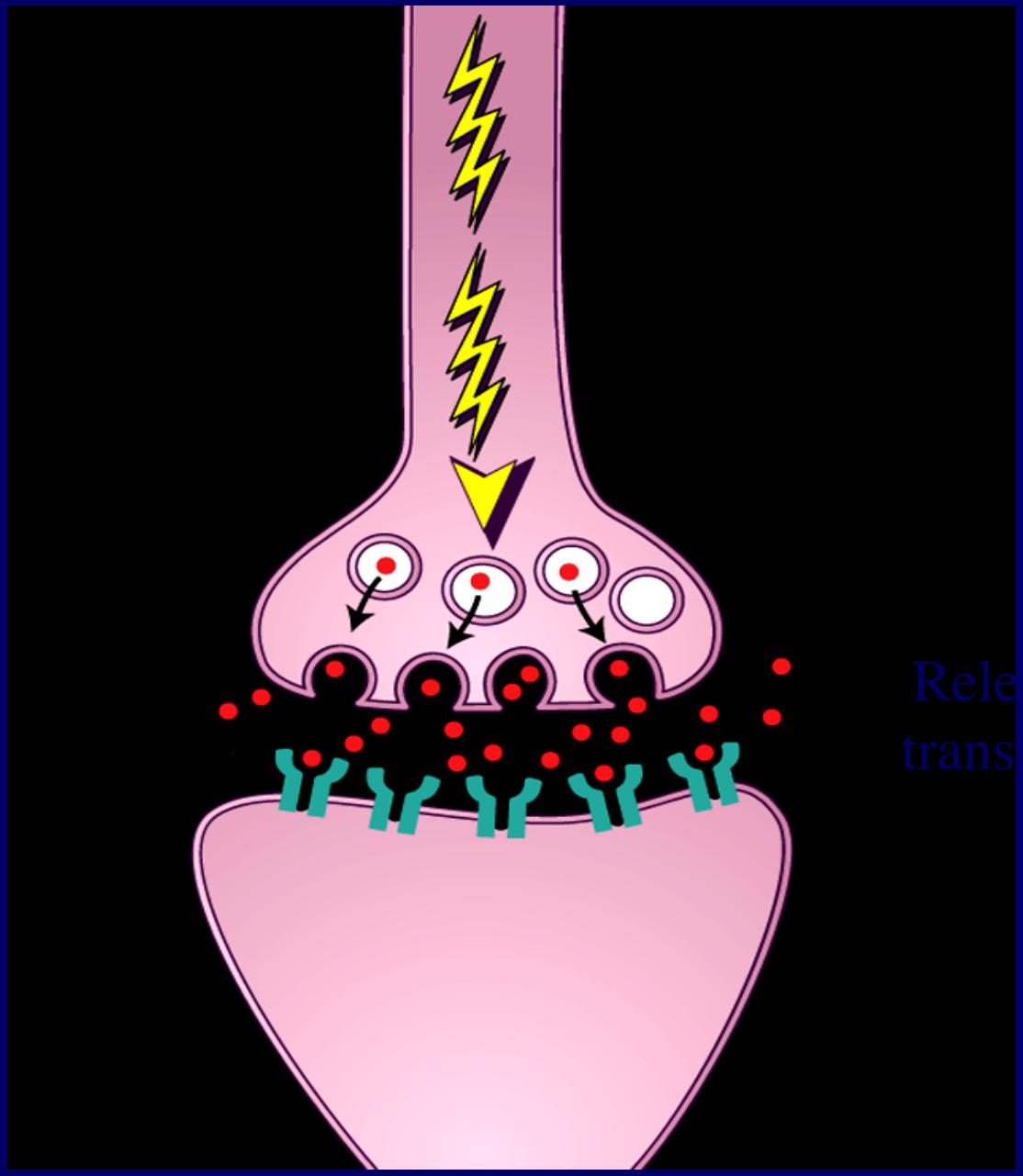

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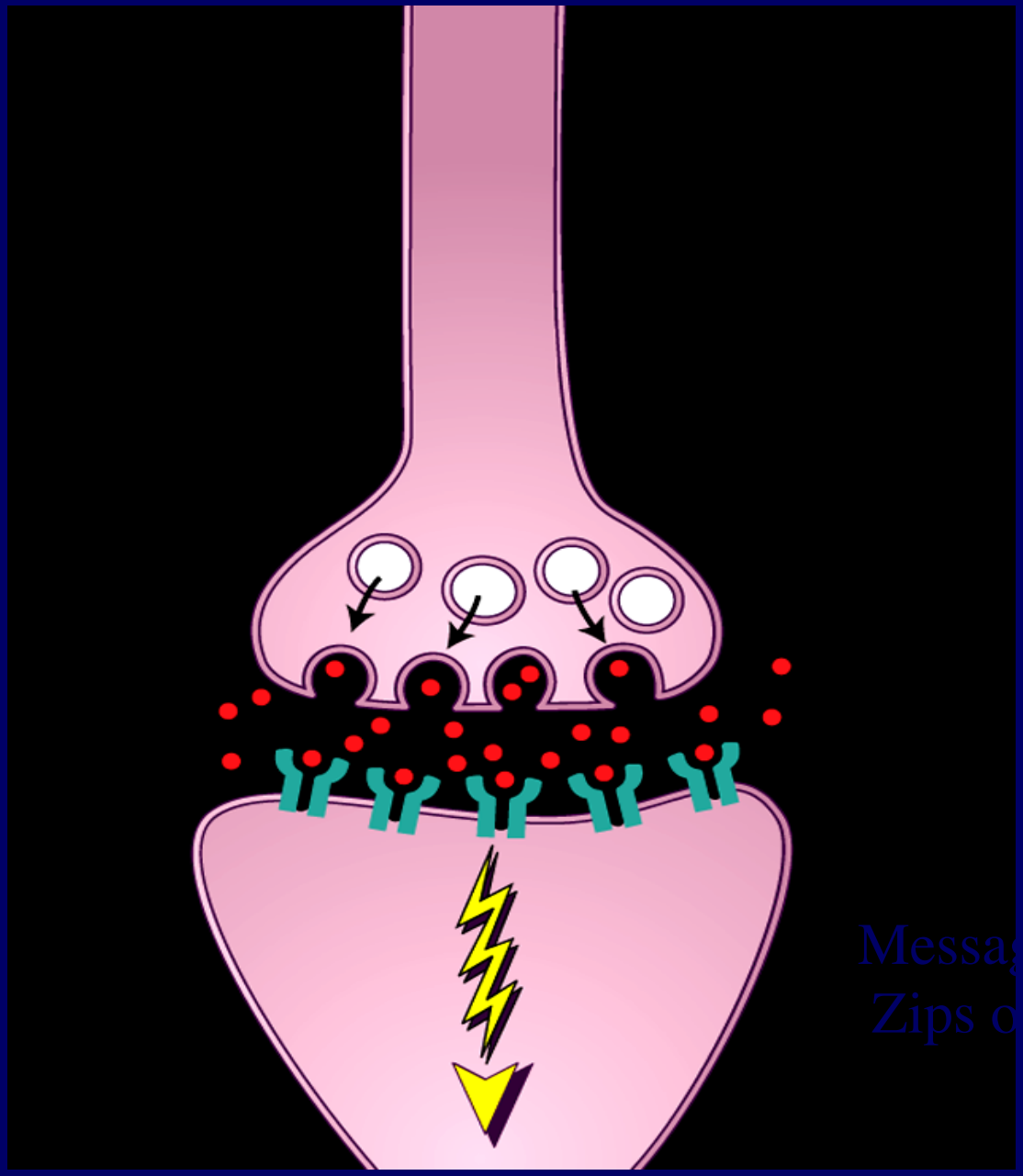

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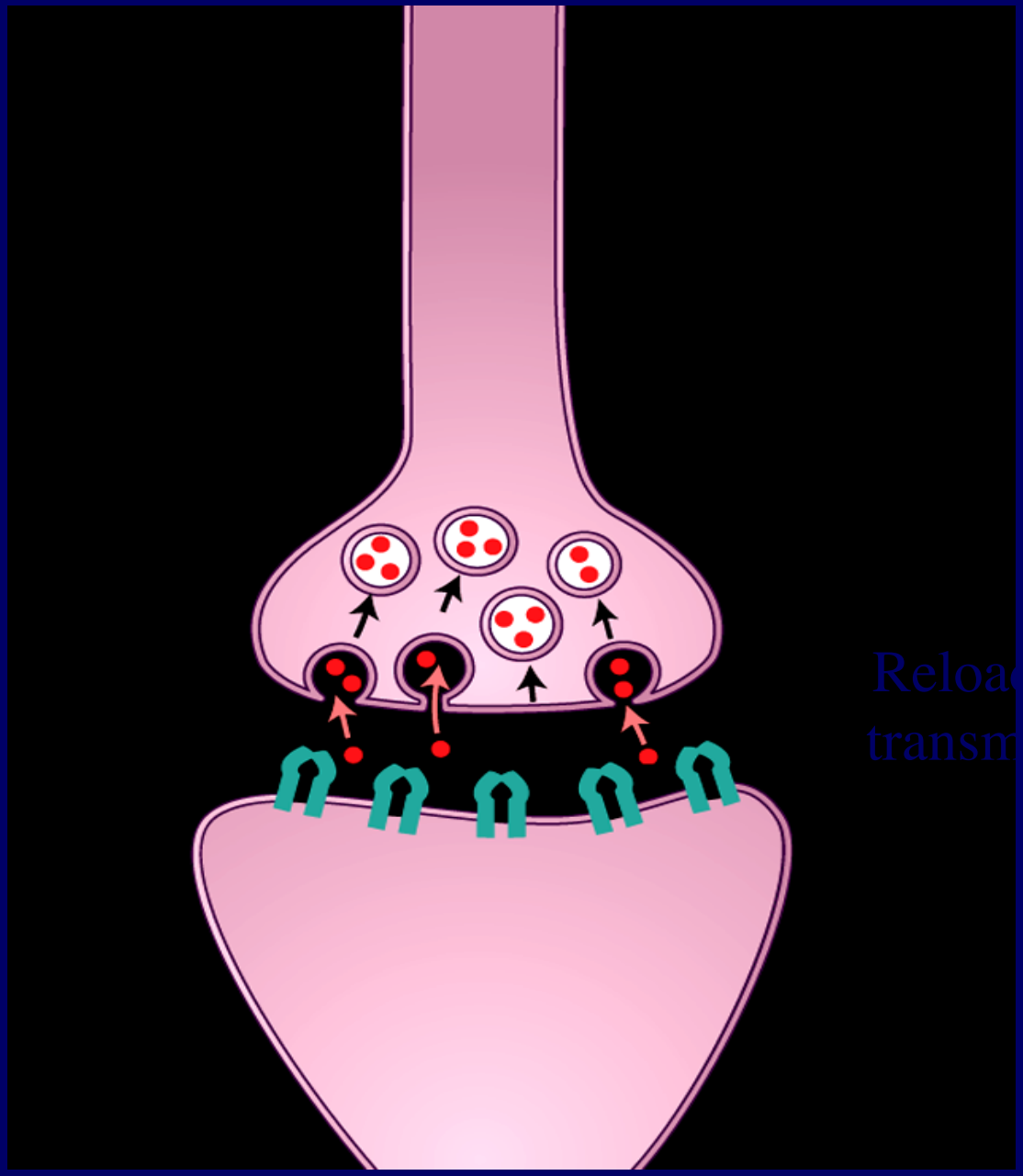
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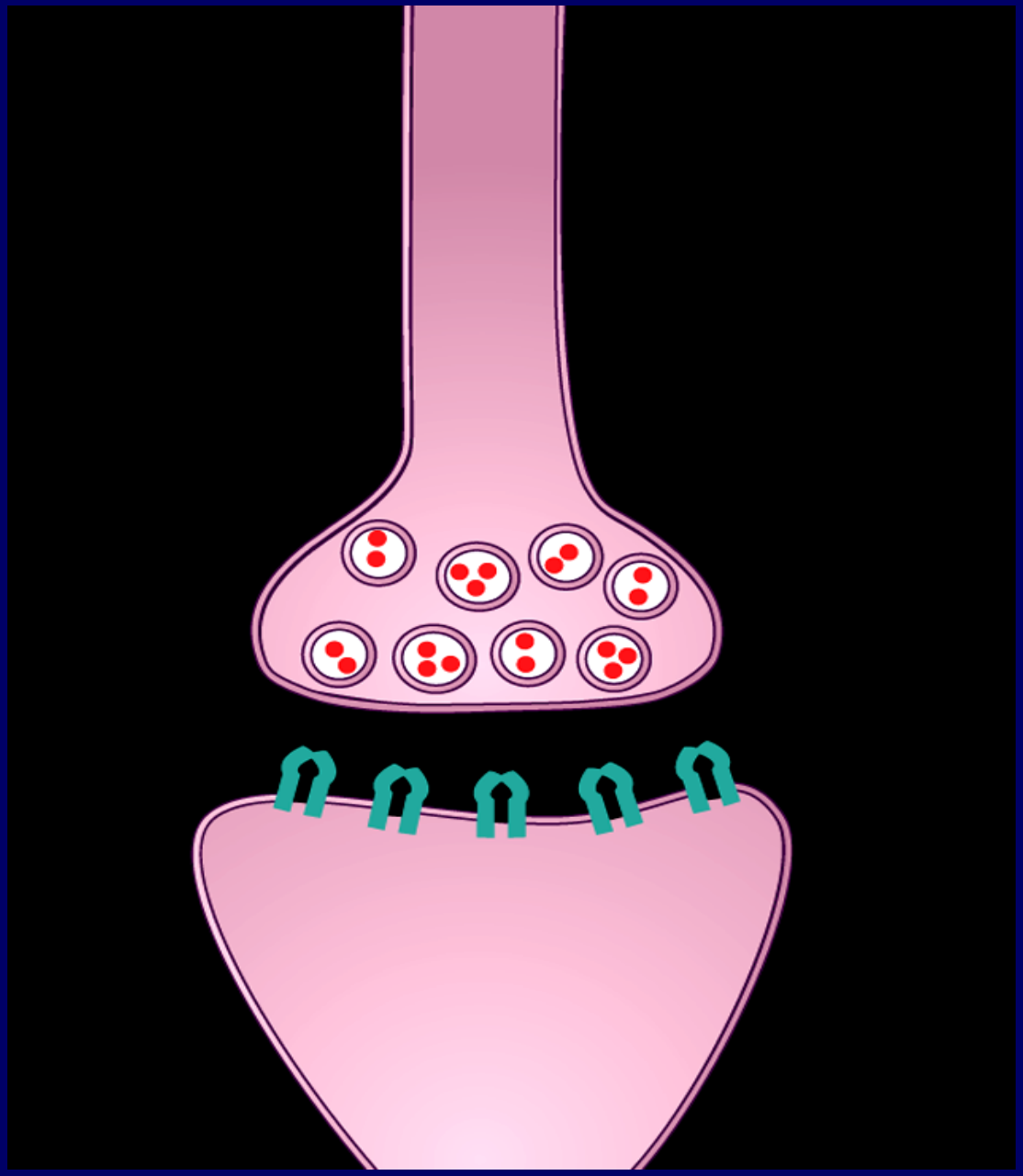
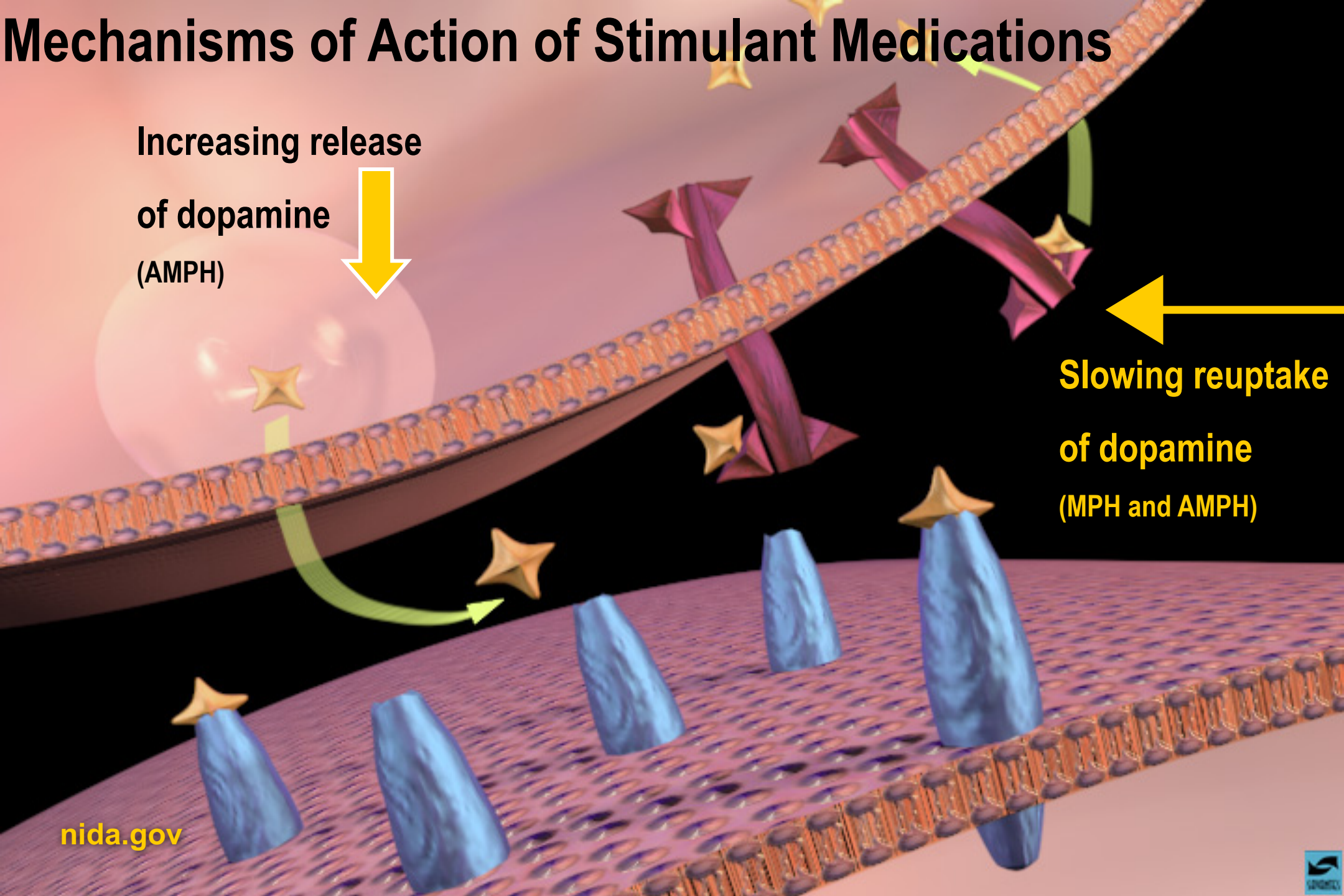
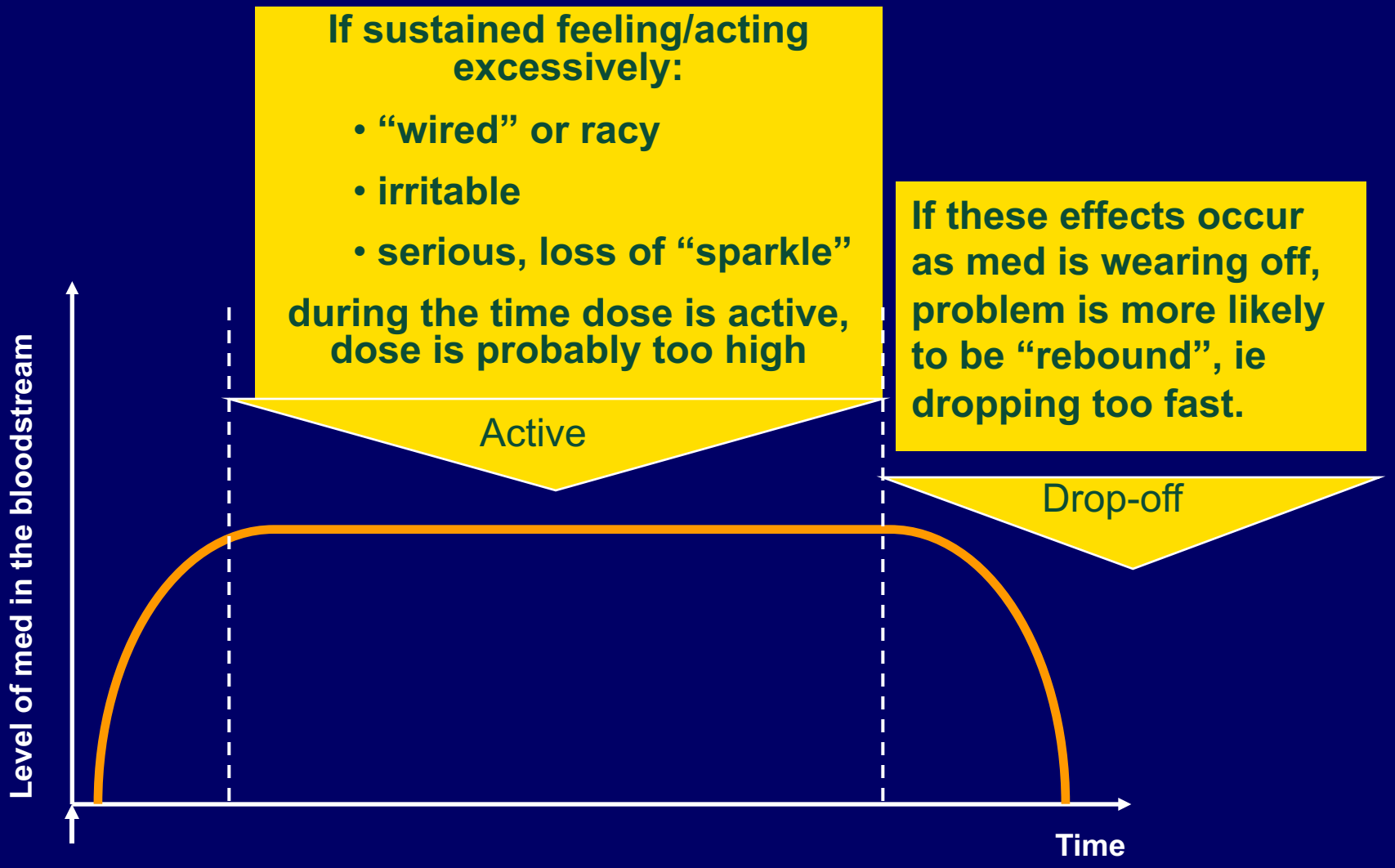



Mechanisms of Action of Stimulant Medications
Increasing release
of dopamine
(AMPH)
Slowing reuptake
of dopamine
(MPH and AMPH)
nida.gov

Medications for ADHD

- Evidence for safe and effective
- Effective dose not based on age, wt or severity of sx
- Require titration and monitoring to "fine tune" to individual sensitivity and time frames for schedule and tasks

Time Frames and Rebound



TE Brown, 2002

How do ADHD Impairments of EF Usually Respond to Medication?

- This wide range of cognitive impairments responds to medication treatment in 70-90% of cases in children, adolescents and adults
- Symptom improvement varies from modest to very dramatic
- Adverse effects are usually transient, not significant

Set Realistic Expectations for Tx
Medications do not cure ADHD!

- Cannot realistically promise "there will be no problematic effects" for any medication for any disorder.
- Cannot realistically promise that medication will effectively treat ADHD. ~80% success rate w/stims
- Close prescriber-patient collaboration is essential for "fine-tuning"

How ADHD sometimes gets worse

1. Being required to undertake new challenges without adequate support
2. Being repeatedly or harshly criticized for failures they cannot control
3. Co-occuring emotional, cognitive, or behavioral problems, eg drugs or alcohol, anxiety, depression

How ADHD sometimes gets worse

4. Environmental adversities, persistent family stresses, eg poverty, violence
5. Bodily changes of aging & menopause
6. Lack of appropriate diagnosis and treatment

How ADHD Sometimes Improves

1. Brain development may be delayed, then catch up
2. Ongoing interaction with supportive family members, teachers, friends
3. After completing basic schooling, finding work that fits interest & skills
4. Stable relationship with a partner with mutual support and compensations

How ADHD Sometimes Improves

5. Co-occurring disorder may improve,
   eg, stopping excessive etoh or drugs
6. Developing compensatory strategies to compensate for ADHD impairments
7. Getting adequate assessment and effective treatment

Key Points

1. Essential problem in ADHD is developmental impairment of EF
2. Those with ADHD usually can focus well for some tasks, though not for most others.
3. Inherited brain differences underlie ADHD.
4. Brain developmental delays & environmental stresses can worsen ADHD
5. Adequate treatment with meds and supports can improve it.

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A Useful Resource

Understood.org

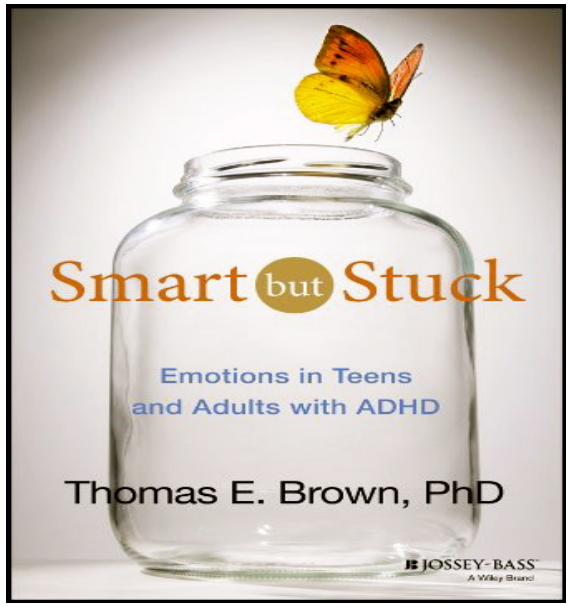
free objective information from experts

In understandable English or Spanish

24/7

Books by Thomas E. Brown, Ph.D.

(www.DrThomasEBrown.com)



- "Smart but Stuck: Emotions in Teens and Adults with ADHD " – 2014
- "A New Understanding of ADHD in Children and Adults: Executive Function Impairments" – 2013
- "ADHD Comorbidities: Handbook for ADHD Complications in Children and Adults" – 2009
- "Attention Deficit Disorder: The Unfocused Mind in Children and Adults" - 2005